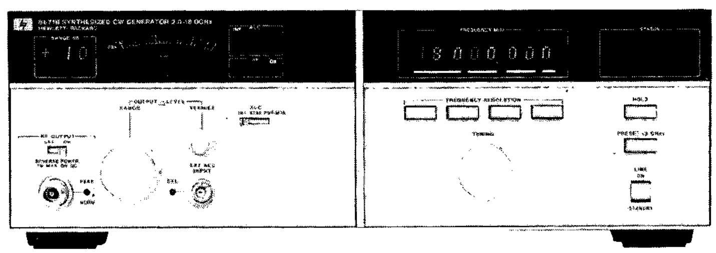
HP 8671B

OPERATING AND SERVICE MANUAL

HP 8671B

SYNTHESIZED CW GENERATOR

2.0—18.0 GHz



HEWLETT PACKARD

HP 8671B

MANUAL CHANGES

SYNTHESIZED CW GENERATOR

MANUAL IDENTIFICATION

Model Number:	HP 8671B
Date Printed:	June 1986
Part Number:	08671-90017

ABOUT THIS SUPPLEMENT

Use this supplement to correct your manual or to update it for instrument changes that occurred after the manual was printed.

Some material in this supplement should be substituted for material in the manual. You can either perform the physical substitution or simply mark your manual with reference to appropriate pages in the supplement.

Change instructions are arranged in the manual's page-number order. Then, each instruction is identified by the word "Errata" or with a change number. Errata changes relate to all instruments. Instructions with change numbers relate only to certain instruments. These instruments are identified by serial number or prefix in the following table.

-- This symbol identifies instructions that are appearing in the supplement for the first time.

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
2629A	1	2747A	1-7
2640A	1,2	2752A	1-8
2644A	1-3	# 2823A	1-9
2703A	1-4		
2707A	1-5		
2708A	1-6		

CHANGE INSTRUCTIONS

Page 1-3:

In the right-hand column, under paragraph 1-49 Chassis Slide Mount Kit, change the fifth sentence to read "If the instrument rack mounting slides are to be mounted in a non-HP rack...". *(Errata)*

Page 1-4, Table 1-1:

Under FREQUENCY, change the performance limits of Switching Time to <20 ms. *(Change 4)*

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

20 June 1988
13 Instruction Pages
35 Revised Material Pages
Printed in U.S.A.

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Page 3-2:

For serial number prefixes 2752A and above, the front panel annunciators have changed. Change the front panel annunciators as indicated below. The same changes should be made anywhere in the manual that reference to these annunciators is made.

old	new
LVL UNCAL	UNLVL
OVEN	OVEN COLD
OUT OF RANGE	OUT OF RNG
NOT PHASE LOCKED	∅UNLOCKED
INTERNAL REF OFF	EXT REF

(Change 8)

Page 3-18, Table 3-3:

In the column labeled "Interface Functions", change the Interface Function of "Remote" to RL2. *(Errata)*

Page 4-10:

Under step 19, line 150 of the partial program, add one more zero to the program string; change it to "P18000000Z". *(Errata)*

Page 5-2, Table 5-1:

Add the following:

Reference Designator: A3A1A5L2
Service Sheet: 5
Range of Values: 39-68 nH
Basis of Selection: M/N Output Assembly. Selected to adjust the gain of the mixer amplifier to eliminate spurious signals at a 9 and 10 kHz offset from the fundamental signal. *(Change 2)*

Page 5-17:

For change 6, delete 5-12 20/30 PHASE DETECTOR NOTCH FILTER ADJUSTMENT. *(Change 6)*

 # Page 5-19:

For change 19, a different adjustment procedure is needed. Substitute the Revised Material For Pages 5-19 and 5-20 in this supplement. *(Change 9)*

Page 5-24:

If A3A9A6 is changed to 0955-0331, (18 dB attenuator, see "Page 6-61"), Change step 15 to read "Adjust the A3A9A5R1, IF GAIN, so that the displayed IF signal at 30 MHz is 0 +/-1 dBm." *(Change 2)*

Pages 6-5 and 6-6, Table 6-3:

For serial number prefixes 2752A and above, substitute Revised Material For Pages 6-5 and 6-6 in this supplement. *(Change 8)*

Page 6-9, Table 6-3:

Change A1A5U8 to 1820-0477 CD6, same description. *(Change 6)*

 # Page 6-10, Table 6-3:

Change A1A6R37 to 0699-2422 CD5 RESISTOR 17.74K .1% .125W TF TC=0+/-10. *(Change 9)*

Change A1A6R40 to 0699-2376 CD8 RESISTOR 30.615K .1% .125W TF TC=0+/-15. *(Change 9)*

 # Page 6-11, Table 6-3:

Change A1A6U6 to 1826-0520 CD2 IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG. *(Change 9)*

Page 6-12, Table 6-3:

Change A1A7R30 to 0698-0083 CD8 RESISTOR 1.96K 1% .125W F TC=0+/-100. *(Change 3)*

Change A1A7U4 to 1820-0477 CD6, same description. *(Change 6)*

 # Page 6-13, Table 6-3:

Change A1A8R4 to 0699-2446 CD3 RESISTOR 11K 1% .1W TF TC=0+/-10. *(Change 9)*

Change A1A8R9 to 0699-2420 CD3 RESISTOR 3.79K .1% .125W TF TC=0+/-10. *(Change 9)*

Change A1A8R18 to 0699-2419 CD0 RESISTOR 10.4K .1% .125W TF TC=0+/-10. *(Change 9)*

Change A1A8R19 to 0698-3904 CD0 RESISTOR 14.7K .1% .1W TF TC=0+/-10. *(Change 9)*

Change A1A8R21 to 0699-2423 CD6 RESISTOR 25.6K .1% .1W TF TC=0+/-10. *(Change 9)*

Change A1A8R29 to 0699-2421 CD4 RESISTOR 5.13K .1% .125W TF TC=0+/-5. *(Change 9)*

Page 6-14, Table 6-3:

\# Change A1A8R58 to 0699-0237 CD6 RESISTOR 1.7K .1% .1W TF TC=0+/-5. *(Change 9)*

Change A1A8U2, 3, 6, 9 to 1820-0477 CD6, same description. *(Change 6)*

Page 6-16, Table 6-3:

\# Change A1A10R19 to 0699-2417 CD8 RESISTOR 1.7K .1% .1W TF TC=0+/-5. *(Change 9)*

\# Change A1A10R37 to 0699-2418 CD9 RESISTOR 32.26K .5% .125W TF TC=0+/-5. *(Change 9)*

Change A1A10U8 to 1820-0477 CD6, same description. *(Change 6)*

Page 6-17, Table 6-3:

Change A1A13 to 08672-60217 CD1, same description. *(Change 7)*

 # Page 6-21, Table 6-3:

Change A2A1U7 to 1826-0065 CD0, same description. *(Change 6)*

Change A2A3 to 08672-60211 CD6, same description. *(Change 6)*

Change A2A3C2 to 0160-0164 CD7 CAPACITOR-FXD .038UF +/-10% 200VDC POLYE. *(Change 6)*

 # Page 6-22, Table 6-3:

For change 8, see the instructions for Pages 6-19 through 6-22. *(Change 8)*

In the Revised Material for Pages 6-19 through 6-22, change A2A3Q1 to 1855-0276 CD6 IC V RGLTR-FXD-POS 4.8/5.2V TO-92 PKG. *(Change 9)*

Pages 6-19 through 6-22, Table 6-3:
For serial number prefixes 2752A and above, substitute Revised Material For Pages 6-19 through 6-22 in this supplement. *(Change 8)*

 # Page 6-23, Table 6-3:
For change 6, see the instructions for Pages 6-23 through 6-24. *(Change 6)*
In the Revised Material For Pages 6-23 through 6-24, change A2A4C21 to 0160-5901 CD0 CAPACITOR-FXD 10PF +/-.5PF 200VDC CER. *(Change 9)*

Page 6-24, Table 6-3:
A2A4U4: If replacement is needed, use the part listed in Change 2. *(Errata)*
Change A2A4U4 to 1820-1645 CD2 IC BFR TTL LS BUS QUAD. *(Change 2)*
See instructions for Pages 6-23 through 6-24, Table 6-3. *(Change 6)*

Pages 6-23 through 6-24, Table 6-3:
For the A2A4 parts list, substitute the Revised Material For Pages 6-23 through 6-24 in this supplement. *(Change 6)*

Page 6-26, Table 6-3:
Delete A2A6. *(Change 7)*

Page 6-32, Table 6-3:
Change A2A11C8 to 0160-3334 CD9 CAPACITOR-FXD .01UF +/-10% 100VDC CER. *(Change 4)*

Page 6-34, Table 6-3:
Change A2A12 to 08672-60213 CD8, same description. *(Change 7)*

Page 6-35, Table 6-3:
Delete A2DS1 through A2DS8. *(Change 8)*
Add A2W4 5060-0366 CD4, Qty 1, RIBBON CABLE ASSY-50 PIN. *(Change 7)*

Page 6-38, Table 6-3:
Change A3A1A1U5 to 1820-0477 CD6, same description. *(Change 6)*
Change A3A1A2C4 to 0121-0493 CD3 CAPACITOR-V TRMR-AIR 1.7-11PF 175V. *(Change 6)*
Change A3A1A2C8 to 0160-2251 CD7 CAPACITOR-FXD 5.6PF +/-25PF 500VDC CER. *(Change 6)*

Page 6-39, Table 6-3:
Delete A3A1A2C45. *(Change 2)*

Page 6-40, Table 6-3:
Change A3A1A2L2 to 9100-2250 CD9 INDUCTOR RF-CH-MLD 180NH 10%. *(Change 6)*
Change A3A1A2L2 to 9100-2249 CD6 INDUCTOR RF-CH-MLD 150NH 10% *(Change 9)*

Page 6-41, Table 6-3:

In the Revised Material For Pages 6-41 through 6-46, change:
A3A1A2R67, 69 to 0698-3437 CD2 RESISTOR 133 1% .125W F TC=0+/-100. *(Change 6)*
A3A1A2R68 to 0698-4037 CD0 RESISTOR 47.4 1% .125W F TC=0+/-100. *(Change 6)*

Page 6-45, Table 6-3:

Add an asterisk (*) to A3A1A5L2 to indicate a factory selected component. The allowable range of inductor values is 39-68 nH. *(Change 2)*
See the instructions for Pages 6-41 through 6-46, Table 6-3. *(Change 4)*
In the Revised Material For Pages 6-41 through 6-46, change A3A1A5C30 to 0160-0575 CD4 CAPACITOR-FXD .047 UF +/-20% 50VDC CER. *(Change 9)*
In the Revised Material For Pages 6-41 through 6-46, change A3A1A5R42 to 0698-7272 CD1 RESISTOR 31.6K 1% .05W F TC=0+/-100. *(Change 6)*

Page 6-46, Table 6-3:

In the Revised Material for Pages 6-41 through 6-46 in this supplement, change A3A1A6 to 86701-60101 CD2, same description. *(Change 7)*
Change A3A2 to A3A12, 08673-60133 CD1, same description. *(Change 3)*
Change all part number prefixes of A3A2 to A3A12. *(Change 3)*
See the instructions for Pages 6-41 through 6-46, Table 6-3. *(Change 4)*
In the Revised Material For Pages 6-41 through 6-46 in this supplement, delete A3A1A6C9. *(Change 9)*

Pages 6-41 through 6-46, Table 6-3:

For the A3A1A3 and A3A1A5 parts lists, substitute the Revised Material For Pages 6-41 through 6-46 in this supplement. *(Change 4)*

Page 6-47, Table 6-3:

Change A3A2C8, 9 to 0160-6633 CD3 CAPACITOR-FXD 2.2UF +/-20% 100V. *(Change 3)*
Add A3A2MP1 3050-0876 CD8, Qty 1, WASHER-FL NM NO. 10 .194-IN-ID. *(Change 4)*
Add A3A2MP2 3050-0876 CD8, Qty 1, WASHER-FL NM NO. 10 .194-IN-ID. *(Change 4)*
Change A3A2R6, 8 to 0757-0346 CD2 RESISTOR 10 1% .125W F TC=0+/-100. *(Change 3)*
Change A3A2R7 to 0698-3428 CD1 RESISTOR 14.7 1% .125W F TC=0+/-100. *(Change 3)*
Change all part number prefixes of A3A2 to A3A12. *(Change 3)*
A3A3: If replacement is needed, use the part listed in Change 1. *(Errata)*
Change A3A3 to 86701-60096 CD4. *(Change 1)*

 # Page 6-48, Table 6-3:

Change A3A3CR9, 10 to 1990-0486 CD6 LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V. *(Change 9)*

Change A3A3R4 to 0757-0420 CD3 RESISTOR 750 1% .125W TF TC=0+/-100. *(Change 9)*

Page 6-49, Table 6-3:

Change A3A3U2, 3 to 1820-0477 CD6, same description. *(Change 6)*

A3A4: If replacement is needed, use the part listed in Change 1. *(Errata)*

Change A3A4 to 86701-60095 CD3. *(Change 1)*

Page 6-50, Table 6-3:

Add A3A4C17 0160-6295 CD7 CAPACITOR-FXD 910PF +/-5% 50VDC CER. *(Change 1)*

\# Change A3A4CR10, 11, 13 to 1990-0486 CD6 LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V. *(Change 9)*

Page 6-51, Table 6-3:

Change A3A4U1-3 to 1820-0477 CD6, same description. *(Change 6)*

\# For change 9, a different parts list for A3A5 is needed. Substitute the Revised Material for Pages 6-57 through 6-60 in this supplement. *(Change 9)*

 # Page 6-53, Table 6-3:

Change A3A6Q2, 6 to 1854-0810 CD2 TRANSISTOR NPN SI PD=625MW FT=200MH. *(Change 9)*

Page 6-55, Table 6-3:

Delete A3A7C3. *(Change 5)*

Add A3A7C27 0160-3879 CD7 CAPACITOR-FXD .01UF +/-20% 100 VDC CER. *(Change 5)*

Delete A3A7R7. *(Change 5)*

Change A3A7R12 to 0198-7212 CD9 RESISTOR 100 1% .05W F TC=0+/-100. *(Change 5)*

Page 6-56, Table 6-3:

Change A3A7R21 to 0698-3155 CD1 RESISTOR 4.64K 1% .125W F TC=0+/-100. *(Change 6)*

Change A3A7R28 to 0698-0083 CD8 RESISTOR 1.96K 1% .125W F TC=0+/-100. *(Change 6)*

Page 6-59, Table 6-3:

Change A3A9A4U2 to 1826-0065 CD0, same description. *(Change 6)*

Page 6-61, Table 6-3:

A3A9A6: If replacement is needed, use the part listed in Change 2. *(Errata)*

Change A3A9A6 to 0955-0331 CD5, ATTENUATOR ASSEMBLY, 18 dB. *(Change 2)*

Change A3A10 to 08672-60215 CD9, same description. *(Change 7)*

Page 6-63, Table 6-3:

Change MP73 to 08671-20020, same description. *(Change 8)*

Page 6-64, Table 6-3:

Change MP78 to 08672-20194, same description. *(Change 8)*

Delete all information related to MP138 through MP142 in the columns to the right of each. Add the words "NOT ASSIGNED" opposite MP138 through MP142. *(Change 8)*

Page 6-65, Table 6-3:

Delete all information related to MP154, MP155, and MP168 in the columns to the right of each. Add the words "NOT ASSIGNED" opposite MP154, MP155, and MP168. *(Change 8)*

 # Page 6-67, Table 6-3:

Change MP412 to 86701-00066 CD2, same description. *(Change 9)*

Page 6-73, Figure 6-4:

Change A1S5 to A1S3. *(Change 8)*

Page 6-74, Figure 6-5:

Delete MP138 through MP142. *(Change 8)*

Page 6-75, Figure 6-6:

Delete MP154, MP155 and MP168. *(Change 8)*

Page 8-16:

In the left column, change step 5 to read: "Using a soft-bristle brush only, remove dust from the pc boards." *(Errata)*

Service Sheet 2, Figure 8-54:

Delete C45. *(Change 2)*

Service Sheet 3, Figure 8-59:

For change 4, a different schematic is needed. Substitute the Revised Material For Service Sheet 3 in this supplement. *(Change 4)*

In the Revised Material for Service Sheet 3, on the left side of the schematic:

a.) Under "P/O A3A1A6", delete C13-23. *(Change 7)*

b.) Under "P/O A3A10", on off-board connector "JT", change "M1" to "M2". *(Change 4)*

For serial number prefixes 2747A and above, inductors have been placed in series with the digital lines on the A3A10 Motherboard Assembly. On the Revised Material for Service Sheet 3, on the left side of the page, draw the inductors onto their corresponding digital lines as shown in the following table.

Digital Line	Inductor Reference Designator	Inductor Value
N1	L12	4.7 nH
N2	L11	4.7 nH
N3	L10	4.7 nH
N4	L9	4.7 nH
N5	L8	4.7 nH
N6	L7	4.7 nH
M1	L4	4.7 nH
M2	L5	4.7 nH
M3	L2	4.7 nH
M4	L3	4.7 nH
M5	L1	4.7 nH
M/N UNLOCKED	L6	4.7 nH

(Change 7)

Service Sheet 5, Figure 8-63:

Add an asterisk (*) to L2 to indicate a factory selected component. The allowable range of inductor values is 39-68 nH. *(Change 2)*

For change 4, a different schematic is needed. Substitute the Revised Material For Service Sheet 5 in this supplement. *(Change 4)*

In the Revised Material For Service Sheet 5, on the left side of the schematic, on the -40V(F) power supply line, change C30 to .047 uF. *(Change 9)*

In the Revised Material For Service Sheet 5, in the upper half of the schematic, near Q4 and CR4, change R4 to 750 Ohms. *(Change 9)*

Service Sheet 6, Figure 8-65:

For serial number prefixes 2747A and above, there is a ribbon cable between A3A10 and A2A12. On the left side of the schematic, between A3A10 and A2A12, change the following edge connector pins:

a.) Change 43 to 35.
b.) Change 44 to 11.
c.) Change 15, 45 to 12, 13, 37, 38.
d.) Change 18, 48 to 15, 16.
e.) Change 19, 49 to 40, 41.
f.) Change 20, 50 to 17.
g.) Change 17, 47 to 14.
h.) Change 46 to 39.
(Change 7)

Service Sheet 7, Figure 8-68:

In the table of Transistor and Integrated Circuit Part Numbers, change the part number of U4 to 1820-1645. *(Change 2)*

For change 6, a different schematic is needed. Substitute the Revised Material For Service Sheet 7 in this supplement. *(Change 6)*

\# In the Revised Material For Service 7, in the right section of the schematic, near U10B, change C21 to 10 pF. *(Change 9)*

 # Page 8-90 (text):

For change 9, a new theory of operation for the Revised Material for Service Sheet 9 is needed. Insert the Revised Material For Page 8-90 (in this supplement) in front of Service Sheet 9. *(Change 9)*

 # Service Sheet 9, Figure 8-72:

For change 9, a different schematic is needed. Substitute the Revised Material For Service Sheet 9 in this supplement. *(Change 9)*

Service Sheet 12, Figure 8-79:

In the table of Transistor and Integrated Circuit Part Numbers, change U2 to 1826-0065. *(Change 6)*

Service Sheet 13, Figure 8-81:

On the left side of the schematic, delete R7 and C3. *(Change 5)*

In the upper half of the schematic, next to Q3, change R12 to 100 Ohms. *(Change 5)*

Add C27, .01 uf, to the collector of Q3. *(Change 5)*

Service Sheet 14, Figure 8-84:

In the table of Transistor and Integrated Circuit Part Numbers, change U8 to 1820-0477. *(Change 6)*

For serial number prefixes 2747A and above, W10 has been deleted. On the upper left corner of the schematic, delete "P/O W10". The off-page connectors to page 24 attach directly to A1A13. *(Change 7)*

Service Sheet 15, Figure 8-87:

In the table of Transistor and Integrated Circuit Part Numbers, change U2, 3, 6, 9 to 1820-0477. *(Change 6)*

Service Sheet 16, Figure 8-89:

In the lower right corner of the schematic, change R30 to 1.96k Ohms. *(Change 3)*

In the table of Transistor and Integrated Circuit Part Numbers, change U4 to 1820-0477. *(Change 6)*

Service Sheet 18, Figure 8-93:

In the table of Transistor and Integrated Circuit Part Numbers, change U8 to 1820-0477. *(Change 6)*

Service Sheet 19, Figure 8-95:

For serial number prefixes 2747A and above, W10 has been deleted. On the left side of the schematic, delete "P/O W10". The off-page connectors to page 24 attach directly to A1A13. *(Change 7)*

Service Sheet 20, Figures 8-96, 8-97, and 8-98:

Delete Figure 8-96. *(Change 8)*

For serial number prefixes 2752A and above, substitute Revised Material For Service Sheet 20 in this supplement. *(Change 8)*

Service Sheet 24, Figure 8-105:

For Serial number prefixes 2747A and above, A2A6 and A3W10 have been deleted. In the lower right corner of the schematic:

a.) Delete "P/O A3W10".

b.) Change "P/O A2A6 to "P/O A1A13".

c.) Attach the off-page connectors directly to A1A13.

In the lower left corner of the schematic, refer to the above instructions.

In the upper left corner of the schematic, delete A2A6 and A3W10.

In the upper center of the schematic:

a.) Delete "P/O A3W10".

b.) Change "P/O A2A6" to "P/O A1A13".

c.) Attach the off-page connectors directly to A1A13.

(Change 7)

Service Sheet 25, Figure 8-107:

For serial number prefixes 2747A and above, there is a ribbon cable (A2W4) between A2A12 and A3A10. On the upper left corner of the schematic, change the following edge connector pin numbers:

a.) Change 29 to 25.

b.) Change 21 to 42.

c.) Change 16 to 36.

d.) Change 6 to 2.

(Change 7)

Service Sheet 26, Figure 8-109:

On the right-hand side of the schematic diagram, change the titles above U14 and U3 to "P/O DECODING ROMS". *(Errata)*

In the lower right corner of the schematic, near U4E, add "U12A" to the OR gate labeled "1 MHz LIMIT". *(Errata)*

For serial number prefixes 2747A and above, there is a ribbon cable (A2W4) between A2A12 and A3A10. In the upper and lower right corners of the schematic, change the following edge connector pin numbers:

a.) Change 36 to 28.
b.) Change 35 to 29.
c.) Change 34 to 27.
(Change 7)

Service Sheet 27, Figure 8-111:

In the upper center section of the schematic, belowe U6A, interchange pin numbers 2 and 3 on U7A. *(Errata)*

Service Sheet 28, Figure 8-113:

In the upper right corner of the schematic, at the off-page reference to Service Sheet 27, change "EN" to "NL", "EP" to "LP", and "EO" to "LO". *(Errata)*

Service Sheet 30, Figure 8-117:

For serial number prefixes 2747A and above, there is a ribbon cable (A2W4) between A3A10 and A2A12. Change the edge connector pin numbers as shown in the table below.

Digital Line	New Pin Number
M5	8
M3	7
M4	34
M1	6
M2	33
N5	5
N6	32
N3	4
N4	31
N2	30
N1	3
DAC3200 MHz	18
DAC800 MHz	19
DAC400 MHz	20
DAC200 MHz	21
DAC100 MHz	22
DAC4800 MHz	44
DAC10 MHz	49
DAC20 MHz	24
DAC40 MHz	50
DAC80 MHz	23
DAC 8MHz	48
DAC 4MHz	47
DAC 2MHz	46
DAC 1MHz	45

(Change 7)

Service Sheet 31, Text:

Substitute Revised Material For Pages 8-137 and 8-138 in this supplement. *(Change 8)*

Service Sheet 31, Figures 8-118 and 8-119:

For serial number prefixes 2747A and above, there is a ribbon cable (A2W4) between A2A12 and A3A10. On the left side of the schematic, change the following edge connector pins:

a.) Change 13 to 9.
b.) Change 14 to 10.
(Change 7)

For serial number prefixes 2752A and above, substitute Revised Material For Service Sheet 31 in this supplement. *(Change 8)*

Service Sheet 32, Text:

For serial number prefixes 2752A and above, substitute Revised Material For Page 8-140 in this supplement. *(Change 8)*

Service Sheet 32, Figures 8-120 and 8-121:

In the upper right corner of the schematic, change C8 to 33 uF. *(Errata)*

In the table of Transistor and Integrated Circuit Part Numbers, change U7 to 1826-0065. *(Change 6)*

For serial number prefixes 2747A and above, there is a ribbon cable (A2W4) between A2A12 and A3A10. On the left side of the schematic, change edge connector pin number 33 to 26. *(Change 7)*

For serial number prefixes 2752A and above, substitute Revised Material For Service Sheet 32 in this supplement. *(Change 8)*

Service Sheet 34, Figure 8-125:

In the upper left corner, change the A3A3 part number to 86701-60096. *(Change 1)*

In the table of Transistor and Integrated Circuit Part Numbers, change U2, 3 to 1820-0477. *(Change 6)*

Service Sheet 35, Figure 8-127:

In the upper left corner, change the A3A4 part number to 86701-60095. *(Change 1)*

Add capacitor C17, 910 pF, from U2 pin 6 to the anode of CR3 (across R4). *(Change 1)*

In the table of Transistor and Integrated Circuit Part Numbers, change U1, 3 to 1820-0477. *(Change 6)*

ADJUSTMENTS

5-13. YTO PRETUNE DIGITAL-TO-ANALOG CONVERTER ADJUSTMENT

Reference Service Sheet 9

Description This adjustment sets the analog output voltage with respect to the digital frequency tuning data.

Equipment Digital Voltmeter (DVM) .... HP 3456A

Procedure

1. Key in RCL 0 on the Signal Generator and set the frequency to 6598.000 MHz.
2. Connect the DVM ground lead to the reference ground, A3A6TP5. (The ground lead remains connected here for the rest of the procedure).
3. Check the voltage of the Reference Voltage Buffer at A3A5TP4. Verify that the voltage is −6.300 ±0.063 Vdc. Make repairs if necessary.
4. Connect the DVM to the YTO Pretune Output, A3A5TP5.
5. Connect test points A3A5TP1 and A3A5TP2 together with an alligator clip.
6. Adjust A3A5R15 (OFFSET) to obtain a DVM reading of +6.00 mV ±0.02 mVdc.
7. Remove the alligator clip from testpoints A3A5TP1 and A3A5TP2.
8. Adjust A3A5R8 (GAIN) to obtain a voltage of −19.794 ±0.001 Vdc.
9. Tune the Signal Generator to 3066.000 MHz. Verify that the voltage at A3A5TP5 is −9.198 ±0.003 Vdc.
10. Tune the Signal Generator to 4049.000 MHz. Verify that the voltage at A3A5TP5 is −12.147 ±0.03 Vdc.
11. Disconnect the DVM from the Signal Generator.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A1	08671-60021	4	1	BOARD ASSEMBLY, FRONT PANEL (INCLUDES A1S1, A1S2 AND A1S3 CONTACT ASSEMBLIES)	28480	08671-60021
A1A1	08671-60011	2	1	BOARD ASSEMBLY, FRONT PANEL, LESS A1S1, A1S2 AND A1S3 CONTACT ASSEMBLIES	28480	08671-60011
A1A1C1	0180-0229	7	3	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A1C2	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A1C3	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A1DS1- A1A1DS3				NOT ASSIGNED		
A1A1DS4	1990-0759	6	2	LED-LIGHT BAR MODULE LUM-INT=3MCD	28480	HLMP-2620
A1A1DS5	1990-0759	6		LED-LIGHT BAR MODULE LUM-INT=3MCD	28480	HLMP-2620
A1A1J1	1251-3119	2	1	CONN-POST TYPE .100-PIN-SPCG 20-CONT	28480	1251-3119
A1A1J2	1251-3025	9	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1251-3025
A1A1J3	1200-0645	6	2	SOCKET-STRP 12-CONT DIP-SLDR	28480	1200-0645
A1A1J4	1200-0645	6		SOCKET-STRP 12-CONT DIP-SLDR	28480	1200-0645
A1A1Q1	1854-0810	2	4	TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A1Q2	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A1Q3	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A1Q4	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A1R1	0698-7229	8	3	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A1A1R2	1810-0370	7	2	NETWORK-RES 8-SIP 220.0 OHM X 7	11236	750-81-R220
A1A1R3	1810-0370	7		NETWORK-RES 8-SIP 220.0 OHM X 7	11236	750-81-R220
A1A1R4	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A1A1R5	0698-7230	1	1	RESISTOR 562 1% .05W F TC=0+-100	24546	C3-1/8-T0-562R-F
A1A1R6	0698-7264	1	1	RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1472-F
A1A1R7	0698-7216	3	2	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A1A1R8	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A1A1R9	0698-7212	9	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A1U1	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A1A1U2	1820-1740	8	1	IC DRVR TTL DSPL	27014	DS8863N
A1A1XDS1- A1A1XDS3				NOT ASSIGNED		
A1A1XDS4	1200-0507	9	2	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A1A1XDS5	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
				A1A1 MISCELLANEOUS		
	1251-0600	0	5	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
	08672-20060	8	1	GUIDE, SLIDE SWITCH	28480	08672-20060
	08672-20061	9	1	GUIDE, SLIDE SWITCH	28480	08672-20061
	08672-20062	0	1	GUIDE, SLIDE SWITCH	28480	08672-20062
	08672-20063	1	2	GUIDE, SLIDE SWITCH	28480	08672-20063
A1A2				NOT ASSIGNED		
A1A3	5086-7151	3	1	YTM ASSEMBLY (INCLUDES A1A3A1)	28480	5086-7151
A1A3	5086-6151	1	1	YTM ASSEMBLY(RESTORED 5086-7151)	28480	5086-6151
A1A3CR2	1901-0376	6	1	DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A3A1	5061-1036	9	1	YTM, HEATER CONTROL ASSEMBLY	28480	5061-1036
A1A3A1C1	0180-2182	5	1	CAPACITOR-FXD 18UF+-10% 50VDC TA	56289	150D186X9050R2
A1A3A1C2	0160-0127	2	1	CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-0127
A1A3A1CR1	1901-0033	2	1	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A3A1J1	1200-0508	0	1	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0508
A1A3A1MP1	0380-0322	5	2	SPACER-RVT-ON .062-IN-LG .152-IN-ID	28480	0380-0322
A1A3A1MP2	0380-0322	5		SPACER-RVT-ON .062-IN-LG .152-IN-ID	28480	0380-0322
A1A3A1Q1	1853-0038	4	2	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1A3A1Q2	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1A3A1R1	0698-7245	8	2	RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-F
A1A3A1R2	0698-7260	7	1	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A3A1R3	0698-7273	2	2	RESISTOR 34.8K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3482-F
A1A3A1R4	0698-7284	5	1	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A1A3A1R5	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A3A1R6	0757-0394	0	2	RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A1A3A1R7	0698-3102	8	1	RESISTOR 237 1% .5W F TC=0+-100	28480	0698-3102
A1A3A1R8	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A1A3A1R9	0698-7273	2		RESISTOR 34.8K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3482-F
A1A3A1R10	0698-8827	4	1	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A1A3A1R11	0698-7245	8		RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-F
A1A3A1U1	1826-0261	8	1	IC OP AMP LOW-NOISE TO-99 PKG	3L585	CA6741T SELECTED
A1A3A1VR1	1902-0176	6	1	DIODE-ZNR 47V 5% PD=1W IR=5UA	28480	1902-0176
A1A3A1VR2	1902-0025	4	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A1A4				NOT ASSIGNED		
A1A5	08672-60044	2	1	ASSEMBLY, ALC	28480	08672-60044
A1A5C1	0180-0197	8	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A5C2	0180-0291	3	2	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A5C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A5C4	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A5C5	0160-2209	5	1	CAPACITOR-FXD 360PF +-5% 300VDC MICA	28480	0160-2209

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1M1	1120-1908	6	1	METER (MISC ITEM) 1M A; FULL SCALE +/-2%	32171	00-823-367
A1Q1	1853-0344	5	1	TRANSISTOR PNP 2N5876 SI TO-3 PD=150W	04713	2N5876
A1R1	2100-3840	8	1	RESISTOR-VAR CONTROL CP 10K 10% LIN	28480	2100-3840
A1R2	2100-2590	3	1	RESISTOR-VAR CONTROL CCP 10K 10% 10CW	28480	2100-2590
A1R3	2100-3530	3	1	RESISTOR-VAR W/SW 10K 20% LIN SPST-NO	28480	2100-3530
A1R4	0811-3409	0	1	RESISTOR 40 1% 12W PW TC=0+-2	28480	0811-3409
A1S1	08672-60075	9	1	SLIDE SWITCH ASSEMBLY, 1.C. (ALC MODE)	28480	08672-60075
	5020-3440	7	2	SPRING:DETENT	28480	5020-3440
A1S2	08672-60077	1	1	SLIDE SWITCH,(RF)	28480	08672-60077
	5020-3440	7		SPRING:DETENT	28480	5020-3440
A1S3	3130-0517	4	1	SHAFT & INDEX ASSY-RANGE,1[illegible]US-22DEG	28480	3130-0517
	5040-6948	8	1	INSULATOR, PC, ROTARY SWITCH, MALE	28480	5040-6948
	5040-6949	9	1	INSULATOR,PC, ROTARY SWITCH, FEMALE	28480	5040-6949
	5001-0157	7	1	SPRING, PC, INSULATOR RETAINER	28480	5001-0157
	3130-0384	3	2	CONTACT-SPRING .15-WD PAL-7	28480	3130-0384
A1W1	08672-20206	4	1	CABLE, RF INPUT	28480	08672-20206
A1W2				NOT ASSIGNED		
A1W3				NOT ASSIGNED		
A1W4	1250-1397	2	1	CABLE, ISOLATOR INPUT	28480	1250-1397
A1W5	08672-20067	5	1	CABLE ASSEMBLY, YIG INPUT	28480	08672-20067
A1W6	08672-20066	4	1	CABLE ASSEMBLY, YIG OUTPUT	28480	08672-20066
A1W7	08672-20065	3	1	CABLE ASSEMBLY,DIRECTIONAL COUPLER	28480	08672-20065
A1W8	08672-20130	3	1	CABLE, RF OUTPUT	28480	08672-20130
				(DOES NOT INCLUDE A1J1).		
A1W9	08672-60065	7	1	CABLE ASSEMBLY, ALC	28480	08672-60065
	1250-0872	6	1	CONNECTOR-RF SMB FEM UNMTD 50-OHM	28480	1250-0872
	1250-1167	4	1	CONNECTOR-RF SMC FEM UNMTD 50-OHM	28480	1250-1167
	1250-1174	3	1	COVER-RF CONN 50 OHM SUBMINIATORE	98291	5561-27
	1250-1175	4	1	SLEEVE-RF CONN 0.150IN OD: 0.122 IN	98291	6100-42
	8120-1111	0	1	CABLE-COAX 50-OHM 1KV BLU	28480	8120-1111
A1W10	08672-60071	5	2	CABLE, 14-CONDUCTOR	28480	08672-60071
	1251-2499	9	4	CONNECTOR 14-PIN M RECTANGULAR	28480	1251-2499
	8120-1458	8	4	CABLE-FL-RBN 28AWG 14-CNDCT GRA-INSUL	28480	8120-1458
A1W11	08672-60071	5		CABLE, 14-CONDUCTOR	28480	08672-60071
	1251-2499	9		CONNECTOR 14-PIN M RECTANGULAR	28480	1251-2499
	8120-1458	8		CABLE-FL-RBN 28AWG 14-CNDCT GRA-INSUL	28480	8120-1458
A1W12	08672-60063	5	1	CABLE ASSEMBLY,ALC INPT(YELLOW;INCL A1J2	28480	08672-60063
A1W13				NOT ASSIGNED		
A1W14	08672-60073	7	1	CABLE ASSEMBLY, ATTENUATOR DRIVER	28480	08672-60073
A1W15	08672-60091	9	1	CABLE ASSEMBLY, 34-CONDUCTOR	28480	08672-60091
A1W16	08672-60057	7	1	CABLE ASSEMBLY, 20-CONDUCTOR	28480	08672-60057

See introduction to this section for ordering information
***Indicates factory selected value**

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A1	08672-60209	1	1	DCU FRONT PANEL BOARD ASSEMBLY	28480	08672-60209
A2A1C1	0180-0229	5	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A1C2	0160-4831	3	1	CAPACITOR-FXD 4700PF +-10% 100VDC CER	28480	0160-4831
A2A1C3	0160-4574	1	5	CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
A2A1C4	0160-4830	2	1	CAPACITOR-FXD 2200PF +-10% 100VDC CER	28480	0160-4830
A2A1C5	0160-3336	1	3	CAPACITOR-FXD 100PF +-10% 50VDC CER	28480	0160-3336
A2A1C6	0160-3336	1		CAPACITOR-FXD 100PF +-10% 50VDC CER	28480	0160-3336
A2A1C7	0160-3336	1		CAPACITOR-FXD 100PF +-10% 50VDC CER	28480	0160-3336
A2A1C8	0180-0229	7	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A1C9	0160-4574	1		CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
A2A1C10	0160-4574	1		CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
A2A1C11	0160-4574	1		CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
A2A1C12	0160-4574	1		CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
A2A1C13	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A1CR1	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A1CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A1CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A1DS1	1990-0793	8	3	LED-LIGHT BAR MODULE LUM-INT=6MCD	28480	HLMP-2635
A2A1DS2	1990-0793	8		LED-LIGHT BAR MODULE LUM-INT=6MCD	28480	HLMP-2635
A2A1DS3	1990-0793	8		LED-LIGHT BAR MODULE LUM-INT=6MCD	28480	HLMP-2635
A2A1DS4	1990-0686	8	4	DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A2A1DS5	1990-0686	8		DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A2A1DS6	1990-0686	8		DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A2A1DS7	1990-0686	8		DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A2A1DS8	1990-0651	7	4	DISPLAY-AN-DOT MAT	28480	5082-7340
A2A1DS9	1990-0651	7		DISPLAY-AN-DOT MAT	28480	5082-7340
A2A1DS10	1990-0651	7		DISPLAY-AN-DOT MAT	28480	5082-7340
A2A1DS11	1990-0651	7		DISPLAY-AN-DOT MAT	28480	5082-7340
A2A1DS12	1990-1118	3	8	LED-SET LUM-INT=6MCD IF=25MA-MAX BVR=6V	28480	1990-1118
A2A1DS13	1990-1118	3		LED-SET LUM-INT=6MCD IF=25MA-MAX BVR=6V	28480	1990-1118
A2A1DS14	1990-1118	3		LED-SET LUM-INT=6MCD IF=25MA-MAX BVR=6V	28480	1990-1118
A2A1DS15	1990-1118	3		LED-SET LUM-INT=6MCD IF=25MA-MAX BVR=6V	28480	1990-1118
A2A1DS16	1990-1118	3		LED-SET LUM-INT=6MCD IF=25MA-MAX BVR=6V	28480	1990-1118
A2A1DS17	1990-1118	3		LED-SET LUM-INT=6MCD IF=25MA-MAX BVR=6V	28480	1990-1118
A2A1DS18	1990-1118	3		LED-SET LUM-INT=6MCD IF=25MA-MAX BVR=6V	28480	1990-1118
A2A1DS19	1990-1118	3		LED-SET LUM-INT=6MCD IF=25MA-MAX BVR=6V	28480	1990-1118
A2A1J1	1251-3024	8	1	CONN-POST TYPE .100-PIN-SPCG 26-CONT	28480	1251-3024
A2A1R1	0698-7253	8	3	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R2	1810-0370	7	5	NETWORK-RES 8-SIP 220.0 OHM X 7	11236	750-81-R220
A2A1R3	1810-0370	7		NETWORK-RES 8-SIP 220.0 OHM X 7	11236	750-81-R220
A2A1R4	1810-0370	7		NETWORK-RES 8-SIP 220.0 OHM X 7	11236	750-81-R220
A2A1R5	1810-0370	7		NETWORK-RES 8-SIP 220.0 OHM X 7	11236	750-81-R220
A2A1R6	1810-0370	7		NETWORK-RES 8-SIP 220.0 OHM X 7	11236	750-81-R220
A2A1R7	0757-0317	7	2	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1331-F
A2A1R8	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1331-F
A2A1R9	0698-7244	7	2	RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A2A1R10	0698-7277	6	3	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A2A1R11	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R12	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A2A1R13	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A2A1R14	0698-7264	1	1	RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1472-F
A2A1R15	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R16	0698-7212	9	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A2A1R17	0698-7260	7	3	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A2A1R18	0698-7273	2	1	RESISTOR 34.8K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3482-F
A2A1R19	0698-7269	6	1	RESISTOR 23.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2372-F
A2A1R20	0698-7268	5	2	RESISTOR 21.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2152-F
A2A1R21	0698-7268	5		RESISTOR 21.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2152-F
A2A1R22	0698-7236	7	2	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A2A1R23	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A2A1R24	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A2A1R25	0698-7254	9	1	RESISTOR 5.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5621-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A1R26	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A2A1R27	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A2A1R28	0698-7229	8	1	RESISTOR 511 1% .05W F TC=0+ 100	24546	C3-1/8-T0-511R-F
A2A1S1	3101-0624	3	6	SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S2	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S3	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S4	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S5	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S6	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1U1	1820-3298	5	1	IC GATE CMOS/74HC OR QUAD 2-INP	27014	MM74HC32N
A2A1U2	1820-1740	8	1	IC DRVR TTL DSPL	27014	DS8863N
A2A1U3	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A1U4	1820-1433	6	2	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A2A1U5	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A2A1U6	1820-3182	6	1	IC RGTR CMOS/74HC D-TYPE 4-BIT	04713	MC74HC173N
A2A1U7	1820-2079	8	1	IC GATE CMOS NOR DUAL 4-INP	04713	MC14002BCP
A2A1U8	1826-0065	0	1	IC COMPARATOR PRCN 8-DIP-P PKG	27014	LM311N
A2A1U9	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A1U10	1820-2031	2	1	IC SHF-RGTR CMOS ASYNCHRO PRL-IN	04713	MC14021BCP
A2A1XDS1-A2A1XDS3				NOT ASSIGNED		
A2A1XDS4	1200-0648	9	6	SOCKET-STRP 12-CONT SIP DIP-SLDR	28480	1200-0648
A2A1XDS5	1200-0648	9		SOCKET-STRP 12-CONT SIP DIP-SLDR	28480	1200-0648
A2A1XDS6	1200-0648	9		SOCKET-STRP 12-CONT SIP DIP-SLDR	28480	1200-0648
A2A1XDS7	1200-0648	9		SOCKET-STRP 12-CONT SIP DIP-SLDR	28480	1200-0648
A2A1XDS8	1200-0648	9		SOCKET-STRP 12-CONT SIP DIP-SLDR	28480	1200-0648
A2A1XDS9	1200-0648	9		SOCKET-STRP 12-CONT SIP DIP-SLDR	28480	1200-0648
A2A1XDS10	1200-0649	0	2	SOCKET-STRP 8-CONT SIP DIP-SLDR	28480	1200-0649
A2A1XDS11	1200-0649	0		SOCKET-STRP 8-CONT SIP DIP-SLDR	28480	1200-0649
				A2A1 MISCELLANEOUS		
A2A1MP1	0340-1163	0	3	SPACER-IC FOR A 16 DIP IC; 0.053 IN DIA (P/O A2A1DS1)	17117	8682-2
A2A1MP2	0340-1163	0		SPACER-IC FOR A 16 DIP IC; 0.053 IN DIA (P/O A2A1DS2)	17117	8682-2
A2A1MP3	0340-1163	0		SPACER-IC FOR A 16 DIP IC; 0.053 IN DIA (P/O A2A1DS3)	17117	8682-2
A2A2	0960-0684	2	1	ROTARY PULSE GENERATOR INPUT POWER: 5VDC	28480	0960-0684
A2A3	08672-60211	5	1	ASSEMBLY, VCO, 160-240 MHZ	28480	08672-60211
A2A3C1	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C2	0160-0164	7	1	CAPACITOR-FXD .039UF +-10% 200VDC POLYE	28480	0160-0164
A2A3C3	0160-3879	7	2	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A3C4	0180-0116	1	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A3C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A3C6	0160-2259	5	1	CAPACITOR-FXD 12PF +-5% 500VDC CER 0+-30	28480	0160-2259
A2A3C7	0160-0301	4	2	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A2A3C8	0160-0166	9	2	CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A3C9	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C10	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C11	0160-0301	4		CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A2A3C12	0160-3456	6	16	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C13	0180-2211	1	1	CAPACITOR-FXD 5UF+50-10% 150VDC AL	56289	30D505F150CC2
A2A3C14	0180-2214	4	1	CAPACITOR-FXD 90UF+75-10% 16VDC AL	56289	30D906G016CC2
A2A3C15	0160-0166	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A3C16	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C17	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C18	0160-3466	8	1	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A2A3C19	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C20	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C21	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C22	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C23	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C24	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C25	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A3C26	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C27	0160-2240	4	1	CAPACITOR-FXD 2PF +-.25PF 500VDC CER	28480	0160-2240
A2A3C28	0160-2262	0	2	CAPACITOR-FXD 16PF +-5% 500VDC CER 0+-30	28480	0160-2262
A2A3C29	0160-2262	0		CAPACITOR-FXD 16PF +-5% 500VDC CER 0+-30	28480	0160-2262
A2A3C30	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C31	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C32	0140-0195	2	2	CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
A2A3C33	0140-0195	2		CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
A2A3CR1	0122-0085	1	4	DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	S0545	1S2208(B)
A2A3CR2	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	S0545	1S2208(B)
A2A3CR3	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	S0545	1S2208(B)
A2A3CR4	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	S0545	1S2208(B)
A2A3J1	1250-0544	9	2	CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A3J2	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A3L1	9140-0180	4	1	INDUCTOR RF-CH-MLD 2.7UH 10%	28480	9140-0180
A2A3L2	9100-2583	1	2	INDUCTOR RF-CH-MLD 6.8MH 10%	28480	9100-2583
A2A3L3	9100-2583	1		INDUCTOR RF-CH-MLD 6.8MH 10%	28480	9100-2583
A2A3L4	9100-2249	6	1	INDUCTOR RF-CH-MLD 150NH 10%	28480	9100-2249
A2A3L5	9100-2891	4	1	INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A2A3L6	9100-2248	5	2	INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A2A3L7	9100-2254	3	1	INDUCTOR RF-CH-MLD 390NH 10%	28480	9100-2254
A2A3L8	9100-2248	5		INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A2A3MP1	08672-20135	8	1	VCO COVER	28480	08672-20135
A2A3Q1	1855-0392	7	1	TRANSISTOR J-FET N-CHAN D-MODE TO-72 SI	28480	1855-0392
A2A3Q2	1854-0345	8	3	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q5	1853-0020	4	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A3Q6	1853-0451	5	1	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A2A3R1	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A3R2	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A3R3	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1472-F
A2A3R4	0757-0834	3	1	RESISTOR 5.62K 1% .5W F TC=0+-100	28480	0757-0834
A2A3R5	0757-0279	0	2	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A3R6	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A3R7	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A3R8	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A2A3R9	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A3R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A3R11	0698-3444	1	3	RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A3R12	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A3R13	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A3R14	0757-0180	2	1	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A2A3R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F

See introduction to this section for ordering information
*Indicates factory selected value

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A3R16	0757-0278	9	3	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A2A3R17	0757-0279	0	2	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A3R18	0698-3440	7	3	RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A2A3R19	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A2A3R20	0698-3160	8	2	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3162-F
A2A3R21	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1473-F
A2A3R22	0757-0123	3	1	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A2A3R23	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A2A3R24	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A2A3R25	0698-3444	1	2	RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A3R26	0757-0346	2	8	RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A3R27	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A2A3R28	0757-0418	9	2	RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A2A3R29	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A3R30	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A2A3R31	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A3R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A3R33	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A3R34	0757-0401	0	3	RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A2A3S1	3101-1524	4	1	SWITCH-SL DP3T SUBMIN .5A 125VAC/DC PC	28480	3101-1524
A2A3T1	08672-80003	5	1	COIL, INDUCTOR	28480	08672-80003
A2A3U1	1820-1225	4	1	IC FF ECL D-M/S DUAL	04713	MC10231P
A2A3U2	1820-0794	0	1	IC FF ECL D-M/S	04713	MC1670L
				A2A3 MISCELLANEOUS		
	86701-40001	9	2	EXTRACTOR, P.C. BOARD	28480	86701-40001
A2A4	08672-60211	5	1	ASSEMBLY, 20/30 PHASE DETECTOR	28480	08672-60211
A2A4C1	0180-0116	1	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A4C2	0160-6650	8	5	CAPACITOR-FXD .022UF +-1% 50VDC	84411	X463UW-0.022-1%-50VDC
A2A4C3	0180-0197	8	3	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A4C4	0180-0141	2	1	CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A2A4C5	0160-4835	7	8	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A2A4C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A4C7	0160-0161	4	2	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A2A4C8	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A2A4C9	0160-2290	4	2	CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A2A4C10	0160-4800	6	1	CAPACITOR-FXD 120PF +-5% 100VDC CER	28480	0160-4800
A2A4C11	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A2A4C12	0160-2290	4		CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A2A4C13	0160-6650	8		CAPACITOR-FXD .022UF +-1% 50VDC	84411	X463UW-0.022-1%-50VDC
A2A4C14	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A2A4C15	0160-6294	6	1	CAPACITOR-FXD 1000PF +-5% 50VDC CER	28480	0160-6294
A2A4C16	0160-3334	9	1	CAPACITOR-FXD .01UF +-10% 50VDC CER	28480	0160-3334
A2A4C17	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A2A4C18	0170-0040	9	1	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A2A4C19	0160-6650	8		CAPACITOR-FXD .022UF +-1% 50VDC	84411	X463UW-0.022-1%-50VDC
A2A4C20	0160-6650	8		CAPACITOR-FXD .022UF +-1% 50VDC	84411	X463UW-0.022-1%-50VDC
A2A4C21	0160-4805	1	2	CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A2A4C22	0160-6650	8		CAPACITOR-FXD .022UF +-1% 50VDC	84411	X463UW-0.022-1%-50VDC
A2A4C23	0160-6649	5	3	CAPACITOR-FXD .1UF +-1% 50VDC MET-POLYC	84411	X463UW-0.1-1%-50VDC
A2A4C24	0160-6649	5		CAPACITOR-FXD .1UF +-1% 50VDC MET-POLYC	84411	X463UW-0.1-1%-50VDC
A2A4C25	0160-6649	5		CAPACITOR-FXD .1UF +-1% 50VDC MET-POLYC	84411	X463UW-0.1-1%-50VDC
A2A4C26	0160-0301	4	1	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A2A4C27	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A2A4C28	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A2A4C29	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A2A4C30	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A2A4C31	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A2A4CR1	1901-0535	9	4	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR2	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR3	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR4	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A4L1	9100-1629	4	2	INDUCTOR RF-CH-MLD 47UH 5%	28480	9100-1629
A2A4L2	9100-1629	4		INDUCTOR RF-CH-MLD 47UH 5%	28480	9100-1629
A2A4L3	9140-1191	9	4	INDUCTOR 390 MH +-5%	28480	9140-1191
A2A4L4	9140-1191	9		INDUCTOR 390 MH +-5%	28480	9140-1191
A2A4L5	9140-1191	9		INDUCTOR 390 MH +-5%	28480	9140-1191
A2A4L6	9140-1191	9		INDUCTOR 390 MH +-5%	28480	9140-1191
A2A4Q1	1854-0071	7	1	TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A4R1	0757-0280	3	6	RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R2	0698-3629	4	1	RESISTOR 270 5% 2W MO TC=0+-200	28480	0698-3629
A2A4R3	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A2A4R4	0698-3153	9	3	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3831-F
A2A4R5	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3831-F
A2A4R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R8	0757-0440	7	2	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A2A4R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R10	0757-0438	3	5	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R11	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A2A4R12	0757-0422	5	3	RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A2A4R13	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A2A4R14	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R15	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3162-F
A2A4R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R17	0757-0467	8	2	RESISTOR 121K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1213-F
A2A4R18	0698-6362	8	4	RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A2A4R19	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A2A4R20	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R21	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A2A4R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R23	0757-0819	4	1	RESISTOR 909 1% .5W F TC=0+-100	28480	0757-0819
A2A4R24	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R25	0757-0424	7	1	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1101-F
A2A4R26	0698-3443	0	1	RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A2A4R27	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3831-F
A2A4R28	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A4R29	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5621-F
A2A4R30	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A2A4R31	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A2A4R32	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A2A4R33	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A2A4R34	0698-7394	8	1	RESISTOR 698 .1% .125W F TC=0+-25	19701	5033R-1/8-T9-698R-R
A2A4R35	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A2A4R36	0757-0467	8		RESISTOR 121K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1213-F
A2A4R37	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R38	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A2A4R39	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A2A4R40	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A4R41	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A4R42	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A4R43	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A4R44	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A4R45	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A4R46*	0698-3158	4	1	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2372-F
A2A4R47	0698-3441	8	4	RESISTOR 215 1% .125W F TC=0+-100	24546	CT4-1/8-T0-215R-F
A2A4R48	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	CT4-1/8-T0-215R-F
A2A4R49	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	CT4-1/8-T0-215R-F
A2A4R50	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	CT4-1/8-T0-215R-F
A2A4TP1	1251-0600	0	4	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4U1	1820-0429	8	1	IC V RGLTR TO-39	18324	LM309H
A2A4U2	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A4U3	1820-0281	0	1	IC FF TTL J-K M/S PULSE CLEAR DUAL	01295	SN74107N
A2A4U4	1820-1422	3	2	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2A4U5	1826-0783	9	1	IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A4U6	1826-0716	8	2	IC OP AMP LOW-NOISE DUAL 8-DIP-C PKG	18324	NE5532AFE
A2A4U7	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A4U8	1820-1422	3		IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2A4U9	1820-1645	2	1	IC BFR TTL LS BUS QUAD	01295	SN74LS126AN
A2A4U10	1826-0716	8		IC OP AMP LOW-NOISE DUAL 8-DIP-C PKG	18324	NE5532AFE
A2A4VR1	1902-3234	3	1	DIODE-ZNR 19.6V 5% DO-35 PD=.4W	28480	1902-3234
	08672-20136	9	1	COVER-PHASE DET	28480	08672-20136
	08672-20211	1	1	BOARD-PHASE DET	28480	08672-20211
	0890-0212	3	1	TUBING-FLEX .032-ID TFE .012-WALL	28480	0890-0212
	1205-0250	9	1	THERMAL LINK SGL TO-5/TO-39-CS	28480	1205-0250
	2200-0101	0	4	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0103	2	1	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2A5	08672-60145	4	1	ASSEMBLY, 20/30 DIVIDER	28480	08672-60145
A2A5C1	0160-2055	9	9	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C2	0180-0229	7	3	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C3	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C4	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
A2A5C5	0160-3466	8	1	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A2A5C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C7	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A5C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A2R31	0698-3429	2	2	RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A1A2R32	0698-3443	0	3	RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A1A2R33	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A1A2R34	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A1A2R35	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A1A2R36	0698-3150	6	4	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R37	0757-0422	5	2	RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A1A2R38	0757-0401	0	6	RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R39	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R40	0757-0416	7	7	RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R41	0757-0394	0	4	RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A2R42	0698-0084	9	3	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A1A2R43	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A3A1A2R44	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A1A2R45	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A1A2R46	0757-0279	0	3	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A3A1A2R47	0757-0439	4	2	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6811-F
A3A1A2R48	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R49	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A3A1A2R50	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6811-F
A3A1A2R51	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R52	0757-0280	3	7	RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A2R53	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A2R54	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A2R55	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A1A2R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R57	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R58	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R59	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A2R61	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0+-100	24546	CT4-1/8-T0-215R-F
A3A1A2R62	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R63				NOT ASSIGNED		
A3A1A2R64				NOT ASSIGNED		
A3A1A2R65				NOT ASSIGNED		
A3A1A2R66				NOT ASSIGNED		
A3A1A2R67*	0757-0402	1	2	RESISTOR 110 1% .125W F TC=0+-100	24546	CT4-1/8-T0-111-F
A3A1A2R68*	0757-0246	1	1	RESISTOR 536 1% .25W F TC=0+ 25	19701	5043R-1/4-T9-536R-F
A3A1A2R69*	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	CT4-1/8-T0-111-F
A3A1A2T1	86701-60081	7	3	TRANSFORMER, RF, BLUE	28480	86701-60081
A3A1A2T2	86701-60081	7		TRANSFORMER, RF, BLUE	28480	86701-60081
A3A1A2T3	86701-60081	7		TRANSFORMER, RF, BLUE	28480	86701-60081
A3A1A2TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2W1	86701-60031	7	1	CABLE ASSEMBLY, GRAY/RED/WHITE	28480	86701-60031
A3A1A2Y1	0410-1086	5	1	CRYSTAL-QUARTZ 100 MHZ HC-35/U-HLDR	28480	0410-1086
			1	A3A1A2 MISCELLANEOUS		
	2190-0009	4	14	WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2580-0002	4	14	NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
	2200-0101	0	7	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	6040-0239	9	1	LUBRICANT-GREASE SIL	05820	120
	86701-60073	7	1	SHIELD ASSEMBLY	28480	86701-60073
	86701-20039	1	1	COVER, P.C. VCXO	28480	86701-20039
	86701-40001	9	5	EXTRACTOR, P.C.	28480	86701-40001
A3A1A3	86701-60098	6	1	M/N PH DET BD AY	28480	86701-60098
A3A1A3C1	0160-4299	7	4	CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C2	0160-0574	3	6	CAPACITOR-FXD .022UF +-20% [illegible]0VDC CER	28480	0160-0574
A3A1A3C3	0160-429[illegible]	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3[illegible]	0180-0100	3	1	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A3A1A3C5	0160-0572	1	2	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A3C6	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A3A1A3C7	0160-3876	4	3	CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A3A1A3C8	0160-3877	5	1	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A3A1A3C9	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A3A1A3C10	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A1A3C11	0160-3873	1	2	CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A3A1A3C12	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A1A3C13	0160-3878	6	25	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A3C14	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A1A3C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A3C16	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A3C17	0180-0197	8	3	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A3C18	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C19	0180-0291	3	2	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3A1A3C20	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A1A3C21	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C22	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A1A3J1	1250-0690	6	1	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0690
A3A1A3L1	9100-1641	0	3	INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A1A3L2	9100-2259	8	1	INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-2259
A3A1A3L3	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A1A3L4	9100-2891	4	9	INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A3L5	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A3L6	9100-2248	5	3	INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A3A1A3L7	9100-2248	5		INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A3A1A3L8	9100-2248	5		INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A3A1A3MP1	85660-20136	7	1	M/N PHASE DET BD	28480	85660-20136
A3A1A3MP2				NOT ASSIGNED		
A3A1A3MP3	0520-0129	8	13	SCREW-MACH 2-56 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1A3MP4	0590-0533	5	15	THREADED INSERT-NUT 2-56 .06-IN-LG SST	28480	0590-0533
A3A1A3MP5	1205-0285	0	6	HEAT SINK SGL DIP	28480	1205-0285
A3A1A3MP6	2190-0014	1	3	WASHER-LK INTL T NO. 2 .089-IN-ID	78189	1902-00-00-2580
A3A1A3MP7	2190-0124	4	9	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A3A1A3MP8	2200-0101	0		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1A3MP10	2950-0078	9	5	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A3A1A3MP11				NOT ASSIGNED		
A3A1A3MP12	86701-20101	8	1	CV-PC M/N PH DET	28480	86701-20101
A3A1A3MP13	85660-20068	4	4	GROUND LUG	28480	85660-20068
A3A1A3MP14	86701-00032	2	1	HEATSINK	28480	86701-00032
A3A1A3MP15				NOT ASSIGNED		
A3A1A3MP16	86701-40001	9		EXTRACTOR PC	28480	86701-40001
A3A1A3MP17				NOT ASSIGNED		
A3A1A3MP18	8151-0013	4	2	WIRE 22AWG 1X22	28480	8151-0013
A3A1A3Q1	1853-0451	5	4	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A3Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A3Q3	1854-0345	8	6	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A3Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A3R1	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-4221-F
A3A1A3R2	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-4221-F
A3A1A3R3	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-4221-F
A3A1A3R4	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-4221-F
A3A1A3R5	0698-7267	4	1	RESISTOR 19.6K 1% .05W F TC=0+-100	24546	C3-1/8-TO-1962-F
A3A1A3R6	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-TO-101-F
A3A1A3R7	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1961-F
A3A1A3R8	0698-7192	4	2	RESISTOR 14.7 1% .05W F TC=0+-100	24546	C3-1/8-TO-14R7-F
A3A1A3R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1001-F
A3A1A3R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1001-F
A3A1A3R11	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-4221-F
A3A1A3R12	0698-7212	9	5	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-TO-100R-F
A3A1A3R13	0698-3157	3	2	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1962-F
A3A1A3R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-TO-511R-F
A3A1A3R15	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-TO-511R-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A3R16	0698-7248	1	7	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A3R17	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A3R18	0698-7223	2	5	RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-TO-287R-F
A3A1A3R19	0698-7256	1	1	RESISTOR 6.81K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6811-F
A3A1A3R20	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A3R21	0698-7220	9	2	RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-TO-215R-F
A3A1A3R22	0698-7220	9		RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-TO-215R-F
A3A1A3R23	0698-7192	4		RESISTOR 14.7 1% .05W F TC=0+-100	24546	C3-1/8-TO-14R7-F
A3A1A3R24	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A3R25	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A3R26	0757-0441	8	2	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8251-F
A3A1A3R27	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8251-F
A3A1A3R28	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1962-F
A3A1A3R29	0698-3162	0	1	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4642-F
A3A1A3R30	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A1A3TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3U1	1820-1344	8	1	IC PL LOOP 14-DIP-C PKG	04713	MC12040L
A3A1A3U2	1826-0092	3	1	IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A1A3U3	1810-0251	3	3	NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U4	1820-1225	4	2	IC FF ECL D-M/S DUAL	04713	MC10231P
A3A1A3U5	1810-0204	6	6	NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U6	1820-3126	8	2	IC CNTR ECL HEXADEC SYNCHRO	04713	MC10136P
A3A1A3U7	1820-0802	1	4	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U8	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U9	1820-0806	5	2	IC GATE ECL OR-NOR DUAL 4-5-INP	04713	MC10109P
A3A1A3U10	1820-0820	3	2	IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
A3A1A3U11	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U12	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U13	1810-0251	3		NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U14	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A3A1A3U15	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U16	1820-3126	8		IC CNTR ECL HEXADEC SYNCHRO	04713	MC10136P
A3A1A3U17	1810-0251	3		NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U18	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U19	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U20	1820-0806	5		IC GATE ECL OR-NOR DUAL 4-5-INP	04713	MC10109P
A3A1A3U21	1820-0820	3		IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
A3A1A3U22	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U23	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U24	0955-0063	0	1	U-WAVE MIXER 500 MHZ MAX	28480	0955-0063
A3A1A3VR1	1902-3082	9	1	DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A3A1A3W1	86701-60051	1	1	CBL AY IF IN-OUT	28480	86701-60051
A3A1A3W2	85660-60085	9	1	CABLE ASSY	28480	85660-60085
	2190-0112	0	12	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0112
	6040-0454	0	2	THERMAL COMPOUND	28480	6040-0454
	7121-4611	2	1	LABEL-INFORMATION .15-IN-WD .6-IN-LG	28480	7121-4611
	86701-64098	4	1	SQ-M/N PH DET BD	28480	86701-64098
A3A1A4	86701-60029	3	1	M/N VCO ASSEMBLY (INCL. A3A1A4A1, A3A1A4A2)	28480	86701-60029
A3A1A4	86701-60071	5	1	M/N VCO ASSEMBLY (RESTORED 08672-60029)	28480	86701-60071
				A3A1A4 MISCELLANEOUS		
	0380-0020	0	1	SPACER-RND .25-IN-LG .128-IN-ID	28480	0380-0020
	0520-0128	7	5	SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0520-0133	4	2	SCREW-MACH 2-56 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0510-0003	6	1	THREADED INSERT-NUT 8-32 .094-IN-LG STL	28480	0510-0003
	2190-0045	8	4	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045
	3050-0672	2	1	WASHER-SHLDR NO. 4 .118-IN-ID .25-IN-OD	28480	3050-0672
	86701-20046	0	1	PROBE	28480	86701-20046
	86701-20047	1	1	SUPPORT, RESONATOR	28480	86701-20047

See introduction to this section for ordering information
***Indicates factory selected value**

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A4A1				VCO RESONATOR ASSEMBLY (NSR, P/O A3A1A4)		
A3A1A4A2	86701-60027	1	1	BOARD ASSEMBLY, M/N VCO	28480	86701-60027
A3A1A4A2C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C3	0160-3879	7	2	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A4A2C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C5	0180-0116	1	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A1A4A2C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C8	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A3A1A4A2C9	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A4A2C11	0180-2161	0	1	CAPACITOR-FXD .75UF+-10% 50VDC TA	56289	150D754X9050A2
A3A1A4A2L1	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A4A2L2	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A4A2L3	86701-20051	7	1	INDUCTOR	28480	86701-20051
A3A1A4A2L4	9140-0158	6	1	INDUCTOR RF-CH-MLD 1UH 10%	28480	9140-0158
A3A1A4A2Q1	1854-0610	0	1	TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A3A1A4A2Q2	1854-0686	0	2	TRANSISTOR NPN SI TO-72 PD=200MW FT=4GHZ	28480	1854-0686
A3A1A4A2R1	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A4A2R2	0698-7219	6	1	RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A4A2R3	0698-7193	5	1	RESISTOR 16.2 1% .05W F TC=0+-100	24546	C3-1/8-T0-16R2-F
A3A1A4A2R4	0698-3154	0	6	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A4A2R5	0757-0428	1	2	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A3A1A4A2R6	0698-7262	9	1	RESISTOR 12.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1212-F
A3A1A4A2R7	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A3A1A4A2R8	0698-7254	9	1	RESISTOR 5.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5621-F
A3A1A4A2R9	0698-7205	0	2	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A4A2R10	0698-7265	2	1	RESISTOR 16.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1622-F
A3A1A4A2R11	0698-7250	5	1	RESISTOR 3.83K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3831-F
A3A1A4A2R12	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A4A2R13	0757-0400	9	1	RESISTOR 90.9 1% .125W F TC=0+-100	24546	CT4-1/8-T0-90R9-F
A3A1A4A2TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A4A2W1	86701-60058	8	1	CABLE ASSEMBLY, VCO OUTPUT	28480	86701-60058
A3A1A4A2W2	86701-20050	6	1	CABLE, S/R JUMPER	28480	86701-20050
				A3A1A4A2 MISCELLANEOUS		
	0590-0526	6	1	THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
	86701-20052	8	2	SPACER, INSULATOR	28480	86701-20052
A3A1A5	86701-60097	5	1	M/N OUTPUT BD AY	28480	86701-60097
A3A1A5C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C3	0160-3874	2	1	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A1A5C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C6	0160-4383	0	1	CAPACITOR-FXD 6.8PF +-.5PF 200VDC CER	20932	5024E0200RD689D
A3A1A5C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C9	0160-4491	1	1	CAPACITOR-FXD 8.2PF +-.5PF 200VDC CER	28480	0160-4491
A3A1A5C10	0160-4490	0	1	CAPACITOR-FXD 1.8PF +-.25PF 200VDC CER	28480	0160-4490
A3A1A5C11				NOT ASSIGNED		
A3A1A5C12	0160-2261	9	1	CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A5C13	0160-2290	4	2	CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A3A1A5C14	0160-2290	4		CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A3A1A5C15	0160-0196	5	1	CAPACITOR-FXD 24PF +-5% 300VDC MICA	28480	0160-0196
A3A1A5C16	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C18	0160-4389	6	1	CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A3A1A5C19	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A3A1A5C20	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C22	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C23	0160-4351	2	1	CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4351
A3A1A5C24	0160-0161	4	2	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A5C25	0160-0153	4	1	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153

See introduction to this section for ordering information
***Indicates factory selected value**

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A5C26	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A5C27	0160-3534	1	1	CAPACITOR-FXD 510PF +-5% 100VDC MICA	28480	0160-3534
A3A1A5C28	0160-0298	8	1	CAPACITOR-FXD 1500PF +-10% 200VDC POLYE	28480	0160-0298
A3A1A5C29	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A5C30	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C31	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A5C32				NOT ASSIGNED		
A3A1A5C33	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C34	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C35	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C36	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3A1A5C37	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C38	0180-0630	4	1	CAPACITOR-FXD 4.7UF+-20% 50VDC TA	28480	0180-0630
A3A1A5CR1				NOT ASSIGNED		
A3A1A5CR2				NOT ASSIGNED		
A3A1A5CR3	1901-0040	1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A1A5CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A1A5CR5	1901-1098	1	2	DIODE-SWITCHING 1N4150 50V 200MA 4NS	15818	1N4150
A3A1A5CR6	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A5CR7	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	15818	1N4150
A3A1A5J1	1250-0657	5	2	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0657
A3A1A5J2	1250-0657	5		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0657
A3A1A5J3	1250-0257	1	1	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A3A1A5L1	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A5L2	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A5L3	9135-0073	3	2	INDUCTOR RF-CH-MLD 47NH 6.596%	28480	9135-0073
A3A1A5L4	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A5L5				NOT ASSIGNED		
A3A1A5L6	9100-1634	1	1	INDUCTOR RF-CH-MLD 75UH 5%	28480	9100-1634
A3A1A5L7	9100-1635	2	1	INDUCTOR RF-CH-MLD 91UH 5%	28480	9100-1635
A3A1A5L8	9100-1620	5	1	INDUCTOR RF-CH-MLD 15UH 10%	28480	9100-1620
A3A1A5L9	9140-0210	1	1	INDUCTOR RF-CH-MLD 100UH 5%	28480	9140-0210
A3A1A5L10	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A5L11	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A5L12	9135-0079	9	1	INDUCTOR 100NH 5.5% 2.6D-MMX6.6LG-MM	28480	9135-0079
A3A1A5L13	9135-0073	3		INDUCTOR RF-CH-MLD 47NH 6.596%	28480	9135-0073
A3A1A5L14	9140-0144	0	1	INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0144
A3A1A5L15	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A1A5MP1				NOT ASSIGNED		
A3A1A5MP2				NOT ASSIGNED		
A3A1A5MP3	2190-0009	4		WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
A3A1A5MP4	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A3A1A5MP5	2200-0101	0		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1A5MP6	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
A3A1A5MP7	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A3A1A5MP8	3050-0082	8	1	WASHER-FL NM NO. 4 .116-IN-ID .188-IN-OD	28480	3050-0082
A3A1A5MP9	4330-0145	9	1	INSULATOR-BEAD GLASS	28480	4330-0145
A3A1A5MP10	8151-0013	4		WIRE 22AWG 1X22	28480	8151-0013
A3A1A5MP11	86701-20100	7	1	COV-PC M/N OUT	28480	86701-20100
A3A1A5MP12	85660-20068	4		GROUND LUG	28480	85660-20068
A3A1A5MP13	86701-40001	9		EXTRACTOR PC	28480	86701-40001
A3A1A5MP14	2200-0103	2	2	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1A5MP15	0520-0128	7		SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1A5MP16	0590-0533	5		THREADED INSERT-NUT 2-56 .06-IN-LG SST	28480	0590-0533
A3A1A5MP17	1205-0285	0		HEAT SINK SGL DIP	28480	1205-0285
A3A1A5MP18	85660-00065	9	1	HEAT SINK	28480	85660-00065
A3A1A5MP19	2190-0112	0		WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0112
A3A1A5MP20	6040-0454	0		THERMAL COMPOUND	28480	6040-0454
A3A1A5Q1	1854-0546	1	2	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q5	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546

See introduction to this section for ordering information
***Indicates factory selected value**

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A5Q6	1854-0686	0		TRANSISTOR NPN SI TO-72 PD=200MW FT=4GHZ	28480	1854-0686
A3A1A5Q7	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q8	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A5Q9	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A5Q10	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A3A1A5R1	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R2	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R3	0698-7243	6	4	RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R4	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A5R5	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-F
A3A1A5R6	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R7	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R8	0757-0316	6	1	RESISTOR 42.2 1% .125W F TC=0+-100	28480	0757-0316
A3A1A5R9	0698-7221	0	2	RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-T0-237R-F
A3A1A5R10	0698-7188	8	4	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R11	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R12	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A5R13	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R14	0757-1094	9	4	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A3A1A5R15	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A3A1A5R16	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A3A1A5R17	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A3A1A5R18	0698-7260	7	2	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A3A1A5R19	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R20	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-F
A3A1A5R21	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-F
A3A1A5R22	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R23	0698-7229	8	3	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A3A1A5R24	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R25	0698-7221	0		RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-T0-237R-F
A3A1A5R26	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R27	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R28	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A3A1A5R29	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R30	0698-7195	7	1	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T0-19R6-F
A3A1A5R31	0698-7227	6	1	RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-F
A3A1A5R32	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A5R34	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A3A1A5R35	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-F
A3A1A5R36	0698-7210	7	1	RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T0-82R5-F
A3A1A5R37	0698-7257	2	1	RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-F
A3A1A5R38	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A3A1A5R39	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A3A1A5R40	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A3A1A5R41	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A3A1A5R42	0698-7263	0	1	RESISTOR 13.3K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1332-F
A3A1A5R43	0698-7277	6	1	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A3A1A5R44	0698-0024	7	1	RESISTOR 2.61K 1% .5W F TC=0+-100	28480	0698-0024
A3A1A5R45	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A1A5R46	0757-0447	4	1	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1622-F
A3A1A5R47	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R48	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A5U1	1826-0059	2	1	IC OP AMP GP TO-99 PKG	01295	LM201AL
A3A1A5U2	1820-3485	2	1	IC PRESCR ECL	04713	MC12090L
A3A1A5VR1	1902-3070	5	2	DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A3A1A5VR2	1902-3070	5		DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A3A1A5W1	85660-60103	2	1	JUMPER WIRE AY	28480	85660-60103
	85660-20266	4	1	M/N OUTPUT BD	28480	85660-20266
	86701-64097	3	1	SEQ-M/N OUT BD	28480	86701-64097
A3A1A6	86701-60099	7	1	M/N REFERENCE MOTHERBOARD ASSEMBLY	28480	86701-60099

See introduction to this section for ordering information
***Indicates factory selected value**

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A6C1	0160-2437	1	12	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C2	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C3	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C4	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C5	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C6	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C7	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C8	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C9	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C10	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C11	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C12	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6XA3A1A	5060-0112	8	2	CONNECTOR:15 CONTACTS	28480	5060-0112
A3A1A6XA3A1B	5060-0112	8		CONNECTOR:15 CONTACTS	28480	5060-0112
A3A1A6XA3A1	1251-4423	3	1	CONNECTOR-PC EDGE	28480	1251-4423
A3A1A6XA3A1	1251-4174	1	2	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-4174
A3A1A6XA3A1	1251-2035	9	1	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A3A1A6XA3A1	1251-4174	1		CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-4174
				A3A1A6 MISCELLANEOUS		
	0360-1514	7	5	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	2190-0009	4		WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
	86701-00031	1	2	INSULATOR	28480	86701-00031
	86701-00046	8	1	INSULATOR	28480	86701-00046
	1251-0600	0	18	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A2	86701-60012	4	1	RECTIFIER ASSEMBLY	28480	86701-60012
A3A2C1	0160-2055	9	3	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A2C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A2C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A2C4	0160-4084	8	1	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A2C5	0180-0230	0	1	CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A4R26	0698-6835	0	2	RESISTOR 3.16K .5% .125W TF TC=0+-50	12498	NC55
A3A4R27	0683-0275	9	2	RESISTOR 2.7 5% .25W CF TC=0-400	19701	(CR-25) 1-4-5P-2E7
A3A4R28	0698-3444	1	1	RESISTOR 316 1% .125W TF TC=0+-100	K8479	H8
A3A4R29	0757-0346	2	6	RESISTOR 10 1% .125W TF TC=0+-100	06424	NK4H
A3A4R30	0698-3150	6	4	RESISTOR 2.37K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A4R31	0698-3150	6		RESISTOR 2.37K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A4R32	0812-0066	1	3	RESISTOR .33 5% 2W PW TC=0+-800	11502	SPH
A3A4R33	0812-0066	1		RESISTOR .33 5% 2W PW TC=0+-800	11502	SPH
A3A4R34	0812-0066	1		RESISTOR .33 5% 2W PW TC=0+-800	11502	SPH
A3A4R35	0757-0280	3	2	RESISTOR 1K 1% .125W TF TC=0+-100	12498	CT4
A3A4R36	0757-0441	8	2	RESISTOR 8.25K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A4R37	0698-6835	0		RESISTOR 3.16K .5% .125W TF TC=0+-50	12498	NC55
A3A4R38	0698-7050	3	1	RESISTOR 4.48K .5% .125W TF TC=0+-50	91637	CMF 55-1 T-2
A3A4R39	0698-6853	2	1	RESISTOR 7.68K .5% .125W TF TC=0+-50	12498	NC55
A3A4R40	0683-0275	9		RESISTOR 2.7 5% .25W CF TC=0-400	19701	(CR-25) 1-4-5P-2E7
A3A4R41	0757-0441	8		RESISTOR 8.25K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A4R42	0698-3160	8	1	RESISTOR 31.6K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A4R43	0757-0401	0		RESISTOR 100 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A4R44	0757-0401	0		RESISTOR 100 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A4R45	0757-0401	0		RESISTOR 100 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A4R46	0757-0280	3		RESISTOR 1K 1% .125W TF TC=0+-100	12498	CT4
A3A4R47	0757-0442	9	4	RESISTOR 10K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A4R48	0757-0401	0	7	RESISTOR 100 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A4TP1	1251-0600	0	15	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A4TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A4TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A4TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A4TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A4U1	1820-0223	0	3	IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4U2	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4U3	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4VR1	1902-0025	4	2	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A3A4VR2	1902-3171	7	1	DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%	28480	1902-3171
A3A4VR3	1902-3330	0	1	DIODE-ZNR 44.2V 2% DO-35 PD=.4W	28480	1902-3330
A3A4VR4	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A3A4XF1	2110-0269	0	6	FUHLR-CLP-TYP	91506	6008-32CN
A3A4XF2	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3A4XF3	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
				A3A4 MISCELLANEOUS		
	5000-9043	6	4	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2	4	EXTRACTOR, P.C. BOARD	28480	5040-6843
A3A5	08672-60229	7	1	DIGITAL-TO-ANALOG CONVERTER ASSEMBLY	28480	86701-60015
A3A5C1	0180-2141	6	1	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	12344	T110B335K050AS
A3A5C2	0160-3879	7	6	CAPACITOR-FXD .01UF +-20% 100VDC CER	06383	FD12X7R2A103M
A3A5C3	0180-0229	7	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	K7253	TAAB33K10RX
A3A5C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	06383	FD12X7R2A103M
A3A5C5	0180-0116	1	3	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	K7253	TAAB6R8K35RX
A3A5C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	06383	FD12X7R2A103M
A3A5C7	0180-3721	0	1	CAPACITOR-FXD 22UF+-20% 50VDC AL	00494	KM50T22RM6.3X16LL
A3A5C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	06383	FD12X7R2A103M
A3A5C9	0180-1731	8	2	CAPACITOR-FXD 4.7UF+-10% 50VDC TA	12344	T110B475K050AS
A3A5C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	06383	FD12X7R2A103M
A3A5C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	06383	FD12X7R2A103M
A3A5L1	9100-1631	8	1	INDUCTOR RF-CH-MLD 56UH +-5%	99800	1537-64
A3A5L2	9100-1641	0	2	INDUCTOR RF-CH-MLD 240UH +-5%	99800	1537-94
A3A5L3	9100-1641	0		INDUCTOR RF-CH-MLD 240UH +-5%	99800	1537-94
A3A5MP1	0590-0526	6	1	THREADED INSERT-NUT 4-40 .065-IN-LG SST	46384	KFS2-440
A3A5MP2	2200-0103	2	1	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A5MP3	5000-9043	6		PIN-PC BOARD EXTRACTOR	28480	5000-9043
A3A5MP4	5040-6843	2		EXTRACTOR-PC BOARD	28480	5040-6843

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A5Q1	1854-0474	4	1	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A3A5Q2	1853-0451	5	3	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q3	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5R1	0698-3132	4	1	RESISTOR 261 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A5R2	0699-0476	5	1	RESISTOR 100 .1% .1W F TC=0+-10	28480	0699-0476
A3A5R3	0698-3442	9	1	RESISTOR 237 1% .125W TF TC=0+-100	K8479	H8
A3A5R4	0699-2410	1	1	RESISTOR 250 .1% .125W TF TC=0+-5	19701	5033Z
A3A5R5	0699-0078	3	1	RESISTOR 2.1K .1% .1W F TC=0+-10	28480	0699-0078
A3A5R6	0698-3150	6		RESISTOR 2.37K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A5R7	0698-3150	6		RESISTOR 2.37K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A5R8	2100-4215	3	1	RESISTOR-TRMR 100 10% TF SIDE-ADJ 25-TRN	18612	1202Y100R10
A3A5R9	0699-0236	5	1	RESISTOR 2.5K .1% .1W F TC=0+-5	28480	0699-0236
A3A5R10	0757-0401	0		RESISTOR 100 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A5R11	0757-0465	6	4	RESISTOR 100K 1% .125W TF TC=0+-100	12498	CT4
A3A5R12	0757-0317	7	1	RESISTOR 1.33K 1% .125W TF TC=0+-100	K8479	H8
A3A5R13	0698-3136	8	1	RESISTOR 17.8K 1% .125W TF TC=0+-100	06424	NK4H
A3A5R14	0757-0438	3	3	RESISTOR 5.11K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A5R15	2100-3122	9	1	RESISTOR-TRMR 100 10% TKF SIDE-ADJ	09969	2101P
A3A5R16	0757-0465	6		RESISTOR 100K 1% .125W TF TC=0+-100	12498	CT4
A3A5R17	0699-0072	7	1	RESISTOR 6.81M 1% .125W F TC=0+-150	28480	0699-0072
A3A5R18	0699-0642	7	1	RESISTOR 10K .1% .1W F TC=0+-5	28480	0699-0642
A3A5R19	0757-1094	9	1	RESISTOR 1.47K 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A5R20	0698-3455	4	1	RESISTOR 261K 1% .125W TF TC=0+-100	K8479	H8
A3A5R21	0757-0421	4	3	RESISTOR 825 1% .125W TF TC=0+-100	19701	SFR25H
A3A5R22	0698-4037	0	1	RESISTOR 46.4 1% .125W TF TC=0+-100	D8439	MK2
A3A5R23	0757-0290	5	2	RESISTOR 6.19K 1% .125W TF TC=0+-100	K8479	H8
A3A5R24	0757-0818	3	1	RESISTOR 825 1% .5W TF TC=0+-100	K8479	H2
A3A5R25	0698-3408	7	1	RESISTOR 2.15K 1% .5W TF TC=0+-100	19701	5053R
A3A5R26	0698-3454	3	1	RESISTOR 215K 1% .125W TF TC=0+-100	K8479	H8
A3A5R27	0757-0346	2		RESISTOR 10 1% .125W TF TC=0+-100	06424	NK4H
A3A5R28	0757-0421	4		RESISTOR 825 1% .125W TF TC=0+-100	19701	SFR25H
A3A5R29	0757-0158	4	1	RESISTOR 619 1% .5W TF TC=0+-100	91637	CMF-65-2
A3A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A5TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A5U1	1826-0607	6	1	IC-REGULATOR 7815A	28480	1826-0607
A3A5U2	1826-1590	8	1	IC OP AMP PRCN QUAD 14-DIP-P PKG	28480	1826-1590
A3A5U3	08673-80098	9	2	IC EPROM 256K D27256	28480	08673-80098
A3A5U4	08673-80098	9		IC EPROM 256K D27256	28480	08673-80098
A3A5U5	1826-1386	0	1	D/A 12-BIT 18-PLASTIC CMOS	24355	AD11/548
A3A5VR1	1902-0692	1	1	DIODE-ZNR 6.3V 1% DO-7 PD=.4W TC=+.001%	28480	1902-0692
A3A5VR2	1902-0958	2	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A3A5VR3	1902-0085	6	1	DIODE-ZNR 27V 5% PD=1W IR=5UA	28480	1902-0085
				A3A5 MISCELLANEOUS		
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
A3A6	86701-60016	8	1	YTO DRIVER ASSEMBLY	28480	86701-60016
A3A6C1	0160-3451	1	7	CAPACITOR-FXD .01UF +80-20% 100VDC CER	06383	CK45YV2A103Z-A
A3A6C2	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	12344	T110B475K050AS
A3A6C3	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	K7253	TAAB6R8K35RX
A3A6C4	0160-0574	3	1	CAPACITOR-FXD .022UF +-20% 100VDC CER	06383	FD12X7R2A223M
A3A6C5	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	K7253	TAAB6R8K35RX
A3A6C6	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	06383	CK45YV2A103Z-A
A3A6C7	0180-2139	2	1	CAPACITOR-FXD 10UF+-20% 60VDC TA	19701	40EW106A060MIC
A3A6C8	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	06383	CK45YV2A103Z-A
A3A6C9	0160-3452	2	1	CAPACITOR-FXD .02UF +-20% 100VDC CER	06383	CK45YV2A203Z-A
A3A6C10	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	K7253	TAAB33K10RX
A3A6C11	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	06383	CK45YV2A103Z-A
A3A6C12	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	06383	CK45YV2A103Z-A
A3A6C13	0180-0197	8	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	K7253	TAAA2R2K20RX
A3A6C14	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	K7253	TAAB22K16RX
A3A6C15	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	12344	T110B156K020AS

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

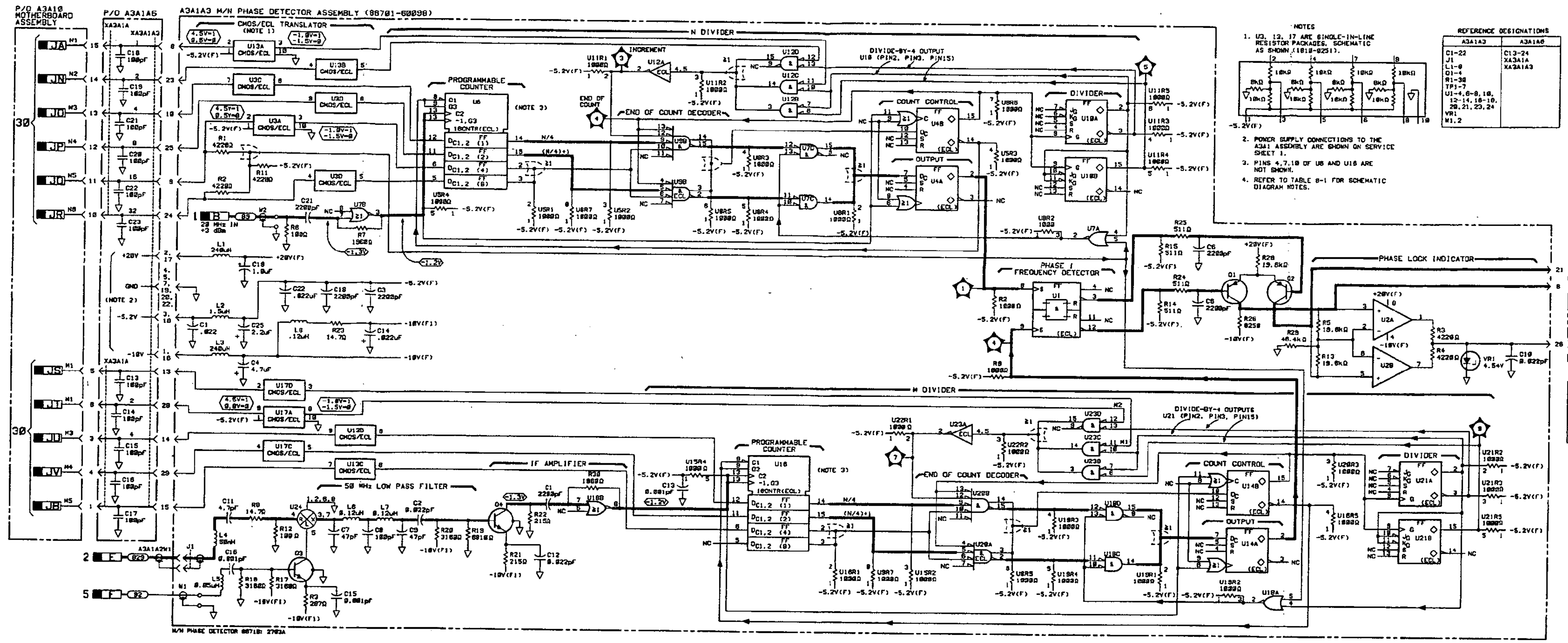
Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A6C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	06383	CK45YV2A103Z-A
A3A6C17	0160-3460	2	1	CAPACITOR-FXD .05UF +80-20% 100VDC CER	06383	CK45YV2A503Z-H
A3A6C18	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	06383	CK45YV2A103Z-A
A3A6C19	0160-3877	5	1	CAPACITOR-FXD 100PF +-20% 200VDC CER	06383	FD12X7R2D101M
A3A6CR1	1901-0033	2	6	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR2	1901-0040	1	4	DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A6CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A6CR4				NOT ASSIGNED		
A3A6CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A6CR9	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A6Q1	1854-0237	7	1	TRANSISTOR NPN SI TO-66 PD=20W FT=10MHZ	28480	1854-0237
A3A6Q2	1854-0404	0	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A6Q3	1854-0022	8	2	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A3A6Q4	1854-0232	2	1	TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
A3A6Q5	1853-0038	4	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A3A6Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A6Q7	1853-0007	7	2	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A6Q8	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A3A6Q9	1854-0712	3	1	TRANSISTOR-DUAL NPN PD=1.8W	06665	MAT-01GH
A3A6Q10	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A6Q11	1853-0050	0	2	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A3A6Q12	1853-0012	4	1	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A6Q13	1853-0050	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A3A6R1				NOT ASSIGNED		
A3A6R2				NOT ASSIGNED		
A3A6R3	0757-0456	5	1	RESISTOR 43.2K 1% .125W TF TC=0+-100	12498	CT4
A3A6R4	0698-4492	1	1	RESISTOR 32.4K 1% .125W TF TC=0+-100	06001	NK4
A3A6R5	0757-0440	7	2	RESISTOR 7.5K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R6	0757-0440	7		RESISTOR 7.5K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R7	0698-0083	8	1	RESISTOR 1.96K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R8	0698-3440	7	2	RESISTOR 196 1% .125W TF TC=0+-100	K8479	H8
A3A6R9	0757-0346	2		RESISTOR 10 1% .125W TF TC=0+-100	06424	NK4H
A3A6R10	0757-0465	6		RESISTOR 100K 1% .125W TF TC=0+-100	12498	CT4
A3A6R11	0698-3157	3	1	RESISTOR 19.6K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R12	0757-0442	9		RESISTOR 10K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R13	0698-3440	7		RESISTOR 196 1% .125W TF TC=0+-100	K8479	H8
A3A6R14	0757-0401	0		RESISTOR 100 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A6R15	0757-0421	4		RESISTOR 825 1% .125W TF TC=0+-100	19701	SFR25H
A3A6R16	0811-3440	9	1	RESISTOR 125 1% 25W PW TC=0+-2	01686	ALN-25
A3A6R17	0757-0465	6		RESISTOR 100K 1% .125W TF TC=0+-100	12498	CT4
A3A6R18	0757-0442	9		RESISTOR 10K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R19	0757-0442	9		RESISTOR 10K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R20	0698-3155	1	3	RESISTOR 4.64K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R21	0698-3155	1		RESISTOR 4.64K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R22	0757-0290	5		RESISTOR 6.19K 1% .125W TF TC=0+-100	K8479	H8
A3A6R23	0757-0346	2		RESISTOR 10 1% .125W TF TC=0+-100	06424	NK4H
A3A6R24	0811-2936	6	1	RESISTOR 15 .1% .5W PWW TC=0+-5	54294	VA34
A3A6R25	2100-0635	3	2	RESISTOR-TRMR 2K 10% TKF SIDE-ADJ 20-TRN	05165	960-20-202-49023
A3A6R26	0757-0438	3		RESISTOR 5.11K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R27	0757-0438	3		RESISTOR 5.11K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R28	0757-0467	8	1	RESISTOR 121K 1% .125W TF TC=0+-100	12498	CT4
A3A6R29	0757-0346	2		RESISTOR 10 1% .125W TF TC=0+-100	06424	NK4H
A3A6R30	0698-8025	4	1	RESISTOR 1.91K .25% .125W TF TC=0+-50	12498	NC55
A3A6R31	0757-0402	1	1	RESISTOR 110 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A6R32	0757-0458	7	2	RESISTOR 51.1K 1% .125W TF TC=0+-100	12498	CT4
A3A6R33	0757-0428	1	1	RESISTOR 1.62K 1% .125W TF TC=0+-100	19701	SFR25H
A3A6R34	2100-0635	3		RESISTOR-TRMR 2K 10% TKF SIDE-ADJ 20-TRN	05165	960-20-202-49023
A3A6R35	0698-3153	9	1	RESISTOR 3.83K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A6R36	0698-3447	4	1	RESISTOR 422 1% .125W TF TC=0+-100	K8479	H8
A3A6R37	0757-0458	7		RESISTOR 51.1K 1% .125W TF TC=0+-100	12498	CT4
A3A6R38	0698-5673	2	1	RESISTOR 3.9K 1% .125W TF TC=0+-25	2M627	CRB14 OR CRB25
A3A6R39	0698-3155	1		RESISTOR 4.64K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3A6R40	0698-8420	3	1	RESISTOR 4.22K 1% .125W TF TC=0+-25	12498	NE55
A3A6R41	0757-0401	0		RESISTOR 100 1% .125W TF TC=0+-100	91637	CMF-55-1, T-1
A3A6R42	0757-0346	2		RESISTOR 10 1% .125W TF TC=0+-100	06424	NK4H
A3A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A6TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3A6U1	1826-0092	3	1	IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A6VR1	1902-0680	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A3A6VR2	1902-3404	9	1	DIODE-ZNR 82.5V 5% DO-7 PD=.4W TC=+.082%	28480	1902-3404
A3A6VR3	1902-3323	1	1	DIODE-ZNR 42.2V 5% DO-35 PD=.4W TC=+.08%	28480	1902-3323
A3A6VR4	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
				A3A6 MISCELLANEOUS		
	1205-0085	8	1	HEAT SINK TO-66-CS	13103	6166B BASE ONLY
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
	2200-0107	6	2	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0143	0	2	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII



NOTES

1. U3, 13, 17 ARE SINGLE-IN-LINE RESISTOR PACKAGES, SCHEMATIC AS SHOWN (1810-0251).
2. POWER SUPPLY CONNECTIONS TO THE A3A1 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1.
3. PINS 4,7,10 OF U8 AND U18 ARE NOT SHOWN.
4. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

A3A1A3	A3A1A6
C1-22 J1 L1-8 Q1-4 R1-30 TP1-7 U1-4,6-8,10, 12-14,16-18, 20,21,23,24 VR1 W1,2	C13-24 XA3A1A XA3A1A3

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBER
Q1,2	1853-0451
Q3,4	1854-0345
U1	1820-1344
U2	1826-0092
U3,13,17	1810-0251
U4,14	1820-1225
U6,16	1820-3126
U7,12,18,23	1820-0802
U9,20	1820-0806
U10,21	1820-0820
U24	1955-0063

LOGIC LEVELS

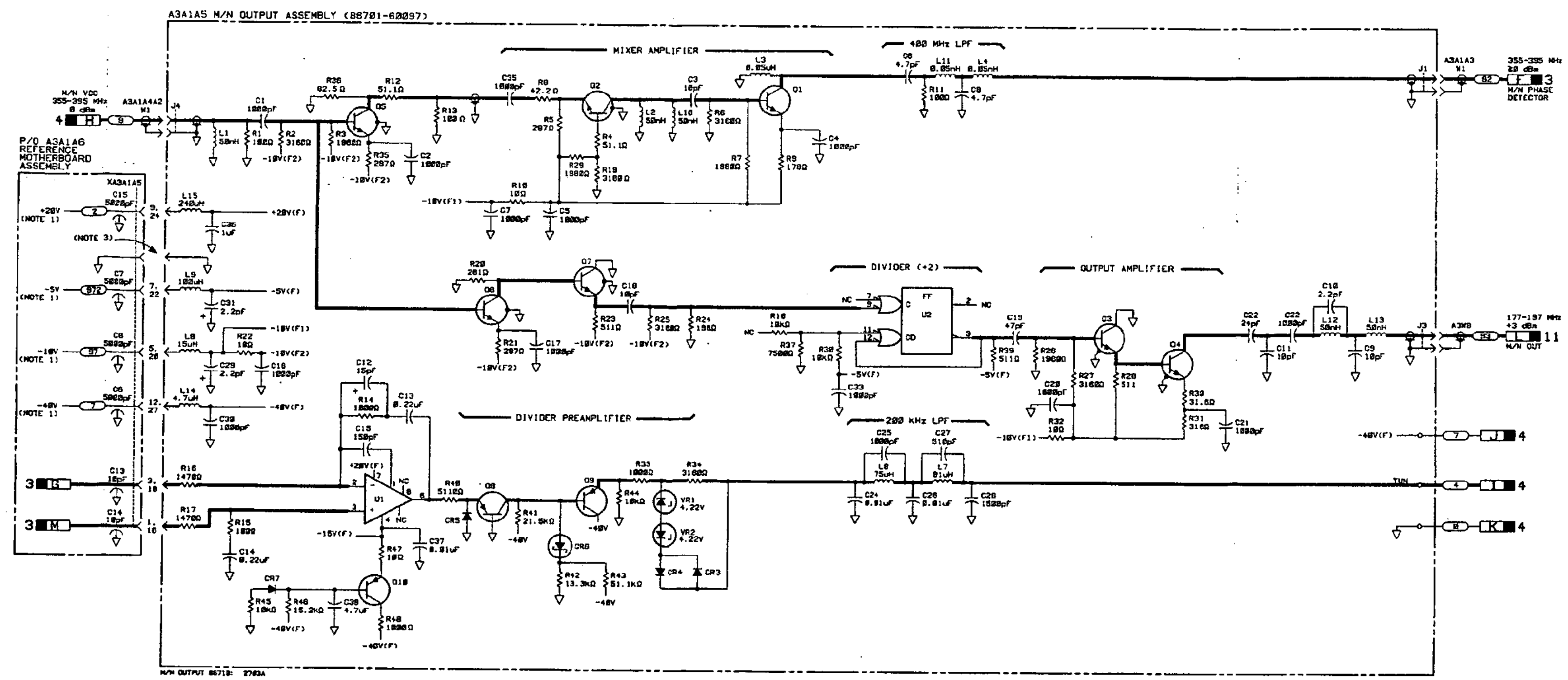
LOGIC	TTL	ECL	EECL	CMOS
HIGH(1)	>2V	>-0.5V	>-0.1V	VDD
LOW(0)	<0.8V	<-1.5V	>-0.8V	>0.1V
<=EQUAL TO OR MORE NEGATIVE THAN >=EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND - 0V; X=UNDEFINED				

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U1	-5V - 7 ▽ -1,14
U2	-18V- 4 +20V- 8
U3,13,17	-5V - 1 ▽ -10
U4,6,7,9, 10,12,14, 16,18,20, 21,23	-5V - 8 ▽ -1,16
U24	▽ -1,6,8

3
A3A1A3

Figure 8-59. M/N Phase Detector Assembly Schematic Diagram
Revised Material for Service Sheet 3
(Change 4)



NOTES

1. POWER SUPPLY CONNECTIONS TO THE A3A1 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1
2. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
3. MOTHERBOARD GROUND CONNECTIONS ARE AT PINS 2, 4, 6, 8, 10, 11, 13, 15, 17, 19, 21, 23, 25, 26, 28, 30.

REFERENCE DESIGNATIONS

A3	A3A1A5
MB	C1-10, 12-31, 33-38
A3A1A2	CR3-7
W1	J1, 2
A3A1A3	L1-4, 6-15
W1	Q1-10
A3A1A4A2	R1-47
W1	U1, 2
	VR1, 2
	W1
	A3A1A6
	C6-8, 13-15 XA3A1A5

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBER
Q1, 5	1854-0546
Q2-4, 7	1854-0345
Q6	1854-0686
Q8, 9	1853-0451
Q10	1853-0281
U1	1826-0059
U2	1820-3465

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH(1)	>2V	>-0.9V	>-0.1V	VDD
LOW(0)	<0.8V	<-1.5V	>-0.8V	>0.1V
<=EQUAL TO OR MORE NEGATIVE THAN				
>=EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND = 0V; X=UNDEFINED				

INTEGRATED CIRCUIT VOLTAGES AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U2	-5V - 8 ▽ -1, 16

5
A3A1A5

Figure 8-83. M/N Output Assembly Schematic Diagram
Revised Material for Service Sheet 5
(Change 4)

A2A4 ASSEMBLY

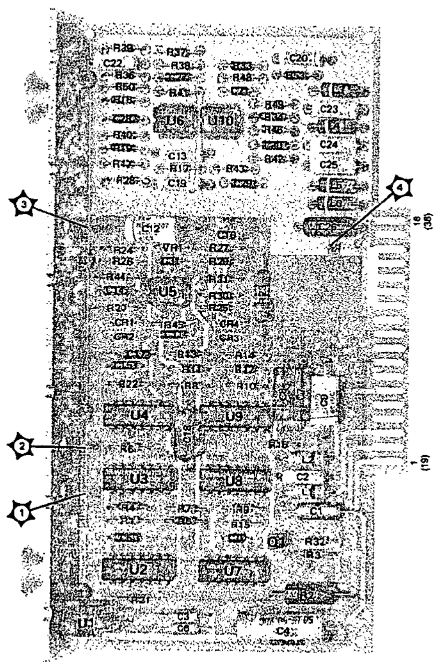
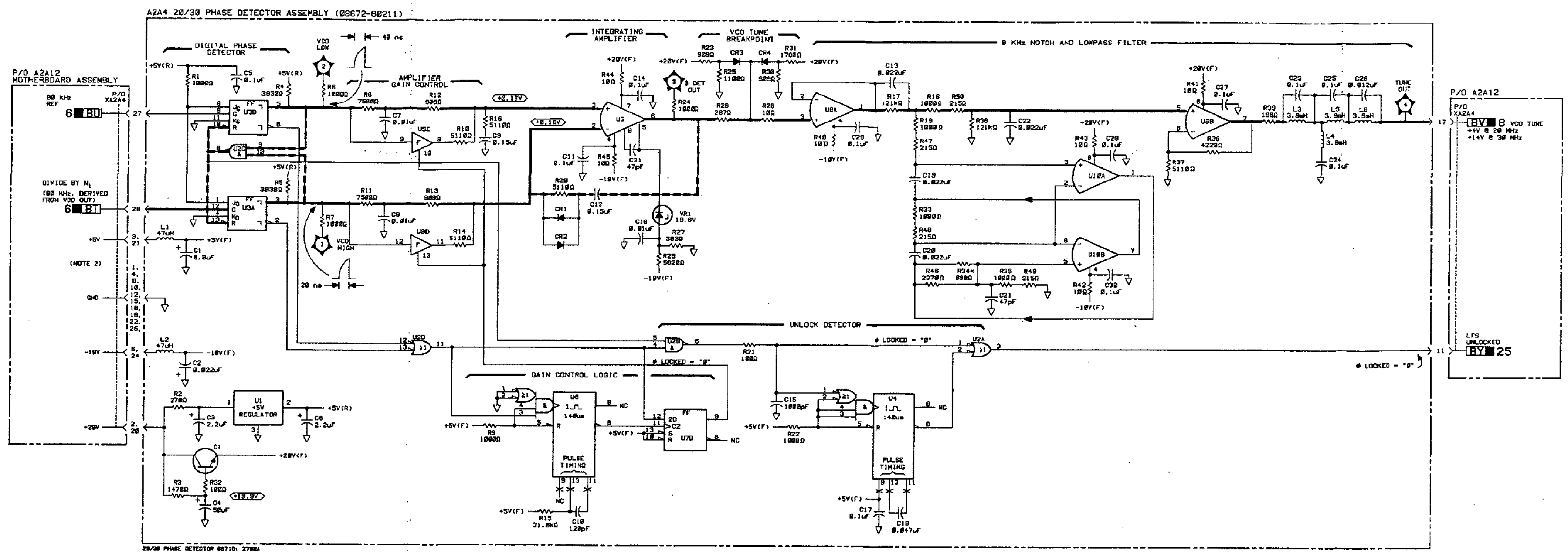


Figure 8-67. A2A4 20/30 Phase Detector Assembly Component and Test Point Locations
Revised Material for Service Sheet 7
(Change 6)



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.

* ASTERISK INDICATES FACTORY SELECTED COMPONENT. NOMINAL VALUE SHOWN.

REFERENCE DESIGNATIONS

A2A4	A2A13
CI-31 CR1-4 L1-6 Q1 R1-50 TP1-4 UI-10	XA2A4

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBER
Q1	1854-0071
U1	1820-0429
U2	1820-1197
U3	1820-0281
U4,8	1820-1422
U5	1826-0783
U6,10	1826-0716
U7	1820-1112
U9	1820-1845

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH(1)	≥2V	≥-0.6V	≥-0.1V	≈VDD
LOW(0)	≤0.8V	≤-1.5V	≥-0.8V	≥0.1V
≥=EQUAL TO OR MORE NEGATIVE THAN ≤=EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND - 0V; X=UNDEFINED				

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U2,3	+5V(R)-14 ▽ - 7
U4,7-9	+5V(F)-14 ▽ - 7

7
A2A4

Figure 8-68. 20/30 Phase Detector Assembly Schematic Diagram
Revised Material for Service Sheet 7
(Change 6)

SERVICE SHEET 9

DIGITAL TO ANALOG CONVERTER ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 ..... Service Sheet BD1
YTO Loop Block Diagram ... Service Sheet BD4
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YTO DAC board, A3A5, generates a DC voltage proportional to the output frequency of the Signal Generator. This voltage is generated from digital information sent to the A3A5 board from the controller section. This voltage tunes the YIG Tuned Oscillator to within 50 MHz of the desired frequency. The Signal Generator's phase-locked loops then lock the YTO to the exact frequency.

The YTO DAC board has four basic sections: (1) the BCD-to-binary converter (2) the voltage reference (3) the digital-to-analog converter (4) the summing amplifier.

Detailed Discussion

BCD-to-Binary Converter. The output voltage of the YTO DAC board is controlled by the 14 digital control lines that come onto the board from the controller section. These lines are labeled DAC 1 MHz through DAC 4800 MHz on the schematic. Each line is labeled to reflect the change in output frequency that occurs when it changes state. These lines are weighted in a binary coded decimal (BCD) format. The BCD data is converted to binary format by U3 and U4. U3 and U4 are 256K EPROMs which are used as look-up tables. The BCD lines (DAC 1 MHz - DAC 4800 MHz) are input to U3 and U4 at the address input ports. The binary outputs (B2 through B4096) are connected to the data bus. Each BCD input to U3 and U4 creates a unique set of binary data on the output data lines.

Voltage Reference. The voltage reference generates a stable voltage on which to base the output voltage of the board. This is derived from VR1, a 6.3V temperature compensated Zener diode. U2B and R1 through R5 are used to establish a stable Q-point for VR1. U2B, R4, and R5 generate a fixed voltage of −7.05V at pin 7 of U2B. This, in conjunction with R2, ensures that the current through VR1 is fixed at 7.5 mA. U2A is a buffer for VR1. U2A provides a buffered −6.3V at the voltage reference input port of U5.

Digital-to-Analog Converter. U5 is a CMOS DAC that consists of a resistor network and a series of CMOS switches controlled by the 12 digital inputs (B2 to B4096). The internal switches adjust the resistance seen by the input of U2C, thereby controlling the gain of U2C. This creates a voltage at pin 8 of U2C that is proportional to the digital data input.

Summing Amplifier. The summing amplifier performs four functions. (1) It amplifies the DAC output voltage, (2) sums in an offset voltage, (3) sums the LSB signal (DAC 1 MHz) into the output voltage, and (4) filters out noise from the DAC and the voltage reference.

The overall gain of the amp is set by R8, R9, and R18. R8 is a gain adjustment used to set the output voltage of A3A5 to −3 V/GHz. R14, R15, and R16 are used to adjust the offset of the overall circuit so that a frequency of 0.0 GHz will result in an output voltage of exactly 0.0V.

R10, R11, R12, and R13 sum the least significant bit from the controller, (DAC 1 MHz), directly into the output amplifier. This is done to achieve 1 MHz resolution at the output of A3A5. DAC U5 has only twelve data input lines, and therefore can switch in only 2 MHz increments. 1 MHz resolution is achieved by weighting the voltage on the DAC 1 MHz to cause a voltage change of 3 mV, and then summing this voltage directly into the output.

Q1, Q2, R20, and C1 form a switchable filter in the summing amp. This filter operates as follows: In normal operation, the current into the base of Q3 is very small. The current through R20 is also very small. The voltage drop across R20 is about 50 mV, so the base-emitter voltages of Q1 and Q2 are not enough to bias them on. R20 and C1 therefore form a low pass filter that attenuates high frequency noise. This filter, in conjunction with the other

SERVICE SHEET 9 (cont'd)

elements in the summing amplifier's feedback path, gives the summing amplifier a bandwidth of about 150 Hz.

A 150 Hz bandwidth is too narrow for the rapid voltage changes the board must produce during frequency changes. Q1 and Q2 are therefore used to bypass the filter during frequency transitions. A voltage swing at the summing amplifier input will produce a large voltage change at the output of U2D. This will increase the base-emitter voltage of either Q1 or Q2. One of the transistors will turn on, charging C1 up quickly. When the output voltage nears its desired value, the base-emitter voltage will drop causing the transistors to turn off.

R17 and R22 improve the summing amplifier's response to frequency changes. Without R17, U2D would introduce a low frequency pole of about 1 Hz into the open loop response of the circuit. R17 moves the frequency of this pole into the kilohertz range. The low pass filter (R20 and C1) also introduces a 1 Hz pole into the frequency response. R22 adds a zero at 1 kHz to improve the phase margin of the loop. Without this compensation, the summing amplifier would (1) ring after frequency changes, and (2) exhibit peaking, which would appear as a spurious signal at the output of the Signal Generator.

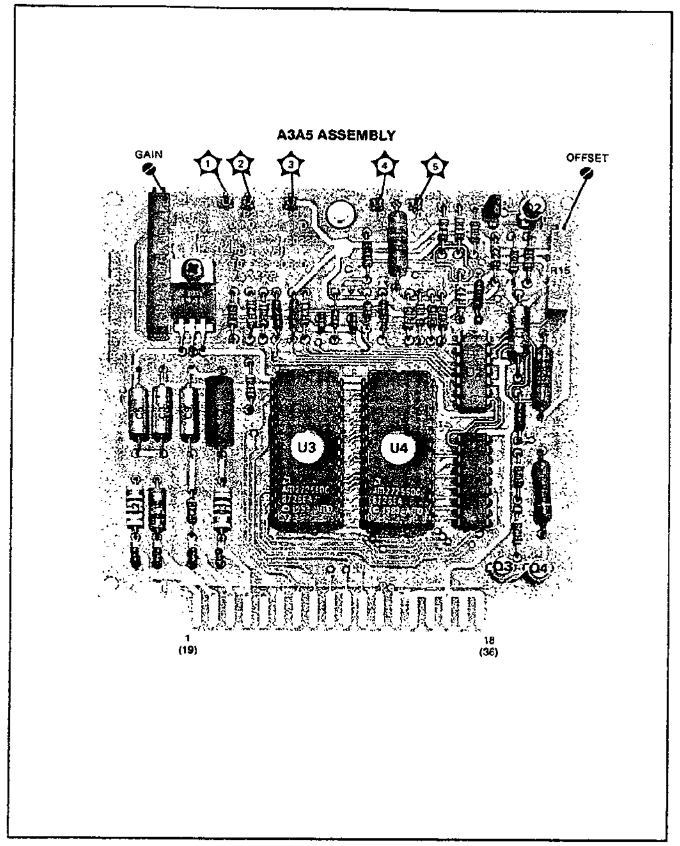
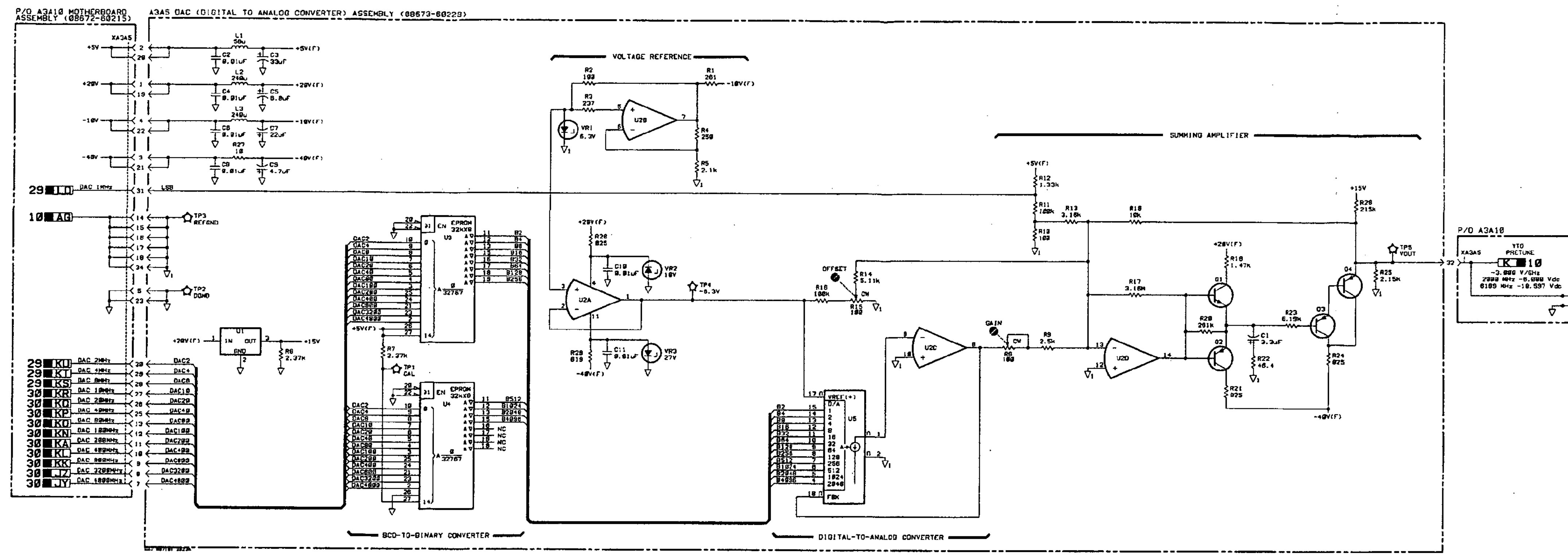


Figure 8-71. A3A5 DAC Assembly Component and Test Point Location

Revised Material for Service Sheet 9
(Change 9)



NOTES

1. SEE TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE SHOWN ON SERVICE SHEET 1.

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBER
Q1	1854-0474
Q2-4	1853-0451
U1	1826-0607
U2	1826-1590
U3, 4	08673-80098
U5	1826-1386

REFERENCE DESIGNATIONS

A3	A3A10
W4	XA3A5
A3A5	
C1-11	
L1-3	
MP1-4	
Q1-4	
R1-29	
TP1-5	
U1-5	
VR1-3	

INTEGRATED CIRCUIT VOLTAGE, GROUND AND BYPASS CAPACITOR CONNECTIONS

REFERENCE DESIGNATION	BYPASS CAP	PIN NUMBER
U3, 4		+5V(F)-1, 28 ▽ - 14
U5		+15V - 18 ▽ - 3

9
A3A5

Figure 8-72. Digital to Analog Converter Assembly Schematic Diagram

Revised Material for Service Sheet 9
(Change 9)

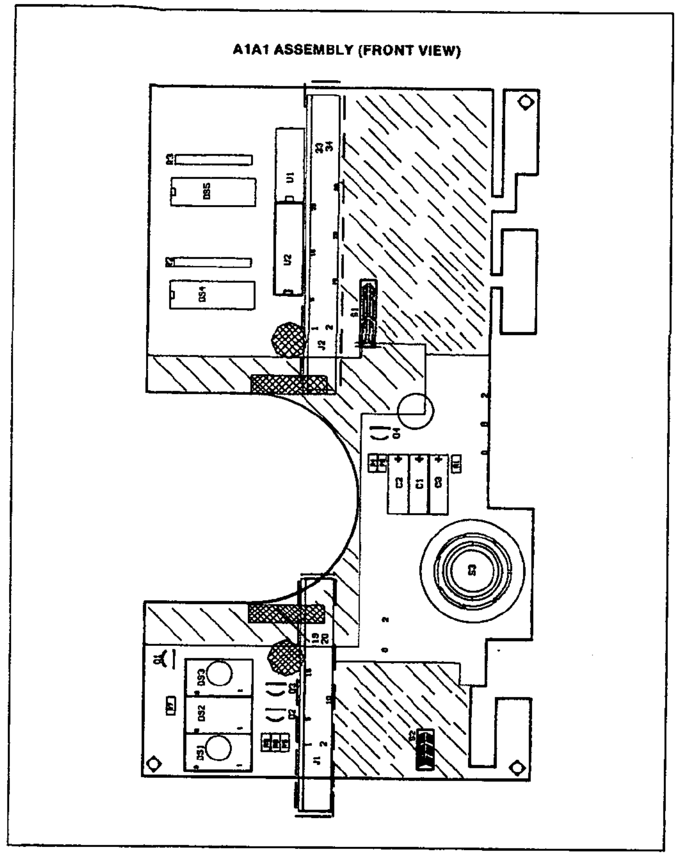
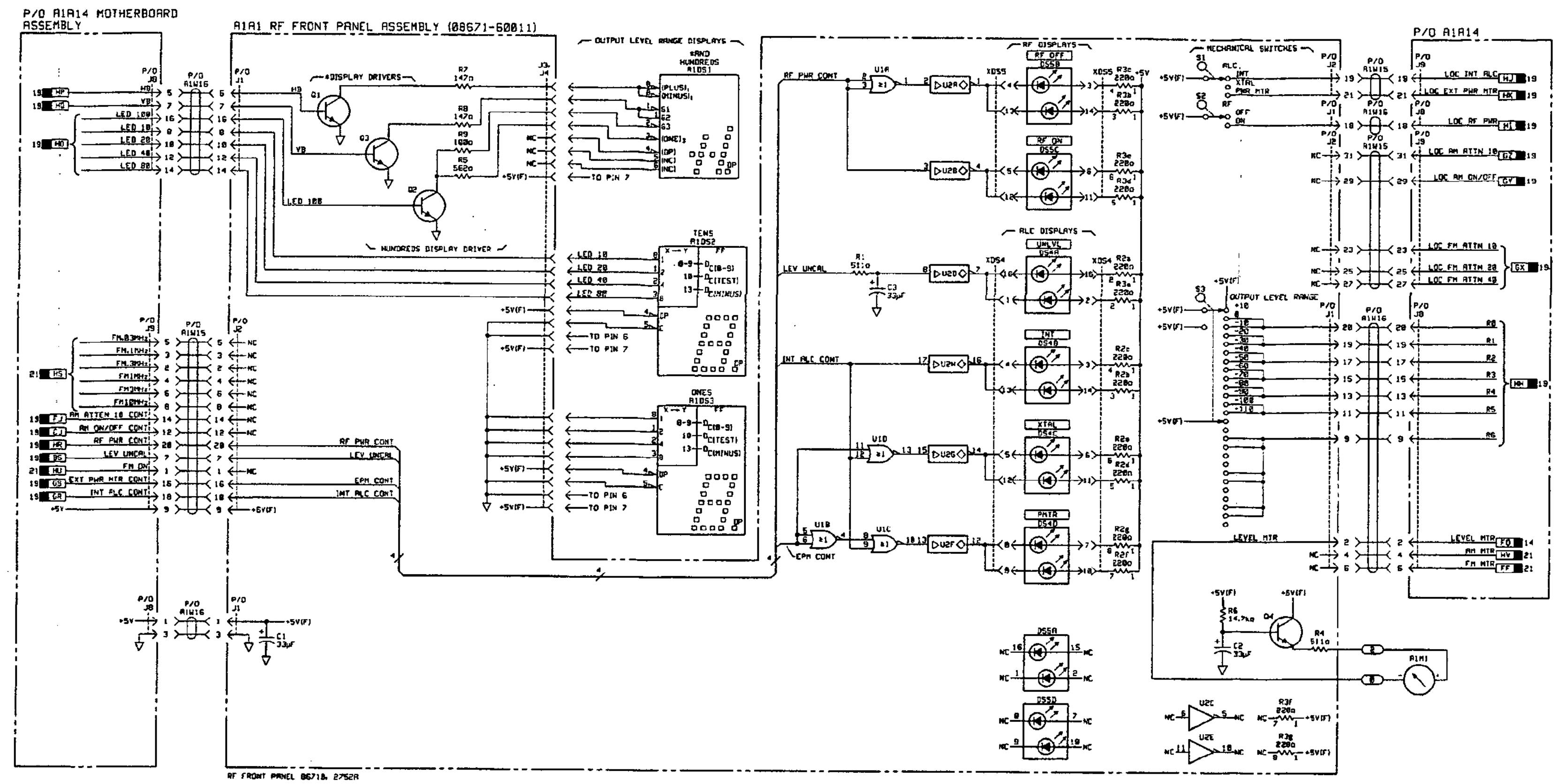


Figure 8-96. A1A1 RF Output Front Panel Assembly Component Locations
Revised Material for Service Sheet 20
(Change 8)



NOTES

1. POWER SUPPLY CONNECTIONS TO THE A1 ASSEMBLY ARE SHOWN ON SERVICE SHEET 14.

REFERENCE DESIGNATIONS

A1	A1A1
DS1-3 M1 S1-3 W15, 16	C1-3 DS4,5 J1-4 Q1-4 R1-9
A1A14	
J8,9	

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBER
A1	
DS1	1990-0399
DS2, 3	1990-0686
A1A1	
Q1-4	1854-0810
U1	1820-1144
U2	1820-1740

LOGIC LEVELS

	TTL	ECL	EECL	CMOS
HIGH(1)	>2V	V>-0.5	V>-0.1	<VDD
LOW(0)	<0.8V	<-1.5V	<-0.6V	>0.1V
<=EQUAL TO OR MORE NEGATIVE THAN >=EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND=0V; X=UNDEFINED				

INTEGRATED CIRCUIT VOLTAGE, GROUND AND BYPASS CAPACITOR CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
A1	
DS1	+5V(F)- 7 ▽ - NONE
DS2,3	+5V(F)- 7 ▽ - 6
A1A1	
U1	+5V(F)- 14 ▽ - 7
U2	+5V(F)- 9 ▽ - 10

20
A1A1

Figure 8-97. RF Output Front Panel Controls and Displays Schematic Diagram
(Revised Material for Service Sheet 20
(Change 8)

SERVICE SHEET 31

P/O DCU FRONT PANEL ASSEMBLY

REFERENCES

Overall Block Diagram ..... Service Sheet BD1
Remote/Local Interface
Block Diagram .... Service Sheet BD7
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety
Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The DCU front panel (A2A1) consists of the power switch, frequency controls and indicators, and status annunciators.

This portion of the A2A1 Assembly contains status annunciators, frequency resolution indicators and the ±1 Bit control circuitry. The LED drivers and status indicators show, by front panel lights, the following conditions: REMOTE, frequency OUT OF RNG, ΦUNLOCKED and EXT REF. When the instrument is first turned on or the HOLD button is pressed, the tuning resolution circuits will disable the Signal Generator tuning. If one of the FREQUENCY RESOLUTION keys is pressed, the Frequency Resolution Indicators and LED drivers will indicate the selected resolution corresponding to the button that was pressed and load that information into the resolution register. The ±1 Bit output of this register tells the ±1 Adder (located on A2A11) on which digit to operate.

P/O DCU Front Panel Board Assembly

Pin 2 of the Resolution Register U10 goes high when the appropriate digit is clocked through the ±1 Adder by CLK1. The desired resolution, selected by switches S3 through S6 and latched by U6, is clocked into U10 by the inverted GO line. When GO changes level, U10 becomes a serial register and the selected resolution is shifted through by CLK1. Three supporting circuits are significant. Diode CR1 clocks U6 when the LOCAL line goes low (that is when the instrument switches to remote). This causes the lows at U6's D inputs to appear at U10, thus disabling the ±1 Adder. U7A and associated capacitor and resistors debounce the FREQUENCY RESOLUTION keys. Inverter Buffer, U2, drives the Frequency Resolution Indicator circuitry, ensuring that the selected resolution light and any higher significant digit lights are on.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD7 was used to isolate a front panel problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Oscilloscope .... HP 1980B
Controller .... HP 85B or HP 9836A

1. Set the LINE switch to ON. Press the PRESET (3 GHz) key. Push the right hand (least significant digit) FREQUENCY RESOLUTION key. All four Frequency Resolution indicators should light. Rotate the TUNING knob clockwise and counterclockwise. The frequency should change in 1 kHz steps. If the Frequency Resolution indicators and the FREQUENCY MHz display do not change as indicated, skip to step 9.
2. Press the next FREQUENCY RESOLUTION key. The least significant Frequency Resolution indicator should extinguish. The frequency should tune in 10 kHz steps when the TUNING knob is turned.
3. Press the next FREQUENCY RESOLUTION key. The 10 kHz resolution indicator should extinguish. The frequency should tune in 1 MHz steps.
4. Press the most significant FREQUENCY RESOLUTION key. Only the most significant resolution indicator should remain lit. The frequency should tune in 100 MHz steps.
5. Press the HOLD key. The remaining Frequency Resolution indicator should extinguish and the frequency should not change when the TUNING knob is turned. If everything is correct so far, the tuning circuits on this service sheet are working. Otherwise, skip to step 9.

SERVICE SHEET 31 (cont'd)

6. Set the rear panel FREQ STANDARD INT/EXT switch to EXT. The EXT REF and ΦUNLOCKED annunciators should light. Return the switch to INT.

7. Using the HP-IB code below, program the Signal Generator to 40 GHz (out of range). The REMOTE and OUT OF RNG LED's should light.

   OUTPUT 719;"P4Z1"

   If everything is correct through this step, the circuits on Service Sheet 31 are working.

8. Return the Signal Generator to local operation and press PRESET (3 GHz).

   NOTE

   When the Signal Generator is returned to local with an out-of-range frequency displayed, it will begin to search in 1 kHz steps until an in-range frequency is reached. If one of the FREQUENCY RESOLUTION keys is pressed, the instrument will search in the resolution selected.

9. If the frequency tunes but one or more of the Frequency Resolution indicators does not light, troubleshoot U2, the LED's and their drivers.

10. If the frequency display does not tune, the problem may be in any of several places including:

    - A2A11 Timing and Control Assembly (Service Sheets 27 and 28)
    - Reference Phase Locked Loop (Service Sheets 1 and 2)
    - Rotary Pulse Generator (Service Sheet 32)
    - Register 1 (Service Sheet 26)
    - Resolution Register (this service sheet).

To check the resolution register, connect test point pair A2A11TP1 together with an alligator clip to continuously generate clock signals. Compare the signal at A2A1U10 pin 2 with CLK1 (clock 1) as each FREQUENCY RESOLUTION key is pushed. U10 pin 2 should go high along with the clock 1 cycle corresponding to the digit selected by a FREQUENCY RESOLUTION key.

If these pulses are correct, the circuits on Service Sheet 31 are working.

If the pulses are not correct or not present, check A2A1U10 pin 10 for the presence of CLK1 before troubleshooting U6, U10 and U7.

MNEMONICS

Mnemonic	Definition	Explanation
GO	Start Data Cycle	True when the RPG is turned, PRESET is pushed, or a new frequency is remote programmed.
ERRS	Error Store	An out of range frequency is stored in Data Register 1.
NLSDR	Not Lease Significant Digit Range	True (low) indicates the 1 kHz FREQUENCY RESOLUTION key was pressed.
±1 BIT	Add now	Tells the ±1 Adder that the digit now at its input is the one selected by a FREQUENCY RESOLUTION key.
CLK1	Clock 1	Nine pulses occurring during the first half of a data cycle. Each pulse corresponds to a frequency digit.

DEFINITION

Data Cycle — The process of cycling frequency data through the various registers and the ±1 Adder, usually for the purpose of changing frequency.

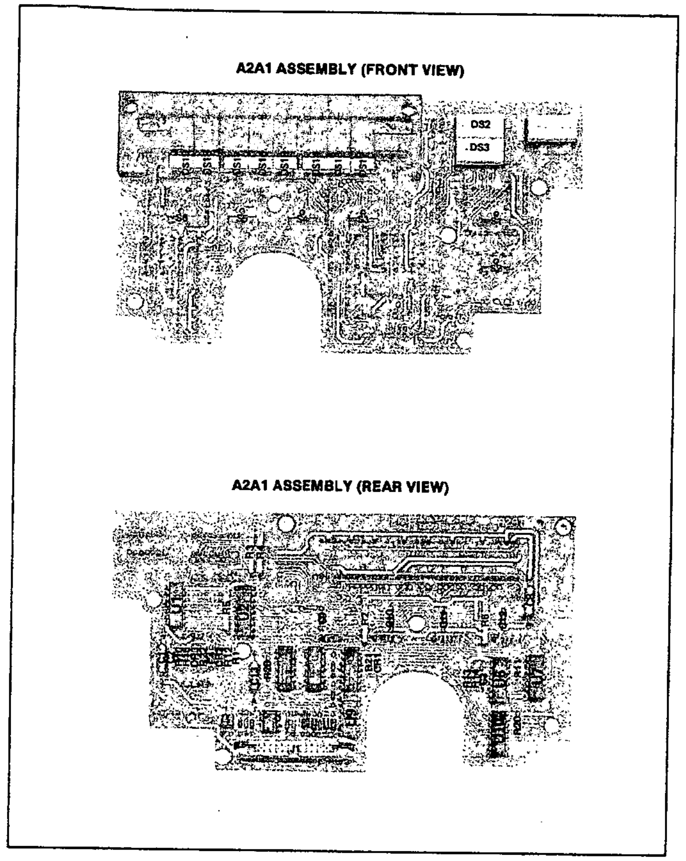
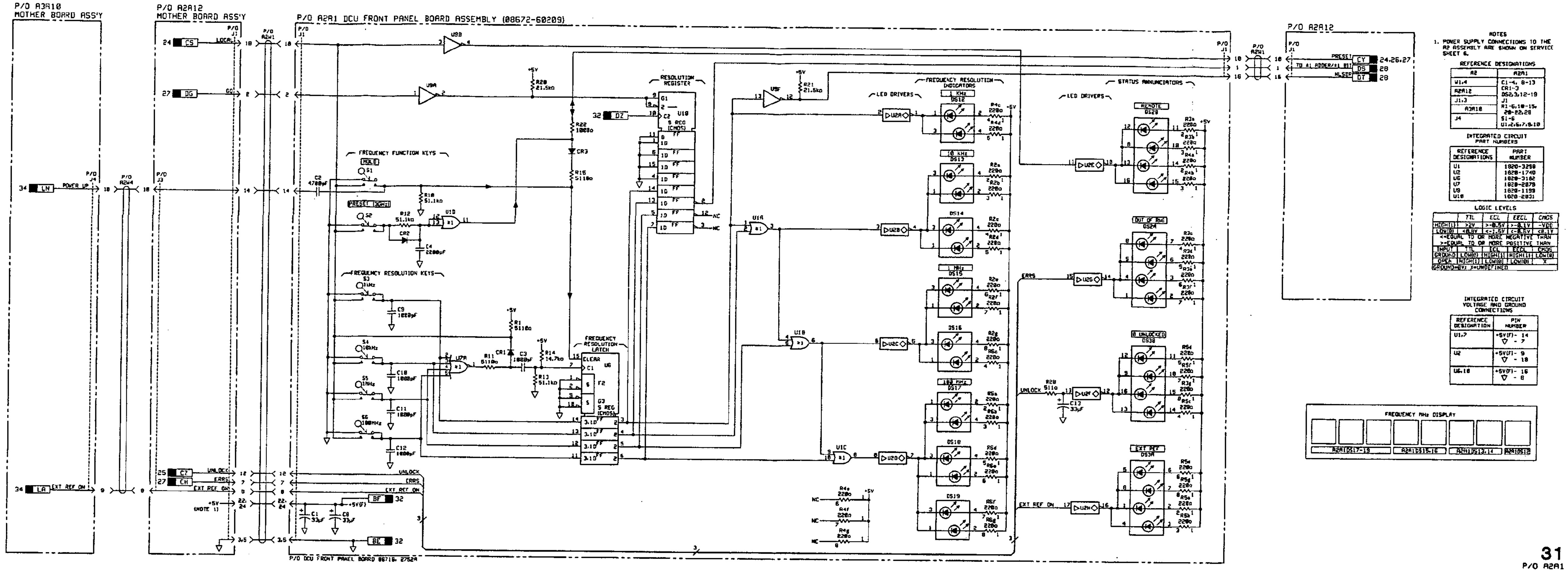


Figure 8-118. P/O A2A1 DCU Front Panel Assembly Component Locations
Revised Material for Service Sheet 31
(Change 8)



31
P/O A2A1

Figure 8-119. P/O DCU Front Panel Board Assembly Schematic Diagram
(Revised Material for Service Sheet 31
(Change 8)

SERVICE SHEET 32
P/O DCU FRONT PANEL ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
Remote/Local Interface Block Diagram	Service Sheet BD7
Power Supplies Block Diagram	Service Sheet BD10
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The DCU front panel (A2A1) consists of the line (power) switch, frequency controls and indicators, and status annunciators.

This part of the A2A1 assembly contains the FREQUENCY MHz display circuits, the oven temperature comparator, the LINE (on-standby) switch, and the TUNING Rotary Pulse Generator (RPG).

P/O DCU Front Panel Board Assembly

Decoder/displays DS4 through DS11 display the Signal Generator's output frequency. The display is updated during the first half of each data cycle. As each digit, starting with 1 kHz, appears on the DR1I 1—8 lines, the strobe latch, U5, sequentially latches the data in the associated display. U5 is clocked by CLK1 which is delayed by R23, C5, U9C and U9E. The delay allows the data lines to settle.

The four-digits on the left (DS8—DS11) have leading zeroes blanked by U4 and associated components. Blanking is done sequentially starting with DS8 but a display blanks only when the blanking input stays high thus ensuring that only leading zeroes are blanked. NOR gate U7B indicates zeros by outputting a high level. This signal is clocked through U4 by CLK1 (undelayed) and applied to DS8. When a non-zero digit appears at U7B, the low at the output is clocked through U4. At the next CLK1 pulse, U4 is reset by U3C.

The OVEN COLD annunciator comes on when the 10 MHz Reference Oscillator oven is below normal temperature. An analog voltage inversely proportional to the temperature is applied to the inverting input of U8 by the OVEN MON line. When the voltage goes above 17V, the output swings negative turning on DS1A and putting a low on the OVN OK line.

The RPG outputs pulses on lines RPG1 and RPG2 when the TUNING knob is turned. Tuning direction is indicated by the phase relationship of the pulses. When the TUNING knob is turned clockwise, RPG1 leads RPG2.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1, BD7, BD10 and Service Sheet 31 was used to isolate a Front Panel problem to the circuits shown on this schematic. The following information will aid in isolating the defective component:

Test Equipment

Digital Voltmeter	HP 3456A
Oscilloscope	HP 1980B

1. Press the PRESET (3 GHz) pushbutton. The display should indicate exactly 3000.000 MHz. If the display is correct, CLK1 is correct and all the displays are properly receiving data.

   NOTE

   A floating data input on display will be interpreted and displayed as a logic high.

2. Set the frequency to 2345.678 MHz. If the frequency cannot be changed, go to step 7. Disconnect the 10 MHz clock signal (blue cable) from A3A1A1. Select 1 kHz tuning resolution.
3. Turn the TUNING knob clockwise.
4. Use the manual clock switch on A2A11 to generate clock pulses. The display should progress in this manner:

Clock Pulse	Display
1	99999.999
2	77777.779
3	66666.679
4	55555.679
5	44445.679
6	33345.679
7	22345.679
8	02345.679
9	2345.679

SERVICE SHEET 32 (cont'd)

Generate nine (9) more clock pulses to complete the controller cycle. The display should not change during the latter nine pulses.

If the display readings are correct, go to step 5.

If the data does not clock in properly, check the input data (DR1I—8) with the voltmeter to ensure it is correct. If the input data is correct, troubleshoot U5, U4 and DS4—11. If the input data is not correct, go to Service Sheet 28 to continue troubleshooting.

5. Set the instrument to STANDBY. The STANDBY annunciator should light.

6. Unplug the instrument for 1 to 2 minutes. Reconnect the power Mains. The OVEN COLD and STANDBY annunciators should both come on.

   If neither comes on, suspect a burned out LED (OVEN COLD LED DS1A), Oven Temperature Comparator U8, or a defective Reference Oscillator, A3A8.

   If everything is correct through this step, the A2A1 and A2A3 assemblies are working.

7. Swing open the controller front panel (requires removal of four screws) to gain access to the outputs of the A2A2 Rotary Pulse Generator (RPG). Observe the outputs (RPG2 and RPG1) on the oscilloscope. When tuning clockwise the TTL pulses of RPG1 should occur before RPG2 pulses and when tuning counterclockwise RPG2 should occur before RPG1. If the pulses occur properly, the RPG is working and troubleshooting should proceed to Service Sheet 27.

MNEMONICS

Mnemonic	Definition	Explanation
CLK1	Clock 1	Nine pulses during the first half of the data cycle. Each pulse coincides with a frequency digit.
CYCLE	One Data Cycle	Low during the first half of the data cycle, high during the second half.
DR1I 1—8	Data Register 1 In	Four lines that carry frequency information sequentially by digit in BCD format.

DEFINITION

Data Cycle — The process of cycling frequency data through the various registers and the ±1Adder, usually for the purpose of changing frequency.

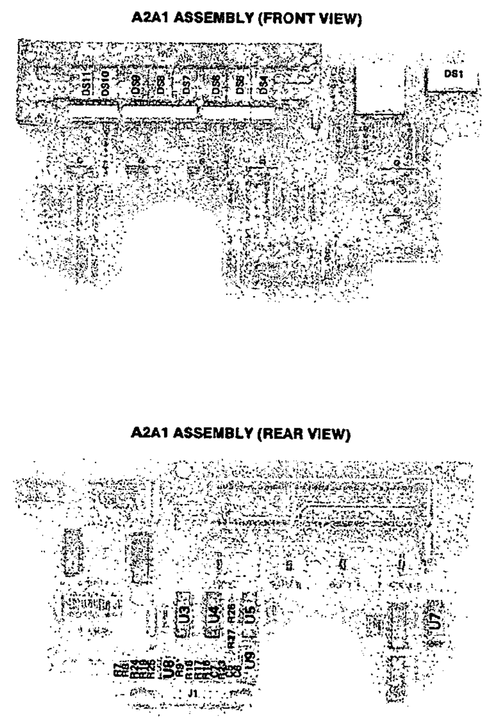
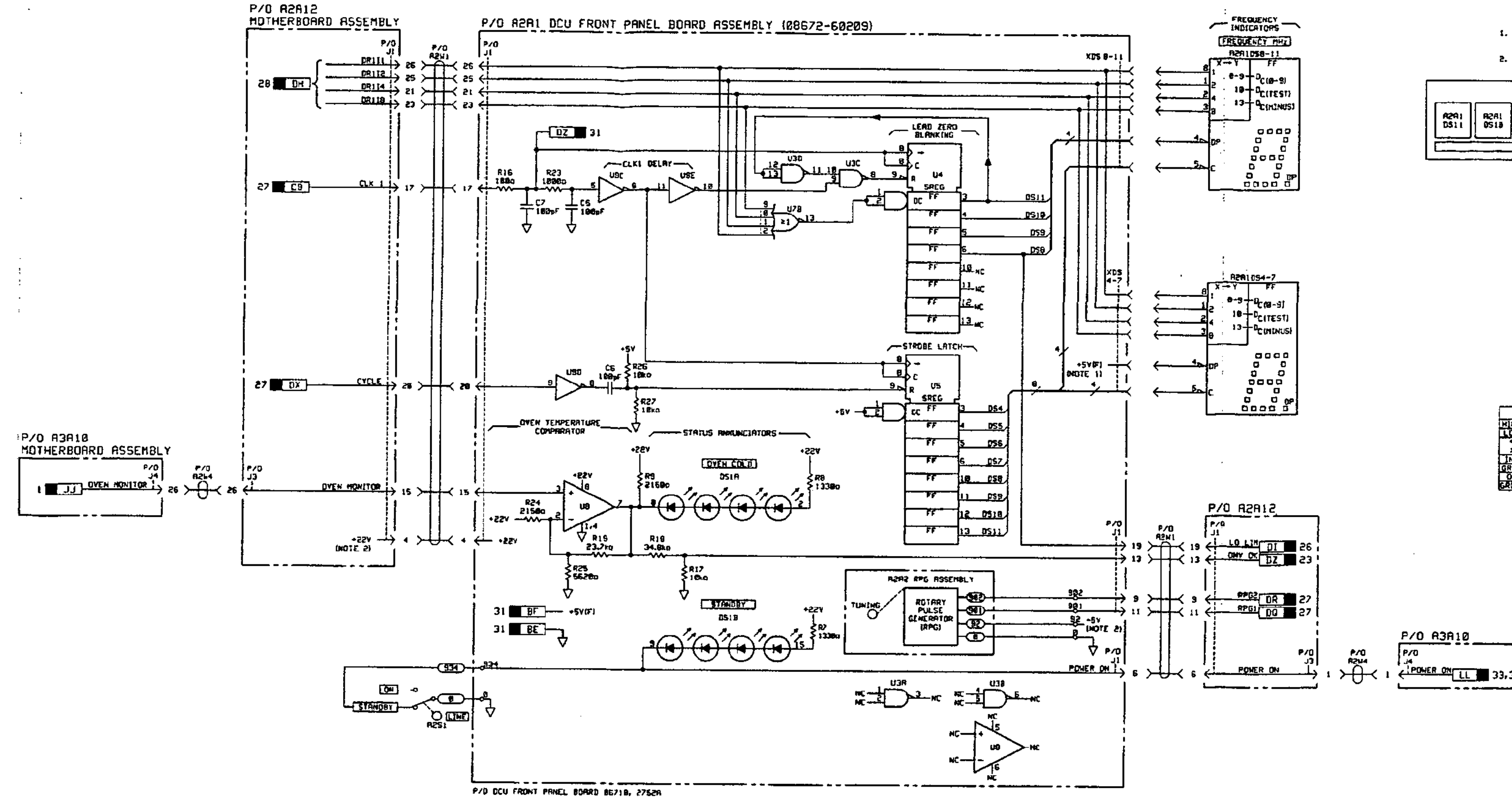


Figure 8-120. P/O A2A1 DCU Front Panel Assembly Component Locations
Revised Material for Service Sheet 32
(Change 8)



NOTES

1. PIN 4 OF A2A1DS7 IS CONNECTED TO GROUND. PIN 4 OF A2A1DS5-6 IS CONNECTED TO +5V(F).
2. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.

FREQUENCY MHz DISPLAY

A2A1 DS11	A2A1 DS10	A2A1 DS9	A2A1 DS8	A2A1 DS7	A2A1 DS6	A2A1 DS5	A2A1 DS4

REFERENCE DESIGNATIONS

A2	A2A1
S1 U1, U4 A2A12 J1,3 A3A10 J4	C5-7 DS1,4-11 J1 R7-9,16-19, 23-27 U3-5,7-9 XDS4-11

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBER
U3	1820-1197
U4,5	1820-1433
U7	1820-2079
U8	1826-0065
U9	1820-1199

LOGIC LEVELS

	TTL	ECL	EECL	CMOS
HIGH(1)	>2V	>-0.5	>-0.1	<VDD
LOW(0)	<0.8V	<-1.5V	<-0.6V	>0.1V
<=EQUAL TO OR MORE NEGATIVE THAN				
>=EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND=0V; X=UNDEFINED				

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
DS4-11	+5V(F) - 7 ▽ - 6
U3-5,7,8	+5V(F) - 14 ▽ - 7

32
P/O A2A1, A2A2

Figure 8-121. P/O DCU Front Panel Board Assembly Schematic Diagram
(Revised Material for Service Sheet 32
(Change 8)

OPERATING AND SERVICE MANUAL

Table of Contents

HP 8671B
SYNTHESIZED CW GENERATOR
2.0—18.0 GHz

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2545A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

HEWLETT PACKARD

OPERATING AND SERVICE MANUAL PART NUMBER 08671-90017
Operating Manual Part No. 08671-90019
Microfiche Part No. 08671-90018

Printed: JUNE 1986

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

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CONTENTS

	Page
Section I GENERAL INFORMATION	
Introduction	1-1
Specifications	1-1
Safety Considerations	1-1
Instruments Covered by This Manual	1-1
Manual Changes Supplement	1-1
Description	1-2
Options	1-2
Mechanical Options	1-2
Accessories Supplied	1-2
Accessories Available	1-3
Electrical Equipment Available	1-3
Recommended Test Equipment	1-3
Section II INSTALLATION	
Introduction	2-1
Initial Inspection	2-1
Preparation For Use	2-1
Power Requirements	2-1
Line Voltage and Fuse Selection	2-1
Power Cables	2-1
HP-IB Address Selection	2-2
Interconnections	2-3
Mating Connectors	2-3
Operating Environment	2-3
Bench Operation	2-4
Rack Mounting	2-4
Storage and Shipment	2-4
Environment	2-4
Packaging	2-4
Section III OPERATION	
Introduction	3-1
Panel Features	3-1
Operating Characteristics	3-1
Local Operation	3-1
Remote (HP-IB) Operation	3-1
Operator's Checks	3-1
Operator's Maintenance	3-1
Turn-On Instructions	3-1
Turn-On	3-1
Frequency Standard Selection	3-1
Simplified Operation	3-3
Frequency	3-3
Output Level	3-3
ALC	3-3
ALC Control	3-4
Frequency Control	3-8
Level Control	3-12
Peak-Norm Adjustment	3-15
RF ON/OFF Switch	3-16
Remote (HP-IB) Operation	3-17
HP-IB Compatibility	3-17
Remote Mode	3-17
Local Mode	3-17
Addressing	3-17
Data Messages	3-17
Receiving Data Messages	3-19
Receiving the Clear Message	3-19
Receiving the Trigger Message	3-20
Receiving the Remote Message	3-20
Receiving the Local Message	3-20
Receiving the Local Lockout Message	3-20
Receiving the Clear Lockout/Set Local Message	3-20
Receiving the Pass Control Message	3-20
Sending the Require Service Message	3-20
Sending the Status Byte Message	3-20
Sending the Status Bit Message	3-20
Receiving the Abort Message	3-20
Operator's Checks	3-22
Basic Functional Checks	3-22
HP-IB Checks	3-26
Section IV PERFORMANCE TESTS	
Introduction	4-1
Abbreviated Performance Test	4-1
Calibration Cycle	4-1
Performance Test Record	4-1
Equipment Required	4-1
Test Procedures	4-1
Frequency Range and Resolution Test	4-2
Frequency Switching Time Test	4-5
Output Level, High Level Accuracy and Flatness Test	4-11
Low Level Accuracy Test	4-16
Output Level Switching Time Test	4-20
Harmonics, Subharmonics & Multiples Test	4-23
Non-Harmonically Related Spurious Signals Test	4-26
Power Line Related Spurious Signals Test	4-28
Single-Sideband Phase Noise Test	4-31
Internal Time Base Aging Rate	4-36
Section V ADJUSTMENTS	
Introduction	5-1
Safety Considerations	5-1
Equipment Required	5-1
Factory Selected Components	5-1
Related Adjustments	5-1
Power Supply Adjustments	5-5
10 MHz Reference Oscillator Adjustment	5-6
100 MHz VCXO Adjustment	5-7
M/N VCO Adjustment	5-10
20/30 Divider Bias Adjustment	5-13
160—240 MHz VCO Pretune Adjustment	5-15
20/30 Phase Detector Notch Filter Adjustment	5-17

CONTENTS (cont'd)

	Page
YTO Pretune Digital-to Analog Converter Adjustment	5-19
YTO Driver Adjustment	5-21
YTO Sampler Adjustment	5-22
YTO Phase Detector Adjustment	5-25
YTM Adjustment	5-28
Power Clamp Adjustment	5-33
ALC Adjustments	5-34
Flatness Adjustment	5-36
External Leveling Adjustment	5-37
Section VI REPLACEABLE PARTS	
Introduction	6-1
Restored Assemblies	6-1
Abbreviations	6-1
Replaceable Parts List	6-1
Factory Selected Parts (*)	6-1
Parts List Backdating (†)	6-1
Parts List Updating	6-1
Ordering Information	6-1
Parts Identification	6-2
Recommended Spares List	6-2
Section VII MANUAL CHANGES	
Introduction	7-1
Instrument Improvement Modifications	7-1
Section VIII SERVICE	
Introduction	8-1
Failure Modes and Service Strategy	8-1
General	8-1
Turn-on Errors	8-1
Operator Errors	8-1
Instrument Performance Out of Specification	8-1
Catastrophic Failures	8-1
Service Sheets	8-2
Manual Backdating (†)	8-2
Manual Updating (Manual Changes Supplement)	8-2
Safety Considerations	8-2
Before Applying Power	8-2
Warnings and Cautions	8-2
After Service Safety Checks	8-3
Recommended Test Equpment	8-3
Service Tools, Aids, and Information	8-3
Service Accessories	8-3
Pozidriv Screwdrivers	8-3
Tuning Tools	8-3
Hardware	8-3
Assembly Locations	8-3
Parts and Cable Locations	8-12
Test Points and Adjustment Locations	8-12
Service Aids on Printed Circuit Boards	8-12
Other Service Documents	8-12
Repair and Replacement	8-12
After Repair Adjustment Procedure	8-12
Disassembly and Reassembly Procedures	8-12
Top and Bottom Cover Removal	8-12
Etched Circuits (Printed Circuit Boards)	8-12
Electrostatic Discharge (ESD) Precautions	8-13
Module Exchange Program	8-14
Non-Repairable Assemblies	8-14
Factory Selected Components (*)	8-14
Cleaning	8-14
Cleaning Intervals	8-14
Cleaning Solution	8-14
Top Cover Removal and Replacement	8-14
6-Month Cleaning	8-14
12-Month Cleaning	8-15
Schematic Symbology	8-16
Basic Logic Symbology	8-16
Complex Device Symbology	8-17

SERVICE SHEETS

Service Sheet		Page
BD1	Overall Block Diagram and Troubleshooting	8-23
BD2	Time Base Reference	8-32
BD3	RF Phase Locked Loops	8-34
BD4	YTO Summing Phase Locked Loop	8-44
BD5	Microwave Signal Path	8-46
BD6	Automatic Level Control (ALC)	8-50
BD7	DCU Remote/Local Interface	8-52
BD8	DCU HP-IB Interface	8-54
BD9	DCU Frequency Control	8-56
BD10	Power Supplies	8-66
1	Reference Phase Detector Assembly	8-69
2	100 MHz VCXO Assembly	8-74
3	M/N Phase Detector Assembly	8-76
4	M/N VCO Assembly	8-80
5	M/N Output Assembly	8-82
6	20/30 Divider Assembly	8-84
7	20/30 MHz Phase Detector Assembly	8-86
8	VCO 160—240 MHz Assembly	8-88
9	Digital to Analog Converter Assembly	8-90
10	YTO Driver Assembly	8-92
11	YTO Sampler Assembly	8-95

CONTENTS (cont'd)

SERVICE SHEETS (cont'd)

Service Sheet Page

- **12** YTO Phase Detector Assembly 8-98
- **13** YTO/HF Coil Driver Assembly 8-100
- **14** RF Amplifier and ALC Assembly 8-102
- **15** YTM Control 8-104
- **16** SRD Control Circuits 8-106
- **17** ALC Detector Assembly 8-108
- **18** RF Output Level Control Assembly 8-110
- **19** Digital Processor Assembly 8-112
- **20** RF Front Panel Controls and Displays 8-114
- **22** P/O HP-IB Address Assembly 8-117
- **23** P/O HP-IB Address Assembly 8-120
- **24** P/O HP-IB Interface Assembly 8-122
- **25** P/O HP-IB Interface Assembly 8-124
- **26** Register 1 Assembly 8-126
- **27** P/O Timing and Control Assembly 8-128
- **28** P/O Timing and Control Assembly 8-130
- **29** P/O Output Register Assembly 8-132
- **30** P/O Output Register Assembly 8-134
- **31** P/O DCU Front Panel Assembly 8-137
- **32** P/O DCU Front Panel Assembly 8-140
- **33** Rectifier Assembly 8-142
- **34** Positive Regulator Assembly 8-144
- **35** Negative Regulator Assembly 8-146
- **A** Disassembly and Reassembly Procedures 8-149
- **B** Internal Views 8-151

ILLUSTRATIONS

Figure Page

- 1-1. HP Model 8671B Accessories Supplied, and Options 907, 908, and 909 1-0
- 2-1. Line Voltage and Fuse Selection 2-2
- 2-2. Power Cable and Mains Plug Part Numbers 2-2
- 2-3. HP-IB Address Switches Shown as Set by the Factory 2-3
- 2-4. Hewlett-Packard Interface Bus Connection 2-5
- ⚠3-1. Front Panel Features 3-2
- 3-2. Rear Panel Features 3-2
- 3-3. External Leveling with a Crystal Detector .. 3-4
- 3-4. External Leveling with a Power Meter 3-5
- 3-5. Frequency Programming Codes and Arguments 3-10
- 3-6. Frequency Switching Time Showing Worst Case 3-11
- 3-7. Frequency Checks Test Setup 3-23
- 4-1. Frequency Range and Resolution Test Setup 4-2
- 4-2. Frequency Switching Time Test Setup 4-6
- 4-3. Frequency Switching Time Measurement Waveform 4-8
- 4-4. Amplitude Recover Measurement Waveform 4-10
- 4-5. Output Level, High Level Accuracy and Flatness Test Setup 4-12
- 4-6. Low Level Accuracy Test Setup 4-17
- 4-7. Output Level Switching Time Test Setup .. 4-20
- 4-8. Output Level Switching Time Measurement Waveform 4-22
- 4-9. Harmonics, Subharmonics, and Multiples Test Setup 4-23
- 4-10. Non-Harmonically Related Spurious Signals Test Setup 4-26
- 4-11. Power Line Related Spurious Signals Test Setup 4-29
- 4-12. Single-Sideband Phase Noise Test Setup .. 4-32
- 4-13. Internal Time Base Aging Rate Test Setup 4-36
- 5-1. 10 MHz Reference Oscillator Adjustment Test Setup 5-6
- 5-2. 100 MHz VCXO Adjustment Test Setup 5-7
- 5-3. M/N VCO Adjustment Test Setup 5-10
- 5-4. 20/30 Divider Bias Adjustment Test Setup 5-13
- 5-5. 20/30 Phase Detector Notch Filter Adjustment Test Setup 5-17
- 5-6. YTO Loop Sampler Adjustment Test Setup 5-22
- 5-7. YTO Sampler Frequency Response 5-23
- 5-8. YTO Phase Detector Adjustment Test Setup 5-25
- 5-9. Special Interconnect Cable 5-25
- 5-10. Spectrum Analyzer Display of Phase Locked Loop Gain 5-26
- 5-11. YTM Adjustment Test Setup 5-28
- 5-12. Optimum Centered YTM Response 5-30
- 5-13. Optimum Offset YTM Response 5-31
- 5-14. External Leveling Adjustment Test Setup 5-37
- 6-1. Cabinet Illustrated Parts Breakdown 6-70

ILLUSTRATIONS (cont'd)

Figure		Page
6-2.	Cabinet and Frame Illustrated Parts Breakdown	6-71
6-3.	Overall Illustrated Parts Breakdown	6-72
6-4.	Front Panel Photo, Front View	6-73
6-5.	RF Front Panel Inside View (Left Side)	6-74
6-6.	DCU Front Panel Inside View (Right Side)	6-75
6-7.	A1 Card Cage Illustrated Parts Breakdown	6-76
6-8.	A1 Microwave Circuits Illustrated Parts Breakdown	6-77
6-9.	A3 Power Supply and RF Source Illustrated Parts Breakdown	6-78
6-10.	A3 RF Source Illustrated Parts Breakdown	6-79
6-11.	A3 Rear Panel Illustrated Parts Breakdown	6-80
6-12.	A3 Power Supply and Rear Panel Illustrated Parts Breakdown	6-81
6-13.	A3 Fan Assembly Illustrated Parts Breakdown	6-82
6-14.	P/O A2 Controller Assembly and Rear Panel Illustrated Parts Breakdown	6-83
6-15.	P/O A2 Controller Assembly Illustrated Parts Breakdown	6-84
6-16.	A3A9 YTO and Reference Oscillator Illustrated Parts Breakdown	6-85
8-1.	Basic Logic Symbols and Qualifiers	8-18
8-2.	Indicator Symbols	8-19
8-3.	Contiguous Blocks	8-20
8-4.	AND Dependency Notation	8-20
8-5.	Address Dependency Notation	8-20
8-6.	OR and Free Dependency Notation	8-21
8-7.	Common Control Block	8-21
8-8.	Quad D-Type Latch (Combined)	8-21
8-9.	Quad D-Type Latch (Individual)	8-21
8-10.	Shift Register	8-22
8-11.	AND-OR Selector	8-22
8-12.	UP-DOWN Counter	8-22
8-13.	Quad D-Type Latch	8-22
8-14.	Major Assemblies	8-23
8-15.	Overall Troubleshooting Block Diagram	8-31
8-16.	Time Base Reference Block Diagram	8-33
8-17.	80 kHz Reference, A2A5TP2	8-39
8-18.	A2A5TP3, A2A3S1 Test Switch HIGH	8-39
8-19.	RF Phase Locked Loops Block Diagram	8-43
8-20.	YTO Summing Loop Block Diagram	8-45
8-21.	YTM Simplified Schematic	8-46
8-22.	Band 1 Squegging	8-46
8-23.	Typical YTM Output Power	8-46
8-24.	Microwave Signal Path Block Diagram	8-49
8-25.	ALC Block Diagram	8-51
8-26.	Remote/Local Interface Block Diagram	8-53
8-27.	DCU HP-IB Interface Block Diagram	8-55
8-28.	A2A11 CLK 1 Test Point	8-56
8-29.	A2A11 CLK 2 Test Point	8-56
8-30.	XA2A11C-7, NCLK 2	8-56
8-31.	XA2A11A-30, NCLK 3	8-56
8-32.	XA2A11B-30, LEFT	8-56
8-33.	XA2A11A-19, CYCLE	8-56
8-34.	XA2A11C-1, GO	8-56
8-35.	XA2A10C-20, NERR	8-58
8-36.	A2A10 HNR1 Test Point	8-58
8-37.	A2A10 HNR2 Test Point	8-58
8-38.	DR101, DR102	8-59
8-39.	XA2A8B-11, NRMDR	8-61
8-40.	A2A8U23, BCD8	8-61
8-41.	A2A8U23-15, BCD4	8-61
8-42.	A2A8U23-13, BCD2	8-62
8-43.	A2A8U23-14, BCD1	8-62
8-44.	A2A8U23-7, DR218	8-62
8-45.	A2A8U23-3, DR214	8-62
8-46.	A2A8U23-4, DR212	8-63
8-47.	A2A8U23-9, DR211	8-63
8-48.	DCU Frequency Control Block Diagram	8-65
8-49.	Power Supply Block Diagram	8-67
8-50.	A3A1A6 Reference and M/N Motherboard Assembly Component Locations	8-71
8-51.	A3A1A1 Reference Phase Detector Assembly Component and Test Point Locations	8-72
8-52.	Reference Phase Detector Assembly Schematic Diagram	8-73
8-53.	A3A1A2 100 MHz VCXO Assembly Component and Test Point Locations	8-75
8-54.	100 MHz VCXO Assembly Schematic Diagram	8-75
8-55.	Divider Operation Timing Diagram	8-76
8-56.	Divider Clock Pulses versus Output Pulses Timing Diagram	8-76
8-57.	A3A1A3TP2 and TP3 Waveforms	8-76
8-58.	A3A1A3 M/N Phase Detector Assembly Component and Test Point Locations	8-79
8-59.	M/N Phase Detector Assembly Schematic Diagram	8-79
8-60.	A3A1A3 M/N Phase Detector Assembly Component and Test Point Locations	8-81
8-61	M/N VCO Assembly Schematic Diagram	8-81
8-62.	A3A1A5 M/N Output Assembly Component and Test Point Locations	8-83
8-63.	M/N Output Assembly Schematic Diagram	8-83
8-64.	A2A5 20/30 Divider Assembly Component and Test Point Locations	8-85

ILLUSTRATIONS (cont'd)

Figure		Page
8-65.	20/30 Divider Assembly Schematic Diagram	8-85
8-66.	Phase Detector Timing	8-86
8-67.	A2A4 20/30 Phase Detector Assembly Component and Test Point Locations	8-87
8-68.	20/30 Phase Detector Assembly Schematic Diagram	8-87
8-69.	A2A3 VCO 160—240 MHz Assembly Component and Test Point Locations	8-89
8-70.	VCO 160—240 MHz Assembly Schematic Diagram	8-89
8-71.	A3A5 DAC Assembly Component and Test Point Locations	8-91
8-72.	Digital-to-Analog Converter Assembly Schematic Diagram	8-91
8-73.	YTO Frequency versus Coil Drive Current	8-92
8-74.	A3A6 YTO Driver Assembly Component and Test Point Locations	8-92
8-75.	YTO Driver Assembly Schematic Diagram	8-93
8-76.	A3A9A5 Sampler Assembly Component and Test Point Locations	8-97
8-77.	YTO Sampler Assembly Schematic Diagram	8-97
8-78.	A3A9A4 Phase Detector Assembly Component and Test Point Locations	8-99
8-79.	P/O YTO Phase Detector Assembly Schematic Diagram	8-99
8-80.	A3A7 YTO/HF Coil Driver Assembly Component and Test Point Locations	8-101
8-81.	YTO/HF Coil Driver Assembly Schematic Diagram	8-101
8-82.	A1A5 ALC Assembly Component Locations	8-103
8-83.	A1A13 Interconnect Assembly Component Locations	8-103
8-84.	RF Amplifier and P/O ALC Schematic Diagram	8-103
8-85.	A1A3 YTM Assembly Component and Test Point Locations	8-105
8-86.	A1A8 YTM Driver Assembly Component, Adjustment and Test Point Locations	8-105
8-87	YTM Control Schematic Diagram	8-105
8-88.	A1A7 SRD Bias Assembly, Component Locations	8-107
8-89.	16 SRD Bias Assembly Schematic Diagram	8-107
8-90.	A1A6 ALC Detector Assembly Component, Adjustment and Test Point Locations	8-109
8-91.	ALC Detector Assembly Schematic Diagram	8-109
8-92.	A1A10 RF Output Level Control Component Locations	8-111
8-93.	RF Output Level Control Schematic Diagram	8-111
8-94.	A1A11 Digital Processor Assembly Component, Adjustment and Test Point Locations	8-113
8-95.	Digital Processor Schematic Diagram	8-113
8-96.	A1A2 Display Driver Assembly Component Locations	8-115
8-97.	A1A1 RF Output Front Panel Assembly Component Locations	8-115
8-98.	RF Front Panel Controls and Displays Schematic Diagram	8-115
8-99.	HP-IB Handshake Waveforms	8-119
8-100.	A2A9 HP-IB Address Assembly Component Location	8-119
8-101.	P/O HP-IB Address Schematic Diagram	8-119
8-102.	A2A9 P/O HP-IB Address Assembly Component Locations	8-121
8-103.	P/O HP-IB Address Assembly Schematic Diagram	8-121
8-104.	P/O A2A7 Interface Assembly Component and Test Point Locations	8-123
8-105.	P/O HP-IB Interface Assembly Schematic Diagram	8-123
8-106.	P/O A2A7 Interface Assembly Component Locations	8-125
8-107.	P/O HP-IB Interface Schematic Diagram	8-125
8-108.	A2A10 Register 1 Assembly Component Locations	8-127
8-109.	Register 1 Assembly Schematic Diagram	8-127
8-110.	P/O A2A11 Timing and Control Assembly Component Locations	8-129
8-111.	P/O Timing and Control Assembly Schematic Diagram	8-129
8-112.	P/O A2A11 Timing and Control Assembly Component and Test Point Locations	8-131
8-113.	P/O Timing and Control Assembly Schematic Diagram	8-131
8-114.	P/O A2A8 Output Register Assembly Component and Test Point Locations	8-133
8-115.	Output Register Assembly Schematic Diagram	8-133
8-116.	P/O A2A8 Output Register Assembly Component and Test Point Locations	8-135

ILLUSTRATIONS (cont'd)

Figure		Page
8-117.	P/O Output Register Assembly Schematic Diagram	8-135
8-118.	P/O A2A1 Front Panel Assembly Component Locations	8-139
8-119.	P/O DCU Front Panel Assembly Schematic Diagram	8-139
8-120.	P/O A2A1 DCU Front Panel Assembly Component Locations	8-141
8-121.	P/O DCU Front Panel Assembly Schematic Diagram	8-141
8-122.	A3A2 Rectifier Assembly Component and Test Point Locations	8-143
8-123.	Rectifier Assembly Schematic Diagram	8-143
8-124.	A3A3 Positive Regulator Assembly Component and Test Point Locations	8-145
8-125.	Positive Regulator Assembly Schematic Diagram	8-145
8-126.	A3A4 Negative Regulator Assembly Component Locations	8-147
8-127.	A3A4 Negative Regulator Assembly Schematic Diagram	8-147
8-128.	Transformer and Filter Capacitor Removal	8-149
8-129.	A1 RF Output Assembly, Amplifier, Attenuator and YTM	8-150
8-130.	YTO Assembly in Service Position	8-150
8-131.	Top View, Assembly Location	8-151
8-132.	Top View, Component Location Covers Removed	8-151
8-133.	Bottom View, Component Location	8-151

TABLES

Table		Page
1-1.	Specifications	1-4
1-2.	Supplemental Characteristics	1-7
1-3.	Recommended Test Equipment	1-8
2-1.	Allowable HP-IB Address Codes	2-3
3-1.	Operating Characteristics	3-1
3-2.	Index of Detailed Operating Instructions	3-1
3-3.	Message Reference Table	3-18
3-4.	Programming Quick Reference Guide	3-21
4-1.	Output Level, High Level Accuracy and Flatness Test Record	4-14
4-2.	Low Level Accuracy Test Record	4-19
4-3.	Harmonics, Subharmonics & Multiples Test Record	4-25
4-4.	Performance Test Record	4-38
5-1.	Factory Selected Components	5-2
5-2.	Performance Test Failure and Required Action	5-2
5-3.	Post-Repair Adjustments	5-3
6-1.	Part Numbers for Exchange Assemblies	6-2

Figure		Page
6-2.	Replaceable Parts	6-5
6-3.	Code List of Manufacturers	6-86
8-1.	Schematic Diagram Notes	8-4
8-2.	Etched Circuit Soldering Equipment	8-13
8-3.	M and N Numbers and Resulting Frequencies	8-34
8-4.	LFS 1K—8M Inputs	8-40
8-5.	LFS 1K—8M Outputs	8-40
8-6.	M1—M5 and N1—N6 Inputs	8-41
8-7.	M1—M5 and M1—N6 Outputs	8-41
8-8.	DAC 1 — 4800 MHz Inputs	8-44
8-9.	DAC 1 — 4800 MHz Outputs	8-44
8-10.	Frequency Bands	8-46
8-11.	YTM Control Inputs	8-46
8-12.	YTM Control Band Inputs	8-46
8-13.	HN1 and HN2 Inputs	8-47
8-14.	Frequency Band Outputs	8-58
8-15.	Register 1 Serial Output	8-60
8-16.	Register 1 Serial Input	8-60
8-17.	M1—M5 and N1—N6 Outputs	8-63
8-18.	LFS 1K—8M Outputs	8-64
8-19.	Divider Operation	8-77
8-20.	Increment Decoder Operation	8-77

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

SAFETY SYMBOLS

⚠ Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (see Table of Contents for page references).

Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

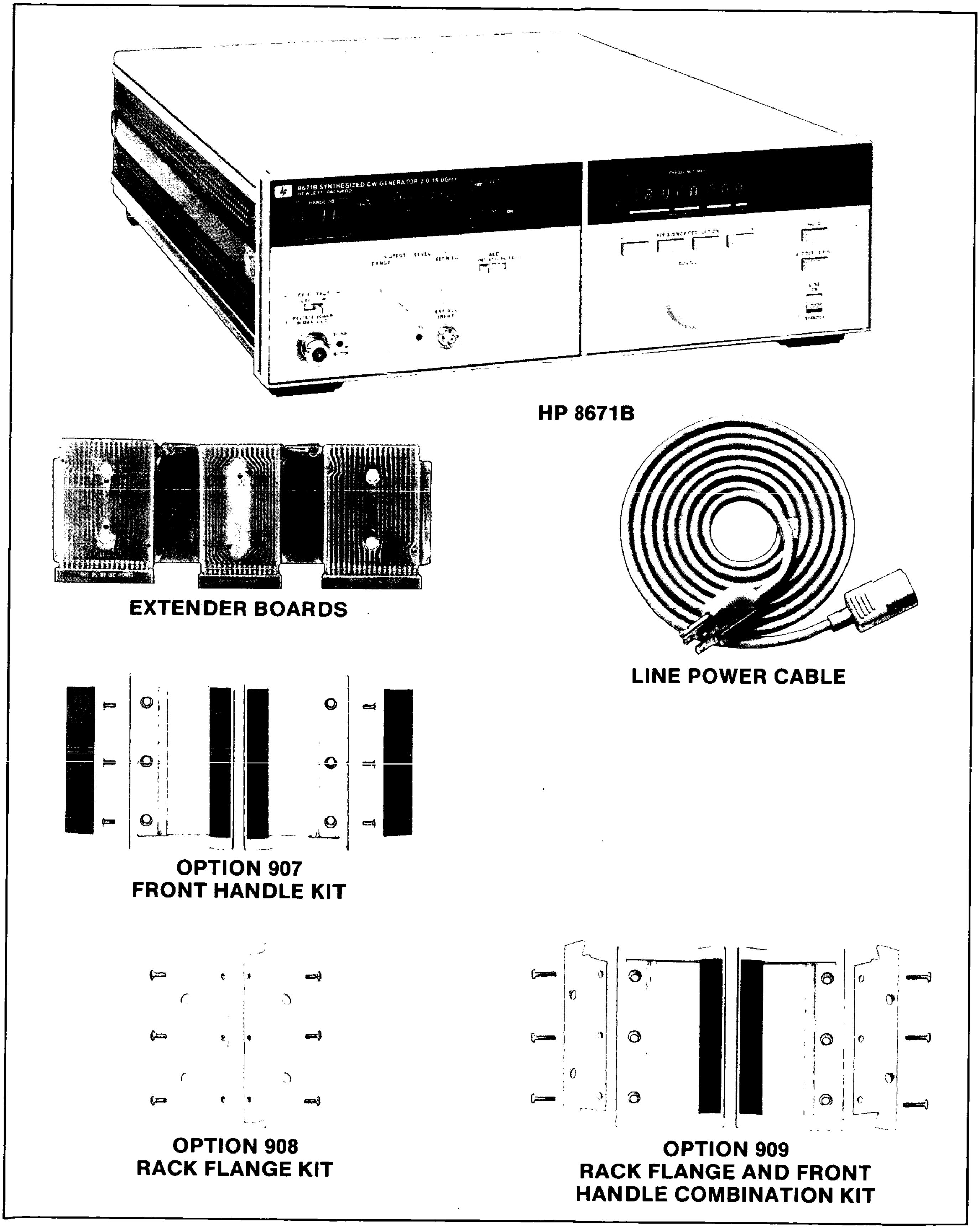


Figure 1-1. HP Model 8671B Accessories Supplied, and Options 907, 908, and 909

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust and service the Hewlett-Packard 8671B Synthesized CW Generator. Figure 1-1 shows the CW Generator with all of its externally supplied accessories.

The 8671B Operating and Service manual has eight sections. The subjects addressed are:

Section I, General Information
Section II, Installation
Section III, Operation
Section IV, Performance Tests
Section V, Adjustments
Section VI, Replaceable Parts
Section VII, Manual Changes
Section VIII, Service

Two copies of the operating information are supplied with the CW Generator. One copy is in the form of an Operating Manual. The Operating Manual is a copy of the first four sections of the Operating and Service Manual. The Operating Manual should stay with the instrument for use by the operator. Additional copies of the Operating Manual can be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

Also listed on the title page of this manual, below the manual part number, is a microfiche part number. This number may be used to order 100 x 150 millimetre (4 x 6 inch) microfilm transparencies of this manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement, as well as all pertinent Service Notes.

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested. Supplemental characteristics are listed in Table 1-2. Supplemental characteristics are not warranted specifications, but are typical characteristics included as additional information for the user.

1-3. SAFETY CONSIDERATIONS

This product is a Safety Class I instrument, that is, one provided with a protective earth terminal. The CW Generator and all related documentation should be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information for installation, operation, performance testing, adjustment, or service is found in appropriate places throughout this manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-5. MANUAL CHANGES SUPPLEMENT

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in this manual. The manual for this newer instrument is accompanied by a Manual Changes supplement. The supplement contains "change information" that explains how to adapt this manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep the manual as current and as accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual print date and part number, both

MANUAL CHANGES SUPPLEMENT (cont'd)

of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-6. DESCRIPTION

The HP 8671B Synthesized CW Generator has a frequency range of 2.0 to 18.0 GHz. The output is leveled and calibrated from +8 dBm to −120 dBm. Frequency, output level, and ALC modes can be remotely programmed via HP-IB.

The frequency can be tuned with one of four frequency resolutions. Tuning resolutions of 100 MHz, 1 MHz, 10 kHz or 1 kHz are selected by front panel pushbuttons. The 1 kHz tuning resolution will give tuning resolutions of 1 kHz for frequencies from 2.0 to 6.2 GHz, 2 kHz for frequencies from 6.2 to 12.4 GHz, and 3 kHz for frequencies from 12.4 to 18.599997 GHz.

Long-term frequency stability is dependent on the time base, either an internal or external reference oscillator. The internal crystal reference oscillator operates at 10 MHz while an external oscillator may operate at 5 or 10 MHz.

The output of the CW Generator is exceptionally flat due to the action of the internal automatic leveling control (ALC) loop. External leveling control using a diode detector or a power meter to sense output power can be used to level the output at a remote load.

The output level is set using the OUTPUT LEVEL RANGE switch and the OUTPUT LEVEL VERNIER. The OUTPUT LEVEL RANGE switch changes the output level in 10 dB increments (+10 to −110 dB). The OUTPUT LEVEL VERNIER is then used to adjust the output level over a continuous 13 dB range (−10 to +3 dBm). The output level is read by adding the vernier setting to the range setting.

The CW Generator is compatible with HP-IB to the extent indicated by the following codes: SH1, AH1, T6, TE0, L4, LE0, SR1, RL2, PP2, DC1, DT0, and C0. An explanation of the compatibility code can be found in IEEE Standard 488 (1978), "IEEE Standard Digital Interface for Programmable Instrumentation" or the identical ANSI Standard MC1.1. For more detailed information relating to programmable control of the CW Generator, refer to Remote Operation, Hewlett-Packard Interface Bus in Section III of this manual.

1-7. OPTIONS

1-8. Mechanical Options

The following options may have been ordered and received with the CW Generator. If they were not ordered with the original shipment and are now desired, they can be ordered from the nearest Hewlett-Packard office using the part numbers included in each of the following paragraphs.

Option 907 (Front Handle Kit). Ease of handling is increased with the front panel handles. The Front Handle Kit part number is 5061-9689.

Option 908 (Rack Flange Kit). The CW Generator can be solidly mounted to the instrument rack using the flange kit. The Rack Flange Kit part number is 5061-9677.

Option 909 (Rack Flange and Front Handle Combination Kit). This is a unique part which combines both functions. It is not simply a front handle kit and a rack flange kit packaged together. The Rack Flange and Front Panel Combination Kit part number is 5061-9683.

1-9. ACCESSORIES SUPPLIED

The accessories supplied with the CW Generator are shown in Figure 1-1.

a. The line power cable is supplied in several configurations, depending on the destination of the original shipment. Refer to Power Cables in Section II of this manual.

b. An additional fuse is shipped only with instruments that are factory configured for 100/120 Vac operation. This fuse has a 1.5A rating and is for reconfiguring the instrument for 220/240 Vac operation.

c. Four extender boards are supplied for performance testing, adjusting, and troubleshooting the instrument.

1. One 30-pin (15 x 2) extender board, HP part number 08672-60117.

ACCESSORIES SUPPLIED (cont'd)

2. Two 36-pin (18 x 2) extender boards, HP part number 08672-60020.

3. One 3-section, 30-pins (15 x 2) per section, extender board, HP part number 08672-60016 (for use in the A2 Assembly).

1-10. ACCESSORIES AVAILABLE

Chassis Slide Mount Kit. This kit is not available as a factory installed option. However, it is extremely useful when the CW Generator is rack mounted. Access to internal circuits and components or the rear panel is possible without removing the CW Generator from the rack. Order HP part number 1494-0059. If the instrument rack mounting slides are to be mounted in a standard EIA rack, then an adapter (HP Part No. 1494-0061) is needed. The slides without the adapter can be directly mounted in the HP system enclosures.

1-11. ELECTRICAL EQUIPMENT AVAILABLE

The CW Generator has an HP-IB interface and can be used with any HP-IB compatible computing controller or computer for automatic systems applications.

The HP-IB Controller is needed for performance testing. Controllers that are supported by this manual include the HP 9826A, 9836A, and HP 85B/82937A.

The HP 11712A Support Kit is available for maintaining and servicing the CW Generator. It includes a special test extender board, cables and adapters.

1-12. RECOMMENDED TEST EQUIPMENT

Table 1-3 lists the test equipment recommended for testing, adjusting and servicing the CW Generator. Essential requirements for each piece of test equipment are described in the Critical Specifications column. Other equipment can be substituted if it meets or exceeds these critical specifications.

Table 1-1. Specifications (1 of 3)

Note: Specifications apply after 1-hour warm-up, over the temperature range 0 to 55°C (except specifications for RF output level which apply over the range 15 to 35° C). Specifications for output flatness and absolute level accuracy apply only when internal leveling is used.

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—18.0 GHz (Overrange to 18.599997 GHz)	
Resolution	1 kHz 2 kHz 3 kHz	2.0 to 6.2 GHz 6.2 to 12.4 GHz 12.4 to 18.0 GHz
Accuracy and Stability	Same as reference oscillator	
Switching Time		
Frequency (to be within the specified resolution −1 kHz in 2.0 to 6.2 GHz range, etc.)	<15 ms	
Amplitude (after switching frequency) to be within ±3 dB of final level	<15 ms	When switching within the same frequency resolution band.
Reference Oscillator		
Frequency	10 MHz	
Aging Rate	$<5 \times 10^{-10}$/day	After a 10 day warmup (typically 24 hours in a normal operating environment)
SPECTRAL PURITY		
Single-sideband Phase Noise		1 Hz bandwidth
2.0—6.2 GHz	<−58 dBc <−70 dBc <−78 dBc <−86 dBc <−110 dBc	10 Hz offset from carrier 100 Hz offset from carrier 1 kHz offset from carrier 10 kHz offset from carrier 100 kHz offset from carrier
6.2—12.4 GHz	<−52 dBc <−64 dBc <−72 dBc <−80 dBc <−104 dBc	10 Hz offset from carrier 100 Hz offset from carrier 1 kHz offset from carrier 10 kHz offset from carrier 100 kHz offset from carrier
12.4—18.0 GHz	<−48 dBc <−60 dBc <−68 dBc <−76 dBc <−100 dBc	10 Hz offset from carrier 100 Hz offset from carrier 1 kHz offset from carrier 10 kHz offset from carrier 100 kHz offset from carrier
Harmonics	<−25 dBc	At +8 dBm

Table 1-1. Specifications (2 of 3)

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY (cont'd)		
Subharmonics and multiples thereof	<−25 dBc	
Spurious Signals, non-harmonically related, except power line and fan rotation related	<−70 dBc	2.0—6.2 GHz
	<−64 dBc	6.2—12.4 GHz
	<−60 dBc	12.4—18.0 GHz
Power line related and fan rotation related within 5 Hz below line frequencies and multiples thereof		
2.0—6.2 GHz	<−50 dBc	<300 Hz offset from carrier
	<−60 dBc	300 Hz to 1 kHz offset from carrier
	<−65 dBc	>1 kHz offset from carrier
6.2—12.4 GHz	<−44 dBc	<300 Hz offset from carrier
	<−54 dBc	300 Hz to 1 kHz offset from carrier
	<−59 dBc	>1 kHz offset from carrier
12.4—18.0 GHz	<−40 dBc	<300 Hz offset from carrier
	<−50 dBc	300 Hz to 1 kHz offset from carrier
	<−55 dBc	>1 kHz offset from carrier
RF OUTPUT		
Output Power	+8 dBm to −120 dBm	+15 to +35°C
Remote Programming Absolute Level Accuracy		
2.0—6.2 GHz	±1.00 dB	+10 dB output level range
	±1.00 dB	0 dB output level range
	±1.50 dB	−10 dB output level range
	±1.70 dB	−20 dB output level range
	±1.90 dB	−30 dB output level range
	±1.90 dB & ±0.3 dB per 10 dB step	<−30 dB output level range
6.2—12.4 GHz	±1.25 dB	+10 dB output level range
	±1.25 dB	0 dB output level range
	±1.75 dB	−10 dB output level range
	±1.95 dB	−20 dB output level range
	±2.15 dB	−30 dB output level range
	±2.15 dB & ±0.3 dB per 10 dB step	<−30 dB output level range
12.4—18.0 GHz	±1.50 dB	+10 dB output level range
	±1.50 dB	0 dB output level range
	±2.10 dB	−10 dB output level range
	±2.30 dB	−20 dB output level range
	±2.40 dB	−30 dB output level range
	±2.40 dB & ±0.4 dB per 10 dB step	<−30 dB output level range

Table 1-1. Specifications (3 of 3)

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT (cont'd)		
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement uncertainty.
Remote Programming Output Level Resolution	1 dB	
Flatness (total variation)		0 dBm Range, +15°C to +35°C
	1.50 dB	2.0 to 6.2 GHz
	2.00 dB	2.0 to 12.4 GHz
	2.50 dB	2.0 to 18.0 GHz
Output Leveling Switching Time (to be within ±1 dB of final level)	<20 ms	
REMOTE OPERATION		
Frequency	Programmable over the full range with the same resolution as manual mode.	
Output Level	Programmable in 1 dB steps, +8 to −120 dBm, plus 5 dB of overrange	
RF Output	Programmable to either ON or OFF.	
ALC	Programmable for internal, crystal diode, or power meter leveling.	
Interface Function Codes	SH1, AH1, T6, TE0, L4, LE0, SR1, RL2, PP2, DC1, DT0, and C0.	
GENERAL		
Operating Temperature	0 to +55°C (see note at the beginning of this table).	
Power	100, 120, 220, or 240V, +5%, −10%, 48—66 Hz, 300 VA maximum.	
E.M.I.	Conducted and radiated interference is within the requirements of MIL-I-6181D.	
Net Weight	27.2 kg (60 lbs)	
Dimensions: Height	146 mm (5.7 in.)	
Width	425 mm (16.8 in.)	
Depth	620 mm (24.4 in.) For ordering cabinet accessories, module sizes are 5-1/4H, 1 MW, 23D, System II	
Accessories	Power Cord, Operating and Service Manual, and four extender boards.	

Table 1-2. Supplemental Characteristics

Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

FREQUENCY

Internal Reference: The internal reference oscillator accuracy is a function of time base calibration ± aging rate, ± temperature effects, and ± line voltage effects. Typical temperature and line voltage effects are $<1 \times 10^{-7}/°C$ and $<5 \times 10^{-10}/+5\%$ to -10% line voltage change. Reference oscillator is kept at operating temperature in STANDBY mode with the instrument connected to mains power. The aging rate is $<5 \times 10^{-10}$/day after a 24 hour warmup.

External Reference Input: 5 or 10 MHz at a level of 0.1 to 1 Vrms into 50Ω. Stability and spectral purity of the microwave output will be partially determined by characteristics of the external reference frequency.

Reference Outputs: 10 MHz at a level of 0.2 Vrms into 50Ω. 100 MHz at a level of 0.2 Vrms into 50Ω.

SPECTRAL PURITY

Residual FM: 80 Hz rms in a 50 Hz—15 kHz Post-detection bandwidth from 2—6.2 GHz. Residual FM doubles in the 6.2—12.4 GHz range and triples in the 12.4—18.0 GHz range.

RF OUTPUT

For power settings >+3 dBm, changes in frequency from <10 GHz to >16 GHz may require a settling period for the power to stabilize at the set level. Spurious output oscillations may occur for settings above +8 dBm.

External leveling device characteristics will determine output flatness, absolute level accuracy, and switching time in external leveling modes.

Maximum Reverse Power: 1W RF input; 1 MHz—20 GHz, 0 Vdc.

Impedance: 50Ω.

Source SWR: ≤2.0:1.

Table 1-3. Recommended Test Equipment (1 of 3)

Instrument	Critical Specifications	Recommended Model	Use*
AC Voltmeter	Range: 1 mV to 10V Accuracy: ±1.5% of full scale ±1.5% of reading Frequency Response: 3 kHz to 3 MHz	HP 400E	A
Attenuator, Fixed 3 dB	Range: dc to 1 GHz Accuracy: ±0.5 dB SWR: < 1.3	HP 8491A Option 003	A
Attenuator, Fixed 20 dB	Range: dc to 18 GHz Accuracy: ±1.0 dB SWR: < 1.6	HP 8491B Option 020	C, P
Cable, Special Interconnect	See YTO Loop Phase Detector Adjustments in Section V	Locally Fabricated	A
Controller, HP-IB	HP-IB compatibility as defined by IEEE Standard 488-1978 and the identical ANSI Standard MC1.1: SH1, AH1, T2, TE0, L2, LE0, SR0, RL0, PP0, DC0, DT0, and C1, 2, 3, 4, 5.	HP 85B/82937A or 9826A Option 011 or 9836A with BASIC 2.0 Operating System	C, A, T, P
Crystal Detector	Frequency Range: 2 to 18 GHz Frequency Response: ±1.5 dB	HP 8470B Option 012	P, A
Current Probe	Frequency Range: 2 to 35 MHz	HP 1110B	A
Digital Voltmeter (DVM)	Range: −60V to +40V dc Resolution: 100 μV on 1V dc range	HP 3456A or HP 3455A	A, T
Foam Pads (2 required)	43 × 58 cm (17 × 23 in.), 5 cm (2 in.) thick		P
Frequency Counter	Range: 2 to 18 GHz Resolution: 1 kHz 10 MHz Frequency Standard Output: ≥0.1 Vrms	HP 5343A	P, A, T
Frequency Standard	Long Term Stability: Better than 10^{-10}/day	HP 5065A	P, A
High Impedance Probe	Frequency: 400 MHz Output Impedance: 50Ω (compatible with Spectrum Analyzer).	HP 1121A	T
Local Oscillator	Range: 2 to 18 GHz Level: +7 dBm Single Sideband Phase Noise and Spurious Signals: Same as HP 8340A	HP 8340A	P, A
Logic State Analyzer	8 Bit Display, Triggerable	HP 1630A	T

Table 1-3. Recommended Test Equipment (2 of 3)

Instrument	Critical Specifications	Recommended Model	Use*
Logic Pulser	TTL compatible	HP 546A	T
Mixer	Response: 2 to 18 GHz VSWR, LO: ≤ 2.5:1 VSWR, RF: ≤ 4.0:1	RHG DMS1—18[1]	P, A
Oscilloscope	Bandwidth: 50 MHz Vertical Sensitivity: 50 mV/div Vertical Input: 50Ω ac or dc coupled External Trigger Capability	HP 1980B	P, A, T
Power Meter	Frequency: 2 to 18 GHz Range: +17 to −25 dBm	HP 436A	P, A, T
Power Sensor	Frequency: 2 to 18 GHz Input Impedance: 50Ω SWR: < 1.28 Range: +17 to −25 dBm Must be compatible with power meter	HP 8481A	P, A, T
Power Source, Variable Frequency AC	Range: 110 to 120 Vac Frequency: 52 to 58 Hz Accuracy ± 2 Hz	California Instruments 501TC/800T[2]	P
Power Supply	0 to 40 Vdc	HP 6200B	A, T
Amplifier, 20 dB	Frequency: 100 kHz Gain: 20 ± 5 dB Output Power: > −10 dBm Noise Figure: < 5 dBm Impedance: 50Ω	HP 8447A	P
Amplifier, 40 dB	Frequency: 100 kHz Gain: 45 ± 5 dB Output Power: > −10 dBm Impedance: 50Ω	HP 8447D and HP 8447E or HP 8447F	P
Probe, 10:1	Must be compatible with the oscilloscope.	HP 10017A	A
Signal Generator	Output Level: −5 to −20 dBm at 240 MHz	HP 8640B or HP 8340A	A
Spectrum Analyzer (with Tracking Generator)	Frequency Range: 20 Hz to 300 kHz Frequency Span/Division: 20 Hz minimum Noise Sidebands: > 90 dB below CW signal, 3 kHz offset, 100 Hz IF bandwidth Input Level Range: −10 to −60 dBm Log Reference Control: 70 dB dynamic range in 10 dB steps Accuracy: ± 0.2 dB	HP 8556A/8552B/141T	A

Table 1-3. Recommended Test Equipment (3 of 3)

Instrument	Critical Specifications	Recommended Model	Use*
Spectrum Analyzer	Frequency Range: 5 Hz to 50 kHz Resolution Bandwidth: 1 Hz minimum Frequency Span/Division: 5 Hz to 500 Hz Amplitude Range: 0 to −70 dBm	HP 3580A	P, T
Spectrum Analyzer	Frequency Range: 100 kHz to 22 GHz Frequency Span/Division: 2 kHz minimum Amplitude Range: +10 to −90 dBm Noise Sideband: > 75 dB down 30 kHz from signal at 1 kHz resolution bandwidth Resolution Bandwidth: 30 Hz to 300 kHz	HP 8566B	P, A
Sweep Oscillator	Center Frequency: 150 to 200 MHz Center Frequency Resolution: 0.1 MHz Sweep Range: 10 and 200 MHz	HP 86222B/8620C or HP 8340A	A
Termination	50Ω BNC	HP 11593A	A
Termination	600Ω BNC Feedthrough	HP 11095A	P, A
Test Coupler Adapter	See YTM Adjustments in Section V	Locally fabricated	A
Test Oscillator	Level: 0 to 3V into 50Ω or 300Ω Range: 60 Hz to 10 kHz	HP 8116A	A, T

* C = Operator's Check, P = Performance Tests, A = Adjustments, T = Troubleshooting

[1] RHG Electronics Laboratory, Inc., 161 East Industry Court, Deer Park, NY 11729, Tel. (516) 242-1100, TWX 510-227-6083.

[2] California Instruments, 5150 Convoy Street, San Diego, CA 92111, Tel. (714) 279-8620.

II Installation

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides the information needed to install the CW Generator. Included is information pertinent to initial inspection, power requirements, line voltage selection, power cables, interconnection, environment, instrument mounting, storage and shipment.

2-2. INITIAL INSPECTION

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, meters).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE

2-4. Power Requirements

The CW Generator requires a power source of 100, 120, 220 or 240 Vac, +5% to −10%, 48 to 66 Hz single phase. Power consumption is 300 VA maximum.

WARNINGS

This is a Safety Class I product (that is, provided with a protective earth terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an external autotransformer, make sure the autotransformer's common terminal is connected to the neutral (that is, the grounded side of the mains supply).

2-5. Line Voltage and Fuse Selection

CAUTION

BEFORE PLUGGING THIS INSTRUMENT into the mains (line) voltage, be sure the correct voltage and fuses have been selected.

Verify that the line voltage selection cards and the fuses are matched to the power source. Refer to Figure 2-1, Line Voltage and Fuse Selection.

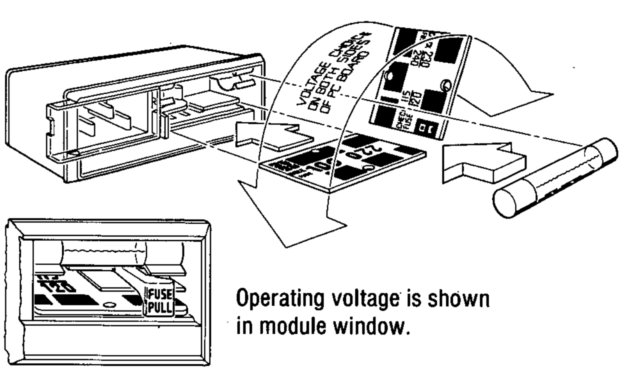
Fuses may be ordered under HP part numbers 2110-0003, 3.0A (250V) for 100/120 Vac operation and 2110-0043, 1.5A (250V) for 220/240 Vac operation.

2-6. Power Cables

WARNING

BEFORE CONNECTING THIS INSTRUMENT, the protective earth terminal of this instrument must be connected to the protective conductor of the (mains) power cables. The mains plug shall only be inserted in socket outlets provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding).

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument



SELECTION OF OPERATING VOLTAGE

1. Open cover door, pull the FUSE PULL lever and rotate to left. Remove the fuse.
2. Remove the Line Voltage Selection Card. Position the card so the line voltage appears at top-left corner. Push the card firmly into the slot.
3. Rotate the FUSE PULL lever to its normal position. Insert a fuse of the correct value in the holder. Close the cover door.

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz [leakage currents at these line settings may exceed 3.5 mA].

Figure 2-1. Line Voltage and Fuse Selection

Power Cables (cont'd)

cabinet. The power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of power cables available.

2-7. HP-IB Address Selection ⚠

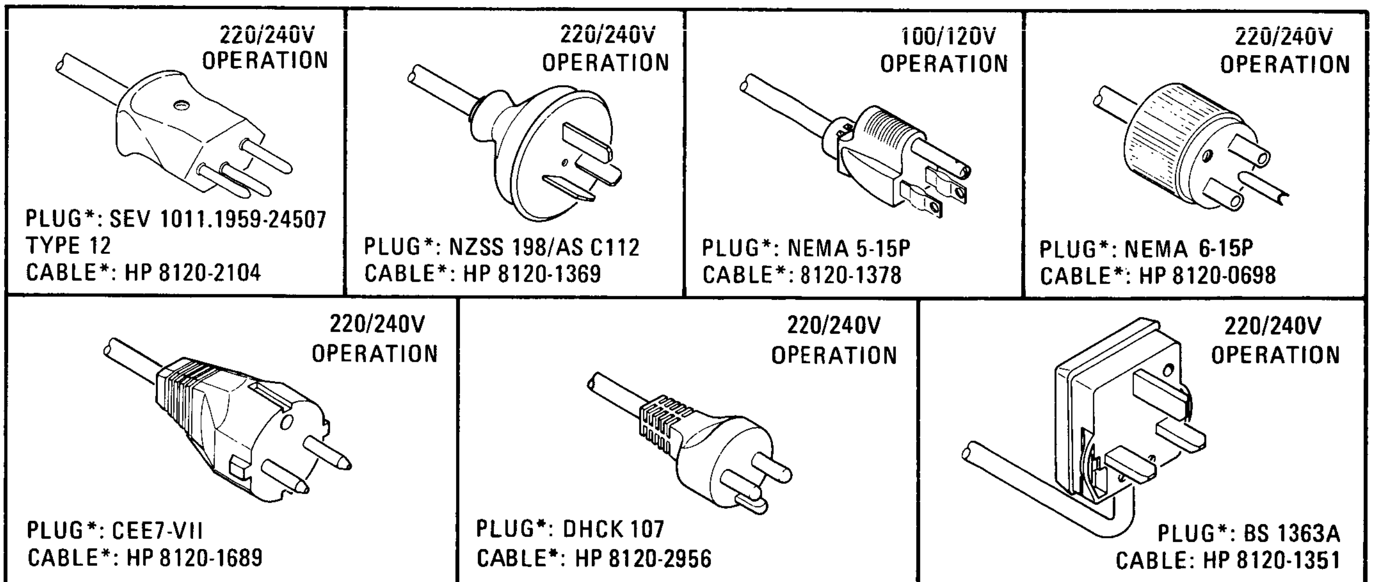
In the CW Generator, the HP-IB talk and listen addresses and the parallel poll sense and response line can be selected by internal switches. Refer to Table 2-1 for a listing of talk and listen addresses. The address is factory set for a Talk address of "S" and a Listen address of "3". (In octal this is 23; in decimal this is 19.)

To change the HP-IB address or to select a different parallel poll response, proceed as follows:

WARNINGS

Internal switch settings should be changed only by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

To avoid hazardous electrical shock, the line (mains) power cable should be disconnected before attempting to change any internal switch settings.



*The number shown for the plug is the industry identifier for the plug only.
The number shown for the cable is an HP part number for a complete cable including the plug.

Figure 2-2. Power Cable and Mains Plug Part Numbers

Table 2-1. Allowable HP-IB Address Codes

Address Switches (Octal)		Talk Address Character	Listen Address Character	Decimal Equivalent
S1	S2			
0	0	@	SP	0
0	1	A	!	1
0	2	B	"	2
0	3	C	#	3
0	4	D	$	4
0	5	E	%	5
0	6	F	&	6
0	7	G	'	7
1	0	H	(	8
1	1	I	)	9
1	2	J	*	10
1	3	K	+	11
1	4	L	,	12
1	5	M	–	13
1	6	N	.	14
1	7	O	/	15
2	0	P	0	16
2	1	Q	1	17
2	2	R	2	18
2	3	S	3	19
2	4	T	4	20
2	5	U	5	21
2	6	V	6	22
2	7	W	7	23
3	0	X	8	24
3	1	Y	9	25
3	2	Z	:	26
3	3	[	;	27
3	4	\	<	28
3	5	]	=	29
3	6	^	>	30

HP-IB Address Selection (cont'd)

a. Set the LINE switch to STANDBY. Disconnect the line power cable.

b. Remove the CW Generator's top cover by removing the two plastic standoffs from the rear of the top cover and loosening the screw at the middle of the rear edge of the top cover. Then remove the A2 Assembly's protective cover. Refer to the Disassembly Procedures in Section VIII, Service Sheet A.

c. Select the new address as shown in Table 2-1. The switches are shown in Figure 2-3. The HP-IB ADDRESS SELECT switch settings (for S1 and S2) are in the octal code. For example, the factory selected addresses are set to 23 (decimal 19). Therefore, the listen address is '3' and the talk address is 'S'.

d. If the parallel poll sense or response switches are to be changed, remove any HP-IB cables or connectors from the HP-IB connector, and remove the HP-IB connector. Then remove the A2A9 Board Assembly.

e. The PARALLEL POLL SENSE switch (S4) is set to either the OFF, 0 (zero) or 1 (one) position. The zero position provides a false (+2.5 to 5 volts) output on the asserted HP-IB data line; the one position provides a true (0 to +0.4V) output on the asserted HP-IB data line.

f. The PPR (Parallel Poll Response) switch (S3) is set to select one of eight lines (one of 1 through 8 of the HP-IB data bus). The selected line passes the CW Generator's parallel poll response to the HP-IB controller.

g. Re-install the A2A9 Assembly and HP-IB connector.

h. Replace the A2 Assembly's internal cover, the instrument's top cover, and rear standoffs.

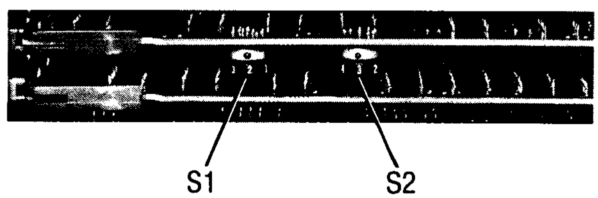


Figure 2-3. HP-IB Address Switches Shown as Set by the Factory

2-8. Interconnections

Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-4.

2-9. Mating Connectors

HP-IB Interface Connector. The HP-IB mating connector is shown in Figure 2-4. Note that the two securing screws are metric.

Coaxial Connectors. Coaxial mating connectors used with the CW Generator RF output should be 50Ω Type N male connectors.

2-10. Operating Environment

The operating environment should be within the following limitations:

Operating Environment (cont'd)

Temperature .... 0 to +55°C
Humidity .... <95% relative
Altitude .... <4570 metres (15,000 feet)

NOTE

Specifications for RF Output apply only between +15 and +35°C.

2-11. Bench Operation

The instrument cabinet has plastic feet and fold-away tilt stands for convenience in bench operation. (The plastic feet are shaped to ensure self-aligning of the instruments when stacked.) The tilt stands raise the front of the instrument for easier viewing of the front panel.

2-12. Rack Mounting

WARNING

The CW Generator weighs 27.2 kg (60 lbs), therefore extreme care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting the instrument.

Rack mounting information is provided with the rack mounting kits. If the kits were not ordered with the instrument as options, they may be ordered through the nearest Hewlett-Packard office. Refer to the paragraph entitled Mechanical Options in Section I.

2-13. STORAGE AND SHIPMENT

2-14. Environment

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature .... −55 to +75°C
Humidity .... <95% relative
Altitude .... 15,300 metres (50,000 feet)

2-15. Packaging

Preparation for Packaging. Remove handles and/or rack mount flanges before packaging instrument for shipping.

Tagging for Service. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the back of this manual and attach it to the instrument.

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. Mark the container "FRAGILE" to assure careful handling. In any correspondence refer to the instrument by model number and full serial number.

Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

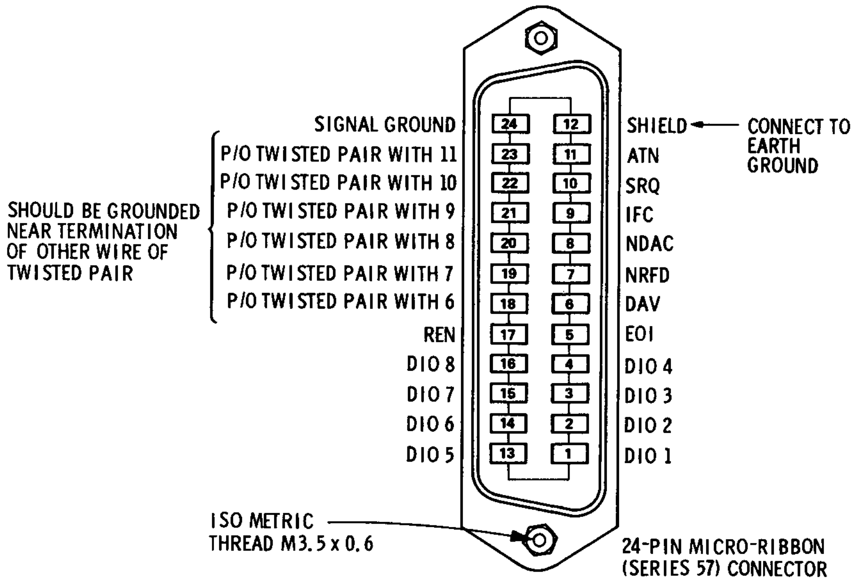
a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, complete one of the blue tags mentioned above and attach it to the instrument.)

b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use enough shock-absorbing material (75 to 100 mm layer; 3 to 4 inches) around all sides of the instrument to provide firm cushion and prevent movement in the container. Protect the front panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container "FRAGILE" to assure careful handling.



Logic Levels

The Hewlett-Packard Interface Bus Logic Levels are TTL compatible, i.e., the true (1) state is 0.0 Vdc to +0.4 Vdc and the false (0) state is +2.5 Vdc to +5.0 Vdc.

Programming and Output Data Format

Refer to Section III, Operation.

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10833A, 1 metre (3.3 ft), HP 10833B, 2 metres (6.6 ft)
HP 10833C 4 metres (13.2 ft), HP 10833D, 0.5 metres (1.6 ft)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus system may contain no more than 2 metres (6 ft) of connecting cable per instrument.

2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus system is 20.0 metres (65.6 ft).

Figure 2-4. Hewlett-Packard Interface Bus Connection

III Operation

FRONT PANEL FEATURES

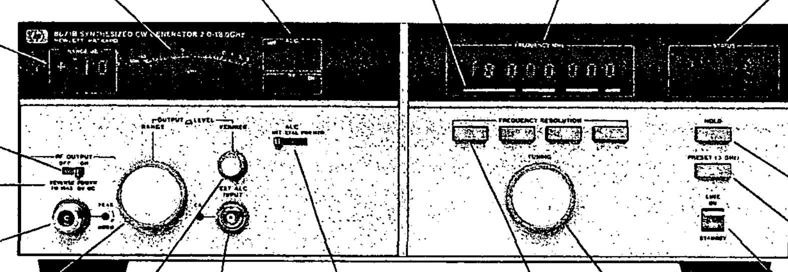
RANGE dB display indicates selected range (+10 to -110 dB).

LEVEL meter reads output level over a 13 dB range (-10 to +3 dBm). The actual output level is the sum of the RANGE dB and meter dBm readings.

ALC and RF annunciators indicate ALC mode and operational status. RF annunciator indicates whether RF is ON or OFF. LVL UNCAL annunciator indicates that the RF output is not leveled and not calibrated.

FREQUENCY RESOLUTION display (light bars) indicates tuning resolution selected by frequency resolution keys.

FREQUENCY MHz display indicates RF output frequency.



RF OUTPUT ON-OFF switch turns off the RF output when in the OFF position. The NOT PHASE LOCKED and LVL UNCAL annunciators are turned on when RF OUTPUT is OFF.

⚠ The RF OUTPUT is protected from reverse power applications up to 1W. However, for best protection of internal circuitry, do not apply any reverse power.

RF OUTPUT connector. Output is controlled in 10 dB steps from +8 to -120 dBm with RANGE and VERNIER knobs, over frequency range of 2.0 to 18.0 GHz. PEAK-NORM control peaks power output at any one frequency. Use NORM position for best overall performance.

OUTPUT LEVEL RANGE sets output from +13 to -120 dBm in 10 dB steps.

OUTPUT LEVEL VERNIER adjusts output over a continuous -10 to +3 dBm range. Resolution is 1 dB under HP-IB control.

EXT ALC INPUT connector accepts external ALC leveling signal. CAL control adjusts external leveling calibration.

ALC switch selects internal, external diode, or external power meter leveling.

FREQUENCY RESOLUTION keys select tuning resolution (from left to right) of 100 MHz, 1 MHz, 10 kHz or 1 kHz.

TUNING control changes frequency with user-selected tuning resolution.

STATUS annunciators indicate operational status of instrument.

OVEN indicates that the internal reference oscillator's oven is not up to operating temperature.

OUT OF RANGE indicates that an out-of-range frequency has been remotely programmed.

REMOTE indicates that the instrument is set to remote operation by an HP-IB controller.

STANDBY indicates that power is connected but the LINE switch is in the STANDBY position.

NOT PHASE LOCKED indicates that the output frequency is not correct or the RF OUTPUT switch is in the OFF position.

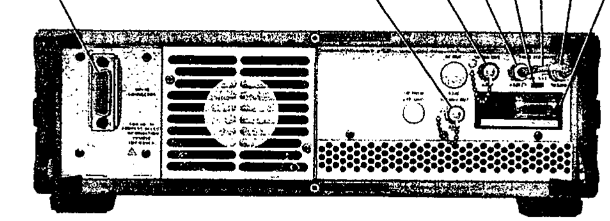
INTERNAL REF OFF indicates that the rear panel FREQUENCY STANDARD INT-EXT SWITCH is in the EXT position.

HOLD key disables frequency tuning control and extinguishes the frequency resolution display.

PRESET key sets frequency to 3000.000 MHz. It also disables the tuning control and extinguishes the frequency resolution display.

LINE switch turns the instrument on and off. It also keeps the internal reference oscillator oven on while in STANDBY position.

Figure 3-1. Front Panel Features



1 **HP-IB CONNECTOR:** connects the CW Generator to the Hewlett-Packard Interface Bus for remote operation. When in remote operation, the 7 REMOTE annunciator illuminates.

2 **100 MHz OUT (A3J7):** 0 dBm (nominal) into 50 ohms, can be used as an external timebase and for troubleshooting.

3 **10 MHz OUT (A3J6):** 0 dBm (nominal) into 50 ohms, can be used as an external timebase and for troubleshooting.

4 **FREQ STANDARD Output (A3J9):** 10.000 MHz into 50 ohms at +7 dBm (nominal) from the internal reference oscillator except when INT/EXT switch 5 is in the EXT position.

5 **FREQ STANDARD INT/EXT switch:** normally set to the INT position. Removes power from internal reference oscillator when in the EXT position.

6 **Jumper (A3W3):** normally connects the Internal Frequency Standard Output (A3J9) to the External Frequency Standard Input (A3J10).

7 **FREQ STANDARD Input (A3J10):** normally connected by A3W3 to A3J9. Also used to connect an external frequency standard of 5 or 10 MHz at 0 dBm to the CW Generator.

8 **Line Power Module:** permits operation from 100, 120, 220, or 240 Vac. The number visible in the window displays the nominal line (Mains) voltage for which the CW Generator is set (see Figure 2-1). The protective grounding conductor connects to the CW Generator through this module. The line power fuse (A3F1) is inside this module and is the only part to be changed by the operator.

Figure 3-2. Rear Panel Features

SECTION III
OPERATION

3-1. INTRODUCTION

This section provides complete operating information for the CW Generator. Included are both simplified and detailed operating instructions, detailed descriptions of the front and rear panel, local and remote operator's checks, and operator's maintenance.

3-2. Panel Features

Front and rear panel features are described in detail in Figures 3-1 and 3-2.

3-3. Operating Characteristics

Table 3-1 briefly summarizes the major operating characteristics of the CW Generator. This table is not intended to be a complete listing of all operations and ranges, but gives a general idea of the instrument's capabilities. For more information on the CW Generator's capabilities, refer to Table 1-1, Specifications, and Table 1-2, Supplemental Characteristics. For information on HP-IB capabilities, refer to Table 3-3, Message Reference Table.

3-4. Local Operation

Information covering front panel operation of the CW Generator is given in the sections described below. To quickly learn the operation of the instrument, begin with Operating Characteristics and Simplified Operation. (Operator's Checks can also be used to gain familiarity with the instrument.) Once familiar with the general operation of the instrument, use the Detailed Operating Instructions as a reference for more complete operating information.

Turn-On Information. Instructions relating to the CW Generator turn-on procedure and frequency standard selection are presented to acquaint the user with the general operation of the instrument.

Simplified Operation. The instructions located on the inside of the fold provide a quick introduction to the operation of the CW Generator. In addition, an index to the Detailed Operating Instructions is provided to direct the user to the more complete discussion of the topic of interest.

Detailed Operating Instructions. The Detailed Operating Instructions provide the complete operating reference for the CW Generator user. The instructions are organized alphabetically by subject. They are indexed by function in Table 3-2.

3-5. Remote (HP-IB) Operation

The CW Generator is capable of remote operation via the Hewlett-Packard Interface Bus (HP-IB).

HP-IB is Hewlett-Packard's implementation of the IEEE Standard 488, "IEEE Standard Digital Interface for Programmable Instrumentation", also described by the identical ANSI Standard MC1.1. For a more detailed information relating to programmable control of the CW Generator, refer to Remote (HP-IB) Operation in this section.

This section includes discussions on capabilities, addressing, input and output formats, the status byte and service request. In Table 3-4 is a complete summary of programming codes. In addition, programming examples are given in HP-IB Checks and in the Detailed Operating Instruction.

3-6. Operator's Checks

Operator's Checks are procedures designed to verify proper operation of the CW Generator's main functions. Two procedures are provided as described below.

Basic Functional Checks. This procedure requires only a 50 ohm load or attentuator to perform. For greater assurance, a microwave counter and a power meter can be used. This procedure assures that most front panel controlled functions are being properly executed by the CW Generator.

HP-IB Checks. This procedure assumes that front panel operation has been verified with the Basic Functional Checks. The procedure checks all of the applicable bus messages summarized in Table 3-3.

Table 3-1. Operating Characteristics

Frequency	Range: 2.0 to 18.0 GHz (Overrange to 18.599997 GHz) Resolution: 1 kHz 2.0 to 6.2 GHz 2 kHz 6.2 to 12.4 GHz 3 kHz 12.4 to 18.0 GHz
Output Level	Range: −120 to +8 dB in 10 dB steps Vernier: −10 to +3 dBm continuously variable
ALC	Internal, external crystal detector, or external power meter leveling.

Table 3-2. Index of Detailed Operating Instructions

3-14	ALC CONTROL	
	Local Procedure	3-4
	Internal Leveling	3-4
	External Crystal Detector Leveling	3-4
	External Power Meter Leveling	3-4
	Remote Procedure	3-5
	Comments	3-7
3-15	FREQUENCY CONTROL	3-8
	Local Procedure	3-8
	Remote Procedure	3-8
	Comments	3-10
3-16	LEVEL CONTROL	3-12
	Local Procedure	3-12
	Remote Procedure	3-12
	Comments	3-13
3-17	PEAK-NORM ADJUSTMENT	3-15
	Local Procedure	3-15
	Comments	3-15
3-18	RF ON-OFF SWITCH	3-16
	Local Procedure	3-16
	Remote Procedure	3-16
	Comments	3-16

3-7. Operator's Maintenance

WARNING

For continued protection against fire hazard, replace the line fuse with a 250V fuse of the same rating only. Do not use repaired fuses or short-circuited fuseholders.

Operator's maintenance consists of replacing defective primary fuses. This fuse is located in the line module assembly. Refer to Figure 2-1 for instructions on changing the fuse.

3-8. TURN-ON INSTRUCTIONS

WARNINGS

Before the instrument is switched on, all protective earth terminals, extension cords, autotransformers and devices connected to it should be connected to a protective earth grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

Only 250V normal blow fuses with the required rated current should be used. Do not use repaired fuses or short circuit fuseholders. To do so could cause a shock or fire hazard.

CAUTIONS

Before the instrument is switched on, it must be set to the voltage of the power source or damage to the instrument may result.

⚠ *The CW Generator's RF OUTPUT is protected against reverse power applications up to 1W. However, for greatest protection of expensive internal components, be careful not to apply any reverse power to the RF OUTPUT.*

3-9. Turn-On

Turn-On Procedure. The CW Generator has a STANDBY state and an ON state. Whenever the power cable is plugged in, an oven is energized to keep the reference oscillator at a stable operating temperature. If the CW Generator is already plugged in, set the LINE switch to ON.

If the power cable is not plugged in, follow these instructions.

On the rear panel:

1. Check the line voltage switch for correct voltage selection.
2. Check that the fuse rating is appropriate for the line voltage used (see Figure 2-1).
3. Plug in the power cable.

On the front panel, set the LINE switch to ON.

NOTE

The OVEN status annunciator should light to indicate that the CW Generator requires warming up. The annunciator should turn off within fifteen minutes and the CW Generator should be ready for general use.

Turn-On Configuration. The CW Generator turns on at the same frequency as before it was switched to STANDBY or even completely off (that is, if line power was removed).

3-10. Frequency Standard Selection

A FREQ STANDARD INT/EXT switch and two connectors are located on the rear panel. A jumper normally connects the FREQ STANDARD INT connector (A3J9) to the FREQ STANDARD EXT connector (A3J10). The FREQ STANDARD EXT connector can accept a reference signal to be used instead of the CW Generator's internal reference oscillator.

Frequency Standard Selection (cont'd)

When the FREQ STANDARD INT/EXT switch is in the INT position and the jumper is connected between A3J9 and A3J10, the internal reference oscillator is enabled.

When the FREQ STANDARD INT/EXT switch is in the EXT position and the jumper is disconnected from the FREQ STANDARD EXT connector, a frequency standard of 5 or 10 MHz at 0 dBm (nominal) can be connected.

NOTE

The INTERNAL REF OFF status annunciator on the front panel will light when an external reference is being used. Also, the NOT PHASE LOCKED status annunciator may light if the external reference is not of sufficient accuracy in frequency or has an insufficient power level. The external reference must be within ±200 Hz of 10 MHz or ±100 Hz of 5 MHz for reliable locking to occur. If the external reference level is not within the specified limits (0.1 to 1 Vrms into 50 ohms), its level may be sufficient to turn off the NOT PHASE LOCKED status annunciator. However, the phase noise of the CW Generator may be degraded.

3-11. SIMPLIFIED OPERATION

3-12. Frequency

Frequency is set using the FREQUENCY RESOLUTION keys and the TUNING knob. For example, to set the frequency to 15345.678 MHz:

Press PRESET (3 GHz). This is not always necessary, but it will set the right-hand six digits to 0, and may provide a convenient starting point.

Select the 100 MHz FREQUENCY RESOLUTION key and adjust the TUNING knob for a frequency of 15300.000 MHz.

Select the 1 MHz FREQUENCY RESOLUTION key and adjust the TUNING knob for a frequency of 15345.000 MHz. Select the 10 kHz FREQUENCY RESOLUTION key and adjust the TUNING knob for a frequency of 15345.670 MHz.

Select the 1 kHz FREQUENCY RESOLUTION key and adjust the TUNING knob for a frequency of 15345.678 MHz.

Press HOLD to disable the TUNING knob.

3-13. Output Level

The output level is set with the OUTPUT LEVEL RANGE and VERNIER controls.

First, adjust RANGE to step the output level up or down by increments of 10 dB. The selected range is shown in the RANGE dB display.

Adjust VERNIER between −10 and +3 dBm, as read on the meter, for the desired output level.

The output level is determined by adding the RANGE dB display to the LEVEL dBm meter reading.

3-14. ALC

ALC (automatic level control) has three modes of operation. They are:

INT (Internal leveling)

XTAL (External leveling using a crystal diode detector)

PWR MTR (External leveling using a power meter)

Internal leveling is selected for most applications. In this mode, an internal detector senses the level at the input of the 10 dB step attenuator, and the internal leveling circuitry keeps the output level constant. Loss of leveling is indicated by the LVL UNCAL annunciator.

For external leveling a crystal diode detector or power meter can be used. Operation is described further in the Detailed Operating Instructions.

3-15. ALC CONTROL

Description

The Synthesized CW Generator has three modes of Automatic Level Control (ALC):

INT (Internal leveling)
XTAL (External leveling using a crystal diode detector)
PWR MTR (External leveling using a power meter)

For most applications internal ALC (INT) will be used. With internal ALC the output power remains flat over the entire 2 to 18 GHz frequency range.

External ALC is used when the power level at a remote point must be kept constant. External ALC reduces power variations due to external cables and connectors.

The ALC switch selects the leveling mode. Positive or negative detectors can be used to supply the external ALC input voltage. A calibration adjustment allows the externally leveled power to be adjusted to match the VERNIER setting over a limited output power range. The calibration adjustment does not affect internal leveling.

ALC mode and status are indicated by the ALC display. The display indicates which leveling source is selected and when the output is unleveled. The status of the ALC, whether leveled or unleveled, can also be determined remotely by reading the status byte.

Local Procedure

To use Internal Leveling:

Set the ALC selector to INT. The output level will be the sum of the range and VERNIER settings.

To use XTAL (External Crystal) Leveling:

1. Connect the crystal detector and the 10 dB coupler as shown in Figure 3-3.
2. Set the ALC selector to INT and adjust the VERNIER to read 0 dBm on the meter. This allows calibration of the meter to the leveled point.
3. Set the output level range to 0 dB and the ALC selector to XTAL.
4. Adjust the ALC CAL control to set the level read on the power meter to the nearest 10 dBm. If the ALC control does not have enough range for a low power level adjustment, step the RANGE down until the adjustment can be made.

This level should be within −3 dB and +10 dB of the desired level. This calibrates the meter to agree with the leveled power. If the detector is operating in the square law

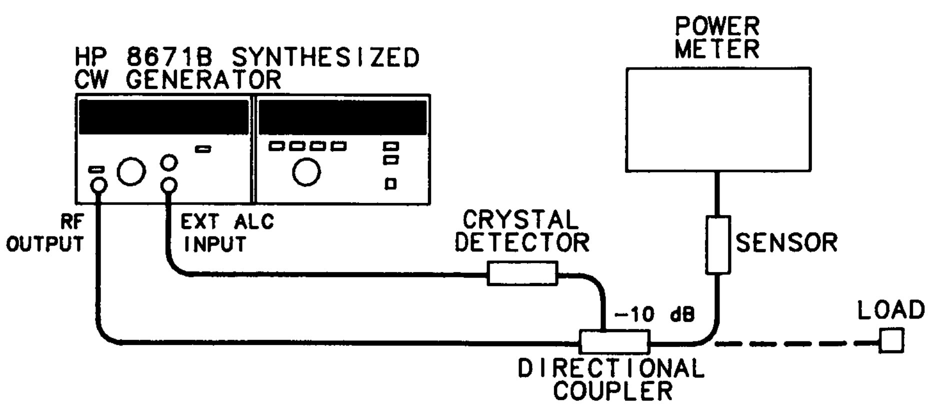


Figure 3-3. External Leveling with a Crystal Detector

ALC CONTROL (cont'd)

Local Procedure (cont'd)

region, the VERNIER will now control the level over a continuous 13 dB range, and the CW Generator's meter reading will track with the power meter reading as the VERNIER control is varied through the −10 to +3 dBm range.

To use external power meter leveling:

1. Set the ALC selector to INT and adjust the VERNIER to read 0 dBm on the meter. This allows calibration of the CW Generator's meter to the leveled point.
2. Connect power meter to the point where leveling is to be used as shown in Figure 3-4. A directional coupler can be used to sample the power at the desired point. Set the output level to the desired power and select the range hold function on the power meter. This disables range changes and keeps the leveled power from oscillating.
3. Connect the recorder output of the power meter to the external ALC input connector. The recorder output is a voltage that is proportional to the measured power in watts. This voltage varies from 0 to 2 volts for each power meter range. Leveling as low as −60 dBm can be accomplished with a sensitive power sensor using this method.
4. Set the output level range to 0 dB and the ALC selector to PWR MTR.
5. Adjust the ALC CAL controls to set the level read on the power meter to the nearest 10 dBm. This level should be within −3 dB and +10 dB of the desired level (minus the coupling factor of the directional coupler). This calibrates the CW Generator's meter to agree with the leveled power. This power leveling method has a slow settling time but has the advantage of high sensitivity and temperature compensation.

   If the ALC CAL control does not have enough range for a low power level adjustment, step the RANGE down until the adjustment can be made.

Remote Procedure

The ALC program code controls the function of the RF output ON/OFF switch, the ALC selector and the +10 dB range of output power. The program string consists of the letter O followed by a single argument representing the desired combination of the control positions.

To set the CW Generator to the +10 dB range, you must first set it to 0 dB with the range command (code and argument) K0. Then you can set the +10 dB range with the appropriate ALC command.

The codes are summarized in the table under Program Codes.

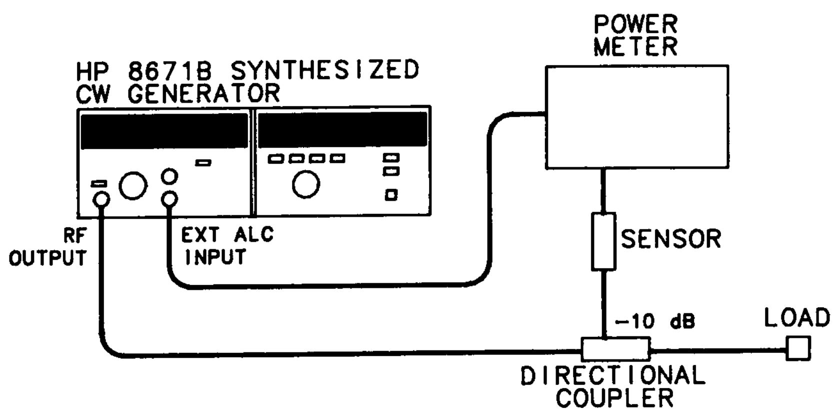


Figure 3-4. External Leveling with a Power Meter

ALC CONTROL (cont'd)

Example To set internal ALC with an output level of +3 dBm:

Local

Set ALC selector to INT, RF output to ON, range to 0 dB and VERNIER for +3 dBm.

Or

Set ALC selector to INT, RF output to ON, range to +10 dB and VERNIER to −7 dBm.

HP-IB

K 0 L 0 O 1

- 1 — Argument for ALC (INT, NORMAL)
- O — Code for ALC
- 0 — Argument for VERNIER (+3 dBm)
- L — Code for VERNIER
- 0 — Argument for RANGE (0 dB)
- K — Code for RANGE

K 0 L : O 3

- 3 — Argument for ALC (INT, +10 dB Range)
- O — Code for ALC
- : — Argument for VERNIER (−7 dBm)
- L — Code for VERNIER
- 0 — Argument for RANGE (0 dB)
- K — Code for RANGE

Program Codes HP-IB

Program Code	ALC Mode			Argument
	RF	RANGE	ALC	
O or _ (letter O, not zero)	OFF	NORM	INT	0
			XTAL	4
			PWR MTR	<
		+10	INT	2
			XTAL	6
			PWR MTR	>
	ON	NORM	INT	1
			XTAL	5
			PWR MTR	=
		+10	INT	3
			XTAL	7
			PWR MTR	?

ALC CONTROL (cont'd)

Comments

Output level flatness is dependent on the ALC circuitry and the maximum available power. In order to have a leveled output it is necessary for the ALC circuitry to continuously control the output level. This can only occur if the selected output power is below the maximum power level available at each frequency. For leveled output power in the +10 dB range, it is necessary that the LVL UNCAL annunciator remain off.

External ALC leveling also requires that the CW Generator can produce enough power to overcome losses in the intervening circuitry. The LVL UNCAL annunciator must remain off to achieve leveling. The 0 dB range should be used when using external leveling. If any of the lower ranges are used, the CW Generator must produce a higher level to overcome the attenuation introduced by the range selected.

For output level settings above +8 dBm, spurious oscillations can occur, resulting in sidebands on the carrier at a level of −30 to −50 dBc. These oscillations occur only over small portions of the frequency range. They can usually be eliminated by performing a PEAK-NORM adjustment or by reducing the output level VERNIER setting 1 or 2 dB.

Typical output level switching times are detailed under Level Control. Enabling the RF output requires less than 30 milliseconds. Disabling the RF output can be accomplished in less than 5 milliseconds.

The state of the RF output (on or off) and the status of the +10 dB range (selected or not selected) can be obtained by reading the status byte. The status of the ALC circuitry (leveled or not leveled) can also be monitored by reading the status byte. Once the status byte indicates that the output is leveled, an application can continue without waiting the specified time for the output level to settle.

Related Sections

Level Control
PEAK-NORM Adjustment

3.16 FREQUENCY CONTROL

Description

The CW Generator uses a simple, convenient frequency tuning system.

All frequencies can be remotely programmed or entered manually by a tuning knob. The knob can be turned in either direction without encountering a mechanical stop. Also, the faster it is turned the greater the frequency change per revolution.

In addition, four degrees of coarse to fine tuning can be selected. Frequency resolution keys located above the tuning knob select 100 MHz, 1 MHz, 10 kHz or 1 kHz tuning increments. Due to frequency multiplication to generate frequencies above 6.2 GHz, the minimum tuning increment (resolution) is 2 kHz above 6.2 GHz and 3 kHz above 12.4 GHz.

Once a desired frequency has been set, pressing the HOLD key will disable the tuning control and prevent unintentional changes in the frequency. The preset key sets the output frequency to 3000.000 MHz for conveniently setting the least significant digits to zeroes.

When the CW Generator is turned off or the power cable is removed, the last frequency setting is stored in battery-powered memory. When the instrument is powered up, the frequency returns to the stored value. This feature maintains the frequency setting even after power failures or extended periods without power.

Local Procedure

To set the output frequency to any desired frequency:

1. Press PRESET (3 GHz). This is not always necessary, but it will set the right-hand six digits to 0, and may provide a convenient starting point.

2. Select the desired tuning increment (100 MHz, 1 MHz, 10 kHz, or 1 kHz) by pressing the appropriate FREQUENCY RESOLUTION key, and use the TUNING knob to set the frequency digits above the rightmost lighted segment in the frequency resolution display.

3. Once the desired frequency is set, press the HOLD key to disable the TUNING knob.

Remote Procedure

The CW Generator accepts any frequency within its range (2000.000 to 18599.997 MHz) to 8 significant digits. Above 6.2 GHz the frequency is randomly rounded up or down to be compatible with the 2 kHz or 3 kHz resolution at the programmed frequency.

The CW Generator ignores spaces, commas, decimal points, carriage returns and line feeds.

Within the CW Generator, frequency information is stored in two separate blocks of four digits each. The effects of programming codes on the two internal frequency data blocks are shown in Figure 3-5. One block contains the 10 GHz through 10 MHz frequency digits and the other contains the 1 MHz through 1 kHz digits. Programming within one block does not change the other blocks unless it is necessary to round off a frequency above 6.2 GHz. The programming codes indicate the most significant digit being programmed.

The output frequency does not change until the frequency execute command (Z1) is received by the CW Generator. This command must be sent sometime after the frequency data has been sent.

FREQUENCY CONTROL (cont'd)

Example

To change frequency from 3000.231 MHz to 3450.001 MHz:

Local

1. Press the 100 MHz (leftmost) FREQUENCY RESOLUTION key. Adjust TUNING for a frequency of 3400.000 MHz.
2. Press the 1 MHz (next) FREQUENCY RESOLUTION key. Adjust TUNING for a frequency of 3450.000 MHz.
3. Press the 1 kHz (rightmost) FREQUENCY RESOLUTION key. Adjust TUNING for a frequency of 3450.001 MHz.

HP-IB Q 3450001 Z 1

- 1 — Dummy Argument for Frequency Execute
- Z — Code for Frequency Execute Command
- 3450001 — Argument for 1 GHz Frequency Resolution
- Q — Code for 1 GHz Frequency Resolution

— or —

R 450001 Z 1

- 1 — Dummy Argument for Frequency Execute
- Z — Code for Frequency Execute Command
- 450001 — Argument for 100 MHz Frequency Resolution
- R — Code for 100 MHz Frequency Resolution

— or —

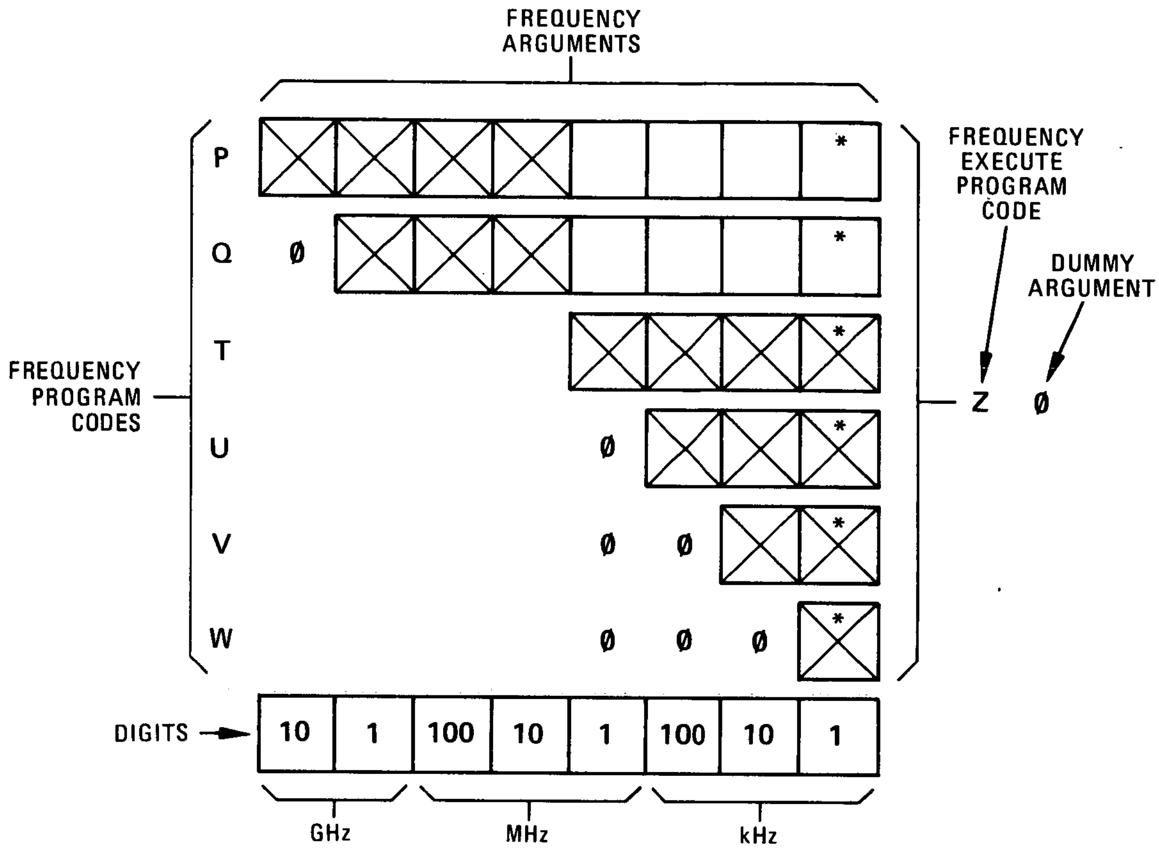
R 45 W 1 Z 1

- 1 — Dummy Argument for Frequency Execute
- Z — Code for Frequency Execute Command
- 1 — Argument for 1 kHz Frequency Resolution
- W — Code for 1 kHz Frequency Resolution
- 45 — Argument for 100 MHz Frequency Resolution
- R — Code for 100 MHz Frequency Resolution

Program Codes HP-IB

	PROGRAM CODES		ARGUMENTS
FREQUENCY	10 GHz	@ or P	0 THROUGH 9
	1 GHz	A or Q	
	100 MHz	B or R	
	10 MHz	C or S	
	1 MHz	D or T	
	100 kHz	E or U	
	10 kHz	F or V	
	1 kHz	G or W	
	EXECUTE	J or Z	

FREQUENCY CONTROL (cont'd)



⊠ means that for a given program code, this digit *will* change (to zero if not programmed).

☐ means that the digit will change only if programmed.

* means that above 6.2 GHz this digit may change due to random rounding (however, it will always be within 2 kHz of programmed value).

Ø means that for a given program code, the leading zero is supplied by the instrument's hardware.

Figure 3-5. Frequency Programming Codes and Arguments

Comments

Due to the use of frequency multiplication to generate frequencies above 6.2 GHz, the frequency sometimes cannot be set precisely to a desired value. Frequencies between 2 and 6.2 GHz can be set to the nearest 1 kHz. All frequencies between 6.2 and 12.4 GHz can be set within 1 kHz of the desired value. All frequencies between 12.4 and 18 GHz can be set within 2 kHz of the desired frequency.

When the CW Generator is programmed to a frequency that is not evenly divisible, a random roundoff occurs. To prevent this, during remote programming one should perform a calculation to determine whether the frequency can be set exactly.

To determine whether a frequency can be set to a given value, divide the desired frequency (in kHz) by two if it is between 6.2 and 12.4 GHz, or by three if it is above 12.4 GHz. If the result is a whole number (with no remainder) the frequency can be set to the

FREQUENCY CONTROL (cont'd)

Comments (cont'd)

desired value. For example, 16 GHz divided by three (it is above 12.4 GHz) is 5333333.33 kHz, so this frequency cannot be set exactly. The nearest frequencies that can be set are 15.999999 GHz (5.333333 × 3) and 16.000002 GHz (5.333334 × 3).

The time it takes to switch from one frequency to the next depends on the largest frequency digit being changed. Generally, the smaller the digit being changed, the shorter the switching time. Typical switching times by largest digit being changed for frequencies between 2 and 6.2 GHz can be summarized as follows:

Largest Digit Changed	Time to be Within 1 kHz
100 MHz	10 ms
10 MHz	10 ms
1 MHz	10 ms
100 kHz	5 ms
10 kHz	3 ms
1 kHz	1.5 ms

For frequencies above 6.2 GHz, actual frequency digits being changed must be determined by dividing the output frequency by two (6.2 to 12.4 GHz) or three (12.4 to 18 GHz). The actual data transfer time is only a small portion of the frequency switching time and can be ignored.

For applications that require fast execution, the status byte can be checked until the frequency is phase locked. Once the status byte indicates that the CW Generator is phase locked, the application may continue with the assurance that the frequency is correct. Figure 3-6 shows the typical worst case lock and settling times.

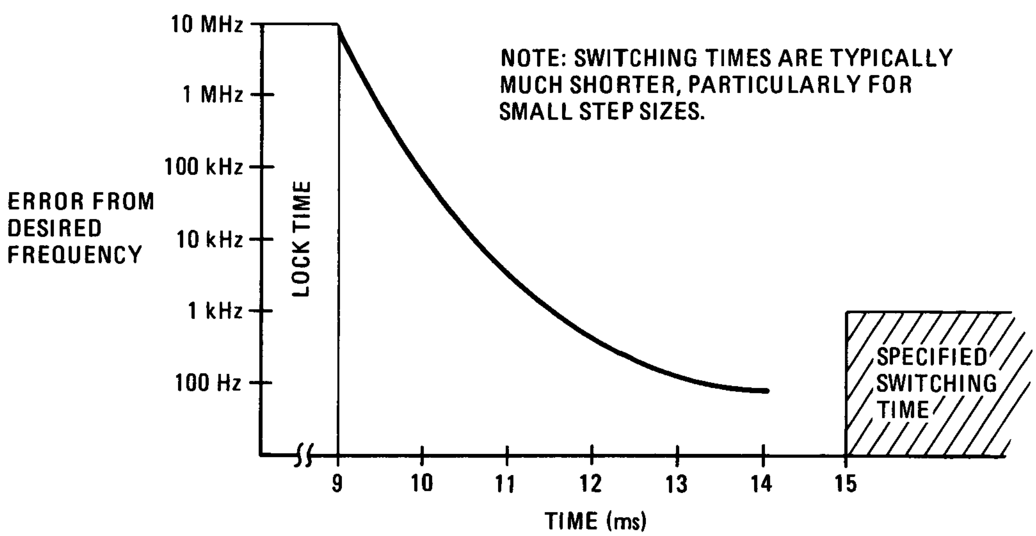


Figure 3-6. Frequency Switching Time Showing Worst Case

3-17. LEVEL CONTROL

Description

The Synthesized CW Generator is calibrated over a wide range of output power levels from +8 dBm to −120 dBm. The output level is set with a RANGE selector and a VERNIER control. The output level is the sum of the settings of these two controls.

The RANGE selector varies the output level in 10 dB steps. The selected range (+10 dB to −110 dB) is digitally displayed in the RANGE display. This display indicates the selected range in both local and remote modes. Output level ranges of 0 dB to −110 dB are programmable with the range program code. The +10 dB range is selected using the ALC program code.

The VERNIER knob continuously varies the output level in the 0 dB range from −10 to +3 dBm. The VERNIER setting is indicated by the front panel meter.

In local mode the VERNIER can be varied continuously over the full 13 dB range. In remote mode the VERNIER can be programmed in fourteen 1 dB steps from −10 dBm to +3 dB. Because the VERNIER can be controlled over greater than 10 dB in both local and remote mode, it is possible to overlap range settings by 3 dB. This is useful in applications where the ability to vary the output power continuously about a given level is critical.

Local Procedure

To set the output level to any desired value:

1. Set the CW Generator ALC mode to internal (INT).
2. Set the OUTPUT LEVEL RANGE to within −3 to +10 dB of the desired output level. For example, for a −56 dBm output level choose the −50 dB range.
3. Adjust the OUTPUT LEVEL VERNIER setting until the sum of the range display and the meter is equal to the desired output level.

Some output levels may be set using either of two adjacent ranges. Either range may be used. For example, +3 dBm may be set with a 0 dB range and +3 dBm VERNIER setting or a +10 dB range and −7 dBm VERNIER setting.

Setting output levels above +8 dBm may cause an ALC unleveled condition due to insufficient power available. The meter will indicate the actual power available when the unleveled condition occurs.

Remote Procedure

The 0 dB to −110 dB ranges and the VERNIER setting are programmed with the output level program codes. The VERNIER setting is programmed in 1 dB steps from −10 dBm to +3 dBm. The range is programmed in 10 dB steps from 0 dB to −110 dB. The +10 dB range is programmed by setting RANGE to 0 dBm and ALC to +10 dB.

When switching from local to remote mode, the VERNIER is reset to −10 dB and the range remains unchanged.

Example

To set the output level to +3 dBm:

Local

Set RANGE to 0 dB and VERNIER to +3 dBm.

Or

Set RANGE +10 dB and VERNIER to −7 dBm.

LEVEL CONTROL (cont'd)

Example (cont'd) HP-IB

K 0 L 0

- 0 — Argument for VERNIER (+3 dBm)
- L — Code for VERNIER
- 0 — Argument for RANGE (0 dB)
- K — Code for RANGE

K 0 L : O 3

- 3 — Argument for ALC (INT, +10 dB Range)
- O — Code for ALC
- : — Argument for VERNIER (−7 dBm)
- L — Code for VERNIER
- 0 — Argument for RANGE (0 dB)
- K — Code for RANGE

Program Codes HP-IB

	Program Codes	Arguments	
OUTPUT LEVEL RANGE	K	0 dBm	0
		−10	1
		−20	2
		−30	3
		−40	4
		−50	5
		−60	6
		−70	7
		−80	8
		−90	9
		−100	:
		−110	;

	Program Codes	Arguments	
OUTPUT LEVEL VERNIER	L	+3 dB	0
		+2	1
		+1	2
		0	3
		−1	4
		−2	5
		−3	6
		−4	7
		−5	8
		−6	9
		−7	:
		−8	;
		−9	<
		−10	=

Comments

Output level flatness is dependent on the ALC circuitry and the maximum available power. In order to have a leveled output it is necessary for the ALC circuitry to continuously control the output level. This can only occur if the selected output power is below the maximum power level available at each frequency. For leveled output power in the +10 dB range, it is necessary that the LVL UNCAL annunciator remain off. If it lights, adjust the PEAK-NORM control, or reduce the VERNIER setting.

For output level settings above +8 dBm, spurious oscillations can occur, resulting in sidebands on the carrier at a level of −30 to −50 dBc. These oscillations occur only over small portions of the frequency range.

LEVEL CONTROL (cont'd)

Comments (cont'd)

They can usually be eliminated by performing a PEAK-NORM adjustment or by reducing the OUTPUT LEVEL VERNIER setting 1 or 2 dB.

External ALC leveling also requires that the CW Generator can produce enough power to overcome losses in the intervening circuitry. The LVL UNCAL annunciator must remain off to achieve leveling. If it lights adjust the PEAK-NORM control, or decrease the VERNIER setting.

Typical output level range change execution time for a 10 dB step is less than 20 milliseconds. An output level VERNIER change of 1 dB will take less than 10 milliseconds. These times are typical for remote programming. The actual data transfer time is a very small part of the execution time and may be ignored for most controllers.

The RF output changing from enabled to disabled takes less than 5 milliseconds. To enable the RF output from a disabled state requires less than 30 milliseconds.

The state of the RF output (on or off) and the +10 dB range (selected or not selected) can be obtained by reading the status byte. These two functions are programmed along with the ALC mode. For more information see ALC Control.

Related Sections

ALC Control
PEAK-NORM Adjustment

3-18. PEAK-NORM ADJUSTMENT

Description

The PEAK-NORM control adjusts an internal filter for maximum power output at a single frequency. This filter is adjusted for best over-all performance with the control in the detent position (NORM), but can be adjusted for maximum power (and reduced harmonics and sub-harmonics) at any one frequency. This adjustment will result in lower maximum power at most other frequencies, and therefore should be left in the NORM position except when maximum power is needed. It should only be required at power levels above +8 dBm.

Local Procedure

To maximize the output power at a set frequency:

Adjust the PEAK-NORM adjustment until the LVL UNCAL annunciator turns off, or for maximum meter reading with the VERNIER fully clockwise.

Remote Procedure

This adjustment cannot be remotely programmed.

Example

To peak an output level of +10 dBm at 8 GHz due to a LVL UNCAL indication:

1. Adjust the PEAK-NORM adjustment until the LVL UNCAL annunciator turns off, or for maximum meter reading with the VERNIER fully clockwise.

2. Return the PEAK-NORM adjustment to NORM (detented) position before resuming normal instrument operation. The +8 dBm output power level is affected by this adjustment and is only specified with the PEAK-NORM adjustment set to NORM.

Comments

For output level settings above +8 dBm, spurious oscillations can occur, resulting in sidebands on the carrier at a level of −30 to −50 dBc. These oscillations occur only over small portions of the frequency range.

They can usually be eliminated by performing a PEAK-NORM adjustment or by reducing the output level VERNIER setting 1 or 2 dB.

The PEAK-NORM adjustment must be in the NORM (detented) position to guarantee the specified +8 dBm level over the entire frequency range.

3-19. RF ON/OFF SWITCH

Description

The RF ON/OFF switch provides a convenient way of turning off the output signal. This is useful when calibrating detectors, zeroing power meters, or making noise measurements with no signal applied. With the switch in the off position the internal 2 to 6.2 GHz oscillator is turned off to prevent any signal leakage to the RF output connector.

The RF annunciator indicates the position of the RF ON/OFF switch in local mode and the programmed state when in remote mode. With the internal 2 to 6.2 GHz oscillator turned off, the CW Generator is no longer phase locked or leveled so the LVL UNCAL and NOT PHASE LOCKED annunciators are lighted.

Local Procedure

To disable the RF output:

Set the RF ON/OFF switch to OFF. Note that the OFF, LVL UNCAL and NOT PHASE LOCKED annunciators should be lighted.

To enable the RF output:

Set the RF ON/OFF switch to ON. The LVL UNCAL and NOT PHASE LOCKED annunciators should extinguish and the ON annunciator should light.

Remote Procedure

See ALC Control for a description of how to program the RF ON/OFF switch function.

Program Codes

HP-IB

See ALC Control

Comments

The status of the RF output (on or off) can be determined by reading the status byte. A service request is not generated for LVL UNCAL or NOT PHASE LOCKED when the RF output is set to OFF.

The RF output off-to-on transition typically requires less than 30 milliseconds when remotely programmed. The on-to-off transition typically requires less than 5 milliseconds.

3-20. REMOTE (HP-IB) OPERATION

The CW Generator can be operated through the Hewlett-Packard Interface Bus (HP-IB). HP-IB compatibility, programming and data formats are described in the following paragraphs.

All front panel functions except that of the ALC CAL control, PEAK-NORM control, and LINE switch are programmable via HP-IB.

A quick test of the CW Generator's HP-IB interface is described in this section under HP-IB Checks. These checks verify that the CW Generator can respond to or send each of the applicable bus messages described in Table 3-3.

3-21. HP-IB Compatibility

The CW Generator's programming capability is described by the twelve HP-IB messages listed in Table 3-3. The CW Generator's compatibility with HP-IB is further defined by the following list of interface functions: SH1, AH1, T6, TE0, L4, LE0, SR1, RL2, PP2, DC1, DT0, and C0. A more detailed explanation of these compatibility codes can be found in IEEE Standard 488-1978 and the identical ANSI Standard MC1.1.

3-22. Remote Mode

Remote Capability. The CW Generator communicates on the bus in both remote and local modes. In remote, the CW Generator's front panel controls are disabled except for the LINE switch. However, front panel displays remain active and valid. In remote, the CW Generator can be addressed to talk or listen. When addressed to listen, the CW Generator automatically stops talking and responds to the following messages: Data, Clear (SDC), Remote, Local, and Abort. When addressed to talk, the CW Generator automatically stops listening and sends one of the following messages: Data, Require Service, or Status Byte. Whether addressed or not, the CW Generator responds to the Clear (DCL), Clear Lockout/Set Local, and Abort messages. In addition, the CW Generator can issue the Require Service message and the Status Bit message.

Local-to-Remote Mode Changes. The CW Generator switches to remote operation upon receipt of the Remote message. The Remote message has two parts. They are:

a. Remote enable bus control line (REN) set true.

b. Device listen address received once (while REN is true).

When the CW Generator switches to remote, the REMOTE annunciator on the front panel turns on. With the exception of VERNIER, which will reset to −10 dBm, the CW Generator's control settings remain unchanged with the Local-to-Remote transition.

3-23. Local Mode

Local Capability. In local, the CW Generator's front panel controls are fully operational and the instrument will respond to a Remote message. The CW Generator can send a Require Service message, a Status Byte message, and a Status Bit message while in the Local mode.

Remote-to-Local Mode Changes. The CW Generator switches to local from remote whenever it receives a Local (GTL), Universal Unlisten address, Abort, or Clear Lockout/Set Local message. (The Clear Lockout/Set Local message sets the Remote Enable control line [REN] false.) The CW Generator can also be switched to local by turning the LINE switch to STANDBY, and then to ON.

With the Remote-to-Local transition, the frequency will remain the same. All other functions will return to the front panel settings. Power may go up, go down, or stay the same.

3-24. Addressing

When the Remote Enable line (REN) and the Attention control line (ATN) are true and the Interface Clear control line (IFC) is false, the CW Generator interprets the byte on the eight HP-IB data lines as an address or a command.

The CW Generator's Talk and Listen addresses can be set by switches located inside the instrument. The address selection procedure is described in Section II. Refer to Table 2-1 for a comprehensive listing of all valid HP-IB address codes.

3-25. Data Messages

The CW Generator communicates on the interface bus primarily with Data messages. Data messages consist of one or more bytes sent over the bus' data lines when the bus is in the data mode (attention control line [ATN] false). The CW Generator receives Data messages when addressed to listen, and sends the Status Byte message when addressed to talk. All instrument operations available in

Table 3-3. Message Reference Table (1 of 2)

HP-IB Message	Appli-cable	Response	Related Commands and Controls	Interface Functions*
Data	Yes	Frequency, Output level (RANGE and VERNIER), and ALC mode can be programmed. The CW Generator sends the status byte when addressed to talk.		AH1 SH1 T6, TE0 L4, LE0
Trigger	No	The CW Generator does not respond to the Group Execute Trigger (GET) bus command	GET	DT0
Clear	Yes	Sets frequency to 3000.000 MHz, RF output to off, ALC mode to Internal, and VERNIER to −10 dBm.	DCL SDC	DC1
Remote	Yes	Remote mode is enabled when the REN bus control line is true. However, remote mode is not entered until the first time the CW Generator is addressed to listen. The front panel REMOTE annunciator lights when the instrument is actually in the remote mode. The VERNIER is set to −10 dBm.	REN	RL1
Local	Yes	The CW Generator returns to local mode (front panel control). The CW Generator returns to the previous front panel settings, except for frequency.	GTL	RL2
Local Lockout	No	The CW Generator does not respond to the local lockout command.	LLO	RL2
Clear Lockout/ Set Local	Yes	The CW Generator returns to local (front panel control) when the REN bus control line goes false.	$\overline{\text{REN}}$	RL2
Pass Control/ Take Control	No	The CW Generator has no controller capability.		C0
Require Service	Yes	The CW Generator sets the SRQ bus control line true if one of the following conditions exists: frequency out of range, not phase locked with RF output on, or RF power level uncalibrated with RF power on.	SRQ	SR1
Status Byte	Yes	The CW Generator responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit status byte when addressed to talk. If the instrument is holding the SRQ control line true (issuing the Require Service message), the RQS bit and the bit representing the condition causing the Require Service message to be issued will both be true.	SPE SPD	T5
Status Bit	Yes	The CW Generator responds to a Parallel Poll Enable (PPE) bus command by sending a status bit on a switch selected HP-IB data line.	PPE	PP2

Table 3-3. Message Reference Table (2 of 2)

HP-IB Message	Appli-cable	Response	Related Commands and Controls	Interface Functions*
Abort	Yes	The CW Generator stops talking and listening.	IFC	T6, TE0 L4, LE0

*Commands, Control lines, and Interface Functions are defined in IEEE Std 488-1978. Knowledge of these may not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column.

Complete HP-IB capability as defined in IEEE Std 488 and ANSI Std MC1.1 is: SH1, AH1, T6, TE0, L4, LE0, DT0, DC1, RL2, C0, SR1, and PP2.

Data Messages (cont'd)

local mode can be performed in remote mode via Data messages except changing the ALC CAL and PEAK-NORM controls and the LINE switch setting.

3-26. Receiving Data Messages

The CW Generator responds to Data messages when it is enabled to remote (REN control line true) and addressed to listen. The instrument remains addressed to listen until it receives an Abort message or until its talk address or a universal unlisten command is sent by the controller.

A data message is a string of alternate codes and arguments, where a code is an ASCII character representing a function, such as frequency, RF output level, or ALC mode, and an argument is an ASCII digit representing a selection of the function. Each code and its argument make a command.

A complete summary of programming formats, codes and arguments is given in Table 3-4. In addition, programming examples are given in HP-IB Checks, and in the Detailed Operating Instructions.

The Complete Data Message. The following program string is a complete data message. It lists the commands in the order that the CW Generator decodes them, along with arguments that will be explained.

"P1Q2R3S4T5U6V7W8Z1K9L7M0N7O1"

The commands preceeding Z1 program a frequency of 12345.678 MHz. Z1 is a frequency execute command which is required to execute a string of frequency commands. K9 and L7 program output RANGE and VERNIER to −90 dB and −4 dBm respectively. M0 and N7 are used to program AM and FM in the HP 8672A (a similar synthesized signal generator with AM and FM capabilities) and are used as dummy commands to make program strings compatible with the HP 8672A. The O1 command programs ALC to internal leveling.

The Abbreviated Data Message. If functions are programmed in the order listed, codes can be omitted from the string, except for the first code, and Z1, the frequency execute command, if programming frequency. Thus, the following string is equivalent to the one above.

"P12345678Z197071"

Furthermore, the string can begin with any code and end with any argument, and can be composed of combinations of this syntax. Thus, the following string will program the CW Generator to a frequency of 2345 MHz, with a VERNIER setting of 0 dBm, without changing the output level RANGE setting.

"Q2345Z1L3"

3-27. Receiving the Clear Message

The CW Generator responds to the Clear message by setting the frequency to 3 GHz, ALC to internal, and RF power off. The message can take two forms: Device Clear which the CW Generator re-

Receiving the Remote Message (cont'd)

sponds to only when addressed, and Selected Device Clear, which it responds to whether addressed or not. The Device Clear message does not affect addressing, while the Selected Device Clear message leaves the CW Generator addressed to listen.

3-28. Receiving the Trigger Message

The CW Generator does not respond to the Trigger message.

3-29. Receiving the Remote Message

The Remote message has two parts. First, the remote enable bus control line (REN) is held true; second, the device listen address is sent by the controller. These two actions combine to place the CW Generator in remote mode. Thus, the CW Generator is enabled to go into remote when the controller begins the Remote message, but it does not actually switch to remote until addressed to listen the first time. When actually in remote, the CW Generator's front panel REMOTE annunciator lights.

3-30. Receiving the Local Message

The Local message is the means by which the controller sends the Go To Local (GTL) bus command. The CW Generator returns to front panel control when it receives the Local message.

When the CW Generator goes to local mode, the front panel REMOTE annunciator turns off. However, even in local, the CW Generator sends the status byte when addressed to talk.

3-31. Receiving the Local Lockout Message

The CW Generator does not respond to the Local Lockout message.

3-32. Receiving the Clear Lockout/ Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable (REN) bus control line false. The CW Generator returns to local mode (full front panel control) when it receives the Clear Lockout/Set Local message. When the CW Generator goes to local mode, the front panel REMOTE annunciator turns off.

3-33. Receiving the Pass Control Message

The CW Generator does not respond to the Pass Control message because it does not have this controller capability.

3-34. Sending the Require Service Message

The CW Generator sends a Require Service message if one or more of the following conditions exists for more than 50 ms:

1) Frequency programmed out of range
2) Not phase locked with RF output on
3) RF power level uncalibrated (LVL UNCAL) with RF power on.

The CW Generator can send a Require Service message in either the local or remote mode, and whether or not addressed. It sends the message by setting the Service Request (SRQ) bus line true.

Once the CW Generator is addressed to talk, the RQS bit is latched, even though CW Generator's need for service may have changed.

3-35. Sending the Status Byte Message

After receiving a Serial Poll Enable bus command (SPE) and when addressed to talk, the CW Generator sends a Status Byte message. The message consists of one 8-bit byte which corresponds to the pattern shown in Table 3-4, Programming Quick Reference Guide.

3-36. Sending the Status Bit Message

The CW Generator sends the Status Bit message in response to the Parallel Poll Enable (PPE) bus command (whether or not it is addressed to talk). If the CW Generator is sending the Require Service message, it will set its assigned status bit true.

The data line that the parallel poll is assigned to respond on, and the sense (active high or active low) can be set from switches located inside the instrument. The selection procedure is described in Section II.

3-37. Receiving the Abort Message

The Abort message is the means by which the controller sets the Interface Clear (IFC) bus control line true. When the Abort message is received, the CW Generator becomes unaddressed and stops talking or listening.

Table 3-4. Programming Quick Reference Guide

PROGRAM STRING SYNTAX

```
                                              ┌─ Level ──┐  ┌ Modulation* ┐
Controller Talk           Frequency           Range  Vernier   AM      FM      ALC
Synthesizer Listen  ,"[ CX...XZX ]            [ KX ] [ LX ]  [ M0 ]  [ N6 ]  [ OX ] "

Stands for Code for Most Significant Frequency Digits. (C)
                     Dummy Argument (last X)
                     Frequency Execute Code (Z)
                     Frequency Digits (X...X)
```

WHERE: **C** = PROGRAM CODE
X = ARGUMENT OR FREQUENCY DIGIT

	PROGRAM CODES		ARGUMENTS
FREQUENCY	10 GHz	@ or P	0 THROUGH 9
	1 GHz	A or Q	
	100 MHz	B or R	
	10 MHz	C or S	
	1 MHz	D or T	
	100 kHz	E or U	
	10 kHz	F or V	
	1 kHz	G or W	
	EXECUTE	J or Z	

	PROGRAM CODES	ARGUMENTS	
OUTPUT LEVEL RANGE	K or [	0 dB	0
		−10	1
		−20	2
		−30	3
		−40	4
		−50	5
		−60	6
		−70	7
		−80	8
		−90	9
		−100	:
		−110	;

	PROGRAM CODES	ARGUMENTS	
OUTPUT LEVEL VERNIER	L or \	+3 dBm	0
		+2	1
		+1	2
		0	3
		−1	4
		−2	5
		−3	6
		−4	7
		−5	8
		−6	9
		−7	:
		−8	;
		−9	<
		−10	=
AM	M or]*	OFF	0 or 1
FM	N or ^*	OFF	6 or 7

	PROGRAM CODES	ARGUMENTS: ALC	RF OFF	RF ON
ALC	O or _	INT NORMAL	0	1
		INT, +10 RANGE	2	3
		XTAL, NORMAL	4	5
		XTAL, +10 RANGE	6	7
		MTR, NORMAL	<	=
		MTR, +10 RANGE	>	?

STATUS BYTE

Bit Number	8	7	6	5	4	3	2	1
Decimal Value	128	64	32	16	8	4	2	1
Function	CRYSTAL OVEN COLD	REQUEST SERVICE	OUT OF RANGE (Frequency)	RF OFF	NOT PHASE LOCKED	LEV UNCAL	0 (NOT USED)	+10 dB, OVER RANGE

* Dummy codes for 8672A program compatibility.

3-38. OPERATOR'S CHECKS

3-39. Basic Functional Checks

Description

The purpose of these checks is to give reasonable assurance that the instrument is operating properly.

Each check has been designed to be performed with a minimum of test equipment, and in as short a time as possible. Therefore, although these checks are extremely valuable in identifying malfunctions, they are not a substitute for the Performance Tests in Section IV, which verify that the instrument is performing within its published specifications.

Each check is independent of the others and can be performed separately.

If a malfunction is suspected and the CW Generator is being returned to Hewlett-Packard for service, perform the entire procedure. Document the checks that failed on a blue repair tag located at the rear of this manual and attach the tag to the instrument. This will help ensure that the malfunction has been accurately described to service technicians for the best possible service.

Equipment

Attenuator, 10 dB .... HP 8491B, Option 010

Procedure

Turn-On Check

1. Set the LINE switch to STANDBY. Remove all external cables from the front and rear panels of the CW Generator, including the power cable connecting the instrument to mains power.

2. Set the rear panel FREQ STANDARD INT/EXT switch to INT and connect the JUMPER (A3W3) between A3J9 and A3J10.

3. After the power cable has been disconnected from the CW Generator for at least 1 minute, reconnect it to the CW Generator. Check the front panel of the instrument to verify that the STANDBY and OVEN status annunciators are on.

4. Leave the instrument's LINE switch set to STANDBY until the OVEN status annunciator turns off. This should occur in 15 minutes or less, depending upon how long the CW Generator was disconnected from mains power. (The OVEN annunciator may flicker off and on temporarily just as the oven stabilization temperature is reached. This is normal operation.) Once the OVEN status annunciator is off set the LINE switch to ON.

5. Set the RF OUTPUT switch to ON. Set the FREQ STANDARD INT/EXT switch to EXT. Verify that the INTERNAL REF OFF and NOT PHASE LOCKED status annunciators turn on. Set the switch back to INT. The status annunciators should then turn off.

Frequency Check

The FREQUENCY MHz display and NOT PHASE LOCKED status annunciator are used to check that the internal phase-lock loops remain phase locked across their tuning range. The actual frequency at the RF OUTPUT connector is not

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

Procedure (cont'd)

checked. However, the frequency can be monitored with a microwave frequency counter or spectrum analyzer for greater assurance that the CW Generator is operating properly.

If a frequency counter is to be used to check frequency, disconnect the jumper from the rear panel connector A3J10 and connect the frequency counter as shown in Figure 3-7. Set the CW Generator rear panel INT-EXT switch to EXT.

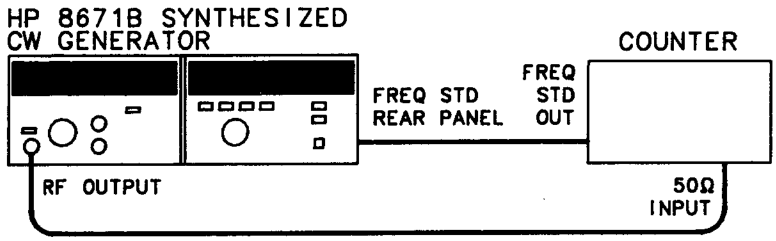


Figure 3-7. Frequency Checks Test Setup

6. Set the CW Generator as follows:

RF OUTPUT	OFF
PEAK-NORM control	NORM (in detent)
OUTPUT LEVEL RANGE selector	fully counter-clockwise
OUTPUT LEVEL VERNIER	fully counter-clockwise
ALC selector	INT
ALC CAL control	fully clockwise

7. Press the HOLD key. Verify that the CW Generator's displays indicate the following conditions:

RANGE dB display	−110 dB
Meter	<−10 dBm
ALC annunciator	INT and LVL UNCAL
RF annunciator	OFF
FREQUENCY MHz display	some frequency between 2.0 and 18.599997 GHz. If the display is not stable, press the PRESET (3 GHz) key.
FREQUENCY RESOLUTION display	All four segments extinguished.
STATUS annunciators:	
OVEN	may be on but should extinguish within 15 minutes after line cord is connected.
NOT PHASE LOCKED annunciator	ON

All other annunciators should be extinguished.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

Procedure (cont'd)

8. Press the PRESET (3 GHz) key and then the 100 MHz FREQUENCY RESOLUTION key. Verify that the leftmost segment in the FREQUENCY RESOLUTION display lights and that the other segments are extinguished.

NOTE

Do not tune above 6199.999 MHz in steps 9 through 17.

9. Verify that the displayed frequency can be tuned in 100 MHz increments using the TUNING knob.
10. Press the 1 MHz FREQUENCY RESOLUTION key. Verify that the two leftmost segments in the FREQUENCY RESOLUTION display are lighted and that the other segments are extinguished.
11. Verify that the displayed frequency can be tuned in 1 MHz increments using the TUNING knob.
12. Press the 10 kHz FREQUENCY RESOLUTION key. Verify that the three leftmost segments in the FREQUENCY RESOLUTION display are lighted and that the other segment is extinguished.
13. Verify that the displayed frequency can be tuned in 10 kHz increments using the TUNING knob.
14. Press the 1 kHz FREQUENCY RESOLUTION key. Verify that all segments in the FREQUENCY RESOLUTION display are lighted.
15. Verify that the displayed frequency can be tuned in 1 kHz increments using the TUNING knob.
16. Tune the frequency to 4 GHz and press the HOLD key. Verify that the four segments of the FREQUENCY RESOLUTION display are extinguished.
17. Press the PRESET (3 GHz) key and verify that the FREQUENCY RESOLUTION display indicates 3000.000 MHz.
18. Set the CW Generator as follows:

RF OUTPUT	ON
PEAK-NORM control	NORM (in detent)
OUTPUT LEVEL RANGE selector	0 dB range
OUTPUT LEVEL VERNIER	for 0 dBm reading on meter
ALC selector	INT
ALC CAL control	fully clockwise

19. Tune the CW Generator frequency to 2 GHz and select 1 kHz FREQUENCY RESOLUTION. Slowly tune from 2000.000 MHz to 2000.010 MHz. Verify that the NOT PHASE LOCKED annunciator remains off at each step.
20. Set the frequency tuning resolution to the values shown in the following table. For each tuning resolution, slowly tune from the corresponding start frequency to the stop frequency. Each time, verify that the NOT PHASE LOCKED annunciator remains off. (Each phase-locked loop is tuned over its entire range.)

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

Procedure (cont'd)

FREQUENCY RESOLUTION	Start Frequency	Stop Frequency
10 kHz	2000.010 MHz	2001.000 MHz
1 MHz	2001.000 MHz	2100.000 MHz
100 MHz	2100.000 MHz	6200.000 MHz

21. Set the frequency to 18599.997 MHz (overrange). Verify that the NOT PHASE LOCKED annunciator remains off.

Output Level Check

The CW Generator's internal output leveling loop (ALC) is checked to ensure that it remains locked at all specified power levels. The internal output leveling loop monitors most of the RF output circuitry. The output level can be monitored with a power meter for greater assurance that the CW Generator is operating properly.

22. Press PRESET (3 GHz). Set the CW Generator as follows:

RF OUTPUT	ON
PEAK-NORM control	NORM (in detent)
OUTPUT LEVEL RANGE selector	fully counter-clockwise
OUTPUT LEVEL VERNIER	fully counter-clockwise
ALC selector	INT
ALC CAL control	fully clockwise

23. Connect a 50 ohm load or attenuator to the CW Generator's RF OUTPUT connector. This reduces unwanted power reflections back into the RF OUTPUT connector, thus avoiding a false LVL UNCAL annunciator indication.
24. Tune the frequency to 6200.000 MHz.
25. Using the OUTPUT LEVEL RANGE selector, step the output level range from −110 to +10 dB. Verify that the LVL UNCAL annunciator remains off.
26. Set OUTPUT LEVEL RANGE to 0 dBm and sweep the OUTPUT LEVEL VERNIER across its entire range. Verify that the annunciator remains off at all VERNIER settings.
27. Select 100 MHz frequency tuning resolution and set the output level to +8 dBm. Tune slowly from 2000.000 MHz to 18000.000 MHz. Verify that the indicated power level on the CW Generator's meter remains constant and stable and that the LVL UNCAL annunciator remains off. This ensures that the instrument can generate specified output power and remain leveled.

NOTE

Momentary flashing of the LVL UNCAL when tuning is normal. Make sure that it remains off after the meter has settled, at each frequency.

OPERATOR'S CHECKS

3-40. HP-IB Checks

DESCRIPTION: These procedures check the CW Generator's ability to process or send the HP-IB messages described in Table 3-3. Only the CW Generator, a controller, and an HP-IB controller interface (for the HP 85B) are needed to perform these checks.

These procedures do not check that all the CW Generator's program codes are being properly executed by the instrument. However, if the Basic Functional Checks and the HP-IB Checks all pass, then the instrument will probably execute all commands.

If the CW Generator fails any of these HP-IB checks, make sure the controller and interface are working properly.

The select code of the controller's HP-IB interface is assumed to be 7. The address of the CW Generator is assumed to be 19 (its factory-set address). This particular select code-address combination (that is, 719) is not necessary for these checks to be valid. However, the program lines presented here must be modified for any other combination.

Instructions for changing the address are in Section II, Installation.

These checks can be performed together or separately. Any special requirements for a check are described at the beginning of the check.

INITIAL SETUP: The test setup is the same for all of the HP-IB Checks. Connect the the CW Generator to the controller and set the CW Generator as follows:

RF Output switch	ON
PEAK-NORM control	NORM (in detent)
OUTPUT LEVEL RANGE selector	fully counter-clockwise
OUTPUT LEVEL VERNIER	fully clockwise
ALC selector	INT
CAL control	fully clockwise
Frequency	6000.000 MHz

EQUIPMENT: HP-IB Controller/Interface .... HP 85B/82937A
— or —
HP 9826A Option 011
(BASIC 2.0 ROM Operating System)
— or —
HP 9836A with BASIC 2.0
Operating System

Remote and Local Message

NOTE: This check determines whether the CW Generator properly switches from local to remote control and from remote to local control. If the instrument is in remote, switch the LINE switch to STANDBY, then to ON.

OPERATOR'S CHECKS

HP-IB Checks (cont'd)

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the Remote message (by setting the Remote Enable bus control line, REN, true and addressing the CW Generator to listen).	REMOTE 719	REMOTE 719

OPERATOR'S RESPONSE: Check that the CW Generator's REMOTE annunciator is on and the OUTPUT LEVEL meter reads −10 dBm.

Send the Local message to the CW Generator.	LOCAL 719	LOCAL 719

OPERATOR'S RESPONSE: Check that the CW Generator's REMOTE annunciator is off and the OUTPUT LEVEL meter reads +3 dBm.

Receiving the Data Message

NOTE: This check determines whether the CW Generator properly receives Data messages.

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the first part of the Remote message (enabling the CW Generator to remote.)	REMOTE 7	REMOTE 7
Address the CW Generator to listen (completing the Remote message), then send a Data message.	OUTPUT 719; "P18W0Z173075"	OUTPUT 719; "P18W0Z173075"

OPERATOR'S RESPONSE: Check that the CW Generator's REMOTE annunciator is on, RANGE dB indicates −70 dB, ALC annunciators show XTAL mode and LVL UNCAL, and the FREQUENCY MHz display shows 18000 MHz.

Sending the Data Message

NOTE: This check determines whether the CW Generator properly issues a Data message when addressed to talk. Before beginning this test, set the LINE switch to OFF, then to ON. (If an HP 9826A or 9836A controller is used, a short program is required to perform this check.)

OPERATOR'S CHECKS

HP-IB Checks (cont'd)

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the Remote message.	REMOTE 719	10 REMOTE 719
Send a Data message to set the status byte.	OUTPUT 719; "M070"	20 OUTPUT 719; "M070"
Address the CW Generator to talk and store its output in variable V.	ENTER 719 using "#,B";V	30 V=0 40 ENTER 719 using "#,B";V
Display the value of V.	DISP V	50 DISP V 60 END

OPERATOR'S RESPONSE: Check that the CW Generator's REMOTE annunciator is on. The controller should display 28.

Receiving the Clear Message

NOTE: This check determines whether the CW Generator responds properly to the Clear message. This Check assumes that the CW Generator is in remote mode.

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send a Data message to initialize the CW Generator	Output 719; "P18W0Z173075"	Output 719; "P18W0Z173075"

OPERATOR'S RESPONSE: Check that the CW Generator is set to 18000 MHz, XTAL ALC mode, and RF OUTPUT ON.

Send the Clear message	CLEAR 719	CLEAR 719

OPERATOR'S RESPONSE: Check that the CW Generator is set to 3000 MHz, INT ALC mode, and RF OUTPUT OFF.

Receiving the Abort Message

NOTE: This check determines whether the CW Generator becomes unaddressed when it receives the Abort message. This check assumes the CW Generator is in remote mode and at a frequency other than 2000 MHz.

OPERATOR'S CHECKS

HP-IB Checks (cont'd)

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Address the CW Generator to listen and send part of a frequency message.	OUTPUT 719; "A2000"	OUTPUT 719; "A2000"
Send the Abort message, unaddressing the CW Generator from listening.	ABORTIO 7	ABORT 7
Address the controller to talk. The CW Generator is not addressed to listen.	SEND 7; MTA	SEND 7; MTA
Attempt to execute the previous frequency command by sending the frequency execute command.	OUTPUT 7; "Z1"	OUTPUT 7; "Z1"

OPERATOR'S RESPONSE: Check that the CW Generator does not display 2000 MHz output frequency. If the controller is an HP 9826A or 9836A, press the CLR I/O key to continue the checks.

Status Byte Message

NOTE: This check determines whether the CW Generator sends the Status Byte message. This check assumes that the Clear message has been sent.

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the Serial Poll message to the CW Generator (causing it to send the Status Byte message). Display the value of the status byte.	SPOLL(719)	SPOLL(719)

OPERATOR'S RESPONSE: Check that the controller's display reads 28.

Require Service Message

NOTE: This check determines whether the CW Generator can issue the Require Service message (set the SRQ bus control line true). This check can be performed in either local or remote mode.

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the Clear message	CLEAR 719	CLEAR 719
Send a Data message containing an out-of-range frequency. This causes the Require Service message to be sent.	OUTPUT 719; "P35Z1"	OUTPUT 719; "P35Z1"

OPERATOR'S CHECKS

HP-IB Checks (cont'd)

NOTE: If an HP 9826A or 9836A controller is being used, a short program is required for the next part of this check.

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Read the binary status of the controller's HP-IB interface and store the data in variable V. In this step, 7 is the interface's select code, and 2 (HP-85B) and 7 (HP 9826A) are status registers for bus control lines.	STATUS 7,2;V	10 V=0 20 STATUS 7,7; V
Display the value of the SRQ bit. In this step, 5 (HP-85B) and 10 (HP 9826A or HP 9836A) are the SRQ bits for the controller, numbered from 0.	DISP "SRQ="; BIT(V,5)	30 DISP "SRQ =";BIT(V,10) 40 END

OPERATOR'S RESPONSE: Check that the SRQ value is 1, indicating that the CW Generator issued the Require Service message.

Status Bit Message

NOTE: This check determines whether the CW Generator sends the Status Bit message. This check can be performed in either local or remote mode. This check assumes that the Clear message has been sent.

Description	HP 85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Set up a Service Request condition by programming an illegal frequency.	OUTPUT 719; "P99Z1"	OUTPUT 719; "P99Z1"
Send the parallel poll message to the CW Generator (causing it to send the Status Bit message).	PPOLL(7)	PPOLL(7)

OPERATOR'S RESPONSE: Check that the controller displays 128, or the value of the bit that parallel poll switch is set to.

IV Performance Tests

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. These tests are suitable for incoming inspection, troubleshooting, and preventive maintenance. All tests can be performed without accessing the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

4-2. ABBREVIATED PERFORMANCE TEST

In most cases, it is not necessary to perform all of the tests in this section. The following tests should be performed after repairing the CW Generator or to verify instrument operation:

- Frequency Range and Resolution
- Output Level, High Level Accuracy and Flatness

These tests can also be used for incoming inspections and preventative maintenance. They are not intended to be a complete check of specifications, but will provide 90% confidence that the CW Generator is meeting its major performance specifications. These tests can be performed with less time and equipment than the full Performance Tests.

NOTE

To consider the performance tests valid, the following conditions must be met:

a. The CW Generator must have a 1-hour warmup for all specifications.

b. The line voltage must be 100, 120, 220, or 240 Vac +5%, −10%.

c. The ambient temperature must be +15 to +35°C for the Output Level Flatness and RF Output Level and Accuracy tests; 0 to 55°C for all other tests.

4-3. CALIBRATION CYCLE

This instrument requires periodic verification of performance to ensure that it is operating within specified tolerances. The performance tests described in this section should be performed at least once each year; under conditions of heavy usage or severe operating environments, the tests should be more frequent. Adjustments that may be required are described in Section V, Adjustments.

4-4. PERFORMANCE TEST RECORD

Results of the performance tests may be tabulated in Table 4-3, Performance Test Record. The Performance Test Record lists all of the performance test specifications and the acceptable limits for each specification. If performance test results are recorded during an incoming inspection of the instrument, they can be used for comparison during periodic maintenance or troubleshooting. The test results may also prove useful in verifying proper adjustments after repairs are made.

4-5. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-3, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted.

4-6. TEST PROCEDURES

It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the CW Generator, are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the sweep time would not be specified and the operator would be expected to set that control and other controls as required to obtain an optimum display. It is also assumed that the technician will select the cables, adapters, and probes (listed in Table 1-3) required to complete the test setups illustrated in this section.

PERFORMANCE TESTS

4-7. FREQUENCY RANGE AND RESOLUTION TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—18.0 GHz (Overrange to 18.599997 GHz)	
Resolution	1 kHz 2 kHz 3 kHz	2.0 to 6.2 GHz 6.2 to 12.4 GHz 12.4 to 18.0 GHz

Description

This test checks the resolution in each of three internal frequency bands using a frequency counter. The performance test is divided into a baseband check (2.0 to 6.2 GHz) and a check for bands 2 and 3 (6.2 to 12.4 GHz and 12.4 to 18.0 GHz respectively).

Equipment

Frequency Counter .... HP 5343A

Procedure

Baseband Test

1. Connect the equipment as shown in Figure 4-1. Set the CW Generator rear panel INT/EXT switch to EXT. Remove FREQ STANDARD jumper and connect A3J10 to the 10 MHz frequency standard output of the frequency counter.

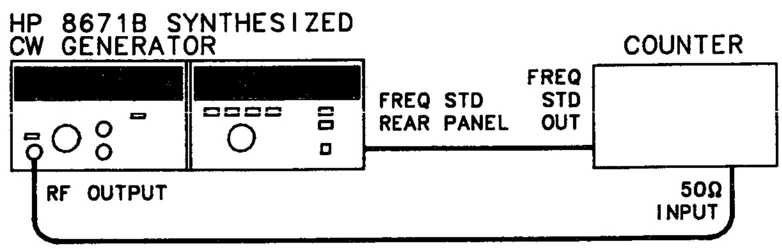


Figure 4-1. Frequency Range and Resolution Test Setup

2. Select 1 kHz display resolution on the counter.
3. Press the CW Generator's PRESET (3 GHz) key and set the output power to 0 dBm.
4. Verify that the frequency counter reads 3 000.000 MHz ±1 count.

   2 999.999 MHz ________ 3 000.001 MHz

5. Set the CW Generator frequency to 2 000.000 MHz.
6. Tune to each of the frequencies listed below. Verify that the CW Generator remains phase locked at all frequencies and that the frequency counter agrees with the CW Generator frequency display ±1 count.

PERFORMANCE TESTS

FREQUENCY RANGE AND RESOLUTION (cont'd)

Procedure (cont'd)

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
2 000.000	1 999.999	______	2 000.001
2 000.001	2 000.000	______	2 000.002
2 001.112	2 001.111	______	2 001.113
2 002.223	2 002.222	______	2 002.224
2 003.334	2 003.333	______	2 003.335
2 004.445	2 004.444	______	2 004.446
2 005.556	2 005.555	______	2 005.557
2 006.667	2 006.666	______	2 006.668
2 007.778	2 007.777	______	2 007.779
2 008.889	2 008.888	______	2 008.890
2 009.999	2 009.998	______	2 010.000

7. Set the CW Generator to 2 000.000 MHz.

8. Tune the CW Generator to each of the frequencies listed below and read the frequency counter at each step. The frequency counter reading should agree with the CW Generator front panel reading within ±1 count. In addition, the CW Generator NOT PHASE LOCKED front panel annunciator should remain off at all frequencies.

NOTE

Fast tuning of frequency may cause the NOT PHASE LOCKED annunciator to flash on momentarily. This is normal and does not indicate a malfunction.

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
2 090.000	2 089.999	______	2 090.001
2 280.000	2 279.999	______	2 280.001
2 470.000	2 469.999	______	2 470.001
2 660.000	2 659.999	______	2 660.001
2 850.000	2 849.999	______	2 850.001
3 040.000	3 039.999	______	3 040.001
3 230.000	3 229.999	______	3 230.001
3 420.000	3 419.999	______	3 420.001

(cont'd)

PERFORMANCE TESTS

FREQUENCY RANGE AND RESOLUTION (cont'd)

Procedure (cont'd)

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
3 610.000	3 609.999	________	3 610.001
3 800.000	3 799.999	________	3 800.001
3 990.000	3 989.999	________	3 990.001
4 180.000	4 179.999	________	4 180.001
4 370.000	4 369.999	________	4 370.001
4 560.000	4 559.999	________	4 560.001
4 750.000	4 749.999	________	4 750.001
4 940.000	4 939.999	________	4 940.001
5 130.000	5 129.999	________	5 130.001
5 320.000	5 319.999	________	5 320.001
5 510.000	5 509.999	________	5 510.001
5 700.000	5 699.999	________	5 700.001
5 900.000	5 899.999	________	5 900.001
6 100.000	6 099.999	________	6 100.001

Bands 2 and 3 Test

9. Tune the CW Generator to 10 000.000 MHz and select 1 kHz tuning resolution.

10. Tune the frequency down one increment and verify that the CW Generator frequency display changes to 9 999.998 MHz and the frequency counter reading agrees within one count.

11. Tune the frequency up two increments and verify that the CW Generator frequency display changes to 10 000.002 MHz. Verify also that the frequency counter reading agrees within one count.

    10 GHz frequency resolution, 2 kHz ______ (√)

12. Tune the CW Generator to 18 000.000 MHz and select 1 kHz tuning resolution.

13. Tune the frequency down one increment and verify that the CW Generator frequency display indicates 17 999.997 MHz and the frequency counter reading agrees within one count.

14. Tune the frequency up two increments and verify that the CW Generator frequency display indicates 18 000.003 MHz and the frequency counter reading agrees within one count.

    18 GHz frequency resolution, 3 kHz ______ (√)

15. Disconnect the frequency standard cable and replace the FREQ STANDARD JUMPER between A3J9 and A3J10. Set the INT/EXT switch to INT.

PERFORMANCE TESTS

4-8. FREQUENCY SWITCHING TIME TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SWITCHING TIME		
Frequency to be within the specified resolution.	<15 ms	
Amplitude to be within ±3 dB of final level after switching frequency.	<15 ms	When switching within the same frequency resolution range.

Description

This test measures the frequency switching speed. The CW Generator is remotely programmed to continuously switch between two frequencies. Its output is mixed with a local oscillator whose output frequency is set to 1 kHz above the second (or destination) frequency. The difference frequency (IF) is displayed on an oscilloscope.

Frequency switching speed is first measured in the CW Generator's base band (2.0—6.2 GHz) using an IF frequency of 1 kHz (which is the specified resolution for the base band). As the unit under test is switched from the starting frequency to the destination frequency the oscilloscope is triggered by the HP-IB controller.

As the CW Generator output changes between the two programmed frequencies the IF signal will pass through zero. This will generate a phase reversal, as shown in Figure 4-3. The last phase change of the IF frequency is the point that the frequency of the unit under test is within the specified resolution.

The amplitude recovery time is tested using the same measurement setup. The ±3 dB amplitude points of the IF signal are calibrated on the oscilloscope display and the amplitude recovery time is tested to ensure that the IF level is within ±3 dB of the final level (see Figure 4-4). The amplitude recovery time is only specified for frequency changes within the same frequency resolution range.

NOTE

A digitizing oscilloscope will make this measurement easier due to the ability to store and view the switching process. The test may be performed without a digitizing oscilloscope by repetitively switching the frequency of the unit under test.

Equipment

HP-IB Controller .... HP 85B/82903 or HP 9836A
Local Oscillator .... HP 8340A
Mixer .... RHG DMS1-18
Oscilloscope .... HP 1980B

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure

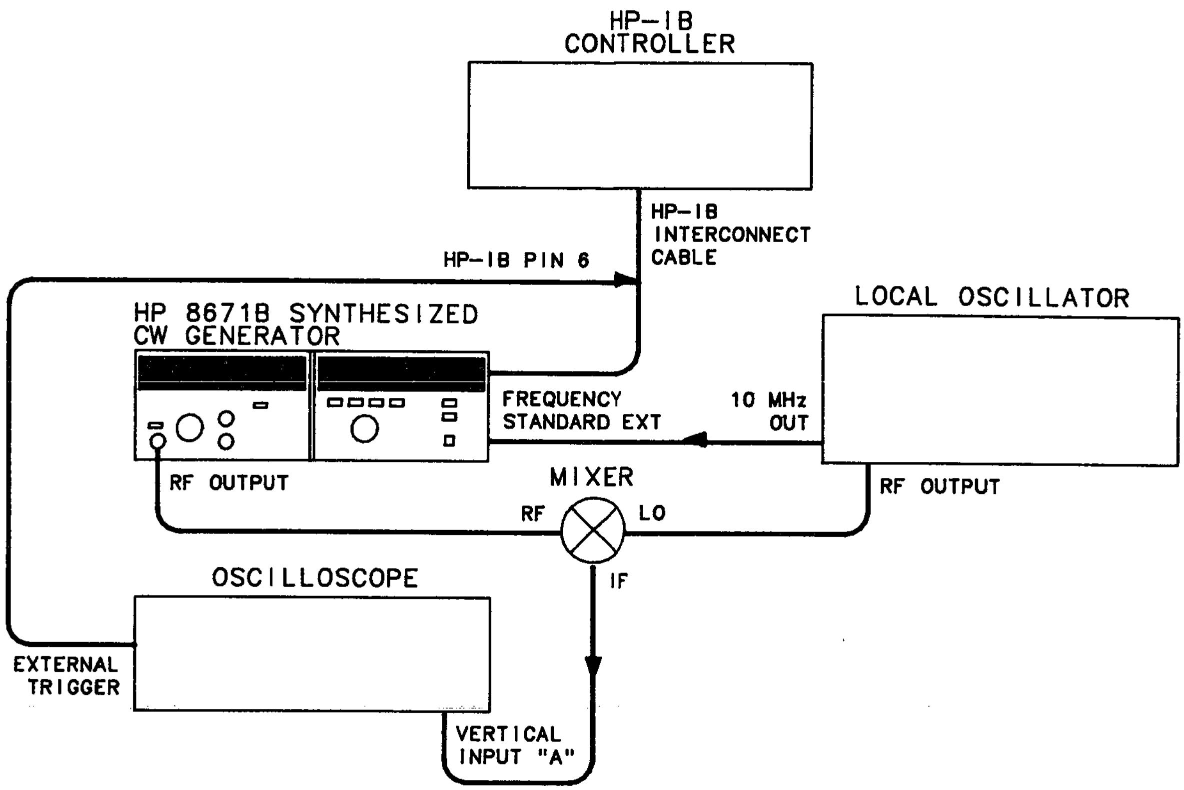


Figure 4-2. Frequency Switching Time Test Setup

Frequency Switching Time

1. Set up the equipment as shown in Figure 4-2. The external trigger input of the oscilloscope should be connected to pin 6 of the HP-IB cable. An HP-IB adapter (HP 10834A) can be used to make a permanent adapter for this test. This test may be performed by connecting the external trigger input of the oscilloscope to A2A7TP1. The test results should be identical for both methods of oscilloscope triggering.

WARNING

To access A2A7TP1 the instruments protective covers must be removed. This should only be done by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

2. Set the local oscillator to 2 100.001 MHz with an output level between +5 dBm and +8 dBm.

3. Set the oscilloscope to external trigger, positive slope trigger, triggered sweep mode (or NORMAL) and 2 ms per division sweep time.

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

NOTE

The following programs are for the HP 9826 or HP 9836 controller. For use with the HP 85B controller, increase the wait statements by a factor of 1000. This is done because the HP 85B executes wait commands in milliseconds while the HP 9836 and HP 9826 execute wait commands in seconds.

4. Load and run the following HP-IB controller program. As the program is executing, adjust the trigger controls for a stable 1 kHz sine wave display.

```
10   CLEAR 719
20   OUTPUT 719;"A2100000Z100075"        2.1 GHz, +3 dBm, Ext ALC
30   GOTO 20
40   END
```

5. Press the pause key on the controller to stop the program. Load and run the following program. The program will continue switching the CW Generator between 18 GHz and 2.1 GHz until the pause key is pressed. If necessary, adjust the oscilloscope triggering to obtain a display similar to that shown in Figure 4-3.

```
10   SEND 7;MTA LISTEN 19          Controller talk, CW Generator listen
20   OUTPUT 7;"K00075"             0 dB range, Ext ALC
30   OUTPUT 7;"P18000000Z1"        Set to 18 GHz
40   WAIT .005                     5 for HP 85B (5 ms)
50   OUTPUT 7;"A2100000Z"          Ready for change to 2.1 GHz
60   WAIT .7                       700 for HP 85B (700 ms)
70   OUTPUT 7;"1"                  Change frequency
80   WAIT .05                      50 for HP 85B (50 ms)
90   GOTO 30
100  END
```

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

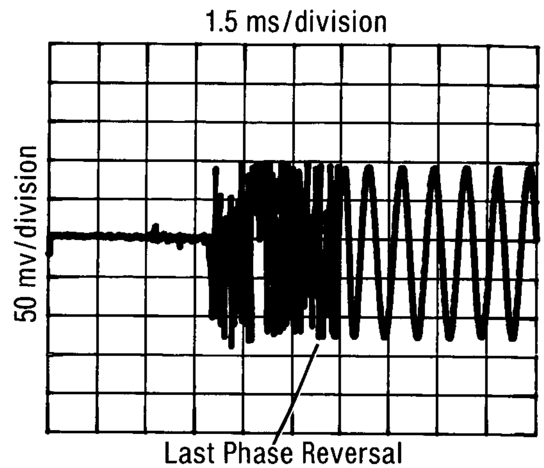


Figure 4-3. Frequency Switching Time Measurement Waveform

6. Measure the switching time by observing the signal on the oscilloscope display. The external trigger is the reference for determining switching speed. The switching time is measured from the display's left graticule to the last phase reversal (as the CW Generator passes the local oscillator frequency) before the IF signal settles into a steady frequency. Refer to Figure 4-3. Record the frequency switching time.

_______ <15 ms

7. Modify lines 30 and 50 to read as follows:

Frequency 2.1 GHz

```
30    OUTPUT  7;"A2100000Z1"

50    OUTPUT  7;"P18000000Z"
```

Frequency 18 GHz

8. Set the local oscillator frequency to 17 999.997 MHz.

9. Run the modified program and measure the switching time to the last phase reversal

_______ <15 ms

Amplitude Recovery Time

10. Set the local oscillator to 6 100.001 MHz.

11. Load and run the following program. Adjust the vertical sensitivity and position of the display until the displayed signal indicates a peak-to-peak change of exactly 2 divisions in amplitude. This calibrates the oscilloscope to ±3 dB about 0 dBm. The smaller signal represents −3 dBm and the larger signal represents +3 dBm.

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

```
10  CLEAR 719
20  OUTPUT 719;"A6100000Z1"        Frequency 6.1 GHz
30  FOR X=1 TO 100
40  OUTPUT 719;"K00071"            Level +3 dBm
50  NEXT X                         Trigger oscilloscope
60  FOR Y=1 TO 100
70  OUTPUT 719;"K06071"            Level -3 dBm
80  NEXT Y
90  GOTO 30
100 END
```

12. Set the top of the displayed signal to a convenient reference near the center of the display. Note the two levels for reference. The measurement will be determined by the time required before the amplitude of the IF signal stays between these two levels.

13. Press the pause key on the controller. Enter and run the following program. Run the program by typing RUN 110 and pressing the EXECUTE key (END LINE for the HP 85).

```
110 OUTPUT 719;"A2000000Z103071"   2.0 GHz, 0 dBm, internal ALC
120 SEND 7;MTA LISTEN 19           Controller talk, CW generator listen
130 OUTPUT 7;"A2100000Z1"          Frequency 2.1 GHz
140 WAIT .005                      5 for HP 85B (5 ms)
150 OUTPUT 7;"A6100000Z"           Frequency 6.1 GHz
160 WAIT .7                        700 for HP 85B (700 ms)
170 OUTPUT 7;"1"                   Change frequency
180 WAIT .05                       50 for HP 85B (50 ms)
190 GOTO 130
200 END
```

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

14. Measure the amplitude recovery time. The measurement is the time from the left graticule of the display to the last time the IF signal amplitude is outside of the reference points noted in step 13. If necessary, adjust the oscilloscope triggering to obtain a display similar to that shown in Figure 4-4.

_______ <15 ms
(Record Results for Step 17) _______ <15 ms
(Record Results for Step 20) _______ <15 ms

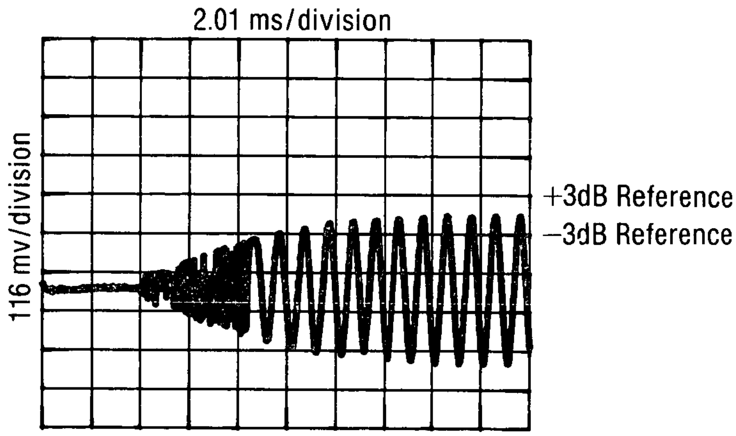


Figure 4-4. Amplitude Recovery Measurement Waveform

15. Set the local oscillator to 12 300.002 MHz.
16. Modify lines 20, 130, and 150 of the program as follows:

```
                                    Frequency 12.3 GHz
20   OUTPUT 719;"P12300000Z1"
                                    Frequency 6.2 GHz
130  OUTPUT 7;"A6200000Z1 "
                                    Frequency 12.3 GHz
150  OUTPUT 7;"P12300000Z1"
```

17. Repeat steps 11 through 14 using the modified programs. The amplitude recovery time will be measured for the 2 kHz resolution band.
18. Set the local oscillator to 18.000 003 GHz.
19. Modify lines 20, 130, and 150 of the program as follows:

```
                                    Frequency 18.0 GHz
20   OUTPUT 719;"P18000000Z1"
                                    Frequency 12.4 GHz
130  OUTPUT 7;"P12400000Z1"
                                    Frequency 18.0 GHz
150  OUTPUT 7;"P1800000Z"
```

20. Repeat steps 11 through 14 using the modified program. The amplitude recovery time will be measured for the 3 kHz resolution band.
21. Disconnect the frequency reference from the rear panel and replace the jumper. Set the switch to INT.

PERFORMANCE TESTS

4-9. OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Output Level:		
Leveled Output	+8 dBm to −120 dBm	+15 to +35°C
Remote Programming Absolute Level Accuracy (+15°C to +35°C)		**2.0—6.2 GHz**
	±1.00 dB	+10 dB output level range
	±1.00 dB	0 dB output level range
	±1.50 dB	−10 dB output level range
	±1.70 dB	−20 dB output level range
		6.2—12.4 GHz
	±1.25 dB	+10 dB output level range
	±1.25 dB	0 dB output level range
	±1.75 dB	−10 dB output level range
	±1.95 dB	−20 dB output level range
		12.4—18.0 GHz
	±1.50 dB	+10 dB output level range
	±1.50 dB	0 dB output level range
	±2.10 dB	−10 dB output level range
	±2.30 dB	−20 dB output level range
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement uncertainty.
Flatness (0 dBm range; 15 to +35°C)	1.50 dB	2.0 to 6.2 GHz
	2.00 dB	2.0 to 12.4 GHz
	2.50 dB	2.0 to 18.0 GHz

Description

This test checks output level (maximum leveled power), absolute level accuracy between +8 dBm and −20 dBm, and output level flatness. The output level test uses a power meter to verify that +8 dBm can be generated over the full 2 to 18 GHz frequency range. Level flatness measures the variation in level over the various specified ranges. The high level accuracy test verifies that power levels between +8 dBm and −20 dBm are within the manual absolute level accuracy specification.

Equipment

Power Meter ....HP 436A
Power Sensor ....HP 8481A

Procedure

Output Level Test

1. Connect the power sensor to the power meter. Calibrate and zero the power meter.
2. Connect the power sensor to the RF OUTPUT connector of the CW Generator as shown in Figure 4-5.

OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)

Procedure (cont'd)

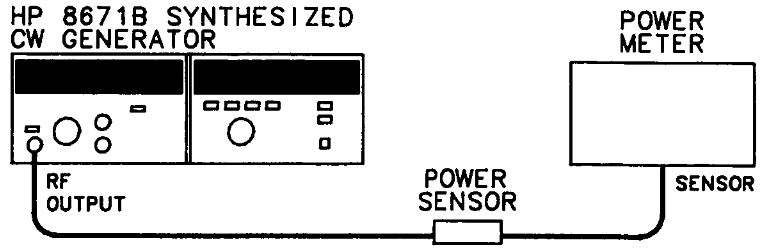


Figure 4-5. Output Level, High Level Accuracy and Flatness Test Setup

3. Set the CW Generator frequency to 2.0 GHz and the output level range to +10 dB.
4. Adjust the VERNIER control to give a power meter reading of +8 dBm.
5. Tune the CW Generator in 100 MHz steps from 2 to 18 GHz, adjusting the power meter's calibration factor and recording the frequency at which minimum power occurs. Reset VERNIER to read +8 dBm on the power meter at the recorded frequency to ensure that the +8 dBm power level can be met.

Frequency ______
Minimum Power >+8 dBm ______

Level Flatness

6. Set the CW Generator frequency to 2 GHz, output level to −5 dBm, and power meter to dB Relative. Slowly tune to 6.2 GHz in 100 MHz steps and record the maximum and minimum relative power outputs. Set the power meter calibration factor appropriate for each frequency. Maximum variation should be within 1.5 dB (highest point to lowest point). Continue to tune to 12.4 GHz. Maximum variation should be within 2 dB. Continue to tune to 18.0 GHz and note level variation. Maximum variation should be less than 2.5 dB.

NOTE

The specification for power output flatness is not referenced to a particular frequency. The specification represents the total power variation over the entire frequency range.

2.0—6.2 GHz

Minimum ______
Maximum ______
Total Variation ______ <1.50 dB

2.0—12.4 GHz

Minimum ______
Maximum ______
Total Variation ______ <2.00 dB

PERFORMANCE TESTS

OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)

Procedure (cont'd)

2.0—18.0 GHz

Minimum ______
Maximum ______
Total Variation ______ <2.50 dB

High Level Accuracy Test

7. Connect the power sensor to the power meter. Calibrate and zero the power meter in the dBm mode.

8. Connect the power sensor to the RF OUTPUT connector of the CW Generator.

9. Set the CW Generator frequency to 2.0 GHz and output level to +8 dBm (+10 dB range and −2 dBm front panel meter setting).

10. Tune the CW Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency in Table 4-1. The power meter readings should be within the limits specified.

11. Repeat steps 9 and 10 for an output level of +3 dBm (+10 dB range, −7 dBm VERNIER).

12. Set the CW Generator frequency to 2.0 GHz and output level to 0 dBm (0 dB range, 0 dBm VERNIER).

13. Tune the CW Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency in Table 4-1. The power meter readings should be within the limits specified.

14. Repeat steps 12 and 13 for output levels of −5 dBm and −10 dBm (0 dB range).

15. Set the CW Generator frequency to 2.0 GHz and output level to −10 dBm (−10 dB range, 0 dBm VERNIER).

16. Tune the CW Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency in Table 4-1. The power meter readings should be within the limits specified.

17. Repeat steps 15 and 16 for an output level of −20 dBm (−20 dB range, 0 dBm vernier).

PERFORMANCE TESTS

OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)

Table 4-1. Output Level, High Level Accuracy and Flatness Test Record (1 of 2)

Test		Results		
		Min.	Actual	Max.
High Level Accuracy				
+8 dBm (+10 dB range)	2 GHz	+ 6.25 dBm	________	+9.75 dBm
	4 GHz	+ 6.25 dBm	________	+9.75 dBm
	6 GHz	+ 6.25 dBm	________	+9.75 dBm
	8 GHz	+ 6.00 dBm	________	+10.00 dBm
	10 GHz	+ 6.00 dBm	________	+10.00 dBm
	12 GHz	+ 6.00 dBm	________	+10.00 dBm
	14 GHz	+ 5.75 dBm	________	+10.25 dBm
	16 GHz	+ 5.75 dBm	________	+10.25 dBm
	18 GHz	+ 5.75 dBm	________	+10.25 dBm
+3 dBm (+10 dB range)	2 GHz	+ 1.25 dBm	________	+4.75 dBm
	4 GHz	+ 1.25 dBm	________	+4.75 dBm
	6 GHz	+ 1.25 dBm	________	+4.75 dBm
	8 GHz	+ 1.00 dBm	________	+5.00 dBm
	10 GHz	+ 1.00 dBm	________	+5.00 dBm
	12 GHz	+ 1.00 dBm	________	+5.00 dBm
	14 GHz	+ 0.75 dBm	________	+5.25 dBm
	16 GHz	+ 0.75 dBm	________	+5.25 dBm
	18 GHz	+ 0.75 dBm	________	+5.25 dBm
0 dBm (0 dB range)	2 GHz	− 1.75 dBm	________	+1.75 dBm
	4 GHz	− 1.75 dBm	________	+1.75 dBm
	6 GHz	− 1.75 dBm	________	+1.75 dBm
	8 GHz	− 2.00 dBm	________	+2.00 dBm
	10 GHz	− 2.00 dBm	________	+2.00 dBm
	12 GHz	− 2.00 dBm	________	+2.00 dBm
	14 GHz	− 2.25 dBm	________	+2.25 dBm
	16 GHz	− 2.25 dBm	________	+2.25 dBm
	18 GHz	− 2.25 dBm	________	+2.25 dBm
−5 dBm (0 dB range)	2 GHz	−6.75 dBm	________	−3.25 dBm
	4 GHz	− 6.75 dBm	________	−3.25 dBm
	6 GHz	− 6.75 dBm	________	−3.25 dBm
	8 GHz	− 7.00 dBm	________	−3.00 dBm
	10 GHz	− 7.00 dBm	________	−3.00 dBm
	12 GHz	− 7.00 dBm	________	−3.00 dBm
	14 GHz	− 7.25 dBm	________	−2.75 dBm
	16 GHz	− 7.25 dBm	________	−2.75 dBm
	18 GHz	− 7.25 dBm	________	−2.75 dBm
−10 dBm (0 dB range)	2 GHz	−11.75 dBm	________	−8.25 dBm
	4 GHz	−11.75 dBm	________	−8.25 dBm
	6 GHz	−11.75 dBm	________	−8.25 dBm
	8 GHz	−12.00 dBm	________	−8.00 dBm
	10 GHz	−12.00 dBm	________	−8.00 dBm

PERFORMANCE TESTS

OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)

Table 4-1. Output Level, High Level Accuracy and Flatness Test Record (2 of 2)

Test		Results		
		Min.	Actual	Max.
High Level Accuracy (cont'd)				
−10 dBm (0 dB range) (cont'd)	12 GHz	−12.00 dBm	________	−8.00 dBm
	14 GHz	−12.25 dBm	________	−7.75 dBm
	16 GHz	−12.25 dBm	________	−7.75 dBm
	18 GHz	−12.25 dBm	________	−7.75 dBm
−10 dBm (−10 dB range)	2 GHz	−12.25 dBm	________	−7.75 dBm
	4 GHz	−12.25 dBm	________	−7.75 dBm
	6 GHz	−12.25 dBm	________	−7.75 dBm
	8 GHz	−12.50 dBm	________	−7.50 dBm
	10 GHz	−12.50 dBm	________	−7.50 dBm
	12 GHz	−12.50 dBm	________	−7.50 dBm
	14 GHz	−12.85 dBm	________	−7.15 dBm
	16 GHz	−12.85 dBm	________	−7.15 dBm
	18 GHz	−12.85 dBm	________	−7.15 dBm
−20 dBm (−20 dB range)	2 GHz	−22.45 dBm	________	−17.55 dBm
	4 GHz	−22.45 dBm	________	−17.55 dBm
	6 GHz	−22.45 dBm	________	−17.55 dBm
	8 GHz	−22.70 dBm	________	−17.30 dBm
	10 GHz	−22.70 dBm	________	−17.30 dBm
	12 GHz	−22.70 dBm	________	−17.30 dBm
	14 GHz	−23.05 dBm	________	−16.95 dBm
	16 GHz	−23.05 dBm	________	−16.95 dBm
	18 GHz	−23.05 dBm	________	−16.95 dBm

PERFORMANCE TESTS

4-10. LOW LEVEL ACCURACY TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Remote Programming Absolute Level Accuracy (+15 to +35°C)		2.0—6.2 GHz
	±1.90 dB	−30 dB output level range
	±1.90 dB plus ±0.3 dB per 10 dB step	<−30 dB output level range
		6.2—12.4 GHz
	±2.15 dB	−30 dB output level range
	±2.15 dB plus ±.3 dB per 10 dB step	<−30 dB output level range
		12.4—18.0 GHz
	±2.40	−30 dB output level range
	±2.40 dB plus ±0.4 dB per 10 dB step	<−30 dB output level range
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy and measurement uncertainty.

Description

This test checks absolute level accuracy between −30 dBm and −110 dBm. An IF signal is calibrated to the spectrum analyzer by measuring the CW Generator's RF output at −20 dBm. A reference level corresponding to the −20 dBm output is set on the spectrum analyzer and each 10 dB decrease in range is checked for a 10 dB decrease on the spectrum analyzer display.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8481A
Local Oscillator .... HP 8340A
Mixer .... RHG DMS 1—18
Spectrum Analyzer .... HP 8566B
40 dB Amplifier .... HP 8447F
20 dB Attenuator .... HP 8491B Option 020
20 dB Preamplifier .... HP 8447A

Procedure

1. Calibrate and zero the power meter in the dBm mode.
2. Connect the equipment as shown in Figure 4-6.

NOTE

Connect the mixer directly to the local oscilator to avoid any power loss.

PERFORMANCE TESTS

LOW LEVEL ACCURACY TEST (cont'd)

Procedure (cont'd)

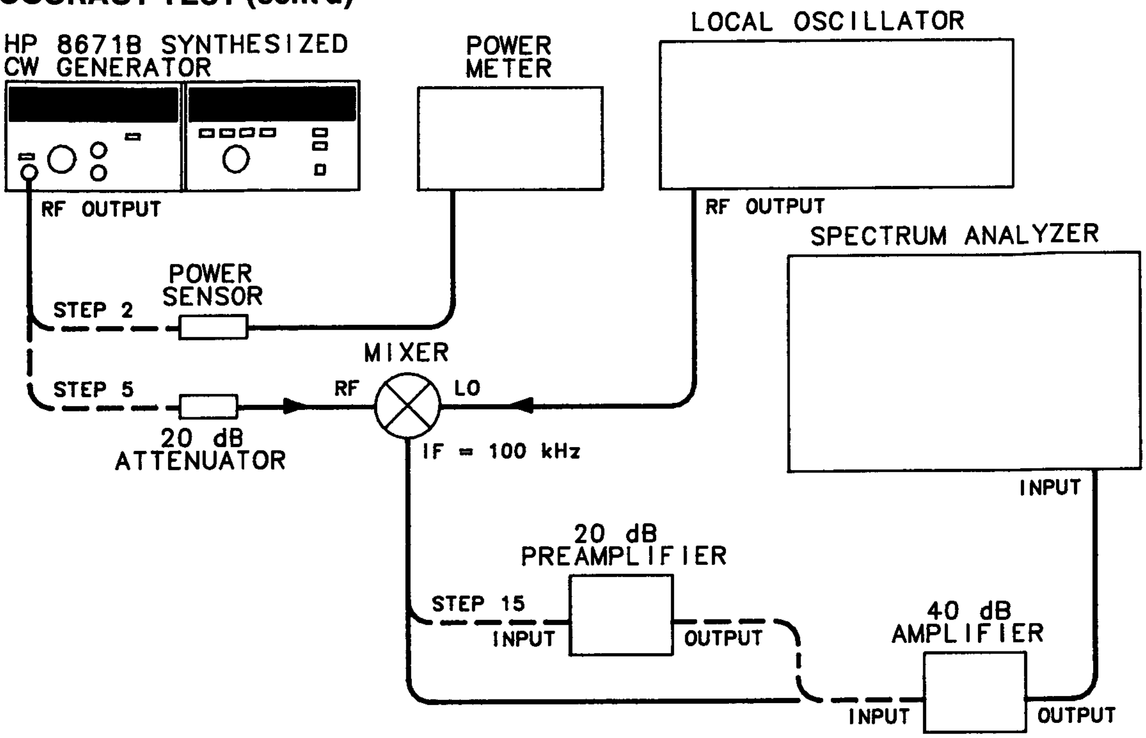


Figure 4-6. Low Level Accuracy Test Setup

3. Set the CW Generator frequency to 2 000.000 MHz, RANGE to −20 dB, and set the VERNIER for 0 dBm.

4. Adjust the VERNIER for a power meter reading of −20.00 dBm ±0.01 dB.

5. Disconnect the power meter and connect the CW Generator to the mixer as shown in Figure 4-6.

6. Set the local oscillator to 2 000.100 MHz and output power to maximum but not greater than +8 dBm.

7. Set the resolution bandwidth on the spectrum analyzer to 300 Hz or less. Adjust the reference level so that the amplitude of the 100 kHz IF signal is set to a convenient horizontal graticule as a reference. This calibrates the graticule line for an absolute reference power level of −20 dBm. Enable the Delta Marker function on the spectrum analyzer, if available, for highest accuracy.

8. Set the range of the CW Generator 10 dB lower and adjust the CW Generator's VERNIER for a front panel meter reading of 0 dBm.

9. Set the spectrum analyzer reference level 10 dB lower to bring the signal level near the reference graticule line.

PERFORMANCE TESTS

LOW LEVEL ACCURACY TEST (cont'd)

Procedure (cont'd)

10. Read the difference between the displayed level and the reference graticule. Calculate the actual power as follows:

NOTE

The difference is positive if the signal is above the reference graticule line, and negative if below.

________ *Output level set in step 8.*
+________ *Difference measured in step 10.*
________ *Actual level.*

Record the actual level calculated in Table 4-2. The level reading should be within the limits specified.

11. Repeat steps 8 through 10, with CW Generator range settings of −40 dB and −50 dB in step 8. Record the output level readings in Table 4-2.

12. Note the CW Generator's signal level (at −50 dBm) on the spectrum analyzer display. Remove the 20 dB attenuator, set the spectrum analyzer reference level 20 dB higher, and adjust the spectrum analyzer to bring the peak of the IF signal back to the same reference level.

13. Repeat steps 8 through 10 with CW Generator range settings of −60 dB through −90 dB. Record the output level readings in Table 4-2.

14. Note the CW Generator's level (at −90 dBm) on the spectrum analyzer display. This will be the reference in step 15.

15. Connect the 20 dB Preamplifier as shown in Figure 4-6. Set the spectrum analyzer IF sensitivity 20 dB higher, and set the vertical sensitivity to bring the signal back to the reference level noted in step 14.

16. Repeat steps 8 through 10, with CW Generator range settings of −100 dB and −110 dB. Record the output level readings in Table 4-2.

17. Repeat steps 3 through 16 for CW Generator frequencies of 10 GHz and 18 GHz. Record the output level readings in Table 4-2.

PERFORMANCE TESTS

LOW LEVEL ACCURACY TEST (cont'd)

Table 4-2. Low Level Accuracy Test Record

Test	Results Min.	Results Actual	Results Max.
2.0 GHz			
−30 dBm	−32.65 dBm	______	−27.35 dBm
−40 dBm	−42.95 dBm	______	−37.05 dBm
−50 dBm	−53.25 dBm	______	−46.75 dBm
−60 dBm	−63.55 dBm	______	−56.45 dBm
−70 dBm	−73.85 dBm	______	−66.15 dBm
−80 dBm	−84.15 dBm	______	−75.85 dBm
−90 dBm	−94.45 dBm	______	−85.55 dBm
−100 dBm	−104.75 dBm	______	−95.25 dBm
−110 dBm	−115.05 dBm	______	−104.95 dBm
10.0 GHz			
−30 dBm	−32.90 dBm	______	−27.10 dBm
−40 dBm	−43.20 dBm	______	−36.80 dBm
−50 dBm	−53.50 dBm	______	−46.50 dBm
−60 dBm	−63.80 dBm	______	−56.20 dBm
−70 dBm	−74.10 dBm	______	−65.90 dBm
−80 dBm	−84.40 dBm	______	−75.60 dBm
−90 dBm	−94.70 dBm	______	−85.30 dBm
−100 dBm	−105.00 dBm	______	−95.00 dBm
−110 dBm	−105.30 dBm	______	−104.70 dBm
18.0 GHz			
−30 dBm	−33.45 dBm	______	−26.55 dBm
−40 dBm	−43.85 dBm	______	−36.15 dBm
−50 dBm	−54.25 dBm	______	−45.75 dBm
−60 dBm	−64.65 dBm	______	−55.35 dBm
−70 dBm	−75.05 dBm	______	−64.95 dBm
−80 dBm	−85.45 dBm	______	−74.55 dBm
−90 dBm	−95.95 dBm	______	−84.15 dBm
−100 dBm	−106.35 dBm	______	−93.75 dBm
−110 dBm	−107.75 dBm	______	−103.35 dBm

PERFORMANCE TESTS

4-11. OUTPUT LEVEL SWITCHING TIME TEST

Specification Less than 20 ms to be within ±1 dB of the final level.

Description This test measures the output level switching speed. The measuring system is set up to trigger the oscilloscope when the unit under test has finished accepting the output level data from the controller. The R.F. output is detected and coupled to the oscilloscope's vertical input. The time to complete switching (which includes settling time) is viewed on the oscilloscope display.

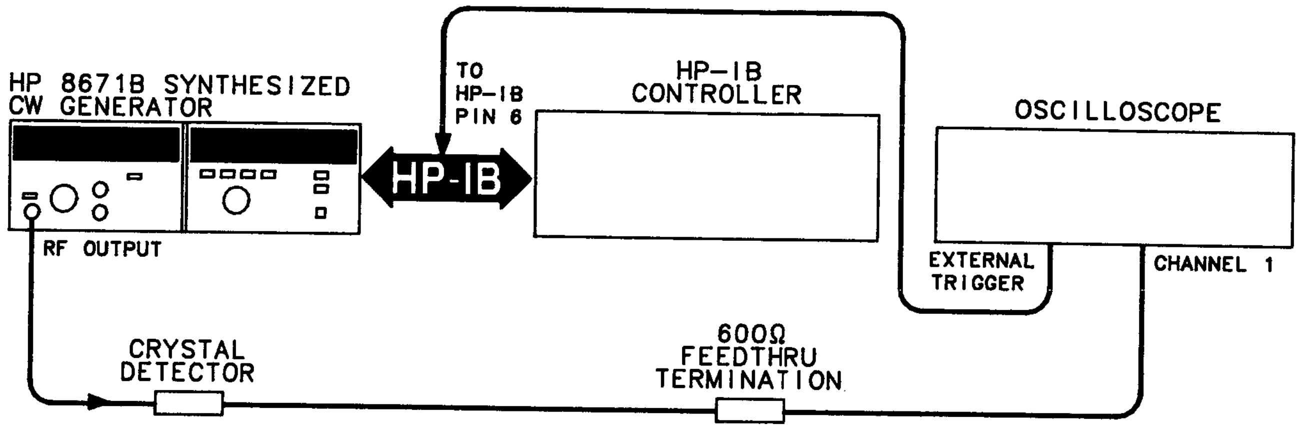


Figure 4-7. Output Level Switching Time Test Setup

Equipment

Oscilloscope	HP 1980B
HP-IB Controller	HP 9836A or HP 85B/82903
Crystal Detector	HP 8470B Opt. 012
600Ω Feedthru Termination	HP 11095A

Procedure

1. Set up the equipment as shown in Figure 4-7. The external trigger input of the oscilloscope should be connected to pin 6 of the HP-IB cable or A2A9U14, pin 15. An HP-IB adapter (HP 10834A) can be used to make a permanent trigger adapter for this test.

WARNING

To access A2A9U14 the instrument's protective cover must be removed. This should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

PERFORMANCE TESTS

OUTPUT LEVEL SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

2. Set the oscilloscope for external triggering, positive trigger slope, triggered sweep mode (or NORM) and 2 ms per division sweep time.

NOTE

The following programs are for the HP 9826 or HP 9836 controller. For use with the HP 85B controller, increase the wait statements by a factor of 1000. This is necessary because the HP 9826 and HP 9836 execute wait commands in seconds while the HP 85B executes wait commands in milliseconds.

3. Load and run the following HP-IB controller program. As the program is executing, adjust the trigger controls for a stable oscilloscope display.

```
10  CLEAR 719
                          3.0 GHz, +3 dBm, Ext ALC
20  OUTPUT 719;"A3000000Z103075"
30  GOTO 20
40  END
```

4. Press the pause key on the controller. Load the following HP-IB controller program.

```
                          Controller talk, CW Generator listen
10  SEND 7;MTA LISTEN 19
20  FOR X=1 TO 50
                          0 dB range, Ext ALC
30  OUTPUT 7;"K0"
                          30 for HP 85B (30 ms)
40  WAIT .03
                          Ready for change to -110 dB Range
50  OUTPUT 7;"K"
60  WAIT .7
                          700 for HP 85B (700 ms)
70  OUTPUT 7;";"
                          Change to -110 dB Range
80  WAIT .05
                          50 for HP 85B (50 ms)
90  NEXT X
100 END
```

PERFORMANCE TESTS

OUTPUT LEVEL SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

NOTE

Run this program only as long as necessary to make the level switching measurements. This measurement cycles the attenuator which causes mechanical wear. The program limits the number of cycles to 50, however, if a digitizing oscilloscope is available only one cycle is needed.

5. Run the program and measure the switching time by observing the signal on the oscilloscope display. Refer to Figure 4-8.

_________ <20 ms

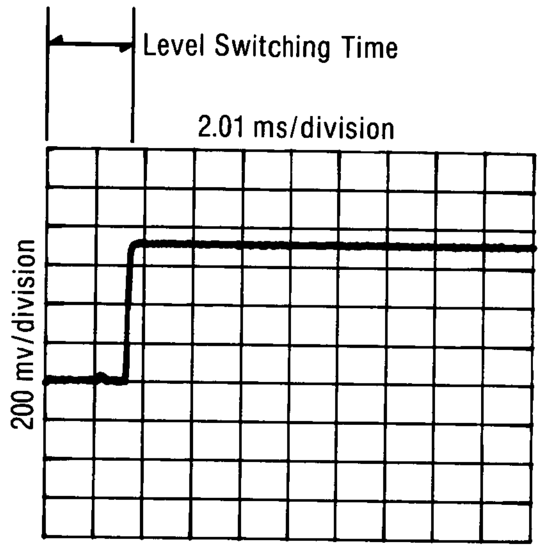


Figure 4-8. Output Level Switching Time Measurement Waveform

PERFORMANCE TESTS

4-12. HARMONICS, SUBHARMONICS, & MULTIPLES TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Harmonics	<−25 dBc	Output level +8 dBm
Subharmonics and Multiples Thereof	<−25 dBc	Output level +8 dBm

Description

This test checks the amplitude of various harmonics of the CW Generator's output signal in the multiplied frequency bands (>6.2 GHz), subharmonics and multiples (harmonics of the internal fundamental signal) are also checked for specific levels. Reasonable care must be taken to ensure that the harmonics are not being generated by the spectrum analyzer.

Equipment

Spectrum Analyzer .... HP 8566B

Procedure

1. Connect the CW Generator RF OUTPUT to the input of the spectrum analyzer as shown in Figure 4-9.

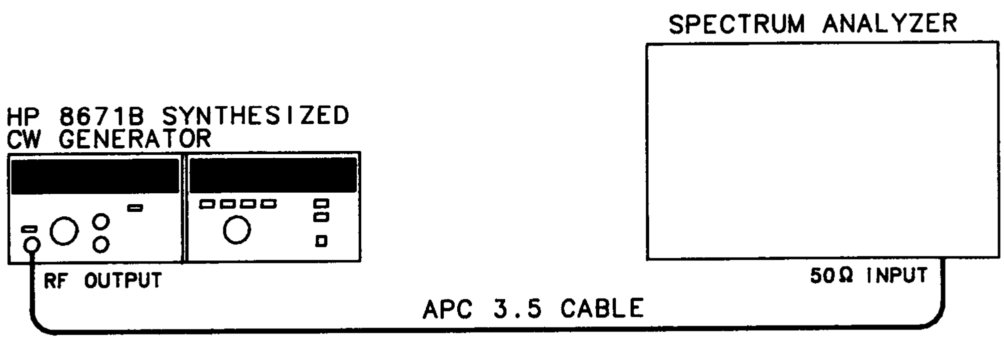


Figure 4-9. Harmonics, Subharmonics, and Multiples Test Setup

2. Tune the CW Generator to 4 000.000 MHz and output level of +8 dBm.

3. Set the spectrum analyzer controls to display the fundamental signal. Set the resolution bandwidth to 10 kHz and the input attenuation to 40 dB. Adjust the log reference level to set the displayed signal at the top graticule line of the display.

4. Tune the CW Generator to 2 000.000 MHz. The second harmonic, now displayed at 4 000.000 MHz, should be greater than 25 dB below the reference.

_________ <−25 dBc

5. Repeat steps 2 through 4, at the other CW Generator frequencies listed, to check each harmonic, subharmonic, and multiple listed in the following table. Record the measurements in Table 4-3.

PERFORMANCE TESTS

HARMONICS, SUBHARMONICS, & MULTIPLES TEST (cont'd)

Procedure (cont'd)

NOTE

This procedure may be repeated for any fundamental frequency of interest within the CW Generator frequency range.

Harmonics, Subharmonics, and Multiples

Set Signal Generator to	Check Harmonic Levels at:			
FUNDAMENTAL	HARMONIC	SUBHARMONIC		MULTIPLE
(GHz)	(GHz)	1/3	1/2	2/3
2.000 000	4.000 000			
4.000 000	8.000 000			
6.000 000	12.000 000			
8.000 000	16.000 000		4.000 000	
10.000 000	20.000 000		5.000 000	
11.000 000	22.000 000		5.500 000	
14.000 000		4.666 667		9.333 333
16.000 000		5.333 333		10.666 667
18.000 000		6.000 000		12.000 000
LIMITS	<−25 dBc	−25 dBc		

PERFORMANCE TESTS

HARMONICS, SUBHARMONICS, & MULTIPLES TEST (cont'd)

Table 4-3. Harmonics, Subharmonics & Multiples Test Record

Test		Results		
		Min.	Actual	Max.
Fundamental	Harmonic or Subharmonic			
2.000 000 GHz	4.000 000 GHz 2f		______	−25 dBc
4.000 000 GHz	8.000 000 GHz 2f		______	−25 dBc
6.000 000 GHz	12.000 000 GHz 2f		______	−25 dBc
8.000 000 GHz	16.000 000 GHz 2f		______	−25 dBc
8.000 000 GHz	4.000 000 GHz 1/2f		______	−25 dBc
10.000 000 GHz	20.000 000 GHz 2f		______	−25 dBc
10.000 000 GHz	5.000 000 GHz 1/2f		______	−25 dBc
11.000 000 GHz	22.000 000 GHz 2f		______	−25 dBc
11.000 000 GHz	5.000 000 GHz 1/2f		______	−25 dBc
14.000 000 GHz	4.666 667 GHz 1/3f		______	−25 dBc
14.000 000 GHz	9.33 3333 GHz 2/3f		______	−25 dBc
16.000 000 GHz	5.333 333 GHz 1/3f		______	−25 dBc
16.000 000 GHz	10.666 667 GHz 2/3f		______	−25 dBc
18.000 000 GHz	6.000 000 GHz 1/3f		______	−25 dBc
18.000 000 GHz	12.000 000 GHz 2/3f		______	−25 dBc

PERFORMANCE TESTS

4-13. NON-HARMONICALLY RELATED SPURIOUS SIGNALS TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Spurious		
Non-Harmonically	<−70 dBc	2.0 to 6.2 GHz
Related	<−64 dBc	6.2 to 12.4 GHz
	<−60 dBc	12.4 to 18.0 GHz

Description This test checks for any spurious signals in the CW Generator's RF output signal. The spectrum analyzer is calibrated for a reference level of −50 dBc and is tuned to any frequency from 2.0 to 6.2 GHz in search of spurious signals.

NOTE

The non-harmonically related spurious signals will always increase in amplitude above 6.2 GHz, due to multiplication in the internal YIG tuned multiplier. The increase is determined by a strict mathematical relationship. Therefore, satisfactory performance in the 2 to 6.2 GHz range will always ensure meeting the less stringent specification in the multiplied ranges, that is, from 6.2 to 18.0 GHz.

Equipment Spectrum Analyzer .... HP 8566B

Procedure

1. Connect the CW Generator's RF OUTPUT to the input of the spectrum analyzer as shown in Figure 4-10.

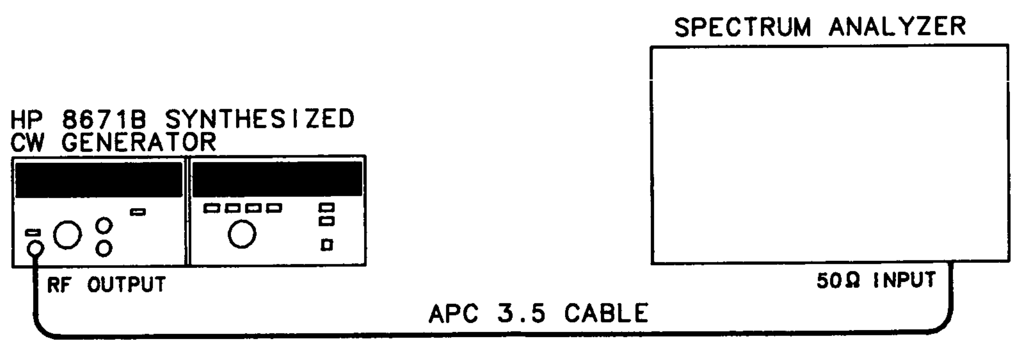


Figure 4-10. Non-Harmonically Related Spurious Signals Test Setup

2. Tune the CW Generator to 3 000.000 MHz and set the output level to −50 dBm.
3. Set the spectrum analyzer controls to display the fundamental signal. Set the resolution bandwidth to 1 kHz and the frequency span per division to 10 kHz.
4. Set the spectrum analyzer controls so that the carrier signal is at the top graticule line.

PERFORMANCE TESTS

NON-HARMONICALLY RELATED SPURIOUS SIGNALS TEST (cont'd)

Procedure (cont'd)

5. Using the RANGE selector, increase the CW Generator's output level to 0 dBm. Do not adjust the spectrum analyzer amplitude calibration. The top graticule line now represents −50 dBc.

6. Tune the spectrum analyzer to any desired frequency in search of non-harmonically related spurious signals. Verify that any signals found are non-harmonically related and are not generated by the spectrum analyzer. Verify that the spurious signals are below the specified limits. Record the results.

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Level
3 000 MHz	____________	____________
3 000 MHz	____________	____________

7. Repeat step 2 through 6 for any desired carrier frequency from 2 000.000 to 6 199.999 MHz. Record the results. (Checking non-harmonically related spurious signals from 2.0 to 6.2 GHz provides a high level of confidence that the instrument meets its published specifications from 2 to 18 GHz.)

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Level
____________	____________	____________
____________	____________	____________
____________	____________	____________
____________	____________	____________

PERFORMANCE TESTS

4-14. POWER LINE RELATED SPURIOUS SIGNALS TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Power line related and fan rotation related within 5 Hz below line frequencies and multiples therof		**2.0—6.2 GHz**
	−50 dBc	<300 Hz offset from carrier
	−60 dBc	300 Hz to 1 kHz offset from carrier
	−65 dBc	>1 kHz offset from carrier
		6.2—12.4 GHz
	−44 dBc	<300 Hz offset from carrier
	−54 dBc	300 Hz to 1 kHz offset from carrier
	−59 dBc	>1 kHz offset from carrier
		12.4—18.0 GHz
	−40 dBc	<300 Hz offset from carrier
	−50 dBc	300 Hz to 1 kHz offset from carrier
	−55 dBc	>1 kHz offset from carrier

Description

The Unit Under Test and local oscillator are isolated from vibration by placing the instruments on two-inch thick foam pads. This eliminates the effects of microphonic spurious signals due to vibrations..

The primary power source is isolated from the power source used for the spectrum analyzer and the local oscillator to differentiate the power line related spurious signals from other power line related spurious signals.

NOTE

The Unit Under Test must be operated at a power line frequency different than that of the local oscillator and spectrum analyzer. This avoids the summing of the power line spurious signals.

Equipment

Local Oscillator .... HP 8340A
Spectrum Analyzer .... HP 3580A
Mixer .... RHG DMS1-18
Variable Frequency AC Power Source .... 501TC/800T, California Instruments

Procedure

1. Place the CW Generator on a 2-inch foam pad. Connect the equipment as shown in Figure 4-11.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

PERFORMANCE TESTS

POWER LINE RELATED SPURIOUS SIGNALS TEST (cont'd)

Procedure (cont'd)

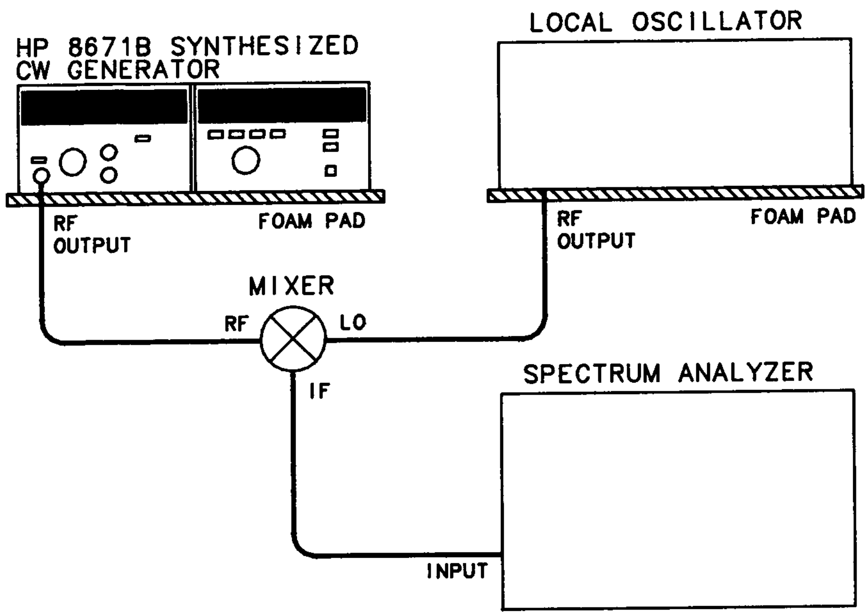


Figure 4-11. Power Line Related Spurious Signals Test Setup

2. Tune the CW Generator to 3 000.000 MHz and set the output level to −20 dBm.

3. Set the local oscillator to 3 000.020 MHz at +7 dBm.

4. Set the spectrum analyzer start frequency to 20 kHz, resolution bandwidth to 3 Hz.

5. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so the peak of the 20 kHz signal is at the top graticule line. Verify that the line related spurious signals of the CW Generator do not exceed the values shown below. Record the highest spurious signal level in each offset band.

   2.0 — 6.2 GHz <300 Hz offset ________ −50 dBc

   300 Hz — 1 kHz offset ________ −60 dBc

6. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the highest spurious signal level.

   2.0 — 6.2 GHz >1 kHz offset ________ −65 dBc

7. Tune the CW Generator and the local oscillator to 7 000.000 MHz and 7 000.020 MHz respectively.

PERFORMANCE TESTS

POWER LINE RELATED SPURIOUS SIGNALS TEST (cont'd)

Procedure (cont'd)

8. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so that the peak of the 20 kHz signal is at the top graticule line. Verify that the line related spurious signals of the CW Generator do not exceed the values shown below. Record the highest spurious signal level in each offset band.

   6.2 — 12.4 GHz <300 Hz offset frequency ________ −44 dBc

   300 Hz — 1 kHz offset frequency ________ −54 dBc

9. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the spurious signal levels.

   6.2 — 12.4 GHz >1 kHz offset frequency ________ −59 dBc

10. Tune the CW Generator and the local oscillator to 16 000.000 MHz and 16 000.020 MHz respectively.

11. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so that the 20 kHz signal is at the top graticule line. Verify that the line related spurious signals of the CW Generator do not exceed the values shown in the table. Record the highest spurious signal level in each offset band.

   12.4 — 18.0 GHz <300 Hz offset frequency ________ −40 dBc

   300 Hz — 1 kHz offset frequency ________ −50 dBc

12. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the spurious signal levels.

   12.4 — 18.0 GHz >1 kHz offset frequency ________ −55 dBc

PERFORMANCE TESTS

4-15. SINGLE-SIDEBAND PHASE NOISE TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY Single-sideband Phase Noise (1 Hz bandwidth)		**2.0 — 6.2 GHz**
	−58 dBc	10 Hz offset from carrier
	−70 dBc	100 Hz offset from carrier
	−78 dBc	1 kHz offset from carrier
	−86 dBc	10 kHz offset from carrier
	−110 dBc	100 kHz offset from carrier
		6.2 — 12.4 GHz
	−52 dBc	10 Hz offset from carrier
	−64 dBc	100 Hz offset from carrier
	−72 dBc	1 kHz offset from carrier
	−80 dBc	10 kHz offset from carrier
	−104 dBc	100 kHz offset from carrier
		12.4 — 18.0 GHz
	−48 dBc	10 Hz offset from carrier
	−60 dBc	100 Hz offset from carrier
	−68 dBc	1 kHz offset from carrier
	−76 dBc	10 kHz offset from carrier
	−100 dBc	100 kHz offset from carrier

Description

The RF output of the CW Generator is mixed with a local oscillator to obtain a 40 kHz or 200 kHz IF signal. The phase noise sidebands are observed on a spectrum analyzer. Correction factors are applied to compensate for using the spectrum analyzer in the log mode, for local oscillator noise contributions, and for using bandwidths wider than 1 Hz.

NOTE

Normally, phase quadrature needs to be maintained between the CW Generator and the local oscillator for true phase noise measurement. However, the additional amplitude noise components are so small that they are not significant in these tests.

Equipment

Local Oscillator .... HP 8340A
Low Frequency Spectrum Analyzer .... HP 3580A
High Frequency Spectrum Analyzer ...... HP 8566B
Mixer .... RHG DMS1-18

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

NOTE

The signal-to-phase noise ratio as measured must be corrected to compensate for 3 errors contributed by the measurement system. These are

a. Using the spectrum analyzer in the log mode requires a +2.5 dB correction.

b. Equal noise contributed by the local oscillator requires a −3 dB correction.

c. The spectrum analyzer noise measurement must be normalized to a 1 Hz noise equivalent bandwidth. The noise equivalent bandwidth for HP spectrum analyzers is 1.2 times the 3 dB bandwidth.

For a 3 Hz bandwidth, the correction factor for the normalized measurement bandwidth would be:

$$\text{Normalizing Factor dB} = 10 \log (1.2 \times 3\ \text{Hz}/1\text{Hz}) = 5.56\ \text{dB}.$$

The total correction for 3 Hz bandwidth would be:

True measurement (dBc) = Reading (dBc) − 5.56 + 2.5 − 3 = Reading (dBc) *−6.06 dB.*

Procedure

1. Set the low frequency spectrum analyzer's start frequency to 40 kHz, resolution bandwidth to 1 Hz, and frequency span per division to 5 Hz.
2. Connect the equipment as shown in Figure 4-12.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

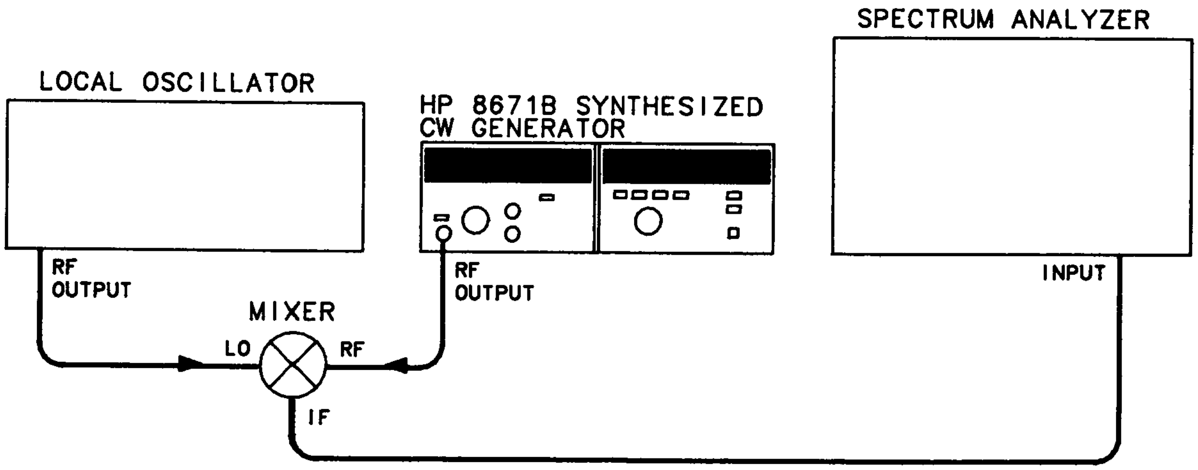


Figure 4-12. Single-Sideband Phase Noise Test Setup

3. Tune the CW Generator to 6 100.000 MHz and set the output level to −20 dBm.
4. Set the local oscillator to 6 100.040 MHz at +8 dBm.

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

5. Set the spectrum analyzer controls so that the peak of the 40 kHz signal is at the top graticule line.

6. Observe the phase noise level 10 Hz from the carrier. It should be greater than 56.7 dB below the carrier. Record the measured level.

   Measured ____________
   Correction −1.30 dB
   Actual level ____________ <−58 dBc

7. Tune the CW Generator and the local oscillator to 12 200.000 MHz and 12 200.040 MHz respectively.

8. Observe the phase noise level 10 Hz from the carrier. It should be greater than 50.07 dB below the carrier. Record the measured level.

   Measured ____________
   Correction −1.30 dB
   Actual level ____________ <−52 dBc

9. Tune the CW Generator and the local oscillator to 18 000.000 MHz and 18 000.039 MHz respectively.

10. Observe the noise level 10 Hz from the carrier. It should be greater than 46.7 dB below the carrier. Record the measured level.

    Measured ____________
    Correction −1.30 dB
    Actual level ____________ <−48 dBc

11. Set the spectrum analyzer controls for a resolution bandwidth of 3 Hz and a frequency span per division of 20 Hz. Using a 3 Hz bandwidth requires a 6.06 dB correction factor.

12. Repeat steps 3 through 10 except observe the noise 100 Hz from the carrier. Record the results below.

Frequency	Measured	Correction	Actual	Limit
6100.000 MHz	________	−6.06 dB =	________	−70 dBc
12 200.000 MHz	________	−6.06 dB =	________	−64 dBc
18 000.000 MHz	________	−6.06 dB =	________	−60 dBc

13. For the remainder of this procedure, use the high frequency spectrum analyzer. Set the spectrum analyzer resolution bandwidth to 30 Hz and frequency span per division to 200 Hz. The 30 Hz bandwidth requires 16.06 dB correction.

14. Tune the CW Generator and the local oscillator to 6 100.000 MHz and 6 100.200 MHz respectively.

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

15. Tune the spectrum analyzer to place the 200 kHz IF signal at the left edge of the display. Set the spectrum analyzer controls to place the peak of the signal at the top graticule line. Increase the log reference level control to move the peak of the carrier 20 dB above the top graticule line. (The top graticule line is now −20 dBc.)

16. Observe the phase noise level 1 kHz from the carrier. The observed level should be greater than 62 dB below the carrier. Record the measured level.

Measured ______
Correction −16.06 dB
Actual Level ______ <−78 dBc

17. Tune the CW Generator and the local oscillator to 12 200.000 MHz and 12 200.200 MHz respectively.

18. Observe the noise level 1 kHz from the carrier. The observed level should be greater than 56 dB below the carrier. Record the measured level.

Measured ______
Correction −16.06 dB
Actual Level ______ <−72 dBc

19. Tune the CW Generator and the local oscillator to 18 000.000 MHz and 18 000.200 MHz respectively.

20. Observe the noise level 1 kHz from the carrier. The observed level should be greater than 52 dB below the carrier. Record the measured level.

Measured ______
Correction −16.06 dB
Actual Level ______ <−68 dBc

21. Set the spectrum analyzer for a resolution bandwith of 300 Hz and a frequency span per division of 2 kHz. Using a 300 Hz bandwidth requires a 26.06 dB correction factor.

22. Repeat steps 14 through 20 except observe the noise 10 kHz from the carrier. Record the results below.

Frequency	Measured	Correction	Actual	Limit
6100.000 MHz	______	−26.06 dB	______	−86 dBc
12 200.000 MHz	______	−26.06 dB =	______	−80 dBc
18 000.000 MHz	______	−26.06 dB =	______	−76 dBc

23. Set the spectrum analyzer controls for a resolution bandwidth of 3 kHz and a frequency span per division of 20 kHz. Using a 3 kHz bandwidth requires a 36.06 dB correction factor.

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

24. Repeat steps 14 through 20 except observe the noise 10 kHz from the carrier. Record the results below.

Frequency	Measured	Correction	Actual	Limit
6100.000 MHz	________	−36.06 dB =	________	−110 dBc
12 200.000 MHz	________	−36.06 dB =	________	−100 dBc
18 000.000 MHz	________	−36.06 dB =	________	−100 dBc

PERFORMANCE TESTS

4-16. INTERNAL TIME BASE AGING RATE

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Reference Oscillator		
Frequency	10 MHz	After a 10 day warmup (typically 24 hours in a normal operating environment)
Aging Rate	$<5 \times 10^{-10}$/day	
Accuracy and Stability	Same as reference oscillator	

Description A reference signal from the CW Generator (10 MHz OUT) is connected to the oscilloscope's vertical input. A frequency standard (with long term stability greater than 1×10^{-10}) is connected to the trigger input. The time required for a specific phase change is measured immediately and after a period of time. The aging rate is inversely proportional to the absolute value of the difference in the measured times.

Equipment

Frequency Standard .... HP 5065A
Oscilloscope .... HP 1980B

NOTE

Be sure the CW Generator has had 10 days to warm up before beginning this test. If the CW Generator was disconnected from the power line for less than 24 hours, only a 24 hour warm-up is needed.

Procedure

1. Set the rear panel FREQ REFERENCE INT-EXT switch to the INT position.
2. Connect the equipment as shown in Figure 4-13.

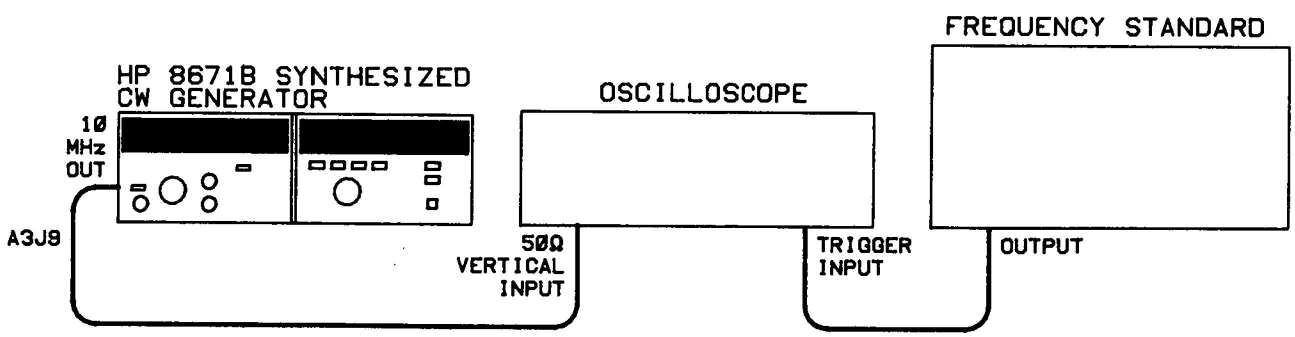


Figure 4-13. Internal Time Base Aging Rate Test Setup

3. Adjust the oscilloscope controls for a stable display of the 10 MHz CW Generator output.

PERFORMANCE TESTS

INTERNAL TIME BASE AGING RATE (cont'd)

Procedure (cont'd)

4. Measure the time required for a phase change of 360°. Record the time (T_1) in seconds.

T_1 = ________ s

5. Wait for a period of time (from 3 to 24 hours) and re-measure the phase change time. Record the period of time between measurements (T_2) in hours and the new phase change time (T_3) in seconds.

T_2 = ________ h

T_3 = ________ s

6. Calculate the aging rate from the following equation:

$$\text{Aging Rate} = \left| \left(\frac{1\ \text{cycle}}{f} \right) \left(\frac{1}{T_1} - \frac{1}{T_3} \right) \left(\frac{T}{T_2} \right) \right|$$

where: 1 cycle = the phase change reference for the time measurement (in this case, 360°)
f = CW Generator's reference output frequency (10 MHz)
T = specified time for aging rate (24h)
T_1 = initial time measurement(s) for a 360° (1 cycle) change
T_2 = time between measurements (h)
T_3 = final time measurement(s) for a 360° (1 cycle) change

for example:

if T_1 = 351s
T_2 = 3h
T_3 = 349s

then:

$$\text{Aging Rate} = \left| \left(\frac{1\ \text{cycle}}{10\ \text{MHz}} \right) \left(\frac{1}{351\text{s}} - \frac{1}{349\text{s}} \right) \left(\frac{24\text{h}}{3\text{h}} \right) \right|$$

$$= 1.306 \times 10^{-11}$$

7. Verify that the aging rate is less than 5×10^{-10}.

NOTE

If the absolute frequencies of the frequency standard and the CW Generator's reference oscillator are extremely close, the measurement time in steps 5 and 6 (T_1 and T_3) can be reduced by measuring the time required for a phase change of something less than 360°. Change 1 cycle in the formula (i.e., 180° = 1/2 cycle, 90° = 1/4 cycle).

Aging Rate ________ $<5 \times 10^{-10}$/day

Table 4-4. Performance Test Record (1 of 6)

Hewlett-Packard Company
Model 8671B
Synthesized CW Generator
Serial Number ______________

Tested by ______________

Date ______________

Para. No.	Test		Results Min.	Actual	Max.
4-7.	FREQUENCY RANGE AND RESOLUTION TEST				
	Baseband	3 000.000	2 999.999	______	3 000.001
		2 000.000	1 999.999	______	2 000.001
		2 000.001	2 000.000	______	2 000.002
		2 001.112	2 001.111	______	2 001.113
		2 002.223	2 002.222	______	2 002.224
		2 003.334	2 003.333	______	2 003.335
		2 004.445	2 004.444	______	2 004.446
		2 005.556	2 005.555	______	2 005.557
		2 006.667	2 006.666	______	2 006.668
		2 007.778	2 007.777	______	2 007.779
		2 008.889	2 008.888	______	2 008.890
		2 009.999	2 009.998	______	2 010.000
		2090.000	2089.999	______	2090.001
		2 280.000	2 279.999	______	2 280.001
		2 470.000	2 469.999	______	2 470.001
		2 660.000	2 659.999	______	2 660.001
		2 850.000	2 849.999	______	2 850.001
		3 040.000	3 039.999	______	3 040.001
		3 230.000	3 229.999	______	3 230.001
		3 420.000	3 419.999	______	3 420.001
		3 610.000	3 609.999	______	3 610.001
		3 800.000	3 799.999	______	3 800.001
		3 990.000	3 989.999	______	3 990.001
		4 180.000	4 179.999	______	4 180.001
		4 370.000	4 369.999	______	4 370.001
		4 560.000	4 559.999	______	4 560.001
		4 750.000	4 749.999	______	4 750.001
		4 940.000	4 939.999	______	4 940.001
		5 130.000	5 129.999	______	5 130.001
		5 320.000	5 319.999	______	5 320.001
		5 510.000	5 509.999	______	5 510.001
		5 700.000	5 699.999	______	5 700.001
		5 900.000	5 899.999	______	5 900.001
		6 100.000	6 099.999	______	6 100.001
	Bands 2 and 3	10 GHz, 2 kHz Resolution		______ (√)	
		18 GHz, 3 kHz Resolution		______ (√)	

Table 4-4. Performance Test Record (2 of 6)

Para. No.	Test		Results Min.	Results Actual	Results Max.
4-8.	**FREQUENCY SWITCHING TIME TEST**				
	Frequency Switching				
	18 GHz to 2.1 GHz			______	15 ms
	2.1 GHz to 18 GHz			______	15 ms
	Amplitude Recovery				
	2.1 to 6.1 GHz, 1 kHz resolution band			______	15 ms
	6.2 to 12.3 GHz, 2 kHz resolution band			______	15 ms
	12.4 to 18.0 GHz, 3 kHz resolution band			______	15 ms
4-9.	**OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST**				
	Output Level				
	Frequency and Power at Minimum Power Point				
	2.0—18.0 GHz				
	Frequency ______				
	Minimum power		+8 dBm	______	
	Level Flatness (total variation)				
	2.0—6.2 GHz			______	1.50 dB
	2.0—12.4 GHz			______	2.00 dB
	2.0—18.0 GHz			______	2.50 dB
	High Level Accuracy				
	+8 dBm (+10 dB range)	2 GHz	+6.25 dBm	______	+ 9.75 dBm
		4 GHz	+6.25 dBm	______	+ 9.75 dBm
		6 GHz	+6.25 dBm	______	+ 9.75 dBm
		8 GHz	+6.00 dBm	______	+10.00 dBm
		10 GHz	+6.00 dBm	______	+10.00 dBm
		12 GHz	+6.00 dBm	______	+10.00 dBm
		14 GHz	+5.75 dBm	______	+10.25 dBm
		16 GHz	+5.75 dBm	______	+10.25 dBm
		18 GHz	+5.75 dBm	______	+10.25 dBm
	+3 dBm (+10 dB range)	2 GHz	+1.25 dBm	______	+4.75 dBm
		4 GHz	+1.25 dBm	______	+4.75 dBm
		6 GHz	+1.25 dBm	______	+4.75 dBm
		8 GHz	+1.00 dBm	______	+5.00 dBm
		10 GHz	+1.00 dBm	______	+5.00 dBm
		12 GHz	+1.00 dBm	______	+5.00 dBm
		14 GHz	+0.75 dBm	______	+5.25 dBm
		16 GHz	+0.75 dBm	______	+5.25 dBm
		18 GHz	+0.75 dBm	______	+5.25 dBm
	0 dBm (0 dB range)	2 GHz	−1.75 dBm	______	+1.75 dBm
		4 GHz	−1.75 dBm	______	+1.75 dBm
		6 GHz	−1.75 dBm	______	+1.75 dBm
		8 GHz	−2.00 dBm	______	+2.00 dBm

Table 4-4. Performance Test Record (3 of 6)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-9.	OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)				
	High Level Accuracy (cont'd)				
	0 dBm (0 dB range) (cont'd)	10 GHz	−2.00 dBm	______	+2.00 dBm
		12 GHz	−2.00 dBm	______	+2.00 dBm
		14 GHz	−2.25 dBm	______	+2.25 dBm
		16 GHz	−2.25 dBm	______	+2.25 dBm
		18 GHz	−2.25 dBm	______	+2.25 dBm
	−5 dBm (0 dB range)	2 GHz	−6.75 dBm	______	−3.25 dBm
		4 GHz	−6.75 dBm	______	−3.25 dBm
		6 GHz	−6.75 dBm	______	−3.25 dBm
		8 GHz	−7.00 dBm	______	−3.00 dBm
		10 GHz	−7.00 dBm	______	−3.00 dBm
		12 GHz	−7.00 dBm	______	−3.00 dBm
		14 GHz	−7.25 dBm	______	−2.75 dBm
		16 GHz	−7.25 dBm	______	−2.75 dBm
		18 GHz	−7.25 dBm	______	−2.75 dBm
	−10 dBm (0 dB range)	2 GHz	−11.75 dBm	______	−8.25 dBm
		4 GHz	−11.75 dBm	______	−8.25 dBm
		6 GHz	−11.75 dBm	______	−8.25 dBm
		8 GHz	−12.00 dBm	______	−8.00 dBm
		10 GHz	−12.00 dBm	______	−8.00 dBm
		12 GHz	−12.00 dBm	______	−8.00 dBm
		14 GHz	−12.25 dBm	______	−7.75 dBm
		16 GHz	−12.25 dBm	______	−7.75 dBm
		18 GHz	−12.25 dBm	______	−7.75 dBm
	−10 dBm (−10 dB range)	2 GHz	−12.25 dBm	______	−7.75 dBm
		4 GHz	−12.25 dBm	______	−7.75 dBm
		6 GHz	−12.25 dBm	______	−7.75 dBm
		8 GHz	−12.50 dBm	______	−7.50 dBm
		10 GHz	−12.50 dBm	______	−7.50 dBm
		12 GHz	−12.50 dBm	______	−7.50 dBm
		14 GHz	−12.85 dBm	______	−7.15 dBm
		16 GHz	−12.85 dBm	______	−7.15 dBm
		18 GHz	−12.85 dBm	______	−7.15 dBm
	−20 dBm (−20 dB range)	2 GHz	−22.45 dBm	______	−17.55 dBm
		4 GHz	−22.45 dBm	______	−17.55 dBm
		6 GHz	−22.45 dBm	______	−17.55 dBm
		8 GHz	−22.70 dBm	______	−17.30 dBm
		10 GHz	−22.70 dBm	______	−17.30 dBm
		12 GHz	−22.70 dBm	______	−17.30 dBm
		14 GHz	−23.05 dBm	______	−16.95 dBm
		16 GHz	−23.05 dBm	______	−16.95 dBm
		18 GHz	−23.05 dBm	______	−16.95 dBm

Table 4-4. Performance Test Record (4 of 6)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-10.	**LOW LEVEL ACCURACY**				
	2.0 GHz				
		−30 dBm	−32.65 dBm	________	−27.35 dBm
		−40 dBm	−42.95 dBm	________	−37.05 dBm
		−50 dBm	−53.25 dBm	________	−46.75 dBm
		−60 dBm	−63.55 dBm	________	−56.45 dBm
		−70 dBm	−73.85 dBm	________	−66.15 dBm
		−80 dBm	−84.15 dBm	________	−75.85 dBm
		−90 dBm	−94.45 dBm	________	−85.55 dBm
		−100 dBm	−104.75 dBm	________	−95.25 dBm
		−110 dBm	−115.05 dBm	________	−104.95 dBm
	10.0 GHz				
		−30 dBm	−32.90 dBm	________	−27.10 dBm
		−40 dBm	−43.20 dBm	________	−36.80 dBm
		−50 dBm	−53.50 dBm	________	−46.50 dBm
		−60 dBm	−63.80 dBm	________	−56.20 dBm
		−70 dBm	−74.10 dBm	________	−65.90 dBm
		−80 dBm	−84.40 dBm	________	−75.60 dBm
		−90 dBm	−94.70 dBm	________	−85.30 dBm
		−100 dBm	−105.00 dBm	________	−95.00 dBm
		−110 dBm	−105.30 dBm	________	−104.70 dBm
	18.0 GHz				
		−30 dBm	−33.45 dBm	________	−26.55 dBm
		−40 dBm	−43.85 dBm	________	−36.15 dBm
		−50 dBm	−54.25 dBm	________	−45.75 dBm
		−60 dBm	−64.65 dBm	________	−55.35 dBm
		−70 dBm	−75.05 dBm	________	−64.95 dBm
		−80 dBm	−85.45 dBm	________	−74.55 dBm
		−90 dBm	−95.95 dBm	________	−84.15 dBm
		−100 dBm	−106.35 dBm	________	−93.75 dBm
		−110 dBm	−107.75 dBm	________	−103.35 dBm
4-11.	**OUTPUT LEVEL SWITCHING TIME**				
		<20 ms		________	20 ms
4-12.	**HARMONICS, SUBHARMONICS, AND MULTIPLES**				
	Fundamental	**Harmonic or Subharmonic**			
	2.000000 GHz	4.000000 GHz 2f		________	−25 dBc
	4.000000 GHz	8.000000 GHz 2f		________	−25 dBc
	6.000000 GHz	12.000000 GHz 2f		________	−25 dBc

Table 4-4. Performance Test Record (5 of 6)

Para. No.	Test		Results Min.	Results Actual	Results Max.
4-12.	HARMONICS, SUBHARMONICS, AND MULTIPLES (cont'd)				
	Fundamental	**Harmonic or Subharmonic**			
	8.000 000 GHz	16.000 000 GHz 2f		________	−25 dBc
	8.000 000 GHz	4.000 000 GHz 1/2f		________	−25 dBc
	10.000 000 GHz	20.000 000 GHz 2f		________	−25 dBc
	10.000 000 GHz	5.000 000 GHz 1/2f		________	−25 dBc
	11.000 000 GHz	22.000 000 GHz 2f		________	−25 dBc
	11.000 000 GHz	5.500 000 GHz 1/2f		________	−25 dBc
	14.000 000 GHz	4.666 667 GHz 1/3f		________	−25 dBc
	14.000 000 GHz	9.333 333 GHz 2/3f		________	−25 dBc
	16.000 000 GHz	5.333 333 GHz 1/3f		________	−25 dBc
	16.000 000 GHz	10.666 667 GHz 2/3f		________	−25 dBc
	18.000 000 GHz	6.000 000 GHz 1/3f		________	−25 dBc
	18.000 000 GHz	12.000 000 GHz 2/3f		________	−25 dBc
4-13.	NON-HARMONICALLY RELATED SPURIOUS SIGNALS (CW AND AM MODES)				
	Carrier Frequency	**Spurious Signal Frequency**		**Spurious Signal Level**	
	2.0 to 6.2 GHz				
	3 000 MHz	________		________	−70 dBc
	________	________		________	−70 dBc
	________	________		________	−70 dBc
	________	________		________	−70 dBc
	________	________		________	−70 dBc
	________	________		________	−70 dBc
4-14.	POWER LINE RELATED SPURIOUS SIGNALS				
		Offset Frequency			
	2.0—6.2 GHz				
	<300 Hz offset	________		________	−50 dBc
	300 Hz—1 kHz offset	________		________	−60 dBc
	>1 kHz offset	________		________	−65 dBc
	6.2—12.4 GHz				
	<300 Hz offset	________		________	−44 dBc
	300 Hz—1 kHz offset	________		________	−54 dBc
	>1 kHz offset	________		________	−59 dBc
	12.4—18.0 GHz				
	<300 Hz offset	________		________	−40 dBc
	300 Hz—1 kHz offset	________		________	−50 dBc
	>1 kHz offset	________		________	−55 dBc

Table 4-4. Performance Test Record (6 of 6)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-14.	**SINGLE-SIDEBAND PHASE NOISE**				
	10 Hz offset from carrier	6100 MHz		________	−58 dBc
		12 200 MHz		________	−52 dBc
		18 000 MHz		________	−48 dBc
	100 Hz offset from carrier	6100 MHz		________	−70 dBc
		12 200 MHz		________	−64 dBc
		18 000 MHz		________	−60 dBc
	1 kHz offset from carrier	6100 MHz		________	−78 dBc
		12 200 MHz		________	−72 dBc
		18 000 MHz		________	−68 dBc
	10 kHz offset from carrier	6100 MHz		________	−86 dBc
		12 200 MHz		________	−80 dBc
		18 000 MHz		________	−76 dBc
	100 kHz offset from carrier	6100 MHz		________	−110 dBc
		12 200 MHz		________	−104 dBc
		18 000 MHz		________	−100 dBc
4-15.	**INTERNAL TIME BASE AGING RATE**			________	5×10^{-10}/day

V Adjustments

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

This section contains adjustments and checks that assure peak performance of the CW Generator. This instrument should be readjusted after repair to assure performance. Allow a one hour warm-up prior to performing the adjustments. If the mains power cable is removed and reinstalled during an adjustment, be sure that the OVEN status annunciator is off before proceeding with the adjustment.

The order in which the adjustments are made is critical. Prior to making any adjustments, refer to the paragraph titled Related Adjustments.

Determining the adjustments to be performed after a component failure and subsequent repair or a performance test failure is important. This will help keep the adjustment time to a minimum. After the repair and/or adjustment, performance tests are usually required to verify proper performance. Refer to the paragraph titled Related Adjustments.

5-2. SAFETY CONSIDERATIONS

This section contains information, cautions and warnings which must be followed for your protection and to avoid damage to the equipment.

WARNINGS

Maintenance described in this section is performed with power supplied to the instrument and with protective covers removed. Maintenance should be performed only by service trained personnel who are aware of the hazard involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

A pin-to-pin voltage difference of 60 Vdc may be found on many of the CW Generator's circuit board connectors. If a circuit board is placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

5-3. EQUIPMENT REQUIRED

Each adjustment procedure contains a list of required test equipment and accessories. The test equipment is identified by callouts in the test setup diagrams included with each procedure.

If substitutions must be made for the specified test equipment, refer to Table 1-3 for the critical specifications. It is important that the test equipment meet the critical specifications listed in the table if the CW Generator is to meet its performance requirements.

The HP 11712A Support Kit is an accessory item available from Hewlett-Packard for use in servicing the CW Generator.

5-4. FACTORY SELECTED COMPONENTS

Factory selected components are identified on the schematics and parts list by an asterisk (*) that follows the reference designator. The nominal value of the component is shown. The manual change sheets will provide updated information pertaining to selected components. Table 5-1 lists the reference designator, the service sheet where the component is shown, the normal value range, and the criteria used for selecting a particular value.

5-5. RELATED ADJUSTMENTS

If all the adjustments are to be performed, they should be done in order of appearance in this manual.

In the event of a performance test or component failure, it must be determined if an individual adjustment procedure should be performed or if the instrument should be repaired. Tables 5-2 and 5-3 indicate the required action in either case.

After the instrument is repaired or adjusted, Performance Tests in Section IV must be performed to verify proper operation of the CW Generator. Tables 5-2 and 5-3 can also be used as a guideline when repairing or adjusting the instrument.

Table 5-1. Factory Selected Components

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A3A1A2C8 and A3A1A2L4	2	0 to 12.0 pF 0.22 to .68 μH	100 MHz VCXO Assembly. Centers the frequency adjustment range of A3A1A2C4 around 100 MHz. Refer to the 100 MHz VCXO Adjustment procedure.
A3A1A2R67, R68, and R69	2	Refer to Table in 100 MHz VCXO adjustment	100 MHz VCXO Assembly. Required change in attenuation necessary for a −10 dBm output level of the 400 MHz signal. Refer to the 100 MHz VCXO Adjustment procedure.
A3A1A5C38, R36, R40, and R41	5	R36: 82.5 or 56.2Ω R41: 100Ω or deleted R40: 51.1Ω or C38 at 27 pF	M/N 5—45 MHz IF Output. If the power output from the IF OUT jack (A3A1A5J2) is less than −12 dBm at any frequency between 5 MHz to 45 MHz, replace R36 82.5Ω with a 56.2Ω resistor, R40 51.1Ω with C38 27 pF capacitor, and remove R41. Proper power output level is between 0 and −12 dBm from 5 to 45 MHz. If this range cannot be met, service may be required.
A3A3R43	34	12 to 14.7 kΩ	Positive Regulator Assembly. Select so that pin 2 of V1 Power Up/Down Detector is 0.1 to 0.2V lower than the +5.2V Power Supply.
A3A9A5C10	11	20—22 pF	Sampler Assembly. Centers YTO phase detector sampler response. Refer to YTO Sampler Adjustment.
A3A9A5C2	11	120—150 pF	Selected for proper IF gain. Perform YTO Sampler Adjustment in this section.
A3A9A4R20	12	348Ω to 1.21 kΩ	YTO Assembly. Sets YTO Phase-Locked Loop gain crossover to 20 ±2 kHz. Refer to the YTO Phase Detector Adjustment.

Table 5-2. Performance Test Failure and Required Action (1 of 2)

Performance Test Failure	Required Action	Repeat Performance Test(s)
Frequency Range and Resolution	Check phase-locked loops. See Service Sheets BD2, 3 and 4.	Frequency Range and Resolution.
Frequency Switching Time	Repair or adjust the phase-locked loop or the remote programming circuit boards A2A7 and A2A9.	Frequency Switching Time. Frequency Range and Resolution.
Output Level, High Level Accuracy and Flatness	Perform Flatness and ALC adjustment. Check output attenuator. See Service Sheets BD5 and BD6.	Output Level, High Level Accuracy and Flatness.
Low Level Accuracy	Check attenuator and level control assembly. See Service Sheets BD5 and BD6.	Low Level Accuracy, Output Level, High Level Accuracy and Flatness.

Table 5-2. Performance Test Failure and Required Action (2 of 2)

Performance Test Failure	Required Action	Repeat Performance Test(s)
Output Level Switching Time	Repair the level control assembly or replace the output attenuator.	Output Level Switching Time
Harmonics, Subharmonics, and Multiples	Perform YTM, ALC and Flatness adjustments. Check the YTM. See Service Sheet BD5.	Harmonics, Subharmonics, and Multiples. Output Level, High Level Accuracy and Flatness.
Non-Harmonically Related Spurious Signals	This problem can occur anywhere in the instrument. Isolate the defective component and make adjustments as required (see Table 5-3).	Non-Harmonically Related Spurious Signals.
Power Line Related Spurious Signals	Refer to Section VIII, Power Supply Schematics, Service Sheets 33—35.	Power Line Related Spurious Signals.
Single-Sideband Phase Noise	Check phase-locked loops. See Service Sheets BD2, 3, and 4.	Single-Sideband Phase Noise. Frequency Range and Resolution.
Internal Time Base Aging Rate	Replace A3A8 or repair power supply.	Internal Time Base Aging Rate.

NOTES

Some obscure performance failures (power level, phase noise, etc.) can be caused by failure of phase-locked loops. Therefore, Frequency Range and Resolution tests should be performed before troubleshooting other failures.

If the output frequency is incorrect or any of the phase-lock loops are unlocked, make the appropriate adjustments and (if necessary) refer to Section VIII for repair information. After adjustment or repair, check for the correct frequency and verify that the phase-locked loops are locked. Perform the single-sideband phase noise test.

Table 5-3. Post-Repair Adjustments (1 of 2)

Repaired Assembly	Adjustments
A1AT1 Programmable Attenuator	ALC, Flatness, and External Leveling.
A1A3 YTM Assembly	YTM, Power Clamp, ALC, Flatness, and External Leveling.
A1A5, A6, A7, A8 YTM and ALC Circuits	YTM, ALC, Flatness, and External Leveling.
A1A6 External Leveling Circuits Only	External Leveling
A1A12 Power Amplifier	YTM, ALC, Flatness, and External Leveling.
A1DC1 — Directional Coupler	Flatness and ALC

Table 5-3. Post-Repair Adjustments (2 of 2)

Repaired Assembly	Adjustments
A2A3, A2A4, A2A5 — LFS Phase-Locked Loop Circuits	20/30 MHz Divider Bias 160—140 MHz VCO Pretune 20/30 Phase Detector Notch Filter
A3A2, A3A3, A3A4 — Power Supplies	Power Supply
A3A1A1, A3A1A2 — Time Base Reference	100 MHz VCXO
A3A1A3, A3A1A4, A3A1A5 — M/N Phase-Locked Loop Circuits.	M/N VCO
A3A5 — DAC Assembly A3A6 — YTO Driver Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Sampler YTO Phase Detector
A3A7 — YTO HF Coil Driver Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Sampler YTO Phase Detector
A3A9A3 — 2.0 to 6.2 GHz YTO Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Sampler YTO Phase Detector

ADJUSTMENTS

5-6. POWER SUPPLY ADJUSTMENTS

Reference Service Sheets 33—35.

Description This procedure adjusts the +22 volt and +20 volt power supplies to their required tolerance. The remaining supply voltages (+11V, +5.2V, −5.2V, −10V, and −40V) are checked.

Equipment Digital Voltmeter (DVM) .... HP 3456A

Procedure

1. Set the CW Generator's rear panel FREQ STANDARD INT/EXT switch to INT.
2. Connect the DVM input to A3A2TP1 on the Rectifier Assembly.
3. Adjust +22 ADJ (A3A2R2) for a DVM reading of +22.00 ±0.02 Vdc.
4. Connect the DVM input to A3A3TP5 on the Positive Regulator Assembly.
5. Set +20 ADJ (A3A3R50) for a DVM reading of +20.000 ±0.002 Vdc.
6. Check the power supplies shown in the following table. All voltages should be within tolerance.

Power Supply	Test Point	Power Supply Voltage (Vdc)	
		Min.	Max.
+11 Vdc	A3A3TP6	+9.9	+12.1
+5.2 Vdc	A3A3TP2	+5.1	+5.3
−5.2 Vdc	A3A4TP5	−5.1	−5.3
−10 Vdc	A3A4TP4	−9.8	−10.2
−40 Vdc	A3A4TP1	−39.00	−40.60

ADJUSTMENTS

5-7. 10 MHz REFERENCE OSCILLATOR ADJUSTMENT

Reference Service Sheet 1.

Description This procedure adjusts the frequency of the internal reference oscillator using an external frequency standard.

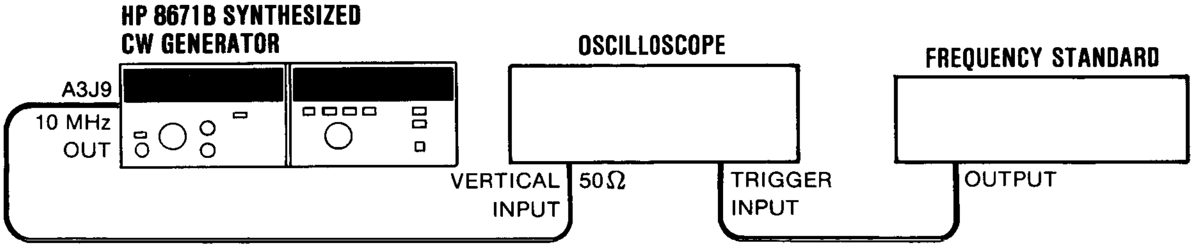


Figure 5-1. 10 MHz Reference Oscillator Adjustment Test Setup

Equipment

Frequency Standard .... HP 5065A
Oscilloscope .... HP 1980B

NOTE

Frequency drift is greatest when the instrument power cable is first connected. Therefore, for best long-term accuracy, the power cord should be connected for at least 30 days before making this adjustment.

Be sure the CW Generator has had one hour to warm up before performing the adjustment. Verify that the OVEN and NOT PHASE LOCKED status annunciators are off. If necessary, refer to the troubleshooting information in Section VIII.

Procedure

1. Set the CW Generator's rear panel FREQ STANDARD INT/EXT switch to the INT position.

2. Connect the equipment as shown in Figure 5-1. Set the vertical input of the oscilloscope for 50Ω input impedance.

3. Set the FREQ adjustment (on the A3A8 10 MHz Reference Oscillator Assembly) so the signal, as observed on the oscilloscope display, is not drifting.

4. Verify that in 10 seconds the display drifts less than 360°. A drift of 360° in 10 seconds corresponds to an adjustment accuracy of 1×10^{-8}. Adjustment accuracy is not specified for this instrument; the numbers shown are what can typically be obtained.

ADJUSTMENTS

5-8. 100 MHz VCXO ADJUSTMENT

Reference Service Sheet 2.

Description The frequency and tuning range output of the 100 MHz Voltage Controlled Crystal Oscillator (VCXO) is centered around 100 MHz. The output is set as close as practical to 100 MHz. The 400 MHz multiplied signal is adjusted for maximum output and minimum spurious signal output. An attenuator is selected to provide a 400 MHz output of −10 dBm.

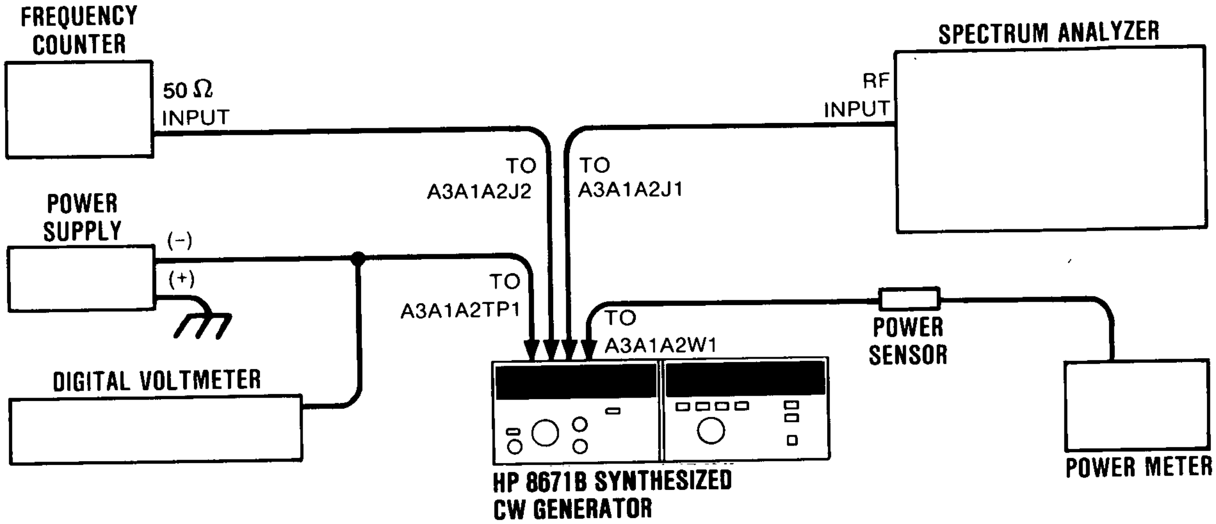


Figure 5-2. 100 MHz VCXO Adjustment Test Setup

Equipment

Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8566B
Power Supply	HP 6200B
Power Meter	HP 436A
Power Sensor	HP 8481A
Digital Voltmeter (DVM)	HP 3456A

Procedure

1. Connect the frequency counter to A3A1A2J2 in place of the termination and connect the spectrum analyzer to A3A1A2J1 in place of the gray-orange-white cable, as shown in Figure 5-2.

2. Set the output of the power supply to −8.00 ±0.01 Vdc. Connect the positive lead to ground and the negative lead to A3A1A2TP1, 100 MHz TUNE.

3. Tune A3A1A2C4, 100 MHz, for the maximum 100 MHz signal level as viewed on the spectrum analyzer display.

4. Tune A3A1A2C4 to increase the frequency (and decrease the amplitude) until the oscillation stops on the high frequency side; then tune A3A1A2C4 to start the oscillation. Continue to decrease the frequency until the oscillation stops. If the VCXO does not stop oscillating at the high end, decrease the value of A3A1A2C8 by 1 pF from its present value. If it does not stop at the low end, increase the value of A3A1A2C8 by 1 pF. If a change is necessary, repeat this step. If a value of

ADJUSTMENTS

5-8. 100 MHz VCXO ADJUSTMENT (cont'd)

Procedure (cont'd)

A3A1A2C8 cannot be found within the range of 0 to 12 pF, change A3A1A2L4 (the range of values for A3A1A2L4 is listed in step 7), then repeat this step.

5. Adjust A3A1A2C4 to obtain the maximum signal level as viewed on the spectrum analyzer display. Slowly tune to a higher frequency until the power drops by 1 dB. Record ΔF_1, that is, how far the frequency of the 1 dB point is above 100 MHz. Use the frequency counter to make the measurement to 10 Hz resolution.

   ______________ ΔF_1

6. Tune to a lower frequency until the power is decreased 1 dB on the other side of the peak. Record ΔF_2, that is, how far the frequency of the 1 dB point is below 100 MHz.

   ______________ ΔF_2

7. The VCXO centering about 100 MHz is correct if $0.5 \leq \frac{\Delta F_1}{\Delta F_2} \leq 2.$

   If the ratio is less than 0.5, decrease A3A1A2L4 one value to increase the center frequency. If the ratio is greater than 2, increase A3A1A2L4 one value to decrease the center frequency. Refer to the following table for the inductor values.

A3A1A2L4 Inductor Values

Value	HP Part Number
0.68 μH	9140-0141
0.56 μH	9100-2256
0.47 μH	9100-2255
0.39 μH	9100-2254
0.33 μH	9100-0368
0.27 μH	9100-2252
0.22 μH	9100-2251

8. If the inductor value is changed, repeat steps 3 through 7.

9. Adjust A3A1A2C4 to obtain a VCXO output of 100 MHz ±100 Hz.

10. Disconnect the spectrum analyzer from A3A1A2J1 and reconnect the gray-orange-white cable.

11. Disconnect the 400 MHz Output cable (gray-red-white cable) from A3A1A5J1 and connect the cable to the spectrum analyzer. Set the spectrum analyzer's controls for a center frequency of 500 MHz, frequency span per division 100 MHz, and vertical sensitivity per division 10 dB log. Adjust the 400 MHz A3A1A2C3, C2, and C1 adjustments in that order to obtain the maximum 400 MHz signal with the lowest harmonic levels possible.

ADJUSTMENTS

5-8. 100 MHz VCXO ADJUSTMENT (cont'd)

Procedure (cont'd)

12. Check the various harmonics of the 100 MHz signal relative to the 400 MHz signal level. The 200 and 800 MHz harmonics should be greater than 25 dB down; 100, 300, 500, 600, 700, and 900 MHz harmonics should be greater than 35 dB down. If necessary, repeat steps 11 and 12.

13. Disconnect the spectrum analyzer from the gray-red-white cable and connect the cable to the power meter.

14. Check the power meter reading. The power should be −10 to −13 dBm. If the power is incorrect, select the values of A3A1A2R67, R68, and R69 from the Attenuator Resistor Values Table to obtain the proper power level. The attenuation should always be 3 dB or greater.

Attenuator Resistor Values

Attenuation (dB)	Resistors (ohms)		
	R67	R68	R69
3	261	17.8	261
4	215	23.7	215
5	178	31.6	178
6	147	38.3	147
7	133	46.4	133
8	121	51.1	121
9	110	61.9	110

15. If the amount of attenuation is changed, recheck the harmonic levels.

16. Set the CW Generator's LINE switch to STANDBY. Disconnect all test equipment except the DVM and reconnect all instrument cables.

17. Set the CW Generator's LINE switch to ON. Verify that the dc voltage at A3A1A2TP1 is −8 ±1 Vdc. If the voltage is out of tolerance, repeat step 9 or check the 10 MHz Reference Adjustment.

18. Connect the frequency counter to the CW Generator's RF OUTPUT connector.

19. Verify that the counter reading is within ±1 kHz of the CW Generator's FREQUENCY MHz display at 2000 and 6199 MHz.

ADJUSTMENTS

5-9. M/N VCO ADJUSTMENT

Reference Service Sheet 4.

Description The M/N Phase-Locked Loop frequency is set to track the VCO tuning voltage across the frequency range. The M/N VCO output level is set and checked to ensure an adequate RF output level across the VCO tuning range.

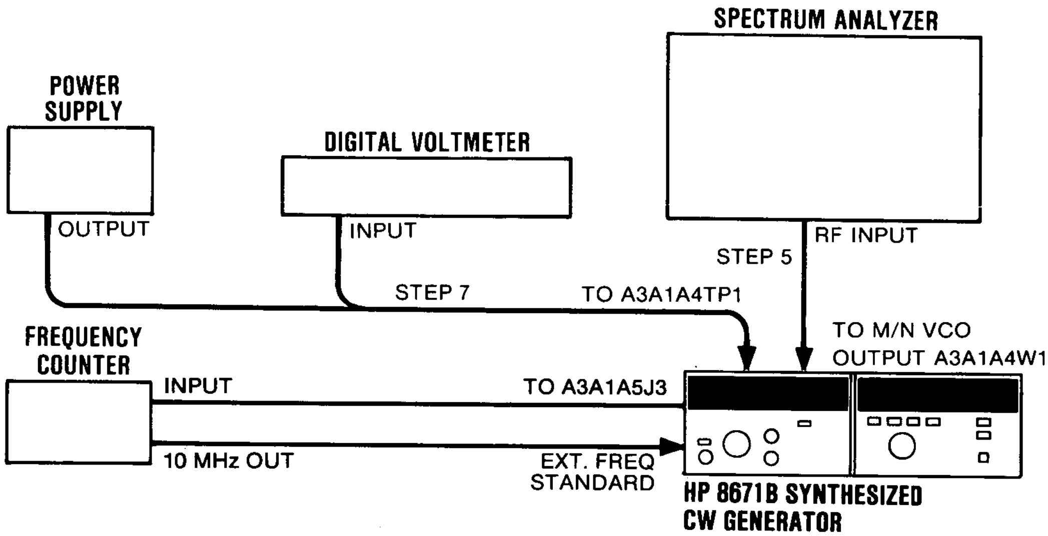


Figure 5-3. M/N VCO Adjustment Test Setup

Equipment

Digital Voltmeter (DVM)	HP 3456A
Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8566B
Power Supply	HP 6200B

Procedure

1. On the CW Generator, press PRESET (3 GHz) and set the frequency to 6090.000 MHz. Set the FREQ STANDARD INT/EXT on the rear panel to EXT.

2. Connect the equipment as shown in Figure 5-3.

3. Verify that the M/N output frequency is 197.419 MHz ±1 kHz.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

4. Set the LINE switch to STANDBY and disconnect the mains power cable. Remove the A3A1A4/A5 Assembly and place it on an extender board.

5. Connect the spectrum analyzer input to the M/N VCO output A3A1A4W1 (white coax).

ADJUSTMENTS

5-9. M/N VCO ADJUSTMENT (cont'd)

Procedure (cont'd)

CAUTION

Do not apply a positive voltage to A3A1A4TP1. A positive voltage will forward bias the VCO tuning diodes and may destroy them.

6. Connect the mains power cable and set the LINE switch to ON.

7. Set the power supply for −35.0 ±0.5 Vdc. Connect the positive output of the power supply to ground and connect the negative output to A3A1A4TP1 TUNE.

8. Release the locknut for the PWR adjustment, A3A1A4A1C5. Adjust A3A1A4A1C5 for an output level of 0 ±2 dBm. Tighten the locknut.

NOTE

The adjustment screws for A3A1A4A1C1 and C5 are held in place by locknuts. After making the adjustment, tighten the locknuts and recheck the frequency and level.

9. Slowly reduce the dc voltage at A3A1A4TP1, TUNE, while monitoring the VCO output power on the spectrum analyzer. The output power should be greater than −2 dBm between 395 MHz (−35 Vdc) and 355 MHz (−2.3 Vdc).

10. Reconnect A3A1A4W1 (white coax) to A3A1A5J4.

11. Connect the spectrum analyzer to A3A1A5J2 and adjust it for a center frequency of 50 MHz.

12. Slowly adjust the dc voltage at A3A1A4TP1, TUNE, while monitoring the VCO output power on the spectrum analyzer. The output power should be −6 ±6 dBm between 5 MHz (−35 Vdc) and 45 MHz (−2.3 Vdc).

13. If the output power is greater than 0 dBm, service may be required. If the output power is less than −12 dBm at any frequency between 5 MHz and 45 MHz, replace R36 (82.5 ohms) with a 56.2 ohm resistor, R40 (51.1 ohms) with C38 (27 pF capacitor), and remove R41.

14. If component replacement is necessary, repeat step 12 after repairs have been made. If the power output is still less than −12 dBm at any frequency between 5 MHz and 45 MHz, service is required. Refer to the troubleshooting procedure in Service Sheet 4, Section VIII.

15. Remove the power supply connection to A3A1A4TP1.

16. Set the LINE switch to STANDBY and disconnect the mains power cable. Remove A3A1A4/A5 from the extender board and reinstall the assembly in the CW Generator.

17. Connect the mains power cable and set the LINE switch to ON. Verify that the frequency is still at 6090.000 MHz.

ADJUSTMENTS

5-9. M/N VCO ADJUSTMENT (cont'd)

Procedure (cont'd)

18. Set FREQ ADJ A3A1A4A1C1 for a voltage level of −35.0 ±0.5 Vdc, measured at A3A1A4TP1.
19. Tune the CW Generator frequency to 2100.000 MHz. Verify that the M/N output frequency is 177.500 MHz and the tuning voltage is −2.4 ±0.7 Vdc.
20. Disconnect all test equipment from the CW Generator and reconnect all internal instrument cables.
21. Connect the frequency counter to the CW Generator's RF OUTPUT connector.
22. Verify that the counter reading is within ±1 kHz of the CW Generator's FREQUENCY MHz display at 2000 and 6199 MHz.

ADJUSTMENTS

5-10. 20/30 DIVIDER BIAS ADJUSTMENT

Reference Service Sheet 6.

Description A substitute VCO feedback signal, derived from an external RF signal source, is monitored with an oscilloscope. The RF signal level is slowly reduced and the CLK BIAS ADJ is set to obtain a stable clock signal. The RF input is reduced to the minimum level that provides a stable signal.

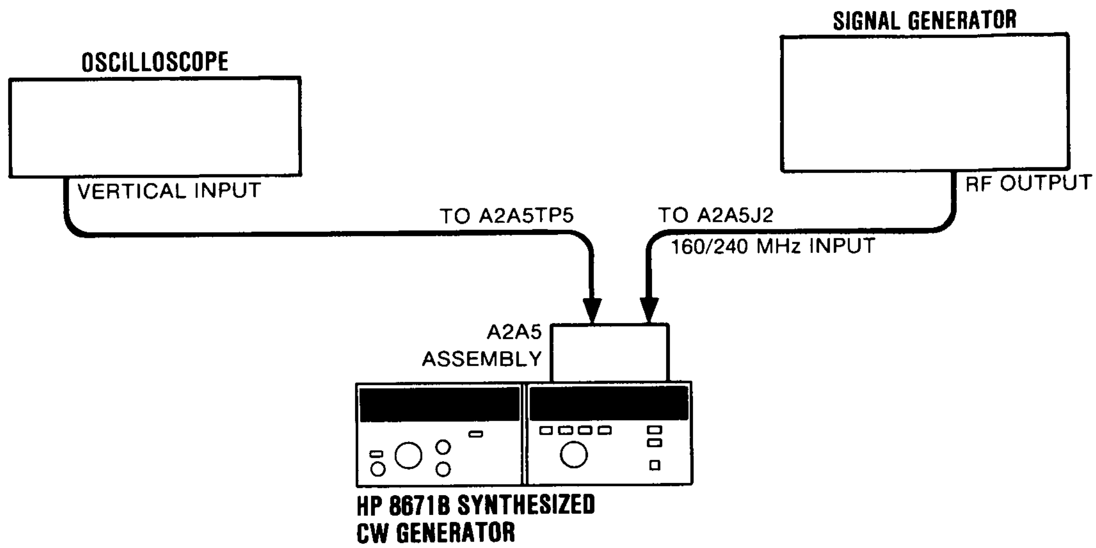


Figure 5-4. 20/30 Divider Bias Adjustment Test Setup

Equipment

Oscilloscope	HP 1980B
Signal Generator	HP 8640B or 8340A

Procedure

1. Set the LINE switch to STANDBY and remove the mains power cable.
2. Remove the screws that hold the A2A5 20/30 MHz Divider Assembly in place.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

3. Remove the A2A5 Assembly, place it on an extender board, and reinstall the assembly.
4. Reconnect the mains power cable and set the LINE switch to ON.
5. Set the controls of the signal generator for continuous wave output of −5 dBm at 240 MHz.

ADJUSTMENTS

5-10. 20/30 MHz DIVIDER BIAS ADJUSTMENT (cont'd)

Procedure (cont'd)

6. Remove the red cable A2W2 from the 160/240 MHz INPUT, A2A5J1.
7. Connect the equipment as shown in Figure 5-4.
8. Center A2A5R4 (CLK BIAS ADJ).
9. Observe the 14—24 MHz clock signal on the oscilloscope display.
10. Adjust A2A5R4 to obtain a stable clock frequency on the oscilloscope display.
11. Reduce the output level of the signal generator while readjusting A2A5R4 to obtain a stable clock at the lowest possible local oscillator signal display.
12. Verify that a stable clock signal is obtained with an input signal of −10 dBm or less.
13. Disconnect the test equipment. Set the CW Generator to STANDBY and disconnect the mains power cable. Reinstall A2A5 in its cavity. Reconnect cable A2W2 to A2A5J1 and reconnect the mains power cable.

ADJUSTMENTS

5-11. 160—240 MHz VCO PRETUNE ADJUSTMENT

Reference Service Sheet 8.

Description This procedure sets the low and high frequency limits of the 160—240 MHz oscillator by moving the oscillator coil closer to or farther from the circuit board.

NOTE

This procedure need be performed only if major repair has been done to the 160—240 MHz oscillator.

Equipment Frequency Counter .... HP 5343A

Procedure

1. Set the LINE switch to STANDBY and remove the mains power cable.
2. Remove the screws that hold the A2A3 VCO assembly in place.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

3. Remove the A2A3 assembly, place it on an extender board, and reinstall the assembly.
4. Remove the green cable A3W14 that is connected to the 20/30 MHz OUTPUT A2A3J1. Connect the frequency counter to A2A3J1.
5. Reconnect the mains power cable and set the LINE switch to ON.
6. Set A2A3S1 (FREQ TEST SWITCH) to the TEST HIGH FREQ position. The frequency should be greater than 30.5 MHz.
7. If the frequency is less than 30.4 MHz, move the oscillator coil closer to the circuit board. The oscillator cover must be removed before adjusting the coil. Unsolder the four corners of the oscillator cover before removing it. Next, unsolder the oscillator coil leads, move the coil closer to the circuit board, and resolder the coil leads. Clip excess oscillator lead length on the circuit side of board if necessary.

NOTE

The oscillator coil is normally mounted parallel to the circuit board with the bottom threads approximately 1.3 mm (0.050 inch) above the board.

8. Replace the oscillator cover by temporarily soldering one corner of the cover and recheck the frequency.

ADJUSTMENTS

5-11. 160—240 MHz VCO PRETUNE ADJUSTMENT (cont'd)

Procedure (cont'd)

9. Set A2A3S1 to the TEST LOW FREQ position. Verify a frequency reading of less than 19.5 MHz. If necessary, set the LINE switch to STANDBY, remove the cover, reset the coil, replace the cover, and repeat steps 6 through 9.

10. Set A2A3S1 to the NORMAL position.

11. Replace the oscillator cover permanently by soldering all four corners. Do not solder the entire perimeter of the oscillator cover. The cover is for frequency stability, not for RFI leakage.

12. Set the LINE switch to STANDBY and remove the mains power cable. Reinstall A2A3 in its cavity and reconnect the green cable to A2A3J1. Reconnect the mains power cable.

ADJUSTMENTS

5-12. 20/30 PHASE DETECTOR NOTCH FILTER ADJUSTMENT

Reference Service Sheet 7.

Description A 7985 Hz signal is passed through the 8 kHz notch filter in the LFS Phase-Locked Loop. The adjustable components of the filter are set for the minimum signal transfer.

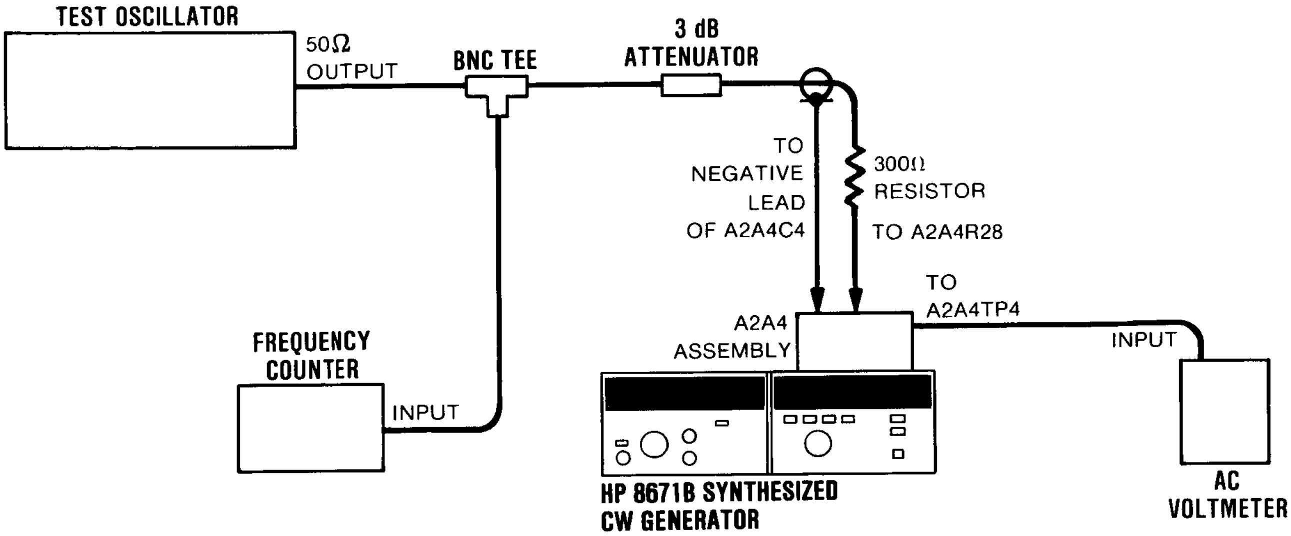


Figure 5-5. 20/30 Phase Detector Notch Filter Adjustment Test Setup

Equipment

Test Oscillator	HP 8116A
Frequency Counter	HP 5343A
AC Voltmeter	HP 400E
3 dB Attenuator	HP 8491A Option 003

Procedure

1. Set the LINE switch to STANDBY.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

2. Remove the A2A4 20/30 Phase Detector Assembly.

3. Unsolder the input end (top) of A2A4R28 (refer to the component location diagram in Section VIII).

4. Install the circuit board on the extender board.

ADJUSTMENTS

5-12. 20/30 PHASE DETECTOR NOTCH FILTER ADJUSTMENT (cont'd)

Procedure (cont'd)

5. Connect the equipment as shown in Figure 5-5. The leads from the 3 dB attenuator should be as short as possible. Connect the ground wire to the negative side of A2A4C4.
6. Set the CW Generator's LINE switch to ON.
7. Set the test oscillator's controls for 1 kHz and an AC voltmeter indication of +10 dBm.
8. Set the test oscillator as close to 7985 Hz as possible.
9. Adjust A2A4L3 and L4 to minimize the meter reading. The indication must be less than −50 dBm.
10. Detune the test oscillator away from 7985 Hz while monitoring the AC voltmeter reading. As the oscillator is detuned, the meter indication should increase.
11. Set the CW Generator's LINE switch to STANDBY. Resolder A2A4R28 and reinstall the A2A4 assembly.

ADJUSTMENTS

5-13. YTO PRETUNE DIGITAL-TO-ANALOG CONVERTER ADJUSTMENT

Reference Service Sheet 9.

Description This adjustment sets the analog voltages with respect to the digital frequency tuning data. Adjustments are made at selected frequencies. Some of these frequencies are below the low frequency limit of the CW Generator (2 GHz). These frequencies are selected by shorting test point pair A2A8TP1 and tuning to the specified frequencies.

Equipment Digital Voltmeter (DVM) .... HP 3456A or HP 3455A

Procedure

1. Press PRESET (3 GHz) on the CW Generator and set the frequency to 4800.000 MHz.
2. Connect the DVM ground lead to the reference ground, A3A6TP5 (the ground lead remains connected here for the remainder of this procedure).
3. Attach the DVM test lead to A3A5TP4. Set REF ADJ (Reference Buffer output) A3A5R13 for a DVM reading of −6.50 ±0.04 Vdc.
4. Check the output voltages of the Reference Buffers at A3A5TP1 (+10.75 ±0.25 Vdc) and A3A5TP2 (+10.00 ±0.15 Vdc). Make repairs if necessary.
5. Connect the DVM to the YTO Pretune Output, A3A5TP3.
6. Short test point pair A2A8TP1 with an alligator clip.
7. Adjust 1.6 GHz A3A5R4 (not 1.61) to obtain a DVM reading of −4.800 ±0.001 Vdc.
8. Remove the clip from test point pair A2A8TP1.
9. Adjust 4.8 GHz A3A5R3 to obtain a reading of −14.400 ±0.001 Vdc.
10. Tune to 4900.000 MHz and short the test point pair A2A8TP1.
11. Adjust 1.7 GHz A3A5R29 to obtain −5.100 ±0.001 Vdc.
12. Tune to 4800.000 MHz and repeat steps 7 through 11 until all voltages are measured within 0.001 Vdc of the specified value.
13. Tune to 4810.000 MHz. Verify that the clip is connected to test point pair A2A8TP1.
14. Adjust 1.61 GHz A3A5R42 (not 1.6) to obtain a DVM reading of −4.830 ±0.001 Vdc.
15. Tune to 5000.000 MHz. Adjust 1.8 GHz A3A5R24 to obtain −5.400 ±0.001 Vdc.
16. Remove the alligator clip. Tune to 2000.000 MHz.
17. Adjust 2.0 GHz A3A5R22 to obtain −6.000 ±0.001 Vdc.
18. Tune to 2400.000 MHz. Adjust 2.4 GHz A3A5R20 to obtain −7.200 ±0.001 Vdc.

ADJUSTMENTS

5-13. YTO PRETUNE DIGITAL-TO-ANALOG CONVERTER ADJUSTMENT (cont'd)

Procedure (cont'd)

19. Tune to 3200.000 MHz. Adjust 3.2 GHz A3A5R18 to obtain −9.600 ±0.001 Vdc.

20. At each frequency listed in the table, check the YTO pretune voltage at A3A5TP3 with the clip attached to the test point pair A2A8TP1.

CW Generator Frequency (MHz)	Voltage at A3A5TP3 (Vdc)
4801	−4.803 ±0.001
4802	−4.806 ±0.001
4804	−4.812 ±0.001
4808	−4.824 ±0.001
4810	−4.830 ±0.001
4820	−4.860 ±0.001
4840	−4.920 ±0.001
4880	−5.040 ±0.001
4910	−5.130 ±0.001

21. Remove the clip and measure the voltage at A3A5TP3. The voltage should now read −14.730 ±0.002 Vdc. If the voltage tolerances in steps 21 and 22 are not met, repeat this procedure starting from step 5. Then if the voltage tolerances cannot be met, refer to Section VIII for troubleshooting information.

ADJUSTMENTS

5-14. YTO DRIVER ADJUSTMENT

Reference Service Sheet 10.

Description The fundamental output of the CW Generator is set to the maximum and minimum frequencies and the YTO driver's gain and offset currents are set to give specified YTO output frequencies.

Equipment Frequency Counter .... HP 5343A

NOTE

All boards must be installed in the instrument before these adjustments are made.

Procedure

1. On the CW Generator, press PRESET (3 GHz) and set the output level to −10 dBm.
2. Connect the frequency counter to the CW Generator's RF OUTPUT connector.
3. Connect A3A6TP5 (GND) to A3A7TP2 (TUN VOLT) with a clip-on jumper wire. (This grounds the feedback voltage and opens the YTO Phase-Locked Loop.)
4. Tune the CW Generator to 2000.000 MHz. Adjust A3A6R34, 2 GHz, to obtain 2000.0 ±0.1 MHz on the frequency counter. Wait until the drift is minimal (approximately 30 seconds) before making this adjustment.
5. Tune the CW Generator to 6199.000 MHz. Adjust A3A6R25, which is labeled 6.199 GHz, to obtain 6199.0 ±0.1 MHz on the frequency counter. Wait until the drift is minimal (approximately 30 seconds) before making this adjustment.
6. Repeat steps 4 and 5 until the required tolerance is obtained at both frequencies.
7. Disconnect A3A6TP5 from A3A7TP2.
8. Verify that the counter reading is within ±1 kHz of the CW Generator's FREQUENCY MHz display at 2.0 and 6.199 GHz.

ADJUSTMENTS

5-15. YTO SAMPLER ADJUSTMENT

Reference Service Sheet 11.
Service Sheet A.

Description The sampler is driven by a sweep oscillator and the sweep output is used to sweep the oscilloscope. The sampler driver circuit is adjusted for maximum amplitude and flatness over the range of the M/N loop. The sampler's IF preamplifier is adjusted for correct level and the frequency response is checked.

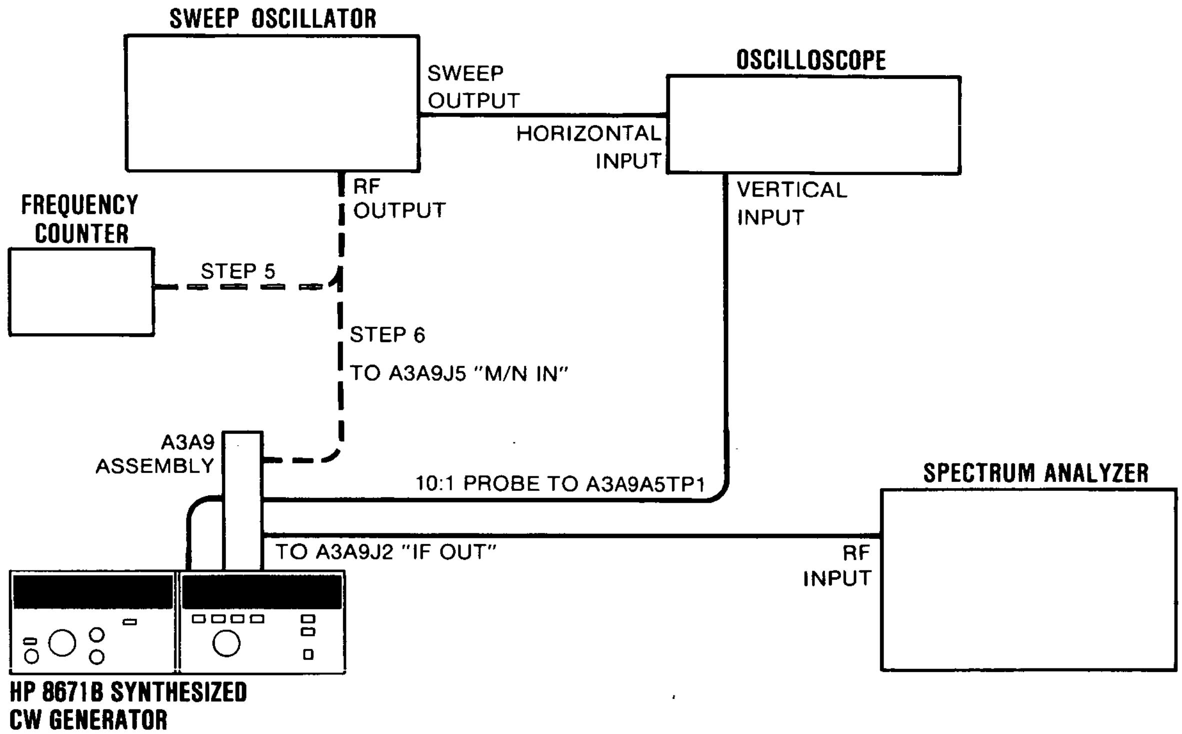


Figure 5-6. YTO Loop Sampler Adjustment Test Setup

Equipment

Oscilloscope	HP 1980B
Sweep Oscillator	HP 86222B/8620C or HP 8340A
Spectrum Analyzer	HP 8566B
Frequency Counter	HP 5343A
50Ω Termination	HP 909A Opt 012

NOTE

An HP 8481A Power Sensor can be used in place of the 50Ω termination.

ADJUSTMENTS

5-15. YTO SAMPLER ADJUSTMENT (cont'd)

Procedure (cont'd)

1. Set the CW Generator's LINE switch to STANDBY and disconnect the mains power cable.
2. Place the A3A9 Assembly into the service position (refer to Service Sheet A for disassembly procedures).
3. Remove the right side cover of A3A9.
4. Connect a 50Ω termination to the A3A9A1 Directional Coupler output, which normally connects to A1W1.
5. Set the sweep oscillator's controls for a leveled output level of 0 dBm, center frequency of 187.5 ±1.0 MHz (measured by frequency counter) and a sweep span of 200 MHz (±100 MHz).
6. Connect the equipment as shown in Figure 5-6. Connect the CW Generator's mains power cord and set the LINE switch to ON.
7. Connect the sweep oscillator's RF output to the M/N LOOP SIGNAL connector, A3A9J5, in place of the white-orange cable.
8. Adjust A3A9A5C1 and C2 (with an insulated adjustment tool) to get an oscilloscope display similar to Figure 5-7. Tune for maximum negative voltage and flatness over the center two divisions. The minimum change from the reference level to the maximum negative voltage should be 0.5 volts. (Troubleshooting Note: If the minimum change is out of tolerance, A3A9A5Q3 and Q8 may have low gain, the YTO feedback signal feeding the RF port of the mixer may be low, or the sampler may be bad.)

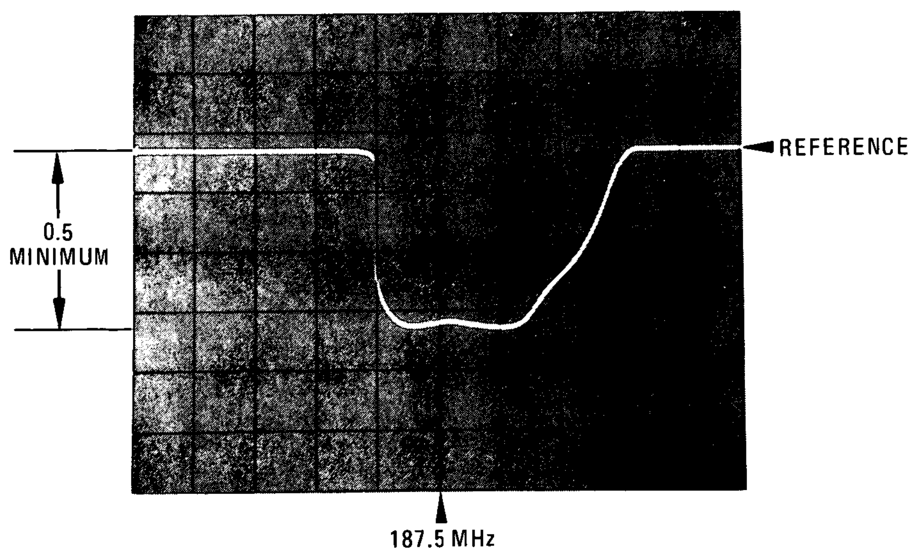


Figure 5-7. YTO Sampler Frequency Response

ADJUSTMENTS

5-15. YTO SAMPLER ADJUSTMENT (cont'd)

Procedure (cont'd)

9. Short A3A7TP2 to ground to open the YTO Phase-Locked Loop.

10. Tune to 2100 MHz and disconnect the gray cable from the phase detector output, A3A9J6. Remove the oscilloscope probe from A3A9A5TP1.

11. Connect the spectrum analyzer's input directly to IF OUT, A3A9J2.

12. Set the sweep oscillator's controls for a center frequency of 177.5 ±1.0 MHz and set the sweep width to 10 MHz.

13. Connect the sweep oscillator's output to the M/N LOOP SIGNAL input A3A9J5.

14. Set the spectrum analyzer's controls for a 0 to 100 MHz frequency span. Set the other controls to display the IF signal. The fundamental, second and third harmonics should be visible at 30, 60, and 90 MHz. Tune the sweep oscillator slightly to align the signals on the display.

15. Adjust the A3A9A5R1, IF GAIN, so that the displayed IF signal at 30 MHz is +2 ±1 dBm. If the level is too low, or if the levels in the following step are not within the levels given, select a new value for C22. Values should be within the range of 120 to 150 pF, and 130 is usually the best value.

16. Slowly tune the sweep oscillator's center frequency from 174 to 181 MHz and observe the fundamental's output level. Verify that the allowable level variation is not exceeded and that the power does not drop below the stated level over the frequency range:
    a. from 6 to 20 MHz, −3 dBm minimum,
    b. from 20 to 30 MHz, +1 to +4 dBm,
    c. from 30 to 70 MHz, −10 dBm minimum.

17. Return the CW Generator to normal operation as follows:
    a. Disconnect all test equipment.
    b. Reconnect the gray cable to A3A9J6 and the white-orange cable to A3A9J3.
    c. Reverse the instructions in step 4, 3, 2, and 1.

18. Connect the frequency counter to the CW Generator's RF OUTPUT connector.

19. Verify that the counter reading is within ±1 kHz of the CW Generator's FREQUENCY MHz display at 2000.0 and 6199.0 MHz.

ADJUSTMENTS

5-16. YTO PHASE DETECTOR ADJUSTMENT

Reference Service Sheet 12.

Description This procedure measures and adjusts the gain crossover frequency of the YTO Phase-Locked Loop using a low frequency spectrum analyzer and tracking generator.

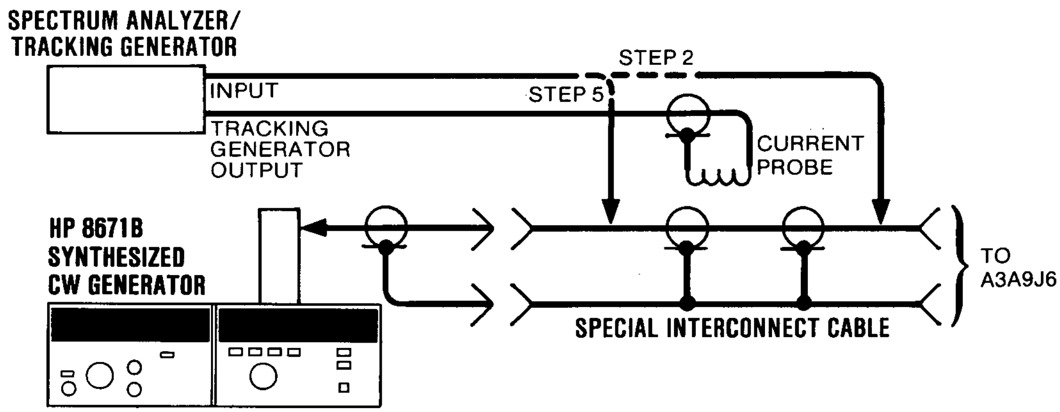


Figure 5-8. YTO Phase Detector Adjustment Test Setup

Equipment

Spectrum Analyzer .... HP 8556A/8552B/141T
(with tracking generator)
Current Probe .... HP 1110B
Special Interconnect Cable .... (See Figure 5-9)

SPECIAL INTERCONNECT CABLE

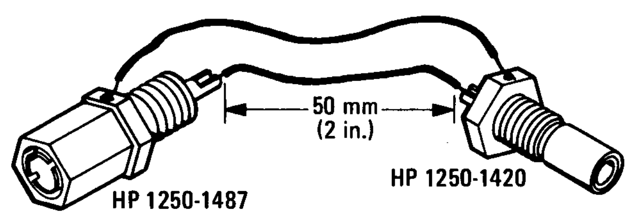


Figure 5-9. Special Interconnect Cable

ADJUSTMENTS

5-16. YTO PHASE DETECTOR ADJUSTMENTS (cont'd)

Procedure

1. Set the CW Generator's RF OUTPUT switch to ON.

2. Connect the equipment as shown in Figure 5-8. The special interconnect cable is inserted between A3W16 (gray cable) and A3A9J6 (YTO TUNE 1).

NOTE

When clipping the current probe around the special cable's center conductor, do not allow the metal surface to come in contact with the center conductor connection of the SMA connectors.

3. Set the spectrum analyzer to scan from 0 to 50 kHz, vertical sensitivity per division to 2 dB, scan mode to single, and set the display's variable persistence to maximum.

4. Press the single sweep key on the spectrum analyzer.

5. Move the spectrum analyzer's input to the cable side (A3W16) of the special cable.

6. Press the single sweep key. Check that the gain-crossover frequency is 20 ±2 kHz. If the gain-crossover frequency is not correct, A3A9A4R20 must be changed to set the correct frequency; otherwise, this adjustment is complete. See Figure 5-10.

18 _______ 22 kHz

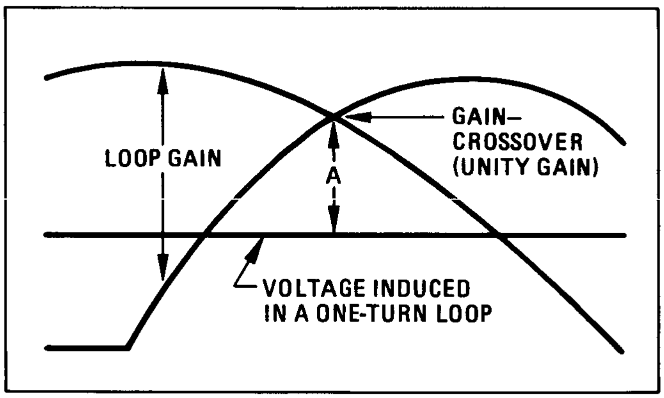


Figure 5-10. Spectrum Analyzer Display of Phase Locked Loop Gain

7. If A3A9A4R20 must be changed, perform the following steps:
   a. Set the LINE switch to STANDBY.
   b. Disconnect the mains power cord.
   c. Place the A3A9 Assembly in the test position. (Refer to Section VIII disassembly procedures.)

ADJUSTMENTS

5-16. YTO PHASE DETECTOR ADJUSTMENTS (cont'd)

Procedure (cont'd)

d. Remove the A3A9A4 cover.

e. Select the value of R20 using the following formula.

$$R2 = R1\left(\frac{F1}{20\ \text{kHz}}\right)$$

where R2 = required value for R20
R1 = present value of R20
F1 = measured frequency

for example, if
R1 = 619Ω
and F1 = 25 kHz
then

$$R2 = 619\left(\frac{25\ \text{kHz}}{20\ \text{kHz}}\right)$$

R2 = 773Ω or 750Ω (closest value)

8. Install R20, reconnect the mains power cord and set the LINE switch to ON. Recheck the gain-crossover frequency.

NOTE

The other loop parameters, phase margin and loop gain, may be checked if the loop does not operate correctly. Loop gain is checked at 1 kHz and should be approximately 40 dB. Phase margin is checked by disconnecting the input to the ac probe, shorting the input, and pressing the single sweep pushbutton. Phase margin should be approximately 45° and is calculated by the following expression:

$$\theta = \cos^{-1}\left(1 - \frac{10^{\left(\frac{A}{10}\right)}}{2}\right)$$

where θ = phase margin
and A = ratio (in dB) of the induced voltage to the gain-crossover. (Gain-crossover is the reference, therefore the ratio is negative.)

9. Return the CW Generator to normal operation as follows:

a. Set the LINE switch to STANDBY.

b. Disconnect the mains power cord.

c. Install the A3A9A4 cover.

d. Return the A3A9 Assembly to its normal position.

e. Install the top and bottom covers.

ADJUSTMENTS

5-17. YTM ADJUSTMENT

Reference Service Sheets 15 and 16.

Description The 12.4 volt reference is adjusted. A low frequency signal is applied to the tuning coil of the YTM (YIG Tuned Multiplier) to sweep the filter through its response curve. The tuning coil drive is adjusted to obtain maximum RF output from the YTM by centering the filter response about the RF output signal. The tuning coil adjustments are repeated to optimize the filter's tracking over the 2 to 18 GHz frequency range. The SRD (Step Recovery Diode) bias for the YTM is adjusted.

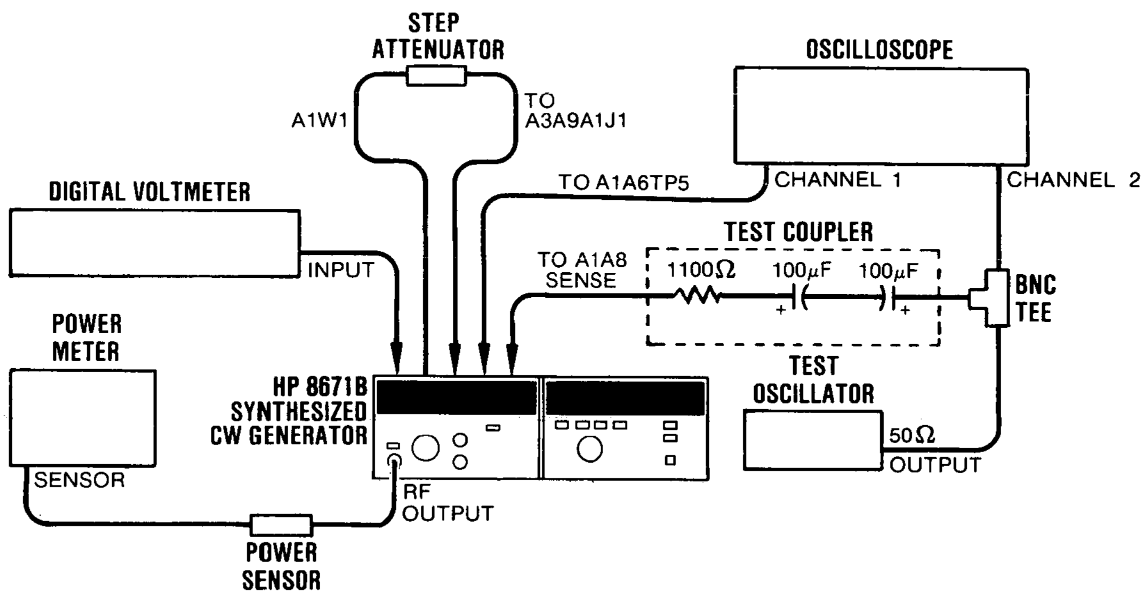


Figure 5-11. YTM Adjustment Test Setup

Equipment

Digital Voltmeter (DVM) ....HP 3456A
Oscilloscope.............................HP 1980B
Power Meter ....HP 436A
Power Sensor ....HP 8481A
Step Attenuator ....HP 8495A Option 002
Test Oscillator ....HP 8116A

Procedure

+12.4 Volt Reference

1. Set the CW Generator as follows:
   LINE switch .... ON
   RF OUTPUT .... ON
   ALC .... XTAL
   RANGE .... +10 dB
   VERNIER .... fully clockwise
   Frequency .... 2000.000 MHz
   PEAK/NORM control .... NORM
   CAL control .... fully clockwise

ADJUSTMENTS

5-17. YTM ADJUSTMENT (cont'd)

Procedure (cont'd)

2. Allow the instrument 30 minutes to warm up with these instrument settings.

3. Connect the DVM to the +12.4V test point on A1A8. Connect the ground lead to the GND test point on A1A8.

4. Adjust A1A8R64, +12.4V, for +12.400 ± 0.005 Vdc.

Band 1 Adjustment (2.0 to 6.199 GHz)

5. Connect the DVM to the +C.S. test point on A1A8.

6. Adjust A1A8R46, BD1 LO, for +8.0 ± 0.2 Vdc.

7. Center A1A7R31, BIAS, and A1A7R29, PWR.

8. Disconnect A1W1 from directional coupler output at A3A9A1J1 (see Service Sheet B, Top View Assembly Locations). Connect the step attenuator between A3A9A1J1 and A1W1. Connect the remaining equipment as shown in Figure 5-11.

   The locally fabricated "test coupler" consists of the resistor and two capacitors shown in the figure.

9. Set the test oscillator output for 60 Hz at 900 mV peak to peak as indicated by the oscilloscope.

10. Set the oscilloscope to 1 vs. 2 mode and adjust channel 2 sensitivity for a ten division horizontal sweep. Set channel 1 sensitivity to approximately 30 mV per division.

11. Remove the blue cable from A2A12 RF amplifier assembly. Removing the cable disables the power clamp for this adjustment.

12. Set the step attenuator for 10 dB attenuation. In the following steps, if the oscilloscope display shows an erratic passband response (squegging), set the attenuator for a higher attenuation. Attenuator settings of 10 to 20 dB should be sufficient to stop squegging for Band 1 frequencies. Increasing the attenuation reduces the power at the input of the YTM and also reduces the sensitivity of the displayed signal. Therefore, keep the attenuator set for as low an attenuation as necessary to stop squegging.

13. Adjust A1A8R46, BD1 LO, at 2 GHz to center the peak of the YTM response as shown in Figure 5-12. The display may show a retrace pattern due to hysteresis in the YTM circuitry. The center of the filter passband is halfway between the peaks of the two displayed signals.

ADJUSTMENTS

5-17. YTM ADJUSTMENT (cont'd)

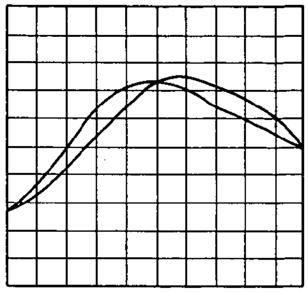


Figure 5-12. Optimum Centered YTM Response

Procedure (cont'd)

14. Tune to 6 GHz and adjust A1A8R20, BD1 HI, to center the filter response.

15. Tune from 2 to 6 GHz using 1 MHz tuning resolution while observing the oscilloscope display. The peak of the filter passband should remain within ± 5 divisions of the center of the display and should remain reasonably centered.

    Readjust the step attenuator as required to maintain a smooth curve. If necessary, repeat steps 13 through 15 until the response remains reasonably well centered. The last adjustment should be at 6 GHz.

Band 2 Adjustment (6.2 to 12.399 GHz)

16. Set the step attenuator to 0 dB attenuation. The attenuator should be set to 0 dB for frequencies above 6.2 GHz.

17. Tune to 6.5 GHz and adjust A1A8R47, BD2 LO, to center the response.

18. Tune to 11.5 GHz and adjust A1A8R16, BD2 HI, to center the response.

19. Tune from 6.2 to 12.3 GHz using 1 MHz tuning resolution. The peak of the response should remain within ± 5 divisions of the center of the display and should remain reasonably centered.

    Readjust the step attenuator if necessary to maintain a smooth curve. If necessary, repeat steps 17 through 19 until the response remains reasonably well centered. The last adjustment should be at 11.5 GHz.

Band 3 Adjustment (12.4 to 18.599 GHz)

20. Tune to 13 GHz and adjust A1A8R41, BD3 LO, to center the response 2.5 divisions to the right of center. The response should be as shown in Figure 5-13.

ADJUSTMENTS

5-17. YTM ADJUSTMENT (cont'd)

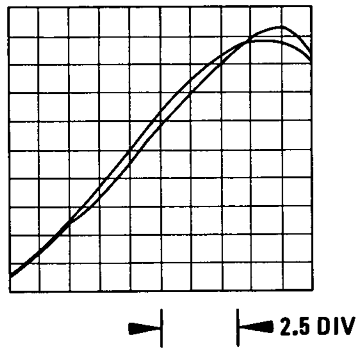


Figure 5-13. Optimum Offset YTM Response

Procedure (cont'd)

21. Tune to 16 GHz and adjust A1A8R11, BD3-16, to center the response 2.5 divisions to the right of center.

22. Tune to 18 GHz and wait 10 minutes for the YTM to temperature stabilize. The stabilization is required to minimize the effect of filter drift during the next adjustments.

23. Tune to 17 GHz and adjust A1A8R17, BD3-17, to center the peak of the response.

24. Tune to 18 GHz and adjust A1A8R23, BD3-18, to center the peak of the response.

25. Tune to 18.599 GHz and adjust A1A8R32, BD3-18.6, to center the peak of the response.

26. Tune from 12.4 to 16 GHz using 1 MHz tuning resolution. The peak of the response should always remain at least 4 divisions from the left edge of the display.

    If necessary, repeat steps 20 and 21 to obtain the desired response. The last adjustment should be made at 16 GHz.

27. Tune from 16 to 18 GHz using 1 MHz tuning resolution. The peak of the response should remain within ± 5 divisions of center and remain reasonably centered.

    If necessary, repeat steps 23 and 24 to obtain the desired response. The last adjustment should be made at 18 GHz.

28. Tune from 18 to 18.599 GHz using 1 MHz tuning resolution. The peak of the response should remain within ± 5 divisions of center and reasonably centered.

    If necessary, repeat steps 24 and 25 to obtain the desired response. The last adjustment should be made at 18.599 GHz.

SRD Bias Adjustment

29. Disconnect the signal from A1A8 SENSE test point and disconnect the oscilloscope.

ADJUSTMENTS

5-17. YTM ADJUSTMENTS (cont'd)

Procedure (cont'd)

30. Connect the power meter to the CW Generator's output.

31. Tune to 11.5 GHz and set A1A7R29, PWR, fully counter-clockwise.

32. Reconnect the blue cable to A1A12 RF Amplifier assembly. Set the CW Generator's ALC switch to INT and set the range to 0 dB.

33. Set the VERNIER for a −10 dBm reading on the power meter. Adjust A1A6R12, INT OS, if necessary, to bring the power level within ±3 dB of −10 dBm.

34. Connect the DVM positive lead to A1A5TP6. Connect the ground lead to A1A7 GND test point. Adjust A1A7R31, BIAS, to maximize the DVM reading.

35. Verify that the voltage at A1A7 BIAS test point is −0.5 ± 0.2 Vdc. If the voltage is not correct, service is required.

36. Disconnect the test equipment and perform the Power Clamp, ALC and Flatness adjustments.

ADJUSTMENTS

5-18. POWER CLAMP ADJUSTMENT

Reference Service Sheet 14.

Description The power clamp circuit is adjusted to obtain the maximum power available without squegging. Squegging is a spurious oscillation that occurs in the YTM (YIG Tuned Multiplier) at high power levels. The input power to the YTM must be limited for frequencies between 2.0 and 6.2 GHz to prevent erratic power variations due to squegging.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8481A

Procedure

1. Connect the power meter and sensor to the CW Generator.
2. Set the CW Generator's frequency to 5 GHz. Set the CW Generator RANGE to 0 dB and the ALC switch to XTAL. Set the RF OUTPUT switch to OFF.
3. Set A1A5R76, PWR CLAMP, fully clockwise. This sets the power clamp for minimum power level.
4. Set the RF OUTPUT switch to ON. Adjust A1A5R76, PWR CLAMP, slowly counter-clockwise to +15.0 dBm on the power meter. If the level drops suddenly by several dB, set the RF OUTPUT switch to OFF and rotate A1A5R76, PWR CLAMP, clockwise slightly to reduce the clamp level. Set the RF OUTPUT switch to ON and continue with step 5.
5. Tune the CW Generator from 2.0 to 6.1 GHz using 100 MHz steps. The power level should not change more than ± 1 dB from the level set in step 4. If a sudden drop in output level occurs, reduce the clamp level by 0.5 dB and repeat this step.
6. Reduce the clamp level by 0.5 dB to ensure best stability with time.

ADJUSTMENTS

5-19. ALC ADJUSTMENTS

Description

The ALC (Automatic Level Control) circuitry offsets are adjusted for proper operation. The meter is calibrated to indicate output level. The +10 dB (Overrange) range circuitry is calibrated, and the absolute ALC level with respect to the vernier voltage is calibrated.

Equipment

Digital Voltmeter (DVM) ....HP 3456A
Power Meter ....HP 436A
Power Sensor ....HP 8481A

Procedure

ALC Offsets

1. Connect the power meter and sensor to the CW Generator.
2. Set the CW Generator's frequency to 4 GHz. Set the power meter CAL factor for 4 GHz.
3. Set the CW Generator RANGE to 0 dB and the ALC switch to INT. Adjust the VERNIER for a power meter reading of −4 dBm.
4. Connect the DVM to A1A5TP4. Connect the ground lead to the A1A5 GND test point. Verify that the LVL UNCAL annunciator is not lighted. Adjust A1A5R7, OS, for a DVM reading of 130.0 ±0.5 mVdc.
5. Adjust the CW Generator's VERNIER control for a power meter reading of 0.0 ±0.5 dBm. Set the RF OUTPUT switch to OFF.
6. Connect the DVM to A1A6TP5. Connect the ground lead to the A1A6 GND (not GND2) test point. Adjust A1A6R12, INT OS, for a DVM indication of 0.00 ±0.01 mVdc.

Level Meter

7. Set the OUTPUT LEVEL RANGE to 0 dB and set the RF OUTPUT switch to ON. Connect the DVM to the A1A10 DAC test point. Connect the ground lead to the A1A10 REF GND test point. Adjust the VERNIER for a DVM indication of −6.50 ±0.05 Vdc. −6.50 Vdc corresponds to an ALC reference voltage for −10 dBm.
8. Adjust A1A10R31, GAIN, (near REF GND), for a front panel meter reading of −10 dBm.
9. Adjust the VERNIER for a DVM reading of −1.50 ±0.05 Vdc (corresponding to 0 dBm).
10. Adjust A1A5R69, MET CAL, for a front panel meter reading of 0.0 dBm.
11. Repeat steps 7 through 10 until there is less than 0.1 dB change at the last adjustment.

Overrange

12. Set the power meter to read dB relative (dB REL). This adjustment will set the −10 dBm VERNIER setting in the +10 dB RANGE equal to the 0 dBm VERNIER setting on the 0 dB RANGE.

ADJUSTMENTS

5-19. ALC ADJUSTMENTS (cont'd)

Procedure (cont'd)

13. Set the OUTPUT LEVEL RANGE to +10 dB. Adjust the CW Generator's VERNIER control for a DVM indication of −6.50 ±0.05 Vdc (−10 dBm).

14. Adjust A1A6R36, OVERRANGE, for a power meter reading of 0.00 ±0.01 dB.

ALC Absolute Level

15. Set the power meter to read absolute power (dBm). Set the OUTPUT LEVEL RANGE to 0 dB and adjust the VERNIER for a DVM reading of −3.00 ±0.05 Vdc. −3 Vdc corresponds to an ALC reference voltage for −3 dBm.

    Adjust A1A6R33, −3, for a power meter reading of −3.0 ±0.1 dBm.

16. Adjust the CW Generator's VERNIER control for a DVM reading of −6.50 ±0.05 Vdc (−10 dBm reference).

    Adjust A1A6R39, −10, for a power meter reading of −10.0 ±0.1 dBm.

17. Set the OUTPUT LEVEL RANGE to +10 dB. Adjust the CW Generator's VERNIER control for a DVM reading of −2.50 ±0.05 Vdc (−2 dBm reference).

    Adjust A1A6R28, +8, for a power meter reading of +8.0 ±0.1 dBm.

18. Repeat steps 15 through 17 until less than 0.1 dB improvement can be made.

19. Disconnect the DVM from the CW Generator and perform the Flatness Adjustment.

ADJUSTMENTS

5-20. FLATNESS ADJUSTMENT

Reference Service Sheet 16.

Description The Flatness Adjustment reduces power variations due to output cable, attenuator, crystal detector, and directional coupler variations.

Equipment

Digital Voltmeter (DVM) .... HP 3456A
Power Meter .... HP 436A
Power Sensor .... HP 8481A

Procedure

1. Connect the power meter and sensor to the CW Generator.
2. Set the CW Generator's frequency to 4 GHz.

NOTE

After each frequency change, make sure the power meter CAL factor is adjusted for the new frequency.

3. Set the OUTPUT LEVEL RANGE to 0 dB and the ALC switch to INT.

   Adjust the CW Generator's VERNIER control for a front panel meter reading of 0 dBm.

4. Set the power meter to read dB relative (dB REL).
5. Set the CW Generator's frequency to 10 GHz. Adjust A1A7R18, SLOPE 10 GHz, for a power meter reading of 0 dB.
6. Set the CW Generator's frequency to 18 GHz. Adjust A1A7R4, SLOPE 18 GHz, for a power meter reading of 0 dB.
7. Set the CW Generator's frequency to 17 GHz. Adjust A1A7R4, SLOPE 18 GHz, for the best overall output power accuracy between 17 and 18 GHz.

ADJUSTMENTS

5-21. EXTERNAL LEVELING ADJUSTMENT

Reference Service Sheet 17.

Description The external ALC (Automatic Level Control) amplifier is adjusted for zero offset. The +10 dB range is calibrated for external leveling modes.

Equipment

Digital Voltmeter (DVM) .... HP 3456A
Power Meter .... HP 436A
Power Sensor .... HP 8481A
50Ω Termination .... HP 11593A

Procedure

1. Set the CW Generator's frequency to 4 GHz. Connect a 50 ohm load to the CW Generator's EXT ALC input connector.

2. Connect the DVM between A1A6TP6 and A1A6TP8 (GND 2). Adjust A1A6R15, EXT OS, for a reading of 0.0 ±0.1 mVdc. Disconnect the 50 ohm load and the DVM.

3. Connect the power meter and sensor to the CW Generator as shown in Figure 5-14.

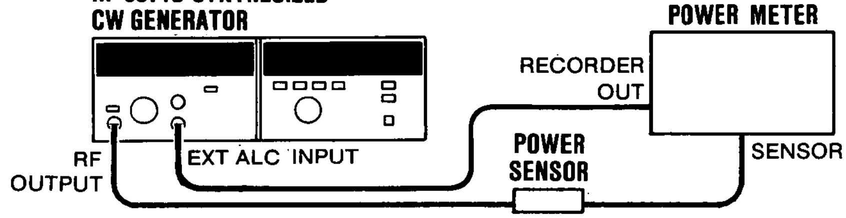


Figure 5-14. External Leveling Adjustment Test Setup

4. Set the CW Generator's frequency to 4 GHz. Adjust the CAL factor on the power meter for 4 GHz.

5. Set the OUTPUT LEVEL RANGE to 0 dB and the ALC switch to INT. Adjust the CW Generator's VERNIER control for a power meter reading of −5 ±1 dBm. Press the range hold key on the power meter.

6. Connect the DVM to A1A10 DAC test point and A1A10 REF GND. Set the CW Generator's ALC switch to PWR MTR.

7. Set the OUTPUT LEVEL RANGE to 0 dB. Adjust the CW Generator's VERNIER control for a DVM reading of −1.50 ±0.05 Vdc. Adjust the CW Generator's front panel CAL control for a power meter reading of −10.0 ±0.1 dBm.

8. Set the OUTPUT LEVEL RANGE to +10 dBm. Adjust A1A6R38, EXT GAIN, for a power meter reading of 0.0 ±0.1 dBm.

9. Repeat steps 7 and 8 until there is less than 0.1 dB change at the last adjustment.

10. Disconnect the power meter from the CW Generator.

VI Replaceable Parts

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

This section contains information for ordering parts. Table 6-1 lists part numbers for restored assemblies. Table 6-2 lists abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designation order. Table 6-4 contains the names and addresses that correspond to the manufacturer's code numbers.

6-2. RESTORED ASSEMBLIES

Table 6-1 lists restored assemblies for the instrument that may be purchased on an exchange basis, thus affording a considerable cost saving. Factory-repaired and tested assemblies are available only on a trade-in basis, therefore, the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number.

6-3. ABBREVIATIONS

Table 6-2 lists abbreviations used in the parts list, schematics, and throughout the manual. Standard abbreviations may be in upper or lower-case letters. However, the replaceable parts list is a computer printout using only upper-case letters. Thus, abbreviations in the replaceable parts list are in upper-case letters only.

6-4. REPLACEABLE PARTS LIST

Table 6-3 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alphanumeric order by reference designation.

b. Chassis-mounted, or non-assembly, parts in alphanumeric order by reference designation.

The information given for each part consists of the following:

a. Reference designation

b. Hewlett-Packard part number

c. Part number check digit (CD)

d. Total quantity (Qty) used in the instrument

e. Part description

f. Five-digit code that represents a typical manufacturer

g. Manufacturer's part number

The total quantity for each part is given, at the first appearance of the part number in each major assembly.

6-5. Factory Selected Parts (*)

Parts marked with an asterisk are factory selected parts. (That is, they are selected in test.) The value shown in the parts list is a nominal value only. Refer to Table 5-1, Factory Selected Components, for instructions on selecting the actual value for replacement.

6-6. Parts List Backdating (†)

Parts marked with daggers are different in some instruments. The replaceable parts list applies directly to only one instrument configuration. This configuration is identified by a serial number prefix described on the title page of the manual. Refer to Section VII for parts information on instruments with lower prefixes.

6-7. Parts List Updating

Instruments made after publication of this manual may have different parts than ones shown in the replaceable parts list. These instruments will have serial number prefixes higher than the one described on the title page. Refer to the MANUAL CHANGES supplement that accompanies these instruments for parts information. The MANUAL CHANGES supplement also contains instructions for correcting errors in the replaceable parts list.

6-8. ORDERING INFORMATION

When ordering a part listed in the replaceable parts list, include the Hewlett-Packard part number, the check digit, and the quantity required.

ORDERING INFORMATION (cont'd)

Address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

NOTE

Within the USA, it is more expedient to order directly from the HP Parts Center in Mountain View, California. Ask your nearest HP office for information and forms for the "Direct Mail Order System."

6-9. PARTS IDENTIFICATION

Most mechanical parts are identified in Figures 6-1 through 6-15. These figures are located at the end of the replaceable parts list. Most electrical parts are shown in figures associated with the schematic diagrams in Section VIII.

To identify a part not shown in Sections VI, VII, or VIII, or in the MANUAL CHANGES supplement, contact the parts identification section of your nearest Hewlett-Packard service center. Be prepared to identify the instrument by model and serial number, and to describe the part by type, function, and location within the instrument.

6-10. RECOMMENDED SPARES LIST

Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard prepares a "Recommended Spares" list for this instrument. The contents of the list are based on failure reports and repair data. Quantities given are for one year of parts support. A complimentary copy of the "Recommended Spares" list may be requested from your nearest Hewlett-Packard office.

When stocking parts to support more than one CW Generator or a variety of Hewlett-Packard instruments, it may be more economical to work from one consolidated list rather than simply adding together stocking quantities from the individual instrument lists. Hewlett-Packard will prepare consolidated "Recommended Spares" lists for any number or combination of instruments. Contact your nearest Hewlett-Packard office for details.

Table 6-1. Part Numbers for Exchange Assemblies

Reference Designation	Description	Part Number[1]	
		Exchange Assy	New Assy
A1A3	YTM Assembly	5086-6151	5086-7151
A1AT1	~~Programmable Attenuator Assembly~~	~~08672-60111~~	~~08672-60114~~
A3A1A4	M/N VCO Assembly	86701-60071	86701-60029

[1]When ordering extra assemblies for spare parts stock, use new assembly part number only. Exchange orders require return of the defective part.

Table 6-2. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A	assembly
AT	attenuator; isolator; termination
B	fan; motor
BT	battery
C	capacitor
CP	coupler
CR	diode; diode thyristor; varactor
DC	directional coupler
DL	delay line
DS	annunciator; signaling device (audible or visual); lamp; LED
E	miscellaneous electrical part
F	fuse
FL	filter
H	hardware
HY	circulator
J	electrical connector (stationary portion); jack
K	relay
L	coil; inductor
M	meter
MP	miscellaneous mechanical part
P	electrical connector (movable portion); plug
Q	transistor; SCR; triode thyristor
R	resistor
RT	thermistor
S	switch
T	transformer
TB	terminal board
TC	thermocouple
TP	test point
U	integrated circuit; microcircuit
V	electron tube
VR	voltage regulator; breakdown diode
W	cable; transmission path; wire
X	socket
Y	crystal unit (piezo-electric or quartz)
Z	tuned cavity; tuned circuit

ABBREVIATIONS

A	ampere
ac	alternating current
ACCESS	accessory
ADJ	adjustment
A/D	analog-to-digital
AF	audio frequency
AFC	automatic frequency control
AGC	automatic gain control
AL	aluminum
ALC	automatic level control
AM	amplitude modulation
AMPL	amplifier
APC	automatic phase control
ASSY	assembly
AUX	auxiliary
avg	average
AWG	American wire gauge
BAL	balance
BCD	binary coded decimal
BD	board
BE CU	beryllium copper
BFO	beat frequency oscillator
BH	binder head
BKDN	breakdown
BP	bandpass
BPF	bandpass filter
BRS	brass
BWO	backward-wave oscillator
CAL	calibrate
ccw	counter-clockwise
CER	ceramic
CHAN	channel
cm	centimeter
CMO	cabinet mount only
COAX	coaxial
COEF	coefficient
COM	common
COMP	composition
COMPL	complete
CONN	connector
CP	cadmium plate
CRT	cathode-ray tube
CTL	complementary transistor logic
CW	continuous wave
cw	clockwise
cm	centimeter
D/A	digital-to-analog
dB	decibel
dBm	decibel referred to 1 mW
dc	direct current
deg	degree (temperature interval or difference)
...°	degree (plane angle)
°C	degree Celsius (centigrade)
°F	degree Fahrenheit
°K	degree Kelvin
DEPC	deposited carbon
DET	detector
diam	diameter
DIA	diameter (used in parts list)
DIFF AMPL	differential amplifier
div	division
DPDT	double-pole, double-throw
DR	drive
DSB	doublesideband
DTL	diode transistor logic
DVM	digital voltmeter
ECL	emitter coupled logic
EMF	electromotive force
EDP	electronic data processing
ELECT	electrolytic
ENCAP	encapsulated
EXT	external
F	farad
FET	field-effect transistor
F/F	flip-flop
FH	flat head
FIL H	fillister head
FM	frequency modulation
FP	front panel
FREQ	frequency
FXD	fixed
g	gram
GE	germanium
GHz	gigahertz
GL	glass
GRD	ground(ed)
H	henry
h	hour
HET	heterodyne
HEX	hexagonal
HD	head
HDW	hardware
HF	high frequency
HG	mercury
HI	high
HP	Hewlett-Packard
HPF	high pass filter
HR	hour (used in parts list)
HV	high voltage
Hz	Hertz
IC	integrated circuit
ID	inside diameter
IF	intermediate frequency
IMPG	impregnated
in	inch
INCD	inncandescent
INCL	include(s)
INP	input
INS	insulation
INT	internal
kg	kilogram
kHz	kilohertz
kΩ	kilohm
kV	kilovolt
lb	pound
LC	inductance-capacitance
LED	light-emitting diode
LF	low frequency
LG	long
LH	left hand
LIM	limit
LIN	linear taper (used in parts list)
lin	linear
LK WASH	lock washer
LO	low; local oscillator
LOG	logarithmic taper (used in parts list)
log	logrithm(ic)
LPF	low pass filter
LV	low voltage
m	meter (distance)
mA	millampere
MAX	maximum
MΩ	megohm
MEG	meg (10^6) (used in parts list)
MET FLM	metal film
MET OX	metallic oxide
MF	medium frequency; microfarad (used in parts list)
MFR	manufacturer
mg	milligram
MHz	megahertz
mH	millihenry
mho	mho
MIN	minimum
min	minute (time)
...′	minute (plane angle)
MINAT	miniature
mm	millimeter

NOTE
All abbreviations in the parts list will be in upper-case.

Table 6-2. Reference Designations and Abbreviations (2 of 2)

MOD	modulator
MOM	momentary
MOS	metal-oxide semiconductor
ms	millisecond
MTG	mounting
MTR	meter (indicating device)
mV	millivolt
mVac	millivolt, ac
mVdc	millivolt, dc
mVpk	millivolt, peak
mVp-p	millivolt, peak-to-peak
mVrms	millivolt, rms
mW	milliwatt
MUX	multiplex
MY	mylar
μA	microampere
μF	microfarad
μH	microhenry
μmho	micromho
μs	microsecond
μV	microvolt
μVac	microvolt, ac
μVdc	microvolt, dc
μVpk	microvolt, peak
μVp-p	microvolt, peak-to-peak
μVrms	microvolt, rms
μW	microwatt
nA	nanoampere
NC	no connection
N/C	normally closed
NE	neon
NEG	negative
nF	nanofarad
NI PL	nickel plate
N/O	normally open
NOM	nominal
NORM	normal
NPN	negative-positive-negative
NPO	negative-positive zero (zero temperature coefficient)
NRFR	not recommended for field replacement
NSR	not separately replaceable
ns	nanosecond
nW	nanowatt
OBD	order by description
OD	outside diameter
OH	oval head
OP AMPL	operational amplifier
OPT	option
OSC	oscillator
OX	oxide
oz	ounce
Ω	ohm
P	peak (used in parts list)
PAM	pulse-amplitude modulation
PC	printed circuit
PCM	pulse-code modulation; pulse-count modulation
PDM	pulse-duration modulation
pF	picofarad
PH BRZ	phosphor bronze
PHL	Phillips
PIN	positive-intrinsic-negative
PIV	peak inverse voltage
pk	peak
PL	phase lock
PLO	phase lock oscillator
PM	phase modulation
PNP	positive-negative-positive
P/O	part of
POLY	polystyrene
PORC	porcelain
POS	positive; position(s) (used in parts list)
POSN	position
POT	potentiometer
p-p	peak-to-peak
PP	peak-to-peak (used in parts list)
PPM	pulse-position modulation
PREAMPL	preamplifier
PRF	pulse-repetition frequency
PRR	pulse repetition rate
ps	picosecond
PT	point
PTM	pulse-time modulation
PWM	pulse-width modulation
PWV	peak working voltage
RC	resistance-capacitance
RECT	rectifier
REF	reference
REG	regulated
REPL	replaceable
RF	radio frequency
RFI	radio frequency interference
RH	round head; right hand
RLC	resistance-inductance-capacitance
RMO	rack mount only
rms	root-mean-square
RND	round
ROM	read-only memory
R&P	rack and panel
RWV	reverse working voltage
S	scattering parameter
s	second (time)
″	second (plane angle)
S-B	slow-blow (fuse) (used in parts list)
SCR	silicon controlled rectifier; screw
SE	selenium
SECT	sections
SEMICON	semiconductor
SHF	superhigh frequency
SI	silicon
SIL	silver
SL	slide
SNR	signal-to-noise ratio
SPDT	single-pole, double-throw
SPG	spring
SR	split ring
SPST	single-pole, single-throw
SSB	single sideband
SST	stainless steel
STL	steel
SQ	square
SWR	standing-wave ratio
SYNC	synchronize
T	timed (slow-blow fuse)
TA	tantalum
TC	temperature compensating
TD	time delay
TERM	terminal
TFT	thin-film transistor
TGL	toggle
THD	thread
THRU	through
TI	titanium
TOL	tolerance
TRIM	trimmer
TSTR	transistor
TTL	transistor-transistor logic
TV	television
TVI	television interference
TWT	traveling wave tube
U	micro (10^{-6}) (used in parts list)
UF	microfarad (used in parts list)
UHF	ultrahigh frequency
UNREG	unregulated
V	volt
VA	voltampere
Vac	volts, ac
VAR	variable
VCO	voltage-controlled oscillator
Vdc	volts, dc
VDCW	volts, dc, working (used in parts list)
V(F)	volts, filtered
VFO	variable-frequency oscillator
VHF	very-high frequency
Vpk	volts, peak
Vp-p	volts, peak-to-peak
Vrms	volts, rms
VSWR	voltage standing wave ratio
VTO	voltage-tuned oscillator
VTVM	vacuum-tube voltmeter
V(X)	volts, switched
W	watt
W/	with
WIV	working inverse voltage
WW	wirewound
W/O	without
YIG	yttrium-iron-garnet
Z_0	characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	fento	10^{-15}
a	atto	10^{-18}

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A1	08671-60118	0	1	BOARD ASSEMBLY, FRONT PANEL (INCLUDES A1S1, A1S2 AND A1S5 CONTACT ASSEMBLIES)	28480	08671-60118
A1A1	08671-60018	9	1	BOARD ASSEMBLY, FRONT PANEL, LESS A1S1, A1S2 AND A1S5 CONTACT ASSEMBLIES	28480	08671-60018
A1A1C1	0180-0229	7	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A1C2	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A1DS1	2140-0427	5	6	LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0427
A1A1DS2	2140-0427	5		LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0427
A1A1DS3	2140-0427	5		LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0427
A1A1DS4	2140-0427	5		LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0427
A1A1DS5	2140-0427	5		LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0427
A1A1DS6	2140-0427	5		LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0427
A1A1J1	1251-3025	9	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1251-3025
A1A1J2	1251-3119	2	1	CONN-POST TYPE .100-PIN-SPCG 20-CONT	28480	1251-3119
A1A1J3	1200-0645	6	2	SOCKET-STRP 12-CONT DIP-SLDR	28480	1200-0645
A1A1J4	1200-0645	6		SOCKET-STRP 12-CONT DIP-SLDR	28480	1200-0645
A1A1MP1	1200-0448	7	33	SOCKET-IC 1-CONT DIP-SLDR (P/O A1A1XA1A2A, B, AND C)	28480	1200-0448
A1A1Q1	1854-0071	7	24	TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A1Q2	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A1Q3	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A1Q4	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A1R1	0698-7216	3	2	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-TO-147R-F
A1A1R2	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-TO-147R-F
A1A1R3	0698-7212	9	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-TO-100R-F
A1A1R4	0698-7230	1	1	RESISTOR 562 1% .05W F TC=0+-100	24546	C3-1/8-TO-562R-F
A1A1R5	0698-7229	8	2	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A1A1R6	0698-7264	1	5	RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-TO-1472-F
A1A1XA1A2A			2	NSR (INCLUDES A1A1MP1)		
A1A1XA1A2B				NSR (INCLUDES A1A1MP1)		
A1A1XA1A2C				NSR (INCLUDES A1A1MP1)		
				A1A1 MISCELLANEOUS		
	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
	08672-20060	8	1	GUIDE, SLIDE SWITCH	28480	08672-20060
	08672-20061	9	2	GUIDE, SLIDE SWITCH	28480	08672-20061
	08672-20062	0	1	GUIDE, SLIDE SWITCH	28480	08672-20062
	08672-20063	1	2	GUIDE, SLIDE SWITCH	28480	08672-20063
A1A2	08672-60042	0	1	DISPLAY DRIVER ASSEMBLY	28480	08672-60042
A1A2C1	0160-4835	7	1	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A1A2P1A	1260-0363	1	3	CONN-LEAD FRAME 11 PINS PER STRIP	28480	1260-0363
A1A2P1B	1260-0363	1		CONN-LEAD FRAME 11 PINS PER STRIP	28480	1260-0363
A1A2P1C	1260-0363	1		CONN-LEAD FRAME 11 PINS PER STRIP	28480	1260-0363
A1A2Q1	1853-0020	4	26	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q3	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q5	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q6	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q7	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q8	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q9	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q11	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q12	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q13	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q14	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A2Q15	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A2Q16	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A2Q17	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A2Q18	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A2R1	1810-0158	9	2	NETWORK-RES 7-SIP 56.0K OHM X 6	28480	1810-0158
A1A2R2	1810-0158	9		NETWORK-RES 7-SIP 56.0K OHM X 6	28480	1810-0158
A1A2R3	0698-7244	7	16	RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R4	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R5	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R6	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R7	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R8	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R9	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R10	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R11	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R12	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R13	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R14	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R15	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R16				NOT ASSIGNED		
A1A2R17	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R18	0698-7233	4	1	RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-F
A1A2R19	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2R20	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2U1	1820-1746	4	2	IC BFR CMOS INV HEX	04713	MC14049UBCP
A1A2U2	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A1A3	5086-7151	3	1	YTM ASSEMBLY (INCLUDES A1A3A1)	28480	5086-7151
A1A3	5086-6151	1	1	YTM ASSEMBLY(RESTORED 5086-7151)	28480	5086-6151
A1A3CR2	1901-0376	6	10	DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A3A1	5061-1036	9	1	YTM, HEATER CONTROL ASSEMBLY	28480	5061-1036
A1A3A1C1	0180-2182	5	1	CAPACITOR-FXD 18UF+-10% 50VDC TA	56289	150D186X9050R2
A1A3A1C2	0160-0127	2	2	CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-0127
A1A3A1CR1	1901-0033	2	9	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A3A1J1	1200-0508	0	3	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0508
A1A3A1MP1	0380-0322	5	2	SPACER-RVT-ON .062-IN-LG .152-IN-ID	28480	0380-0322
A1A3A1MP2	0380-0322	5		SPACER-RVT-ON .062-IN-LG .152-IN-ID	28480	0380-0322
A1A3A1Q1	1853-0038	4	2	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1A3A1Q2	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1A3A1R1	0698-7245	8	2	RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-F
A1A3A1R2	0698-7260	7	31	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A3A1R3	0698-7273	2	2	RESISTOR 34.8K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3482-F
A1A3A1R4	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A1A3A1R5	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A1A3A1R6	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A1A3A1R7	0698-3102	8	1	RESISTOR 237 1% .5W F TC=0+-100	28480	0698-3102
A1A3A1R8	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A1A3A1R9	0698-7273	2		RESISTOR 34.8K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3482-F
A1A3A1R10	0698-8827	4	1	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A1A3A1R11	0698-7245	8		RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-F
A1A3A1U1	1826-0261	8	1	IC OP AMP LOW-NOISE TO-99 PKG	3L680	CA6741T SELECTED
A1A3A1VR1	1902-0176	6	1	DIODE-ZNR 47V 5% PD=1W IR=5UA	28480	1902-0176
A1A3A1VR2	1902-0025	4	5	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A1A4				NOT ASSIGNED		
A1A5	08672-60044	2	1	ASSEMBLY, ALC	28480	08672-60044
A1A5C1	0180-0197	8	12	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A5C2	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A5C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A5C4	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A5C5	0160-2209	5	1	CAPACITOR-FXD 360PF +-5% 300VDC MICA	28480	0160-2209

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A5C6	0160-4084	8	14	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A5C7	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A5C8	0160-2201	7	1	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A1A5C9	0160-3787	6	1	CAPACITOR-FXD 1UF +-10% 50VDC MET-POLYC	28480	0160-3787
A1A5C10	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A5C11	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A5C12	0160-0127	2		CAPACITOR-FXD 1UF +-20% [illegible]VDC CER	28480	0160-0127
A1A5C13	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A1A5C14	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A5C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A5C16	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A5C17	0160-2200	6	1	CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
A1A5C18	0160-2199	2	1	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A1A5C19	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A5C20	0160-0157	8	1	CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A1A5C21	0160-2055	9	4	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A5C22	0160-3466	8	2	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A1A5C23	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A5C24	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A5C25	0160-2256	2	2	CAPACITOR-FXD 9.1PF +-.25PF 500VDC CER	28480	0160-2256
A1A5CR1	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A5CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A5CR3	1901-0050	3	29	DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A5CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A5CR5	1901-1096	9	1	DIODE-PIN	28480	1901-1096
A1A5CR6	1901-0539	3	3	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A5CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A5CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A5L1	9140-0144	0	6	INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0144
A1A5L2	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0144
A1A5L3	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0144
A1A5L4	9100-1623	8	1	INDUCTOR RF-CH-MLD 27UH 5%	28480	9100-1623
A1A5Q1				NOT ASSIGNED		
A1A5Q2	1853-0012	4	1	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A1A5Q3	1853-0322	9	7	TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A5Q4	1854-0404	0	6	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A5Q5	1854-0013	7	1	TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	04713	2N2218A
A1A5Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A5Q7	1854-0712	3	2	TRANSISTOR-DUAL NPN PD=1.8W	06665	MAT-01GH
A1A5Q8	1854-0475	5	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A1A5Q9	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A5Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A5Q11	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A5Q12	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A5Q13	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A5Q14	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A5R1	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A5R2	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A5R3	0757-0465	6	10	RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A5R4	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A5R5	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2612-F
A1A5R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A5R7	2100-3353	8	5	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A5R8	0757-0442	9	20	RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A5R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A5R10	0698-3432	7	2	RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
A1A5R11	0698-3157	3	6	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1962-F
A1A5R12	0757-0439	4	2	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6811-F
A1A5R13	0698-3155	1	3	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A1A5R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A5R15	0698-0085	0	5	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A1A5R16	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A1A5R17	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A5R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A5R19	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A5R20	0757-1094	9	2	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A5R21	2100-3274	2	7	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A5R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A5R23	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A5R24	0698-0083	8	5	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A1A5R25	0757-0438	3	10	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A5R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A5R27	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A1A5R28	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A5R29	0698-4414	7	1	RESISTOR 158 1% .125W F TC=0+-100	24546	CT4-1/8-T0-158R-F
A1A5R30	0698-4014	3	1	RESISTOR 787 1% .125W F TC=0+-100	24546	CT4-1/8-T0-787R-F
A1A5R31	0698-3626	1	1	RESISTOR 180 5% 2W MO TC=0+-200	28480	0698-3626
A1A5R32	0698-3510	2	1	RESISTOR 453 1% .125W F TC=0+-100	24546	CT4-1/8-T0-453R-F
A1A5R33	0698-3495	2	1	RESISTOR 866 1% .125W F TC=0+-100	24546	CT4-1/8-T0-866R-F
A1A5R34	0757-0346	2	5	RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A1A5R35				NOT ASSIGNED		
A1A5R36	0757-0394	0	4	RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A1A5R37	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A5R38	0757-0317	7	2	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1331-F
A1A5R39	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A1A5R40	0698-0084	9	7	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A1A5R41	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A1A5R42	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A1A5R43	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A1A5R44	0698-3444	1	2	RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A1A5R45	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A5R46	0757-0416	7	2	RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A1A5R47	0757-0276	7	1	RESISTOR 61.9 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6192-F
A1A5R48	0757-0290	5	2	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-6191-F
A1A5R49	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A1A5R50	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A5R51	0698-3132	4	2	RESISTOR 261 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2610-F
A1A5R52	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2610-F
A1A5R53	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A5R54	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A5R55	0698-3162	0	3	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4642-F
A1A5R56	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0+-100	24546	CT4-1/8-T0-121R-F
A1A5R57	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A1A5R58	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A1A5R59	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A5R60	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A5R61	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5621-F
A1A5R62	0698-3449	6	1	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2872-F
A1A5R63	0698-3236	9	2	RESISTOR 15K .25% .125W F TC=0+-50	28480	0698-3236
A1A5R64	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A1A5R65	0698-3445	2	1	RESISTOR 348 1% .125W F TC=0+-100	24546	CT4-1/8-T0-348R-F
A1A5R66	0698-3236	9		RESISTOR 15K .25% .125W F TC=0+-50	28480	0698-3236
A1A5R67	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A5R68	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A1A5R69	2100-3351	6	2	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A1A5R70	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A5R71	0698-7576	8	2	RESISTOR 217 .1% .125W F TC=0+-25	19701	5033R-1/8-T9-217R-B
A1A5R72	0757-0402	1	2	RESISTOR 110 1% .125W F TC=0+-100	24546	CT4-1/8-T0-111-F
A1A5R73	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A1A5R74	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A5R75	0757-0421	4	5	RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A1A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP2				NOT ASSIGNED		
A1A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5U1	1826-0486	9	1	IC MULTIPLXR 4-CHAN-ANLG DUAL 16-DIP-P	04713	MC14052BCP
A1A5U2	1826-0501	9	3	ANALOG MULTIPLEXER 6 CHNL 16 -DIP-P	04713	MC14053BCP
A1A5U3	1826-0081	0	5	IC OP AMP WB TO-99 PKG	27014	LM318H
A1A5U4	1826-0059	2	6	IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A5U5	1820-0125	1		IC COMPARATOR GP DUAL TO-100 PKG	07263	711HC

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A5U6	1826-0081	0		IC OP AMP WB TO-99 PKG	27014	LM318H
A1A5U7	1826-0081	0		IC OP AMP WB TO-99 PKG	27014	LM318H
A1A5U8	1820-0223	0	7	IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A5VR1	1902-0041	4	3	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A1A5VR2	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A1A5VR3	1902-0064	1	1	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
A1A5VR4	1902-3082	9	1	DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
				A1A5 MISCELLANEOUS		
	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
	1480-0073	6	12	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3	6	EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0755	2	1	EXTR-PC BD VIO POLYC .062-IN-BD-THKNS	28480	4040-0755
A1A6	08672-60197	6	1	BOARD ASSEMBLY, DETECTOR	28480	08672-60197
A1A6C1	0160-0174	9	3	CAPACITOR-FXD .47UF +80-20% 50VDC CER	28480	0160-0174
A1A6C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C3	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A6C4	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A6C5	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6C6	0160-2240	4	1	CAPACITOR-FXD 2PF +-.25PF 500VDC CER	28480	0160-2240
A1A6C7	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 50VDC CER	28480	0160-0174
A1A6C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C9	0160-2207	3	3	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A1A6C10	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A6C11	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C13	0160-3456	6	1	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A1A6C14	0160-2207	3		CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A1A6C15	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A1A6C16	0160-0575	4	1	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A1A6C17	0180-2206	4	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A1A6C18	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A6C19				NOT ASSIGNED		
A1A6C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A6C21	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A6C22				NOT ASSIGNED		
A1A6C23	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A6C24	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A1A6C25	0160-2256	2		CAPACITOR-FXD 9.1PF +-.25PF 500VDC CER	28480	0160-2256
A1A6C26	0160-2207	3		CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A1A6C27	0160-3094	8	1	CAPACITOR-FXD .1UF +-10% 100VDC CER	28480	0160-3094
A1A6C28	0160-3879	7	1	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A6C29	0160-0574	3	1	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A1A6C30	0180-0291	3	13	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A6CR2	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A6CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A6CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A6CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A6CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A1A6L1	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0144
A1A6L2	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0144
A1A6L3	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0144
A1A6L4				NOT ASSIGNED		
A1A6Q1	1853-0034	0	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A1A6Q2	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A6Q3	1853-0316	1	1	TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
A1A6Q4				NOT ASSIGNED		
A1A6Q5	1853-0388	7	1	TRANSISTOR-DUAL PNP PD=600MW	28480	1853-0388
A1A6Q6	1855-0081	1	2	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
A1A6Q7	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
A1A6Q8	1854-0345	8	2	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A1A6Q9	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A1A6Q10	1855-0049	1	1	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A6R1	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A1A6R2	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A6R3	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A6R4	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A6R5	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A6R6	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A1A6R7	0757-0401	0	4	RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A1A6R8	0698-3432	7		RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
A1A6R9	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A6R10	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A6R11	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A6R12	2100-2039	5	2	RESISTOR-TRMR 20K 5% WW SIDE-ADJ 10-TRN	28480	2100-2039
A1A6R13	0757-0419	0	3	RESISTOR 681 1% .125W F TC=0+-100	24546	CT4-1/8-T0-681R-F
A1A6R14	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A1A6R15	2100-2039	5		RESISTOR-TRMR 20K 5% WW SIDE-ADJ 10-TRN	28480	2100-2039
A1A6R16	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A1A6R17	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A1A6R18	0698-3435	0	1	RESISTOR 38.3 1% .125W F TC=0+-100	28480	0698-3435
A1A6R19	0698-3151	7	4	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2871-F
A1A6R20	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A6R21	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A1A6R22	0757-0422	5	1	RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A1A6R23	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A1A6R24	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2871-F
A1A6R25	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A1A6R26	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A1A6R27	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A1A6R28	2100-3164	9	1	RESISTOR-TRMR 10 20% C SIDE-ADJ 17-TRN	73138	89PR10
A1A6R29	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6811-F
A1A6R30	0757-0461	2	3	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6812-F
A1A6R31	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2873-F
A1A6R32	0757-0459	8		RESISTOR 56.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5622-F
A1A6R33	2100-1922	3	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 22-TRN	32997	3059Y-1-502
A1A6R34	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A1A6R35	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4642-F
A1A6R36	2100-3273	1	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A1A6R37	0811-3249	6	1	RESISTOR 17.74K .1% .125W PWW TC=0+-10	20940	114-1/16-17741-B
A1A6R38	2100-3056	8	2	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	73138	89PR5K
A1A6R39	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	73138	89PR5K
A1A6R40	0811-3202	1	1	RESISTOR 30.615K .1% .05W PWW TC=0+-10	14140	1409-1/40-30615R-B
A1A6R41	0811-1176	4	1	RESISTOR 4.64K 1% .125W PWW TC=0+-10	07088	KP61-4641-1
A1A6R42	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A1A6R43	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A1A6R44	0698-3152	8	3	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3481-F
A1A6R45				NOT ASSIGNED		
A1A6R46	0698-6329	7	1	RESISTOR 845 1% .125W F TC=0+-25	28480	0698-6329
A1A6R47	0811-2031	2	1	RESISTOR 815 3% .25W PWW TC=+5900+-300	20940	143-1/4-815R-3
A1A6R48				NOT ASSIGNED		
A1A6R49				NOT ASSIGNED		
A1A6R50				NOT ASSIGNED		
A1A6R51				NOT ASSIGNED		
A1A6R52	0698-8584	0	1	RESISTOR 274 1% .125W F TC=0+-25	28480	0698-8584
A1A6R53	0698-6362	8	1	RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A1A6R54	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A1A6R55	0698-7576	8		RESISTOR 217 .1% .125W F TC=0+-25	19701	5033R-1/8-T9-217R-B
A1A6R56	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A1A6R57	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A1A6R58	0698-3260	9	13	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A6R59	0698-7278	7	1	RESISTOR 56.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5622-F
A1A6R60	0698-7235	6	2	RESISTOR 909 1% .05W F TC=0+-100	24546	C3-1/8-T0-909R-F
A1A6R61	0698-7235	6		RESISTOR 909 1% .05W F TC=0+-100	24546	C3-1/8-T0-909R-F
A1A6R62	0698-7267	4	1	RESISTOR 19.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1962-F
A1A6R63	0698-7257	2	1	RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-F
A1A6R64	0698-7236	7	4	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A1A6R65	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A6R66	0698-3447	4	1	RESISTOR 422 1% .125W F TC=0+-100	24546	CT4-1/8-T0-422R-F
A1A6R67	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-T0-215R-F
A1A6R68	0698-3438	3	1	RESISTOR 147 1% .125W F TC=0+-100	24546	CT4-1/8-T0-147R-F
A1A6R69	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A1A6R70	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A1A6R71	0757-0274	5	2	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1211-F
A1A6R72	0698-7284	5	2	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A1A6R73	0757-0459	8	2	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5622-F
A1A6R74	0698-7188	8	3	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A6R75	0757-0458	7	9	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A1A6RT1	0837-0124	4	1	THERMISTOR DISC 250-OHM TC=-4.4%/C-DEG	28480	0837-0124
A1A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP7	1251-0600	0	35	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6U1	1826-0081	0		IC OP AMP WB TO-99 PKG	27014	LM318H
A1A6U2	1826-0501	9		ANALOG MULTIPLEXER 6 CHNL 16 -DIP-P	04713	MC14053BCP
A1A6U3	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A6U4	1826-0501	9		ANALOG MULTIPLEXER 6 CHNL 16 -DIP-P	04713	MC14053BCP
A1A6U5	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A6U6	1826-0081	0		IC OP AMP WB TO-99 PKG	27014	LM318H
A1A6U7	1826-0266	3	1	IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-05EJ
A1A6U8	1826-0229	8	2	IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-05CJ
A1A6U9	1820-0125	1	2	IC COMPARATOR GP DUAL TO-100 PKG	07263	711HC
A1A6U10	1820-1422	3	1	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A1A6U11	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A1A6VR1	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A1A6VR2	1902-3182	0	1	DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A1A6VR3	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A1A6VR4	1902-3048	7	1	DIODE-ZNR 3.48V 5% DO-35 PD=.4W	28480	1902-3048
A1A6W1	08672-60064	6	1	CABLE ASSEMBLY, DETECTOR	28480	08672-60064
				A1A6 MISCELLANEOUS		
	1400-0249	0	1	CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0754	1	1	EXTR-PC BD BLU POLYC .062-IN-BD-THKNS	28480	4040-0754
A1A7	08672-60116	9	1	ASSEMBLY, SRD BIAS	28480	08672-60116
A1A7C1	0180-2141	6	5	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A7C2	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A7C3	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A7C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A7C5	0160-2150	5	6	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A1A7C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A7CR1	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A1A7CR2	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A1A7Q1				NOT ASSIGNED		
A1A7Q2				NOT ASSIGNED		
A1A7Q3				NOT ASSIGNED		
A1A7Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A7Q5	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A7Q6				NOT ASSIGNED		
A1A7Q7				NOT ASSIGNED		
A1A7Q8	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A7Q9	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A7Q10	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A7Q11	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A7Q12	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A7Q13	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A7Q14	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A7Q15	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A7R1	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-3832-F
A1A7R2	0698-3158	4	1	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-2372-F
A1A7R3	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1102-F
A1A7R4	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A7R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1002-F
A1A7R6	0698-3160	8	2	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-3162-F
A1A7R7	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-3162-F
A1A7R8	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1962-F
A1A7R9	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1962-F
A1A7R10	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1962-F
A1A7R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1002-F
A1A7R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1002-F
A1A7R13	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-8251-F
A1A7R14	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-3481-F
A1A7R15	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1002-F
A1A7R16	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-3481-F
A1A7R17	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1002-F
A1A7R18	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A7R19	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-7502-F
A1A7R20	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-7501-F
A1A7R21	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	5033R-1/8-TO-6191-F
A1A7R22	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-6812-F
A1A7R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1002-F
A1A7R24	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-6812-F
A1A7R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1002-F
A1A7R26	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1962-F
A1A7R27	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1962-F
A1A7R28	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-TO-101-F
A1A7R29	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A7R30	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-5111-F
A1A7R31	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A7R32	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	CT4-1/8-TO-681R-F
A1A7TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7U1				NOT ASSIGNED		
A1A7U2	1826-0092	3	1	IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A1A7U3				NOT ASSIGNED		
A1A7U4	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A7U5	1820-0681	4	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A1A7VR1	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
				A1A7 MISCELLANEOUS		
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0753	0	1	EXTR-PC BD GRN POLYC .062-IN-BD-THKNS	28480	4040-0753
A1A8	08672-60051	1	1	ASSEMBLY, YTM DRIVER	28480	08672-60051
A1A8C1	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A8C2	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A8C3	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A8C4	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A8C5	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A8C6	0160-2150	5		CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A1A8C7	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A8C8	0160-3451	1	7	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1A8C9	0160-2150	5		CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A1A8C10	0160-2150	5		CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A8C11	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1A8C12	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1A8C13	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1A8C14	0160-2150	5		CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A1A8C15	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1A8C16	0160-2150	5		CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A1A8C17	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1A8C18	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A1A8C19	0160-4103	2	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	72982	8121-M100-COG-221J
A1A8C20	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A8C21	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 50VDC CER	28480	0160-0174
A1A8CR1	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8CR2	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8CR3	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8CR4	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8CR5	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8CR6	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8CR7	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8CR8	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8CR9	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A1A8Q1	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A8Q2	1853-0451	5	2	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A1A8Q3	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A8Q4	1855-0020	8	5	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A1A8Q5	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A1A8Q6	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A1A8Q7	1854-0712	3		TRANSISTOR-DUAL NPN PD=1.8W	06665	MAT-01GH
A1A8Q8	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A8Q9	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A1A8Q10	1853-0235	3	2	TRANSISTOR PNP SI TO-92 PD=400MW	28480	1853-0235
A1A8Q11	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A8Q12	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A8Q13	1853-0235	3		TRANSISTOR PNP SI TO-92 PD=400MW	28480	1853-0235
A1A8Q14	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A8Q15	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A8Q16	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A1A8R1	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A1A8R2	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A1A8R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A8R4	0811-3396	4	1	RESISTOR 11K 1% .05W PWW TC=0+-2	28480	0811-3396
A1A8R5	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A8R6	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A8R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A8R8	0757-0470	3	1	RESISTOR 162K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1623-F
A1A8R9	0811-3378	2	1	RESISTOR 3.79K .1% .125W PWW TC=0+-10	28480	0811-3378
A1A8R10	0811-3377	1	1	RESISTOR 5.62K .1% .125W PWW TC=0+-10	28480	0811-3377
A1A8R11	2100-3103	6	5	RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	73138	89PR10K
A1A8R12	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A1A8R13	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A1A8R14	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A1A8R15	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A8R16	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	73138	89PR10K
A1A8R17	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A8R18	0811-3375	9	1	RESISTOR 10.4K .1% .05W PWW TC=0+-10	28480	0811-3375
A1A8R19	0811-3376	0	1	RESISTOR 14.7K .1% .05W PWW TC=0+-10	28480	0811-3376
A1A8R20	2100-3152	5	1	RESISTOR-TRMR 5K 10% MF SIDE-ADJ 25-TRN	28480	2100-3152
A1A8R21	0811-3371	5	1	RESISTOR 25.6K 1% .05W PWW TC=0+-10	28480	0811-3371
A1A8R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A8R23	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A8R24	0811-3373	7	1	RESISTOR 17.8K .1% .05W PWW TC=0+-10	28480	0811-3373
A1A8R25	0811-3374	8	1	RESISTOR 23.7K .1% .05W PWW TC=0+-10	28480	0811-3374
A1A8R26	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	CT4-1/8-T0-681R-F
A1A8R27	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A8R28	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A1A8R29	0811-3379	3	1	RESISTOR 5.13K .1% .05W PWW TC=0+-2	28480	0811-3379
A1A8R30	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A8R31	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A8R32	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A8R33	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4642-F
A1A8R34	0757-0289	2	2	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-1332-F
A1A8R35	0811-3366	8	2	RESISTOR 5K .1% .05W PWW TC=0+-2	28480	0811-3366
A1A8R36	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A8R37	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2871-F
A1A8R38	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2871-F
A1A8R39	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A1A8R40	0811-3366	8		RESISTOR 5K .1% .05W PWW TC=0+-2	28480	0811-3366
A1A8R41	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	73138	89PR10K
A1A8R42	0811-3370	4	2	RESISTOR 20K 1% .05W PWW TC=0+-10	28480	0811-3370
A1A8R43	0811-3370	4		RESISTOR 20K 1% .05W PWW TC=0+-10	28480	0811-3370
A1A8R44	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A1A8R45	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A8R46	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	73138	89PR10K
A1A8R47	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	73138	89PR10K
A1A8R48	0811-3135	9	3	RESISTOR 10K .1% .125W PWW TC=0+-10	28480	0811-3135
A1A8R49	0811-3135	9		RESISTOR 10K .1% .125W PWW TC=0+-10	28480	0811-3135
A1A8R50	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A1A8R51	0811-3369	1	1	RESISTOR 12K .1% .125W PWW TC=0+-10	28480	0811-3369
A1A8R52	0811-3135	9		RESISTOR 10K .1% .125W PWW TC=0+-10	28480	0811-3135
A1A8R53	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A8R54	0811-3368	0	1	RESISTOR 100K 1% .05W PWW TC=0+-10	28480	0811-3368
A1A8R55	0811-2310	0	1	RESISTOR 2K 1% .125W PWW TC=0+-10	07088	EP20-1/8-D-2001-F
A1A8R56	0811-2870	7	2	RESISTOR 1.96K 1% .05W PWW TC=0+-10	14140	1409-1/20-D-1961-F
A1A8R57	0811-2870	7		RESISTOR 1.96K 1% .05W PWW TC=0+-10	14140	1409-1/20-D-1961-F
A1A8R58	0811-3372	6	1	RESISTOR 1.71K 1% .05W PWW TC=0+-10	28480	0811-3372
A1A8R59	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A1A8R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A8R61	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A8R62	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A8R63	0698-3439	4	1	RESISTOR 178 1% .125W F TC=0+-100	24546	CT4-1/8-T0-178R-F
A1A8R64	2100-3351	6		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A1A8R65	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A1A8R66	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A1A8R67	0811-3157	5	1	RESISTOR 1K 1% .125W PWW TC=0+-10	14140	1274-1/8-1001-F
A1A8R68	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-1332-F
A1A8R69	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A1A8U1	1826-0502	0	2	IC SWITCH ANLG QUAD 14-DIP-P PKG	04713	MC14066BCP
A1A8U2	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A8U3	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A8U4	1826-0502	0		IC SWITCH ANLG QUAD 14-DIP-P PKG	04713	MC14066BCP
A1A8U5	1826-0229	8		IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-05CJ
A1A8U6	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A8U7	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A8U8	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A8U9	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A8VR1	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A1A8VR2	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A1A8VR3	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A1A8VR4	1902-3193	3	1	DIODE-ZNR 13.3V 5% DO-35 PD=.4W	28480	1902-3193
A1A8VR5	1902-0680	7	2	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A1A8VR6	1902-3268	3	1	DIODE-ZNR 26.1V 5% DO-35 PD=.4W	28480	1902-3268
				A1A8 MISCELLANEOUS		
	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0752	9	1	EXTR-PC BD YEL POLYC .062-IN-BD-THKNS	28480	4040-0752

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A9				NOT ASSIGNED		
A1A10	08672-60047	5	1	ASSEMBLY, LEVEL CONTROL	28480	08672-60047
A1A10C1	0180-0141	2	1	CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A1A10C2	0180-1846	6	1	CAPACITOR-FXD 2.2UF+-10% 35VDC TA	28480	0180-1846
A1A10C3	0180-0374	3	1	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A1A10C4	0180-0116	1	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A1A10C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A10C6	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A10C7	0160-0153	4	3	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1A10C8	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A10C9	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1A10C10	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A10C11	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1A10CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR13	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR14	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR15	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR16	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR17	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10CR19	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A10Q1	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A10Q2	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A10Q3	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A10Q4	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A10Q5	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A10Q6	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A10Q7	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A10Q8	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A10Q9	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A10Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A10Q11	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A10Q12	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A1A10Q13	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A1A10Q14	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A1A10Q15	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A1A10R1	0698-7288	9	5	RESISTOR 147K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1473-F
A1A10R2	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R3	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A1A10R4	0698-7264	1		RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1472-F
A1A10R5	0698-7264	1		RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-10-1472-F
A1A10R6	0698-7264	1		RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1472-F
A1A10R7	0698-7264	1		RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1472-F
A1A10R8	0698-7262	9	1	RESISTOR 12.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1212-F
A1A10R9	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A10R10	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A10R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A10R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A10R13	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R14	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R15	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A10R16	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R17	0811-2505	5	1	RESISTOR 400K .025% .5W PWW TC=0+-5	14140	1251-1/8-C-4003-1/40
A1A10R18	0811-3140	6	1	RESISTOR 200K .1% .125W PWW TC=0+-10	20940	114-1/16-2003-B
A1A10R19	0811-0640	5	1	RESISTOR 100K .01% .125W PWW TC=0+-10	28480	0811-0640
A1A10R20	0811-0648	3	1	RESISTOR 50K .01% .125W PWW TC=0+-10	28480	0811-0648
A1A10R21	0811-0641	6	2	RESISTOR 10K 1% .125W PWW TC=0+-5	28480	0811-0641
A1A10R22	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A1A10R23	0698-7288	9		RESISTOR 147K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1473-F
A1A10R24	0698-7288	9		RESISTOR 147K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1473-F
A1A10R25	0698-7288	9		RESISTOR 147K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1473-F
A1A10R26	0698-7288	9		RESISTOR 147K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1473-F
A1A10R27	0811-2590	8	1	RESISTOR 1.333K 1% .125W PWW TC=0+-5	20940	135-1/8-C-1333R-F
A1A10R28	0811-0641	6		RESISTOR 10K 1% .125W PWW TC=0+-5	28480	0811-0641
A1A10R29	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A1A10R30	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A10R31	2100-3161	6	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	73138	89PR20K
A1A10R32	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R33	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R34	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R35	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R36	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A1A10R37	0811-3365	7	1	RESISTOR 32.26K .5% .125W PWW TC=0+-2	28480	0811-3365
A1A10R38	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A10R39	0698-7270	9	1	RESISTOR 26.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2612-F
A1A10R40	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A10R41	0698-7277	6	5	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A10R42	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A10R43	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R44	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R45	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10R46	0698-7265	2	1	RESISTOR 16.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1622-F
A1A10R47	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	CT4-1/8-T0-111-F
A1A10R48	0698-7253	8	2	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A1A10R49	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1211-F
A1A10R50	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1331-F
A1A10R51	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A1A10U1	1820-0535	7	4	IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A10U2	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A10U3	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A1A10U4	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A10U5	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A10U6	1820-1976	2	3	IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A1A10U7	1826-0035	4	1	IC OP AMP LOW-DRIFT TO-99 PKG	27014	LM308AH
A1A10U8	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A10U9	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A10VR1	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A1A10VR2	1902-3245	6	1	DIODE-ZNR 21.5V 5% DO-35 PD=.4W	28480	1902-3245
				A1A10 MISCELLANEOUS		
	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0750	7	1	EXTR-PC BD RED POLYC .062-IN-BD-THKNS	28480	4040-0750
A1A11	08672-60148	7	1	DIGITAL PROCESSOR ASSEMBLY	28480	08672-60148
A1A11C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A11CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A11CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A11CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A11CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A11CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A11CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A11CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A1A11CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150

See introduction to this section for ordering information
*Indicates factory selected value
+Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A11R1	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A11R2	1810-0277	3	1	NETWORK-RES 10-SIP 2.2K OHM X 9	91637	CSC10A01-222G/MSP10A01-
A1A11R3	1810-0206	8	2	NETWORK-RES 8-SIP 10.0K OHM X 7	11236	750-81-R10K
A1A11R4	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R5	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R6	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R7	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R8	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R9	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R10	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R11	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A11R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A11R14	1810-0206	8		NETWORK-RES 8-SIP 10.0K OHM X 7	11236	750-81-R10K
A1A11R15	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R16	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R17	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R18	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R19	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R20	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R21	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R22	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R23	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R24	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A11R25	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A11R26	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A11R27	0757-0280	3	12	RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A1A11TP1	0360-1730	9	8	CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
A1A11TP2	0360-1730	9		CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
A1A11TP3	0360-1730	9		CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
A1A11TP4	0360-1730	9		CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
A1A11TP5	0360-1730	9		CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
A1A11TP6	0360-1730	9		CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
A1A11TP7	0360-1730	9		CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
A1A11TP8	0360-1730	9		CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
A1A11U1	1820-2085	6	5	IC GATE CMOS AND-OR QUAD	27014	CD4019BCN
A1A11U2	1820-2015	2	1	IC GATE CMOS EXCL-OR QUAD	04713	MC14070BCP
A1A11U3	1820-2085	6		IC GATE CMOS AND-OR QUAD	27014	CD4019BCN
A1A11U4	1820-1976	2		IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A1A11U5	1820-2085	6		IC GATE CMOS AND-OR QUAD	27014	CD4019BCN
A1A11U6	1820-2085	6		IC GATE CMOS AND-OR QUAD	27014	CD4019BCN
A1A11U7	1820-1355	1	1	IC ENCDR CMOS 8-BIT	04713	MC14532BCP
A1A11U8	08672-60018	0	1	PROM RANGE ENCODER	28480	08672-60018
A1A11U9	1820-1976	2		IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A1A11U10	1820-2085	6		IC GATE CMOS AND-OR QUAD	27014	CD4019BCN
A1A11U11	1820-1486	9	1	IC GATE CMOS AND QUAD 2-INP	3L680	CD4081BE
				A1A11 MISCELLANEOUS		
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0749	4	1	EXTR-PC BD BRN POLYC .062-IN-BD-THKNS	28480	4040-0749
A1A12	08672-67005	9	1	AMPLIFIER ASSEMBLY, INCLUDES A1A12U1	28480	08672-67005
A1A12	08672-69005	3	1	AMPLIFIER ASSEMBLY, RESTORED 08672-67005	28480	08672-69005
A1A12U1				NSR, P/O A1A12		
A1A13	08672-60049	7	1	INTERCONNECT ASSEMBLY	28480	08672-60049
A1A13C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A13C2	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A13J1	1200-0508	0		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0508
A1A13P1-A1A13P12				NOT ASSIGNED		
A1A13P13	1251-3806	4	1	CONN-RECT D-SUBMIN 50-CKT 50-CONT	28480	1251-3806
A1A13P14	1251-3421	9	1	CONN-RECT D-SUBMIN 24-CKT 17-CONT	28480	1251-3421

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A13R1*	0757-0463	4	1	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8252-F
A1A13R2	0757-0794	4	1	RESISTOR 68.1 1% .5W F TC=0+-100	28480	0757-0794
A1A13R3	0757-0198	2	1	RESISTOR 100 1% .5W F TC=0+-100	28480	0757-0198
A1A13R4	0698-7224	3	1	RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
				A1A13 MISCELLANEOUS		
	0380-0334	9	4	STANDOFF-RVT-ON .375-IN-LG 4-40-THD	28480	0380-0334
	0380-0730	9	4	STANDOFF-RVT-ON .188-IN-LG 4-40-THD	28480	0380-0730
	1251-3172	7	5	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A1A14	08672-60178	3	1	MOTHER BOARD ASSEMBLY	28480	08672-60178
A1A14C1	0180-0183	2	1	CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A1A14C2				NOT ASSIGNED		
A1A14C3	0180-2207	5	2	CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1A14C4	0180-2207	5		CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1A14J1-A1A14J7				NOT ASSIGNED		
A1A14J8	1251-3905	4	1	CONN-POST TYPE .100-PIN-SPCG 20-CONT	28480	1251-3905
A1A14J9	1251-4433	5	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1251-4433
A1A14J10						
A1A14J11	1200-0508	0		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0508
A1A14J12	1250-0257	1	6	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A14J13	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A14J14	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A14J15	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A14J16	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A14J17	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A14XA1-A1A14XA4				NOT ASSIGNED		
A1A14XA5	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A14XA6	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A14XA7	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A14XA8	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A14XA9	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A14XA10				NOT ASSIGNED		
A1A14XA11A	1251-2026	8	7	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A14XA11B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A14XA12				NOT ASSIGNED		
A1A14XA13	1251-1365	6	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
				A1A14 MISCELLANEOUS		
	1251-3052	2	1	CONN STRIP: 11PIN:M:1 GUIDE PIN	9D949	221-69
	03431-01201	8	1	FOOT	28480	03431-01201
	1251-3172	7		CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
				A1 CHASSIS PARTS		
A1AT1	08672-60114	7	1	PROGRAMMABLE ATTENUATOR, 110 DB (INCLUDES A1W14, 8120-4121)	28480	08672-60114
A1AT1	08672-60111	4		PROGRAMMABLE ATTENUATOR (RESTORED 08672-60114)	28480	08672-60111
A1AT2	0960-0699	9	1	ISOLATOR	28480	0960-0699
A1CR1	08672-60129	4	1	LEVELING DETECTOR (OPTION 003)	28480	08672-60129
A1DC1	0955-0101	7	1	DIRECTIONAL COUPLER	28480	0955-0101
A1DS1	1990-0399	0	1	DISPLAY-AN-DOT MAT 1-CHAR .135-H	28480	5082-7304
A1DS2	1990-0686	8	2	DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A1DS3	1990-0686	8		DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A1FL1	08672-60093	1	1	HIGH PASS FILTER	28480	08672-60093
A1J1	08672-60132	9	1	CONNECTOR-RF OUTPUT (DOES NOT INCLUDE HEX NUT OR LOCK WASHER)	28480	08672-60132
	2950-0079	0	1	HEX NUT	28480	2950-0079
	2190-0120	0	1	LOCK WASHER	28480	2190-0120
A1J2				NSR, P/O A1W12		

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1M1	1120-1908	6	1	METER, RF OUTPUT LEVEL	28480	1120-1908
A1Q1	1853-0344	5	1	TRANSISTOR PNP 2N5876 SI TO-3 PD=150W	04713	2N5876
A1R1	2100-3840	8	1	RESISTOR-VAR CONTROL CP 10K 10% LIN	28480	2100-3840
A1R2	2100-2590	3	1	RESISTOR-VAR CONTROL CCP 10K 10% 10CW	28480	2100-2590
A1R3	2100-3530	3	1	RESISTOR-VAR W/SW 10K 20% LIN SPST-NO	28480	2100-3530
A1R4	0811-3409	0	1	RESISTOR 40 1% 12W PW TC=0+-2	28480	0811-3409
A1S1	08672-60075	9	1	SLIDE SWITCH ASSEMBLY, 1.C. (ALC MODE)	28480	08672-60075
	5020-3440	7	2	SPRING:DETENT	28480	5020-3440
A1S2	08672-60077	1	1	SLIDE SWITCH,(RF)	28480	08672-60077
	5020-3440	7		SPRING:DETENT	28480	5020-3440
A1S3				NSR, P/O A1A3		
A1S4				NOT ASSIGNED		
A1S5	3130-0517	4	1	SHAFT & INDEX ASSY-RANGE,13POS-22DEG	28480	3130-0517
	5040-6948	8	1	INSULATOR, PC, ROTARY SWITCH, MALE	28480	5040-6948
	5040-6949	9	1	INSULATOR,PC, ROTARY SWITCH, FEMALE	28480	5040-6949
	5001-0157	7	1	SPRING, PC, INSULATOR RETAINER	28480	5001-0157
	3130-0384	3	2	CONTACT-SPRING .15-WD PAL-7	28480	3130-0384
A1W1	08672-20206	4	1	CABLE, RF INPUT	28480	08672-20206
A1W2				NOT ASSIGNED		
A1W3				NOT ASSIGNED		
A1W4	1250-1397	2	1	CABLE, ISOLATOR INPUT	28480	1250-1397
A1W5	08672-20067	5	1	CABLE ASSEMBLY, YIG INPUT	28480	08672-20067
A1W6	08672-20066	4	1	CABLE ASSEMBLY, YIG OUTPUT	28480	08672-20066
A1W7	08672-20065	3	1	CABLE ASSEMBLY,DIRECTIONAL COUPLER	28480	08672-20065
A1W8	08672-20130	3	1	CABLE, RF OUTPUT	28480	08672-20130
				(DOES NOT INCLUDE A1J1).		
A1W9	08672-60065	7	1	CABLE ASSEMBLY, ALC	28480	08672-60065
	1250-0872	6	1	CONNECTOR-RF SMB FEM UNMTD 50-OHM	28480	1250-0872
	1250-1167	4	1	CONNECTOR-RF SMC FEM UNMTD 50-OHM	28480	1250-1167
	1250-1174	3	1	COVER-RF CONN 50 OHM SUBMINIATORE	98291	5561-27
	1250-1175	4	1	SLEEVE-RF CONN 0.150IN OD: 0.122 IN	98291	6100-42
	8120-1111	0	1	CABLE-COAX 50-OHM 1KV BLU	28480	8120-1111
A1W10	08672-60071	5	2	CABLE, 14-CONDUCTOR	28480	08672-60071
	1251-2499	9	4	CONNECTOR 14-PIN M RECTANGULAR	28480	1251-2499
	8120-1458	8	4	CABLE-FL-RBN 28AWG 14-CNDCT GRA-INSUL	28480	8120-1458
A1W11	08672-60071	5		CABLE, 14-CONDUCTOR	28480	08672-60071
	1251-2499	9		CONNECTOR 14-PIN M RECTANGULAR	28480	1251-2499
	8120-1458	8		CABLE-FL-RBN 28AWG 14-CNDCT GRA-INSUL	28480	8120-1458
A1W12	08672-60063	5	1	CABLE ASSEMBLY,ALC INPT(YELLOW;INCL A1J2	28480	08672-60063
A1W13				NOT ASSIGNED		
A1W14	08672-60073	7	1	CABLE ASSEMBLY, ATTENUATOR DRIVER	28480	08672-60073
A1W15	08672-60091	9	1	CABLE ASSEMBLY, 34-CONDUCTOR	28480	08672-60091
A1W16	08672-60057	7	1	CABLE ASSEMBLY, 20-CONDUCTOR	28480	08672-60057

See introduction to this section for ordering information
*Indicates factory selected value
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A1	08672-60100	1	1	ASSEMBLY, DCU FRONT PANEL	28480	08672-60100
A2A1C1	0180-0229	7	6	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A1C2	0160-0573	2	2	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A2A1C3	0160-3878	6	7	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A1C4	0160-0572	1	4	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A2A1C5	0160-3877	5	24	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A1C6	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A1C7	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A1C8	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A1C9	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A1C10	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A1C11	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A1C12	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A1CR1	1901-0040	1	26	DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A1CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A1CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A1DS1	2140-0253	5	2	LAMP-INCAND 6839 28VDC 24MA T-1-BULB	1F556	6839
A2A1DS2	2140-0092	0	8	LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A2A1DS3	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A2A1DS4	2140-0253	5		LAMP-INCAND 6839 28VDC 24MA T-1-BULB	1F556	6839
A2A1DS5	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A2A1DS6	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A2A1DS7	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A2A1DS8	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A2A1DS9	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A2A1DS10	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A2A1J1	1251-3024	8	2	CONN-POST TYPE .100-PIN-SPCG 26-CONT	28480	1251-3024
A2A1J2A				(INCLUDES A2A1MP1 (16 EACH)		
A2A1J2B				(INCLUDES A2A1MP1 (24 EACH)		
A2A1J2C				(INCLUDES A2A1MP1 (24 EACH)		
A2A1MP1	1200-0448	7	64	SOCKET-IC 1-CONT DIP-SLDR (PART OF A2A1J2A,B,C)	28480	1200-0448
A2A1Q1	1854-0071	7	17	TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A1Q2	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A1Q3	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A1Q4	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A1Q5	1853-0020	4	10	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A1Q6	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A1Q7	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A1Q8	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A1R1	0698-7253	8	11	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R2	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R3	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R4	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R5	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R6				NOT ASSIGNED		
A2A1R7				NOT ASSIGNED		
A2A1R8				NOT ASSIGNED		
A2A1R9				NOT ASSIGNED		
A2A1R10	0698-7277	6	3	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A2A1R11	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R12	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A2A1R13	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A2A1R14	0698-7264	1	1	RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1472-F
A2A1R15	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R16	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R17	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R18	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R19	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A2A1R20	0698-7268	5	2	RESISTOR 21.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2152-F

See introduction to this section for ordering information
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†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A1R21	0698-7268	5		RESISTOR 21.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2152-F
A2A1R22	0698-7236	7	6	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A2A1R23	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A2A1R24	0698-7244	7	2	RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A2A1R25	0698-7254	9	1	RESISTOR 5.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5621-F
A2A1R26	0698-7260	7	3	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A2A1R27	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A2A1R28	0698-7269	6	1	RESISTOR 23.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2372-F
A2A1R29	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A2A1R30	0698-7273	2	1	RESISTOR 34.8K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3482-F
A2A1R31	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A2A1R32	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A2A1R33	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A2A1R34	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A2A1R35	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A2A1R36	0698-7212	9	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A2A1S1	3101-0624	3	6	SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S2	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S3	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S4	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S5	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1S6	3101-0624	3		SWITCH-SENS SPDT-DB SUBMIN 4A 250VAC	28480	3101-0624
A2A1U1	1820-2085	6	1	IC GATE CMOS AND-OR QUAD	27014	CD4019BCN
A2A1U2	1820-1197	9	8	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A1U3	1820-1433	6	2	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A2A1U4	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A2A1U5	1820-2080	1	27	IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A1U6	1820-2079	8	2	IC GATE CMOS NOR DUAL 4-INP	04713	MC14002BCP
A2A1U7	1826-0026	3	1	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A2A1U8	1820-1199	1	4	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A1U9	1820-2031	2	1	IC SHF-RGTR CMOS ASYNCHRO PRL-IN	04713	MC14021BCP
A2A1XA2DS1	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7	10	EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
A2A1XA2DS2	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
A2A1XA2DS3	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
A2A1XA2DS4	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
A2A1XA2DS5	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
A2A1XA2DS6	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
A2A1XA2DS7	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
A2A1XA2DS8	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
A2A1XA2DS9	86290-00034	6		LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
	86290-00034	6	10	LAMP, CONTACT	28480	86290-00034
	0361-0457	7		EYELET-RLD-FLG .065-OD .125-LG .008-THK	07707	S-5994
				A2A1 MISCELLANEOUS		
	1251-0600	0	23	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A2	0960-0684	2	1	ROTARY PULSE GENERATOR INPUT POWER: 5VDC	28480	0960-0684
A2A3	08672-60143	2	1	ASSEMBLY, VCO, 160-240 MHZ	28480	08672-60143
A2A3C1	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C2	0160-0166	9	5	CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A3C3	0160-3879	7	8	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A3C4	0180-0116	1	2	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A3C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A3C6	0160-2259	5	1	CAPACITOR-FXD 12PF +-5% 500VDC CER 0+-30	28480	0160-2259
A2A3C7	0160-0301	4	2	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A2A3C8	0160-0166	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A3C9	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C10	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C11	0160-0301	4		CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A2A3C12	0160-3456	6	21	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C13	0180-2211	1	1	CAPACITOR-FXD 5UF+50-10% 150VDC AL	56289	30D505F150CC2
A2A3C14	0180-2214	4	1	CAPACITOR-FXD 90UF+75-10% 16VDC AL	56289	30D906G016CC2
A2A3C15	0160-0166	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A3C16	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C17	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C18	0160-3466	8	2	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A2A3C19	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C20	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C21	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C22	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C23	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C24	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C25	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C26	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C27	0160-2240	4	1	CAPACITOR-FXD 2PF +-.25PF 500VDC CER	28480	0160-2240
A2A3C28	0160-2262	0	2	CAPACITOR-FXD 16PF +-5% 500VDC CER 0+-30	28480	0160-2262
A2A3C29	0160-2262	0		CAPACITOR-FXD 16PF +-5% 500VDC CER 0+-30	28480	0160-2262
A2A3C30	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C31	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C32	0140-0195	2	2	CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
A2A3C33	0140-0195	2		CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
A2A3CR1	0122-0085	1	4	DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	S0545	1S2208(B)
A2A3CR2	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	S0545	1S2208(B)
A2A3CR3	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	S0545	1S2208(B)
A2A3CR4	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	S0545	1S2208(B)
A2A3J1	1250-0544	9	3	CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A3J2	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A3L1	9140-0180	4	1	INDUCTOR RF-CH-MLD 2.7UH 10%	28480	9140-0180
A2A3L2	9100-2583	1	2	INDUCTOR RF-CH-MLD 6.8MH 10%	28480	9100-2583
A2A3L3	9100-2583	1		INDUCTOR RF-CH-MLD 6.8MH 10%	28480	9100-2583
A2A3L4	9100-2249	6	1	INDUCTOR RF-CH-MLD 150NH 10%	28480	9100-2249
A2A3L5	9100-2891	4	1	INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A2A3L6	9100-2248	5	2	INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A2A3L7	9100-2254	3	1	INDUCTOR RF-CH-MLD 390NH 10%	28480	9100-2254
A2A3L8	9100-2248	5		INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A2A3MP1	08672-20135	8	1	VCO COVER	28480	08672-20135
A2A3Q1	1855-0392	7	1	TRANSISTOR J-FET N-CHAN D-MODE TO-72 SI	28480	1855-0392
A2A3Q2	1854-0345	8	3	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q5	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A3Q6	1853-0451	5	1	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A2A3R1	0757-0199	3	57	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A3R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A3R3	0698-3156	2	2	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1472-F
A2A3R4	0757-0834	3	1	RESISTOR 5.62K 1% .5W F TC=0+-100	28480	0757-0834
A2A3R5	0757-0279	0	6	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A3R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A3R7	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A3R8	0757-0278	9	4	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A2A3R9	0757-0346	2	4	RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A3R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A3R11	0698-3444	1	12	RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A3R12	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A3R13	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A3R14	0757-0180	2	1	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A2A3R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A3R16	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A2A3R17	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A3R18	0698-3440	7	2	RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A2A3R19	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A2A3R20	0698-3160	8	4	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3162-F
A2A3R21	0698-3452	1	2	RESISTOR 147K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1473-F
A2A3R22	0757-0123	3	1	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A2A3R23	0757-0416	7	3	RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A2A3R24	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A2A3R25	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A3R26	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A3R27	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A2A3R28	0757-0418	9	4	RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A2A3R29	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A3R30	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A2A3R31	0698-0083	8	24	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A3R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A3R33	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A3R34	0757-0401	0	6	RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A2A3S1	3101-1524	4	1	SWITCH-SL DP3T SUBMIN .5A 125VAC/DC PC	28480	3101-1524
A2A3T1	08672-80003	5	1	COIL, INDUCTOR	28480	08672-80003
A2A3U1	1820-1225	4	1	IC FF ECL D-M/S DUAL	04713	MC10231P
A2A3U2	1820-0794	0	1	IC FF ECL D-M/S	04713	MC1670L
				A2A3 MISCELLANEOUS		
	86701-40001	9	6	EXTRACTOR, P.C. BOARD	28480	86701-40001
A2A4	08672-60144	3	1	ASSEMBLY, 20/30 PHASE DETECTOR	28480	08672-60144
A2A4C1	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A4C2	0160-0162	5	1	CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A2A4C3	0180-0197	8	18	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A4C4	0180-0141	2	1	CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A2A4C5	0160-3459	9	4	CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A2A4C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A4C7	0160-0161	4	2	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A2A4C8	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A2A4C9	0160-2290	4	2	CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A2A4C10	0160-2205	1	1	CAPACITOR-FXD 120PF +-5% 300VDC MICA	28480	0160-2205
A2A4C11	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A2A4C12	0160-2290	4		CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A2A4C13	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A2A4C14	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A2A4C15	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A4C16	0160-2055	9	13	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A4C17	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A2A4C18	0170-0040	9	1	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A2A4C19	0160-0166	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A4C20	0160-3661	5	2	CAPACITOR-FXD .1UF +-5% 50VDC MET-POLYC	28480	0160-3661
A2A4C21	0160-0166	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A4C22	0160-3661	5		CAPACITOR-FXD .1UF +-5% 50VDC MET-POLYC	28480	0160-3661
A2A4CR1	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR2	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR3	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR4	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4L1	9100-1629	4	2	INDUCTOR RF-CH-MLD 47UH 5%	28480	9100-1629
A2A4L2	9100-1629	4		INDUCTOR RF-CH-MLD 47UH 5%	28480	9100-1629
A2A4L3	08672-80002	4	2	INDUCTOR, 3.8 MH	28480	08672-80002
A2A4L4	08672-80002	4		INDUCTOR, 3.8 MH	28480	08672-80002
A2A4MP1	08672-20136	9	1	COVER, PHASE DETECTOR	28480	08672-20136
A2A4Q1	1854-0475	5	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A2A4Q2	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A4R1	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R2	0698-3629	4	1	RESISTOR 270 5% 2W MO TC=0+-200	28480	0698-3629
A2A4R3	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A2A4R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R8	0757-0440	7	2	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A2A4R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R10	0757-0438	3	28	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R11	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A2A4R12	0757-0422	5	4	RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A2A4R13	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A2A4R14	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R15	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3162-F
A2A4R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R17	0757-0462	3	2	RESISTOR 75K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7502-F
A2A4R18	0757-0458	7	14	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A4R19	0757-0462	3		RESISTOR 75K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7502-F
A2A4R20	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A4R21	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A2A4R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R23	0757-0819	4	1	RESISTOR 909 1% .5W F TC=0+-100	28480	0757-0819
A2A4R24	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A4R25	0757-0424	7	1	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1101-F
A2A4R26	0698-3443	0	1	RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A2A4R27	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3831-F
A2A4R28	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A2A4R29	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5621-F
A2A4R30	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A2A4R31	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A2A4R32	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A2A4TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4U1	1820-0429	8	2	IC V RGLTR TO-39	18324	LM309H
A2A4U2	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A4U3	1820-0281	0	1	IC FF TTL J-K M/S PULSE CLEAR DUAL	01295	SN74107N
A2A4U4	1820-0846	3	1	IC BFR TTL NON-INV QUAD 1-INP	27014	DM8094N
A2A4U5	1820-0223	0	1	IC OP AMP GP TO-99 PKG	3L585	CA301AT
A2A4U6	1820-1422	3	2	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2A4U7	1820-1422	3		IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2A4U8	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A4VR1	1902-3234	3	1	DIODE-ZNR 19.6V 5% DO-35 PD=.4W	28480	1902-3234
				A2A4 MISCELLANEOUS		
	1205-0250	9	2	THERMAL LINK SGL TO-5/TO-39-CS	28480	1205-0250
	86701-40001	9		EXTRACTOR	28480	86701-40001
A2A5	08672-60145	4	1	ASSEMBLY, 20/30 DIVIDER	28480	08672-60145
A2A5C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C2	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C3	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C4	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
A2A5C5	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A2A5C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C7	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A5C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A5C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C19	0160-3537	4	1	CAPACITOR-FXD 680PF +-5% 100VDC MICA	28480	0160-3537
A2A5C20	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A5J1	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A5L1	9100-4078	3	6	INDUCTOR-TOROID	28480	9100-4078
A2A5L2	9100-1618	1	1	INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A2A5L3	9100-4078	3		INDUCTOR-TOROID	28480	9100-4078
A2A5MP1	08672-20134	7	1	COVER, DIVIDER	28480	08672-20134
A2A5Q1	1854-0019	3	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A2A5R1	0698-3628	3	1	RESISTOR 220 5% 2W MO TC=0+-200	28480	0698-3628
A2A5R2	0757-0397	3	1	RESISTOR 68.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-68R1-F
A2A5R3	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A5R4	2100-2413	9	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	73138	82PAR200
A2A5R5	0698-7216	3	16	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R6	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R7	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R8	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A5R12	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A2A5R13	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A5R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A5R16	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R17	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R18	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R19	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R20	0698-3157	3	1	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1962-F
A2A5R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R23	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R24	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R25	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R26	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R27	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R29	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A2A5R30	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A2A5R31	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A2A5R32	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A5R34	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R35	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R36	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R37	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5U1	1820-1251	6	5	IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U2	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U3	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U4	1820-0261	6	1	IC MV TTL MONOSTBL	01295	SN74121N
A2A5U5	1820-0686	9	1	IC GATE TTL S AND TPL 3-INP	01295	SN74S11N

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A5U6	1820-0629	0	2	IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A2A5U7	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A2A5U8	1820-1384	6	1	IC PRESCR ECL	52648	SP8647BDG
A2A5U9	1820-0429	8		IC V RGLTR TO-39	18324	LM309H
A2A5U10	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U11	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U12	1820-0909	9	1	IC MULTR TTL	01295	SN74167N
A2A5U13	1820-0751	9	2	IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N
A2A5U14	1820-0751	9		IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N
A2A5U15	1820-0685	8	1	IC GATE TTL S NAND TPL 3-INP	01295	SN74S10N
A2A5U16	1820-0690	5	1	IC BFR TTL S NAND DUAL 4-INP	01295	SN74S40N
				A2A5 MISCELLANEOUS		
	1205-0250	9		THERMAL LINK SGL TO-5/TO-39-CS	28480	1205-0250
	86701-40001	9		EXTRACTOR, P.C. BOARD	28480	86701-40001
	3050-0079	3	14	WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
	10534-4001	2	8	TACK-RUBBER	28480	10534-4001
A2A6	08672-60014	6	1	ASSEMBLY, INTERCONNECT	28480	08672-60014
A2A6J1	1251-3495	7	1	CONN-RECT D-SUBMIN 50-CKT 50-CONT	28480	1251-3495
A2A6J2	1251-3025	9	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1251-3025
A2A7	08672-60009	9	1	ASSEMBLY, INTERFACE	28480	08672-60009
A2A7C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A7C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A7C3	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A7C4	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A7C5	0180-0218	4	1	CAPACITOR-FXD .15UF+-10% 35VDC TA	56289	150D154X9035A2
A2A7C6	0180-0376	5	2	CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A2A7C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A7C8	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A2A7C9	0180-1745	4	1	CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
A2A7C10	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A2A7CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A7CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A7CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A7CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A7CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A7CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A7CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A7DS1	1990-0404	8	4	LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A2A7DS2	1990-0404	8		LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A2A7DS3	1990-0404	8		LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A2A7DS4	1990-0404	8		LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A2A7J1	1251-5316	5	1	CONNECTOR 34-PIN POST SERIES	28480	1251-5316
A2A7L1	08672-80001	3	1	TOROID-FILTER, 600UH	28480	08672-80001
A2A7Q1	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A7Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A7Q3	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A7Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A7Q5	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A7Q6	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A7Q7	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A7R1	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R2	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R3	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R4	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R5	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R6	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R7	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R9	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R10	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A7R11	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R12	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R13	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R14	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R15	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R16	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R17	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R18	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R19	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R20	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R21	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R22	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R23	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R24	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R25	0757-0465	6	7	RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A2A7R26	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A2A7R27	0698-3450	9	1	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4222-F
A2A7R28	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3832-F
A2A7R29	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R30	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A7R31	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A7R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A7R33	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A7R34	0698-3442	9	5	RESISTOR 237 1% .125W F TC=0+-100	24546	CT4-1/8-T0-237R-F
A2A7R35	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	CT4-1/8-T0-237R-F
A2A7R36	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	CT4-1/8-T0-237R-F
A2A7R37	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	CT4-1/8-T0-237R-F
A2A7R38	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A7R39	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R40	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A7R41	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R42	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A2A7R43	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A2A7R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A7R45	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A7R46	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A7R47	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A7R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A7TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A7U1	1826-0502	0	5	IC SWITCH ANLG QUAD 14-DIP-P PKG	04713	MC14066BCP
A2A7U2	1826-0502	0		IC SWITCH ANLG QUAD 14-DIP-P PKG	04713	MC14066BCP
A2A7U3	1820-1962	6	5	IC DCDR CMOS BCD-TO-DEC	04713	MC14028BCP
A2A7U4	1820-2083	4	1	IC CNTR CMOS UP/DOWN POS-EDGE-TRIG	27014	CD4029BCN
A2A7U5	1820-1962	6		IC DCDR CMOS BCD-TO-DEC	04713	MC14028BCP
A2A7U6	1820-1746	4	12	IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A7U7	1820-1961	5	3	IC GATE CMOS NAND TPL 3-INP	04713	MC14023BCP
A2A7U8	1820-1747	5	13	IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A7U9	1826-0502	0		IC SWITCH ANLG QUAD 14-DIP-P PKG	04713	MC14066BCP
A2A7U10	1826-0502	0		IC SWITCH ANLG QUAD 14-DIP-P PKG	04713	MC14066BCP
A2A7U11	1826-0502	0		IC SWITCH ANLG QUAD 14-DIP-P PKG	04713	MC14066BCP
A2A7U12	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A7U13	1820-1745	3	7	IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A7U14	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A7U15	1820-1569	9	2	IC MV CMOS MONOSTBL RETRIG/RESET DUAL	04713	MC14538BCL
A2A7U16	1820-1569	9		IC MV CMOS MONOSTBL RETRIG/RESET DUAL	04713	MC14538BCL
A2A7U17	1820-1963	7	7	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A2A7U18	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A7U19	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A7U20	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A7U21	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A7U22	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A7U23	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A7U24	1820-1976	2	7	IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A2A7U25	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP

See introduction to this section for ordering information
*Indicates factory selected value
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A7U26	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
				A2A7 MISCELLANEOUS		
	4040-0748	3	5	EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0750	7	1	EXTR-PC BD RED POLYC .062-IN-BD-THKNS	28480	4040-0750
	3050-0079	3		WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
	10534-4001	2		TACK-RUBBER	28480	10534-4001
A2A8	08672-60140	9	1	ASSEMBLY, OUTPUT REGISTER	28480	08672-60140
A2A8C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A8C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C7	0160-4389	6	1	CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A2A8DS1	2140-0016	8	1	LAMP-INCAND 683 5VDC 60MA T-1-BULB	00115	683
A2A8L1	9100-4078	3		INDUCTOR-TOROID	28480	9100-4078
A2A8Q1	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A8Q2	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A8Q3	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A8Q4	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A8R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A8R2	0683-1055	5	1	RESISTOR 1M 5% .25W CF TC=0-800	01121	CB1055
A2A8R3	0757-0461	2	2	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6812-F
A2A8R4	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R5	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R6	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R7	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R9	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6812-F
A2A8R10	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R11	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6811-F
A2A8R12	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A8R13	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R14	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R15	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A8R17	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R18	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R19	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R20	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R21	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A8R22	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A8R23	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A8R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A8R25	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A2A8R26	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A2A8R27	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A2A8TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A81P3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8U1	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U2	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U3	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A6U4	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A8U5	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U6	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U7	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U8	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U9	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U10	1820-1955	7	5	IC ADDR CMOS FULL ADDER 4-BIT	04713	MC14008BCP

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A8U11	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U12	1820-1283	4	4	IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS95BN
A2A8U13	1820-1283	4		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS95BN
A2A8U14	1820-1283	4		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS95BN
A2A8U15	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U16	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U17	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	04713	MC14008BCP
A2A8U18	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	04713	MC14008BCP
A2A8U19	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U20	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	04713	MC14008BCP
A2A8U21	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A8U22	1820-1283	4		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS95BN
A2A8U23	1820-1444	9	2	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS298N
A2A8U24	08672-80014	8	1	PROM DIVIDER 2	28480	08672-80014
A2A8U25	08672-80015	9	1	PROM DIVIDER 1	28480	08672-80015
A2A8U26	1820-1976	2		IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A2A8U28	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A8U29	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	04713	MC14008BCP
A2A8XU23	1200-0507	9	1	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
				A2A8 MISCELLANEOUS		
	1480-0073	6	6	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0753	0	1	EXTR-PC BD GRN POLYC .062-IN-BD-THKNS	28480	4040-0753
	3050-0079	3		WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
	10534-4001	2		TACK-RUBBER	28480	10534-4001
A2A9	08672-60017	9	1	ASSEMBLY, HP-IB ADDRESS	28480	08672-60017
A2A9C1	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A2A9C2	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A2A9C3	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A2A9C4	0160-0574	3	3	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A2A9C5	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A9C6	0160-0571	0	5	CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A2A9C7	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A2A9C8	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A2A9C9	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 50VDC CER	28480	0160-0174
A2A9CR1	1901-0518	8	10	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A9CR2	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A9CR3	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A9CR4	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A9CR5	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A9J1	1251-3283	1	1	CONN-RECT MICRORBN 24-CKT 24-CONT	28480	1251-3283
A2A9L1	9100-4078	3		INDUCTOR-TOROID	28480	9100-4078
A2A9Q1	1854-0039	7	1	TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	3L585	2N3053S
A2A9R1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R2	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R3	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A9R4	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A9R5	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R6	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A9R7	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A9R8	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A9R9	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A9R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A9R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A9R13	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A9R14	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3162-F
A2A9R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A9R16	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A9R17	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R18	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A9R19	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A2A9R20	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A9R21	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A9R22	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R23	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A2A9R24	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A2A9R25	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R26	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R27	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R28	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R29	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R30	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9R31	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A9S1	3100-3371	1	1	SWITCH-RTRY DP4T-NS .55-DIA IDX-ANG=36	28480	3100-3371
A2A9S2	3100-3372	2	1	SWITCH-RTRY SP8T-NS .55-DIA IDX-ANG=36	28480	3100-3372
A2A9S3	3100-3369	7	1	SWITCH-RTRY SP8T-NS .55-DIA IDX-ANG=36	28480	3100-3369
A2A9S4	3100-3370	0	1	SWITCH-RTRY SP3T-NS .55-DIA IDX-ANG=36	28480	3100-3370
A2A9U1	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A9U2	1820-1962	6		IC DCDR CMOS BCD-TO-DEC	04713	MC14028BCP
A2A9U3	1820-1962	6		IC DCDR CMOS BCD-TO-DEC	04713	MC14028BCP
A2A9U4	1820-1962	6		IC DCDR CMOS BCD-TO-DEC	04713	MC14028BCP
A2A9U5	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A9U6	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A9U7	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A9U8	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A9U9	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A9U10	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A9U11	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A9U12	1820-1522	4	2	IC TRANSCEIVER TTL INSTR-BUS IEEE-488	04713	MC3440AP
A2A9U13	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A9U14	1820-1522	4		IC TRANSCEIVER TTL INSTR-BUS IEEE-488	04713	MC3440AP
A2A9U15	1820-1961	5		IC GATE CMOS NAND TPL 3-INP	04713	MC14023BCP
A2A9U16	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A9U17	1820-1964	8	2	IC FF CMOS J-K POS-EDGE-TRIG DUAL	04713	MC14027BCP
A2A9U18	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A9U19	1820-1964	8		IC FF CMOS J-K POS-EDGE-TRIG DUAL	04713	MC14027BCP
A2A9U20	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A2A9U21	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A9U22	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A9U23	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A2A9U24	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A9U25	1820-2079	8		IC GATE CMOS NOR DUAL 4-INP	04713	MC14002BCP
A2A9U26	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A9U27	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A9U28	1820-1976	2		IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A2A9U29	1820-1558	6	2	IC SER-XMTR/RCVR TTL QUAD	04713	MC3441AP
A2A9U30	1820-1558	6		IC SER-XMTR/RCVR TTL QUAD	04713	MC3441AP
				A2A9 MISCELLANEOUS		
	0380-0643	3	2	STANDOFF-HEX .255-IN-LG 6-32-THD	28480	0380-0643
	1200-0173	5	1	INSULATOR-XSTR DAP-GL	28480	1200-0173
	1530-1098	4	2	CLEVIS 0.070-IN W SLT: 0.454-IN PIN CTR	00000	ORDER BY DESCRIPTION
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0755	2	2	EXTR-PC BD VIO POLYC .062-IN-BD-THKNS	28480	4040-0755
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	3050-0079	3		WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
	10534-4001	2		TACK-RUBBER	28480	10534-4001
A2A10	08672-60149	8	1	ASSEMBLY, REGISTER I	28480	08672-60149
A2A10C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A10C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A10C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A10C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A10C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A10C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A10CR1	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A10CR2	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A10L1	9100-4078	3		INDUCTOR-TOROID	28480	9100-4078
A2A10Q1	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A10R1	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A10R2	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R3	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R4	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R5	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R6	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R7	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	CT4-1/8-T0-237R-F
A2A10R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A10R9	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-6191-F
A2A10R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A10R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R13				NOT ASSIGNED		
A2A10R14	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R15	0757-0438	3		RESISTOR 5.11K 1%-.125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R17	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R18	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R20	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A10R21	0757-0280	3	26	RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A10U1	1820-0701	9	1	IC LCH TTL L D-TYPE 4-BIT	07263	93L14PC
A2A10U2	1820-1965	9	1	IC GATE CMOS NOR TPL 3-INP	04713	MC14025BCP
A2A10U3	08672-80012	6	1	PROM BAND-DECODER 2	28480	08672-80012
A2A10U4	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A10U5	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A10U6	1820-1976	2		IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A2A10U7	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A10U8	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A10U9	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A10U10	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A10U11	1820-1976	2		IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A2A10U12	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A10U13	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A10U14	08672-80013	7	1	PROM BAND-DECODER 1	28480	08672-80013
A2A10U15	1820-0910	2	4	IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS83AN
A2A10U16	1820-0961	3	1	IC SHF-RGTR CMOS D-TYPE PRL-IN	3L680	CD4021AF
A2A10U17	1820-1976	2		IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A2A10U18	1820-1976	2		IC BFR CMOS NON-INV HEX	04713	MC14050BCP
A2A10U19	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A10U20	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A10U21	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A10U22	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A10U23	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A10U24	1820-0946	4	1	IC GATE CMOS NOR QUAD 2-INP	3L680	CD4001UBE
A2A10U25	1820-1444	9		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS298N
A2A10U26	1820-1144	6	4	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A2A10U27	1820-1112	8	5	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
				A2A10 MISCELLANEOUS		
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	4040-0755	2		EXTR-PC BD VIO POLYC .062-IN-BD-THKNS	28480	4040-0755
	3050-0079	3		WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
	10534-4001	2		TACK-RUBBER	28480	10534-4001
A2A11	08672-60012	4	1	ASSEMBLY, TIMING CONTROL	28480	08672-60012

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A11C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A11C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A11C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A11C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A11C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A11C6	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A2A11C7	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A2A11C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A11C9	0160-0127	2	1	CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-0127
A2A11C10	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A11C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A11C12	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A2A11C13	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A2A11C14	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A11C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A11C16	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A11C17	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A2A11C18	0160-0570	9	1	CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A2A11C19	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A2A11C20	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A11CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR4	1901-0376	6	2	DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A2A11CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR7	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	9N171	1N3595
A2A11CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR9	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A11CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR12	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A11CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR14	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2A11CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR16				NOT ASSIGNED		
A2A11CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A11CR19				NOT ASSIGNED		
A2A11CR20				NOT ASSIGNED		
A2A11CR21				NOT ASSIGNED		
A2A11L1	9100-4078	3		INDUCTOR-TOROID	28480	9100-4078
A2A11Q1	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A11Q2	1853-0015	7	1	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A2A11Q3	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A11Q4	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2A11Q5	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A11Q6	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A11Q7	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A2A11R1	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A2A11R2	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A11R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A11R5	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R10	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R11	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A2A11R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A2A11R13	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A11R14	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R15	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A11R16	0757-0463	4	2	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8252-F
A2A11R17	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A11R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R20	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R21	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R22	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A11R23	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R24	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A11R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R26	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A11R27	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1472-F
A2A11R28	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A11R29	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A2A11R30	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2610-F
A2A11R31	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A2A11R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A11R33	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R34	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R35	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R36	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3162-F
A2A11R37	0757-0463	4		RESISTOR 82.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8252-F
A2A11R38	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A2A11R39	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2152-F
A2A11R40	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1473-F
A2A11R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R42	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A2A11R43	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A11R44	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A2A11R45	0757-0442	9	16	RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R46	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A2A11R47				NOT ASSIGNED		
A2A11S1	3101-1277	4	1	SWITCH-TGL SUBMIN SPDT .5A 120VAC PC	28480	3101-1277
A2A11U1	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A11U2	1820-2015	2	1	IC GATE CMOS EXCL-OR QUAD	04713	MC14070BCP
A2A11U3	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A2A11U4	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A2A11U5	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A2A11U6	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A11U7	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A2A11U8	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A2A11U9	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A11U10	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A11U11	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A11U12	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A11U13	1820-1204	9	1	IC GATE TTL LS NAND DUAL 4-INP	01295	SN74LS20N
A2A11U14	1820-1194	6	1	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A2A11U15	1820-1211	8	1	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86AN
A2A11U16	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A11U17	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A11U18	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A11U19	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A11U20	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A2A11U21	1820-0778	0	1	IC CNTR TTL L BIN SYNCHRO POS-EDGE-TRIG	07263	93L16PC
A2A11U22	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A11U23	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A11U24	08672-80019	3	1	PROM-OFFSET	28480	08672-80019
A2A11U25	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A11U26	1820-1960	4	1	IC GATE CMOS NAND DUAL 4-INP	04713	MC14012BCP
A2A11U27	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A2A11U28	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A2A11U29	1820-1961	5		IC GATE CMOS NAND TPL 3-INP	04713	MC14023BCP
A2A11U30	1820-0910	2		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS83AN

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†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A11U31	1820-0910	2		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS83AN
A2A11U32	1820-0661	0	1	IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A2A11U33	1820-0910	2		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS83AN
A2A11U34	1820-1423	4	2	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
				A2A11 MISCELLANEOUS		
	0340-0060	4	1	TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	98291	011-6809 000 209
	0360-1730	9	12	CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
	4040-0747	2	1	EXTR-PC BD GRA POLYC .062-IN-BD-THKNS	28480	4040-0747
	4040-0748	3		EXTR-PC BD BLK POLYC .062-IN-BD-THKNS	28480	4040-0748
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	3050-0079	3		WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
	10534-4001	2		TACK-RUBBER	28480	10534-4001
A2A12	08672-60177	2	1	MOTHERBOARD ASSEMBLY	28480	08672-60177
A2A12C1	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C2	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C3	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C4	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C5	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C6	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C7	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C8	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C9	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C10	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C11	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C12	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C13	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C14	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C15	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C16	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A12C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A12C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A12CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A12CR2	1901-0535	9	5	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A12CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2A12J1	1251-3024	8		CONN-POST TYPE .100-PIN-SPCG 26-CONT	28480	1251-3024
A2A12J2	1250-1255	1	1	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1255
A2A12R1	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-TO-101-F
A2A12R2	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-TO-1961-F
A2A12VR1	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A2A12W1	08672-20193	8	1	CABLE ASSY-COAX-10 MHZ	28480	08672-20193
A2A12XA2A3	1251-2026	8	3	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A12XA2A4	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A12XA2A5	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A12XA2A7A	1251-2035	9	12	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A7B	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A7C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A8A	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A8B	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A8C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A9C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A10B	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A10C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A11A	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A11B	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A12XA2A11C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
				A2A12 MISCELLANEOUS		
	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				A2 CHASSIS PARTS		
A2BT1	08672-60092	0	1	BATTERY PACK	28480	08672-60092
	08672-00011	7	1	CLAMP, BATTERY	28480	08672-00011
A2DS1	1990-0651	7	4	DISPLAY-AN-DOT MAT	28480	5082-7340
A2DS2	1990-0651	7		DISPLAY-AN-DOT MAT	28480	5082-7340
A2DS3	1990-0651	7		DISPLAY-AN-DOT MAT	28480	5082-7340
A2DS4	1990-0651	7		DISPLAY-AN-DOT MAT	28480	5082-7340
A2DS5	1990-0686	8	4	DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A2DS6	1990-0686	8		DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A2DS7	1990-0686	8		DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A2DS8	1990-0686	8		DISPLAY-NUM-DOT MAT 1-CHAR .29-H	28480	5082-7300,CAT F,G.
A2XBT1	08672-60029	3	1	BATTERY HOLDER ASSEMBLY INCLUDES:	28480	08672-60029
	0362-0227	1	2	CONNECTOR-SGL CONT SKT 1.14-MM-BSC-SZ	28480	0362-0227
	0363-0067	9	2	CONTACT, BATTERY	28480	0363-0067
	0624-0303	0	4	SCREW-TPG 2-28 .312-IN-LG PAN-HD-PHL STL	28480	0624-0303
	08672-00009	3	1	SUPPORT, BATTERY PAK	28480	08672-00009
	08672-20030	2	1	HOLDER, BATTERY	28480	08672-20030
	0400-0082	8	1	GROMMET, CHANNEL	28480	0400-0082

See introduction to this section for ordering information
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†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1				M/N REFERENCE ASSEMBLY		
A3A1A1	86701-60021	5	1	REFERENCE PHASE DETECTOR ASSEMBLY	28480	86701-60021
A3A1A1C1	0180-0197	8	18	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C3	0180-1746	5	8	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1A1C4	0160-3879	7	31	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C5	0140-0190	7	2	CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3A1A1C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C7	0160-2055	9	50	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C8	0180-1846	6	1	CAPACITOR-FXD 2.2UF+-10% 35VDC TA	28480	0180-1846
A3A1A1C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C12	0160-2199	2	7	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A1A1C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C14	0160-2204	0	6	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A1C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C23	0180-0553	0	1	CAPACITOR-FXD 22UF+-20% 25VDC TA	28480	0180-0553
A3A1A1C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C26	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A1C27	0140-0193	0	6	CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A1A1C28	0180-0491	5	3	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A3A1A1C29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C30	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A1A1C31	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1A1C32	0170-0066	9	1	CAPACITOR-FXD .027UF +-10% 200VDC POLYE	28480	0170-0066
A3A1A1C33	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C34	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C35	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A1A1C36	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C37	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C38	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A1A1C39	0160-3454	4	25	CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A1C40	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1A1C41	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C42	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C43	0160-2206	2	1	CAPACITOR-FXD 160PF +-5% 300VDC MICA	28480	0160-2206
A3A1A1C44	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C45	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C46	0140-0210	2	3	CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A3A1A1C47	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C48	0140-0210	2		CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A3A1A1C49	0160-2201	7	1	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A3A1A1C50	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C51	0140-0210	2		CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A3A1A1C52	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C53	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C54	0180-0183	2	1	CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A3A1A1C55	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1A1C56	0180-0229	7	3	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A3A1A1C57	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A1C58	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C59	0160-3878	6	32	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A1C60	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1C61	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A1C62	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A1CR1	1901-0518	8	6	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR2	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR3	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR4	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR5	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR6	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1J1	1250-0544	9	8	CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1J2	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM NSR; P/O A3A1A1W1	28480	1250-0544
A3A1A1J3	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1J4	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1J5	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1L1	9140-0238	3	2	INDUCTOR RF-CH-MLD 82UH 5%	28480	9140-0238
A3A1A1L2	9140-0238	3		INDUCTOR RF-CH-MLD 82UH 5%	28480	9140-0238
A3A1A1L3	9140-0143	9	2	INDUCTOR RF-CH-MLD 3.3UH 10%	28480	9140-0143
A3A1A1L4	9140-0143	9		INDUCTOR RF-CH-MLD 3.3UH 10%	28480	9140-0143
A3A1A1L5	9100-2261	2	1	INDUCTOR RF-CH-MLD 2.7UH 10%	28480	9100-2261
A3A1A1L6	9140-0114	4	1	INDUCTOR RF-CH-MLD 10UH 10%	28480	9140-0114
A3A1A1L7	9100-2255	4	4	INDUCTOR RF-CH-MLD 470NH 10%	28480	9100-2255
A3A1A1L8	9100-0368	6	4	INDUCTOR RF-CH-MLD 330NH 10%	28480	9100-0368
A3A1A1L9	9100-2257	6	3	INDUCTOR RF-CH-MLD 820NH 10%	28480	9100-2257
A3A1A1L10	9100-2255	4		INDUCTOR RF-CH-MLD 470NH 10%	28480	9100-2255
A3A1A1L11	9100-2257	6		INDUCTOR RF-CH-MLD 820NH 10%	28480	9100-2257
A3A1A1L12	9100-2255	4		INDUCTOR RF-CH-MLD 470NH 10%	28480	9100-2255
A3A1A1L13	9100-2257	6		INDUCTOR RF-CH-MLD 820NH 10%	28480	9100-2257
A3A1A1L14	9100-2255	4		INDUCTOR RF-CH-MLD 470NH 10%	28480	9100-2255
A3A1A1L15	9100-2256	5	1	INDUCTOR RF-CH-MLD 560NH 10%	28480	9100-2256
A3A1A1Q1	1854-0019	3	3	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A3A1A1Q2	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A3A1A1Q3	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A3A1A1Q4	1855-0049	1	1	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A3A1A1Q5	1853-0451	5	14	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A1Q6	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A1Q7	1853-0034	0	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A3A1A1R1	0757-0399	5	3	RESISTOR 82.5 1% .125W F TC=0+-100	24546	CT4-1/8-T0-82R5-F
A3A1A1R2	0757-0417	8	1	RESISTOR 562 1% .125W F TC=0+-100	24546	CT4-1/8-T0-562R-F
A3A1A1R3	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A1R4	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A1R5	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1472-F
A3A1A1R6	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A1R7	0757-0420	3	6	RESISTOR 750 1% .125W F TC=0+-100	24546	CT4-1/8-T0-751-F
A3A1A1R8	0757-0438	3	21	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A1A1R9	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	CT4-1/8-T0-82R5-F
A3A1A1R10	0698-7222	1	2	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-F
A3A1A1R11	0698-7219	6	7	RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A1R12	0757-0442	9	19	RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A1A1R13	0698-3453	2	3	RESISTOR 196K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1963-F
A3A1A1R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A1A1R15	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1963-F
A3A1A1R16	0757-0441	8	6	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8251-F
A3A1A1R17	0698-3438	3	3	RESISTOR 147 1% .125W F TC=0+-100	24546	CT4-1/8-T0-147R-F
A3A1A1R18	0757-0346	2	30	RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A1A1R19	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A1A1R20	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8251-F
A3A1A1R21	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	CT4-1/8-T0-147R-F
A3A1A1R22	0698-3136	8	1	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1782-F
A3A1A1R23	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A1A1R24	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A1R25	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1R26	0757-0280	3	23	RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A1R27	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A1R28	0698-3450	9	3	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4222-F
A3A1A1R29	0698-3449	6	2	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2872-F
A3A1A1R30	0757-0444	1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1212-F
A3A1A1R31	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A1R32	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A1A1R33	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A1R34	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A1A1R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A1R36	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1212-F
A3A1A1R37	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5621-F
A3A1A1R38	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A1A1R39	0757-0440	7	5	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A3A1A1R40	0757-0394	0	15	RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A1R41	0698-3446	3	2	RESISTOR 383 1% .125W F TC=0+-100	24546	CT4-1/8-T0-383R-F
A3A1A1R42	0698-0085	0	6	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A3A1A1R43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A1A1R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A1A1R45	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A1R46	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A1R47	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1963-F
A3A1A1R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A1A1R49	0698-7285	6	1	RESISTOR 110K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1103-F
A3A1A1R50	0698-3157	3	5	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1962-F
A3A1A1R51	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1962-F
A3A1A1R52	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A1R53	0698-3440	7	8	RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A3A1A1R54	0698-7234	5	1	RESISTOR 825 1% .05W F TC=0+-100	24546	C3-1/8-T0-825R-F
A3A1A1R55	0698-7257	2	1	RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-F
A3A1A1R56	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A1R57	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	CT4-1/8-T0-383R-F
A3A1A1R58	0698-7246	9	1	RESISTOR 2.61K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2611-F
A3A1A1R59	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A3A1A1R60	0757-0276	7	3	RESISTOR 61.9 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6192-F
A3A1A1R61	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A1R62	0757-1094	9	3	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A3A1A1R63	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A3A1A1R64	0698-3132	4	4	RESISTOR 261 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2610-F
A3A1A1R65	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A3A1A1R66	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A1A1R67	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A1R68	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A1R69	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A1R70	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A1R71	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1211-F
A3A1A1R72	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2610-F
A3A1A1R73	0757-0317	7	2	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1331-F
A3A1A1R74	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-1332-F
A3A1A1R75	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A1A1T1	86701-60082	8	2	TRANSFORMER, RF GRN	28480	86701-60082
A3A1A1T2	86701-60082	8		TRANSFORMER, RF, GRN	28480	86701-60082
A3A1A1TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A1U1	1821-0001	4	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	3L585	CA3046
A3A1A1U2	1820-0328	6	1	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A3A1A1U3	1820-1383	5	1	IC CNTR ECL BCD POS-EDGE-TRIG	04713	MC10138L
A3A1A1U4	1820-0802	1	6	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A1U5	1820-0223	0	6	IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A1A1U6	1820-0429	8	1	IC V RGLTR TO-39	18324	LM309H
A3A1A1VR1	1902-3082	9	3	DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A3A1A1VR2	1902-3256	9	1	DIODE-ZNR 23.7V 5% DO-35 PD=.4W	28480	1902-3256

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1W1	86701-60059	9	1	CABLE ASSEMBLY, GRAY/ORANGE/WHITE	28480	86701-60059
				A3A1A1 MISCELLANEOUS		
	1205-0250	9	1	THERMAL LINK SGL TO-5/TO-39-CS	28480	1205-0250
	2190-0124	4	6	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2200-0101	0	7	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2950-0078	9	3	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	6040-0239	9		LUBRICANT-GREASE SIL	05820	120
	86701-20040	4	1	COVER, P.C. (PHASE LOCK)	28480	86701-20040
	86701-40001	9	7	EXTRACTOR, P.C.	28480	86701-40001
A3A1A2	86701-60020	4	1	100 MHZ VCXO ASSEMBLY	28480	86701-60020
A3A1A2C1	0121-0495	5	3	CAPACITOR-V TRMR-AIR 1.9-15.7PF 175V	74970	187-0309-125
A3A1A2C2	0121-0495	5		CAPACITOR-V TRMR-AIR 1.9-15.7PF 175V	74970	187-0309-125
A3A1A2C3	0121-0495	5		CAPACITOR-V TRMR-AIR 1.9-15.7PF 175V	74970	187-0309-125
A3A1A2C4	0121-0453	5	1	CAPACITOR-V TRMR-AIR 1.3-5.4PF 175V	74970	187-0303-125
A3A1A2C5	0180-0049	9	1	CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A3A1A2C6	0160-3456	6	3	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3A1A2C7	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C8*	0160-2257	3	2	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A3A1A2C9	0160-4084	8	6	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A1A2C10	0140-0191	8	1	CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
A3A1A2C11	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A2C12	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C13	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C14	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C15	0160-2261	9	8	CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C16	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C17	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C18	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C19	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C20	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C21	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C22	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C23	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C24	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C25	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C26	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C27	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C28	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C29	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C30	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C31	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C32	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C33	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C34	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C35	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C36	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C37	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C38	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C39	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C40	0160-2238	0	1	CAPACITOR-FXD 1.5PF +-.25PF 500VDC CER	28480	0160-2238
A3A1A2C41				NOT ASSIGNED		
A3A1A2C42	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C43	0180-0116	1	12	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A1A2C44	0160-2253	9	1	CAPACITOR-FXD 6.8PF +-.25PF 500VDC CER	28480	0160-2253
A3A1A2C45	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C46	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C47	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C48	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3A1A2C49	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3A1A2C50	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A1A2C51	0160-4299	7	11	CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A2C52	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C53	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C54	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C55	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454

See introduction to this section for ordering information
*Indicates factory selected value
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A2C56	0160-2437	1	13	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A2CR1	0122-0245	5	1	DIODE-VVC 1N5139 6.8PF 10%	04713	1N5139
A3A1A2CR2				NOT ASSIGNED		
A3A1A2CR3	1901-0539	3	3	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A3A1A2CR4	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A3A1A2J1	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A2J2	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A2J3	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A2J4				PART OF A3A1A2W1		
A3A1A2L1				NOT ASSIGNED		
A3A1A2L2	9100-2249	6	3	INDUCTOR RF-CH-MLD 150NH 10%	28480	9100-2249
A3A1A2L3	9140-0158	6	2	INDUCTOR RF-CH-MLD 1UH 10%	28480	9140-0158
A3A1A2L4*	9100-2254	3	3	INDUCTOR RF-CH-MLD 390NH 10%	28480	9100-2254
A3A1A2L5	9100-2538	6	1	INDUCTOR RF-CH-MLD 1UH 10%	28480	9100-2538
				*FACTORY SELECTED PART		
A3A1A2L6	9100-2251	0	5	INDUCTOR RF-CH-MLD 220NH 10%	28480	9100-2251
A3A1A2L7	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10%	28480	9100-2251
A3A1A2L8	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10%	28480	9100-2251
A3A1A2L9	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10%	28480	9100-2251
A3A1A2L10				PART OF CIRCUIT BOARD		
A3A1A2L11				PART OF CIRCUIT BOARD		
A3A1A2L12				PART OF CIRCUIT BOARD		
A3A1A2L13				NOT ASSIGNED		
A3A1A2L14	9100-2247	4	2	INDUCTOR RF-CH-MLD 100NH 10%	28480	9100-2247
A3A1A2L15	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10%	28480	9100-2247
A3A1A2Q1	1854-0345	8	16	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q5	1854-0247	9	5	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A1A2Q6	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q7	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q8	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q9	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q10	1854-0404	0	15	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A1A2Q11	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2R1	0757-0279	0	4	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A3A1A2R2	0757-0419	0	3	RESISTOR 681 1% .125W F TC=0+-100	24546	CT4-1/8-T0-681R-F
A3A1A2R3	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A3A1A2R4	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A1A2R5	0698-3155	1	7	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A3A1A2R6	0698-7224	3	3	RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A3A1A2R7	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A1A2R8	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A1A2R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A1A2R10	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R11	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A2R12	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R13	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A2R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R15	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A1A2R16	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R17	0698-3150	6	18	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R18	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R19	0698-7198	0	2	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-26R1-F
A3A1A2R20	0698-3443	0	8	RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A1A2R21	0698-3429	2	6	RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A1A2R22	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A1A2R23	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R24	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R25	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R26	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R27	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A1A2R28	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A1A2R29	0698-7198	0		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-26R1-F
A3A1A2R30	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A2R31	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A1A2R32	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A1A2R33	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A1A2R34	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A1A2R35	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A1A2R36	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R37	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A1A2R38	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R39	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R40	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R41	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A2R42	0698-0084	9	7	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A1A2R43	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A3A1A2R44	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A1A2R45	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A1A2R46	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A3A1A2R47	0757-0439	4	3	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6811-F
A3A1A2R48	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R49	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A3A1A2R50	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6811-F
A3A1A2R51	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A2R52	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A2R53	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A2R54	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A1A2R55	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A1A2R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R57	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R58	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R59	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A1A2R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A2R61	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0+-100	24546	CT4-1/8-T0-215R-F
A3A1A2R62	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A2R63				NOT ASSIGNED		
A3A1A2R64				NOT ASSIGNED		
A3A1A2R65				NOT ASSIGNED		
A3A1A2R66				NOT ASSIGNED		
A3A1A2R67*	0757-0402	1	3	RESISTOR 110 1% .125W F TC=0+-100	24546	CT4-1/8-T0-111-F
A3A1A2R68*	0757-0246	1	1	RESISTOR 536 1% .25W F TC=0+-25	19701	5043R-1/4-T9-536R-F
A3A1A2R69*	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	CT4-1/8-T0-111-F
A3A1A2T1	86701-60081	7	3	TRANSFORMER, RF, BLUE	28480	86701-60081
A3A1A2T2	86701-60081	7		TRANSFORMER, RF, BLUE	28480	86701-60081
A3A1A2T3	86701-60081	7		TRANSFORMER, RF, BLUE	28480	86701-60081
A3A1A2TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2W1	86701-60031	7	1	CABLE ASSEMBLY, GRAY/RED/WHITE	28480	86701-60031
A3A1A2Y1	0410-1086	5	1	CRYSTAL-QUARTZ 100 MHZ HC-35/U-HLDR	28480	0410-1086
				A3A1A2 MISCELLANEOUS		
	2190-0009	4	14	WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2580-0002	4	14	NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
	2200-0101	0		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	6040-0239	9		LUBRICANT-GREASE SIL	05820	120
	86701-60073	7	1	SHIELD ASSEMBLY	28480	86701-60073
	86701-20039	1	1	COVER, P.C. VCXO	28480	86701-20039
	86701-40001	9		EXTRACTOR, P.C.	28480	86701-40001
A3A1A3	86701-60077	1	1	M/N PHASE DETECTOR ASSEMBLY	28480	86701-60077
A3A1A3C1	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C2	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C3	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C4	0180-1731	8	5	CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A1A3C5	0160-0157	8	2	CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157

See introduction to this section for ordering information
*Indicates factory selected value
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A3C6	0160-0161	4	4	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A3C7	0160-0157	8		CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A3A1A3C8	0160-3535	2	2	CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A3A1A3C9	0160-3535	2		CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A3A1A3C10	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A3C11	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C12	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C13	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C14	0160-2406	4	1	CAPACITOR-FXD .27UF +-10% 80VDC POLYE	28480	0160-2406
A3A1A3C15	0160-3877	5	2	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A3A1A3C16	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A3A1A3C17	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A3C18	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C19	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A3C21	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C22	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A3C24	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3A1A3C25	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A3C26	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A3L1	9100-1641	0	7	INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A1A3L2	9100-2259	8	2	INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-2259
A3A1A3L3	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A1A3L4	9100-2562	6	2	INDUCTOR RF-CH-MLD 100UH 10%	28480	9100-2562
A3A1A3L5	9100-2562	6		INDUCTOR RF-CH-MLD 100UH 10%	28480	9100-2562
A3A1A3Q1	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A3Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A3R1	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A3R2	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A3R3				NOT ASSIGNED		
A3A1A3R4	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A3R5	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A3R6				NOT ASSIGNED		
A3A1A3R7	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A3R8	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A3R9	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A1A3R10	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A1A3R11	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A3R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A1A3R13	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A3A1A3R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A3R15	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A1A3R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A1A3R17	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A3R18	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A3R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A1A3R20	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1962-F
A3A1A3R21	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A1A3R22	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A3R23	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4222-F
A3A1A3R24	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4222-F
A3A1A3R25	0698-0083	8	13	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A1A3R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A3R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A1A3R28	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A1A3TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600

See introduction to this section for ordering information
***Indicates factory selected value**
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A3TP11	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3U1	1820-1344	8	2	IC PL LOOP 14-DIP-C PKG	04713	MC12040L
A3A1A3U2	1820-1225	4	2	IC FF ECL D-M/S DUAL	04713	MC10231P
A3A1A3U3	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U4	1820-0820	3	2	IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
A3A1A3U5	1810-0251	3	3	NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U6	1810-0204	6	7	NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U7	1826-0092	3	4	IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A1A3U8	1820-3126	8	2	IC CNTR ECL HEXADEC SYNCHRO	04713	MC10136P
A3A1A3U9	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U10	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U11	1820-0806	5	2	IC GATE ECL OR-NOR DUAL 4-5-INP	04713	MC10109P
A3A1A3U12	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U13	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A3A1A3U14	1810-0251	3		NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U15	1826-0059	2	1	IC OP AMP GP TO-99 PKG	01295	LM201AL
A3A1A3U16	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U17	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U18	1820-0820	3		IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
A3A1A3U19	1820-3126	8		IC CNTR ECL HEXADEC SYNCHRO	04713	MC10136P
A3A1A3U20	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U21	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A1A3U22	1810-0251	3		NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U23	1820-0806	5		IC GATE ECL OR-NOR DUAL 4-5-INP	04713	MC10109P
A3A1A3U24	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3VR1	1902-3082	9		DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A3A1A3W1	86701-60051	1	1	CABLE ASSEMBLY, WHITE/RED	28480	86701-60051
A3A1A3W2	86701-60060	2	1	CABLE ASSEMBLY, GRAY/WHITE	28480	86701-60060
				A3A1A3 MISCELLANEOUS		
	0520-0128	7	15	SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0520-0129	8	3	SCREW-MACH 2-56 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0590-0533	5	13	THREADED INSERT-NUT 2-56 .06-IN-LG SST	28480	0590-0533
	1205-0285	0		HEAT SINK SGL DIP	28480	1205-0285
	2190-0014	1	5	WASHER-LK INTL T NO. 2 .089-IN-ID	78189	1902-00-00-2580
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2200-0101	0		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	6040-0239	9		LUBRICANT-GREASE SIL	05820	120
	86701-00032	2	1	BRACKET, HEAT SINK	28480	86701-00032
	86701-00033	3	1	BRACKET, HS	28480	86701-00033
	86701-20038	0	1	COVER, P.C. M/N DETECTOR	28480	86701-20038
	86701-40001	9		EXTRACTOR, P.C.	28480	86701-40001
A3A1A4	86701-60029	3	1	M/N VCO ASSEMBLY (INCL. A3A1A4A1, A3A1A4A2)	28480	86701-60029
A3A1A4	86701-60071	5	1	M/N VCO ASSEMBLY (RESTORED 08672-60029)	28480	86701-60071
				A3A1A4 MISCELLANEOUS		
	0380-0020	0	1	SPACER-RND .25-IN-LG .128-IN-ID	28480	0380-0020
	0520-0128	7		SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0520-0133	4	2	SCREW-MACH 2-56 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0510-0003	6	1	THREADED INSERT-NUT 8-32 .094-IN-LG STL	28480	0510-0003
	2190-0045	8	4	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045
	3050-0672	2	1	WASHER-SHLDR NO. 4 .118-IN-ID .25-IN-OD	28480	3050-0672
	86701-20046	0	1	PROBE	28480	86701-20046
	86701-20047	1	1	SUPPORT, RESONATOR	28480	86701-20047
A3A1A4A1				VCO RESONATOR ASSEMBLY (NSR, P/O A3A1A4)		
A3A1A4A2	86701-60027	1	1	BOARD ASSEMBLY, M/N VCO	28480	86701-60027
A3A1A4A2C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A4A2C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C5	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A1A4A2C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C8	0160-3873	1	1	CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A3A1A4A2C9	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A4A2C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A4A2C11	0180-2161	0	1	CAPACITOR-FXD .75UF+-10% 50VDC TA	56289	150D754X9050A2
A3A1A4A2L1	9100-2891	4	6	INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A4A2L2	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A4A2L3	86701-20051	7	1	INDUCTOR	28480	86701-20051
A3A1A4A2L4	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10%	28480	9140-0158
A3A1A4A2Q1	1854-0610	0	1	TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A3A1A4A2Q2	1854-0686	0	1	TRANSISTOR NPN SI TO-72 PD=200MW FT=4GHZ	28480	1854-0686
A3A1A4A2R1	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A4A2R2	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A4A2R3	0698-7193	5	1	RESISTOR 16.2 1% .05W F TC=0+-100	24546	C3-1/8-T0-16R2-F
A3A1A4A2R4	0698-3154	0	11	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A1A4A2R5	0757-0428	1	5	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A3A1A4A2R6	0698-7262	9	1	RESISTOR 12.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1212-F
A3A1A4A2R7	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A3A1A4A2R8	0698-7254	9	1	RESISTOR 5.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5621-F
A3A1A4A2R9	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A4A2R10	0698-7265	2	1	RESISTOR 16.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1622-F
A3A1A4A2R11	0698-7250	5	1	RESISTOR 3.83K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3831-F
A3A1A4A2R12	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A1A4A2R13	0757-0400	9	1	RESISTOR 90.9 1% .125W F TC=0+-100	24546	CT4-1/8-T0-90R9-F
A3A1A4A2TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A4A2W1	86701-60058	8	1	CABLE ASSEMBLY, VCO OUTPUT	28480	86701-60058
A3A1A4A2W2	86701-20050	6	1	CABLE, S/R JUMPER	28480	86701-20050
				A3A1A4A2 MISCELLANEOUS		
	0590-0526	6	14	THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
	86701-20052	8	2	SPACER, INSULATOR	28480	86701-20052
A3A1A5	86701-60065	7	1	M/N OUTPUT ASSEMBLY (INCLUDES A3A1A4)	28480	86701-60065
A3A1A5C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C3	0160-2255	1	1	CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A3A1A5C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C6			1	NOT ASSIGNED		
A3A1A5C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C8	0140-0192	9	2	CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A3A1A5C9	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A5C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A5C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A5C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A5C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A5C14	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A5C16	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C18	0160-2257	3		CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A3A1A5C19	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A1A5C20	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C22	0160-2266	4	1	CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A3A1A5C23				NOT ASSIGNED		
A3A1A5C24	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A5C25	0160-0153	4	1	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A3A1A5C26	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A5C27	0160-3534	1	1	CAPACITOR-FXD 510PF +-5% 100VDC MICA	28480	0160-3534
A3A1A5C28	0160-0298	8	1	CAPACITOR-FXD 1500PF +-10% 200VDC POLYE	28480	0160-0298
A3A1A5C29	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A5C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A5C31	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A5C32	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C33	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C34	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C35	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
*Indicates factory selected value
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A5C36	0140-0192	9		CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A3A1A5C37	0160-4351	2	1	CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4351
A3A1A5C38*	0160-2306	3	1	CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0160-2306
A3A1A5J1	1250-0657	5	3	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0657
A3A1A5J2	1250-0657	5		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0657
A3A1A5J3	1250-0657	5		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0657
A3A1A5J4	1250-1255	1	1	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1255
A3A1A5L1	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A5L2	9135-0081	3	1	INDUCTOR RF-CH-MLD 68NH 5%	28480	9135-0081
A3A1A5L3				NOT ASSIGNED		
A3A1A5L4	9100-2248	5	2	INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A3A1A5L5	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A5L6	9100-1635	2	1	INDUCTOR RF-CH-MLD 91UH 5%	28480	9100-1635
A3A1A5L7	9100-1634	1	1	INDUCTOR RF-CH-MLD 75UH 5%	28480	9100-1634
A3A1A5L8	9100-1620	5	4	INDUCTOR RF-CH-MLD 15UH 10%	28480	9100-1620
A3A1A5L9	9140-0210	1	1	INDUCTOR RF-CH-MLD 100UH 5%	28480	9140-0210
A3A1A5L10	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A1A5L11	9100-2248	5		INDUCTOR RF-CH-MLD 120NH 10%	28480	9100-2248
A3A1A5L12				NOT ASSIGNED		
A3A1A5Q1	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q2	1853-0015	7	2	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A3A1A5Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q5	1854-0546	1	5	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q6	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q7	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q8	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q9	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5R1	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R2	0698-7248	1	5	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R3	0698-7243	6	5	RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R4	0698-7205	0	5	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A5R5	0698-7223	2	3	RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-F
A3A1A5R6	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R7	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R8	0698-7203	8	1	RESISTOR 42.2 1% .05W F TC=0+-100	24546	C3-1/8-T0-42R2-F
A3A1A5R9	0698-7218	5	1	RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-F
A3A1A5R10	0698-7188	8	5	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R11	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A5R12	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R13	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R14	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R15	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A5R16	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R17	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R18	0698-7208	3	1	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-68R1-F
A3A1A5R19	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R20	0698-7222	1		RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-F
A3A1A5R21	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-F
A3A1A5R22	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R23	0698-7229	8	2	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A3A1A5R24	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R25	0698-7247	0	1	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-F
A3A1A5R26	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R27	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R28	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A3A1A5R29	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R30	0698-7200	5	1	RESISTOR 31.6 1% .05W F TC=0+-100	24546	C3-1/8-T0-31R6-F
A3A1A5R31	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A3A1A5R32	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A1A5R34	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3161-F
A3A1A5R35				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A5R36*	0698-7206	1	1	RESISTOR 56.2 1% .05W F TC=0+-100	24546	C3-1/8-T0-56R2-F
A3A1A5R37	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-F
A3A1A5R38				NOT ASSIGNED		
A3A1A5R39	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R40*	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A5R41*	0698-7212	9	11	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R42*	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A5U1	0955-0063	0	1	MIXER, DOUBLE BALANCE	28480	0955-0063
A3A1A5U2	1820-2642	1	1	IC CNTR ECL BIN DUAL	28480	B196-1103
A3A1A5VR1	1902-3070	5	2	DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A3A1A5VR2	1902-3070	5		DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A3A1A5W1	86701-20055	1	1	JUMPER, COAX	28480	86701-20055
				A3A1A5 MISCELLANEOUS PARTS		
	0360-0452	0	1	TERMINAL-SLDR LUG PL-MTG FOR-#10-SCR	28480	0360-0452
	2190-0009	4		WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2200-0101	0		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	5001-0176	0	1	GROUND STRAP	28480	5001-0176
	2200-0167	8	6	SCREW-MACH 4-40 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
	86701-20056	2	1	COVER, BOTTOM	28480	86701-20056
	86701-00041	3	1	COVER, TOP	28480	86701-00041
	86701-40001	9		EXTRACTOR, P.C. BOARD	28480	86701-40001
	86701-20037	9	1	COVER, PC, M/N OUT	28480	86701-20037
	86701-20057	3	1	SHIELD, HOUSING	28480	86701-20057
A3A1A6	86701-60022	6	1	M/N REFERENCE MOTHERBOARD ASSEMBLY	28480	86701-60022
A3A1A6C1	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C2	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C3	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C4	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C5	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C6	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C7	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C8	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C9	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C10	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C11	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C12	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6XA3A1A	5060-0112	8	2	CONNECTOR:15 CONTACTS	28480	5060-0112
A3A1A6XA3A1B	5060-0112	8		CONNECTOR:15 CONTACTS	28480	5060-0112
A3A1A6XA3A1	1251-4423	3	1	CONNECTOR-PC EDGE	28480	1251-4423
A3A1A6XA3A1	1251-4174	1	2	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-4174
A3A1A6XA3A1	1251-2035	9	3	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A3A1A6XA3A1	1251-4174	1		CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-4174
				A3A1A6 MISCELLANEOUS		
	0360-1514	7	5	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	2190-0009	4		WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
	86701-00031	1	2	INSULATOR	28480	86701-00031
	86701-00046	8	1	INSULATOR	28480	86701-00046
	1251-0600	0	54	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A2	86701-60012	4	1	RECTIFIER ASSEMBLY	28480	86701-60012
A3A2C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A2C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A2C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A2C4	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A2C5	0180-0230	0	1	CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A2C6	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A2C7	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A2CR1	1901-0662	3	16	DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR2	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR3	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR4	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR5	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR6	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR7	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR8	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR9	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR10	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR11	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR12	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR13	1901-0496	1	2	DIODE-PWR RECT 100V 12A DO-4	04713	MR1121
A3A2CR14	1901-0496	1		DIODE-PWR RECT 100V 12A DO-4	04713	MR1121
A3A2CR15	1990-0404	8	6	LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A3A2CR16	1884-0018	5	6	THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A2CR17	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A2CR18	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A2F1	2110-0001	8	1	FUSE 1A 250V NTD 1.25X.25 UL	75915	312001
A3A2R1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A2R2	2100-3123	0	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	73138	89PR500
A3A2R3	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A2R4	0698-3444	1	7	RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A3A2R5	0698-3447	4	5	RESISTOR 422 1% .125W F TC=0+-100	24546	CT4-1/8-T0-422R-F
A3A2TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A2U1	1826-0126	4	1	IC 7818 V RGLTR TO-3	04713	MC7818CK
A3A2U1	1200-0043	8	1	INSULATOR-XSTR ALUMINUM	28480	1200-0043
A3A2VR1	1902-3263	8	1	DIODE-ZNR 24.9V 2% DO-35 PD=.4W	28480	1902-3263
A3A2VR2	1902-3404	9	2	DIODE-ZNR 82.5V 5% DO-7 PD=.4W TC=+.082%	28480	1902-3404
A3A2XF1	2110-0269	0	12	FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
				A3A2 MISCELLANEOUS		
	0380-0617	1	2	SPACER-PRESS-IN .187 IN MAX OD; .458 IN	28480	0380-0617
	0590-0526	6		THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
	1200-0081	4	1	INSULATOR-FLG-BSHG NYLON	28480	1200-0081
	1251-2313	6	10	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
	2740-0003	5	4	NUT-HEX-W/LKWR 10-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
	6040-0239	9		LUBRICANT-GREASE SIL	05820	120
	5000-9043	6	6	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2	6	EXTRACTOR, P.C. BOARD	28480	5040-6843
	86701-00018	4	1	HEAT SINK	28480	86701-00018
	86701-00025	3	1	INSULATOR	28480	86701-00025
A3A3	86701-60090	8	1	POSITIVE REGULATOR ASSEMBLY	28480	86701-60090
A3A3C1	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
A3A3C2	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A3C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A3C4	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A3C5	0180-0228	6	11	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A3C6	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A3C7	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A3C8	0160-3460	2	5	CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A3C9	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A3C10	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A3C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A3C12	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A3C13	0160-0127	2	4	CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-0127
A3A3C14	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A3C15	0160-4298	6	1	CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A3C16	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A3A3CR1	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A3CR2	1884-0046	9	1	THYRISTOR-SCR VRRM=50	03508	C230F
A3A3CR3	1990-0487	7	1	LED-LAMP LUM-INT=2MCD BVR=5V	28480	HLMP-1401
A3A3CR4	1901-0033	2	21	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A3CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A3CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A3CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A3CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A3CR9	1990-0404	8		LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A3A3CR10	1990-0404	8		LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A3A3CR11	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A3CR12	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A3F1	2110-0036	9	1	FUSE 8A 125V NTD 1.25X.25 UL	75915	312008
A3A3F2	2110-0003	0	1	FUSE 3A 250V NTD 1.25X.25 UL	75915	312003
A3A3Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A3Q3	1853-0012	4	3	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A3Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q5	1854-0441	5	2	TRANSISTOR NPN SI PD=5.8W FT=800KHZ	28480	1854-0441
A3A3Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q7	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q8	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q9	1854-0005	7	1	TRANSISTOR NPN 2N708 SI TO-18 PD=360MW	04713	2N708
A3A3Q10	1854-0039	7	1	TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	3L585	2N3053S
A3A3R1	0757-0443	0	3	RESISTOR 11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1102-F
A3A3R2	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A3R3	0811-1659	8	1	RESISTOR .27 5% 2W PW TC=0+-800	75042	BWH2-27/100-J
A3A3R4	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A3A3R5	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1102-F
A3A3R6	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A3R7	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A3R8	0698-3442	9	1	RESISTOR 237 1% .125W F TC=0+-100	24546	CT4-1/8-T0-237R-F
A3A3R9	0698-8465	6	1	RESISTOR 7.15K .5% .125W F TC=0+-50	28480	0698-8465
A3A3R10	0698-6835	0	9	RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A3R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A3R12	0757-0278	9	4	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A3A3R13	0683-0275	9	5	RESISTOR 2.7 5% .25W CF TC=0-400	01121	CB27G5
A3A3R14	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A3A3R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A3R16	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A3A3R17	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4642-F
A3A3R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A3R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A3R20	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A3R21	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1331-F
A3A3R22	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A3R23	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A3A3R24	0698-3629	4	1	RESISTOR 270 5% 2W MO TC=0+-200	28480	0698-3629
A3A3R25	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A3R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A3R27	0811-1661	2	3	RESISTOR .39 5% 2W PW TC=0+-800	75042	BWH2-39/100-J
A3A3R28	0811-1661	2		RESISTOR .39 5% 2W PW TC=0+-800	75042	BWH2-39/100-J
A3A3R29	0811-1661	2		RESISTOR .39 5% 2W PW TC=0+-800	75042	BWH2-39/100-J
A3A3R30	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	CT4-1/8-T0-681R-F
A3A3R31	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	CT4-1/8-T0-751-F
A3A3R32	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4221-F
A3A3R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A3R34	0698-8466	7	1	RESISTOR 942 .5% .125W F TC=0+-50	28480	0698-8466
A3A3R35	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A3R36	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A3R37	0683-0275	9		RESISTOR 2.7 5% .25W CF TC=0-400	01121	CB27G5
A3A3R38	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A3A3R39	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A3R40	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A3R41	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A3R42	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A3A3R43*	0698-3156	2	3	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1472-F
A3A3R44	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5622-F
A3A3R45	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A3R46	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A3R47	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-9091-F
A3A3R48	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A3R49	0698-8464	5	2	RESISTOR 12.6K .5% .125W F TC=0+-50	28480	0698-8464
A3A3R50	2100-3095	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TRN	73138	89PR200
A3A3R51	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A3A3R52	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A3R53	0698-4405	6	1	RESISTOR 107 1% .125W F TC=0+-100	24546	CT4-1/8-T0-107R-F
A3A3R54	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A3R55	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A3R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A3R57	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A3R58	0698-3634	1	1	RESISTOR 470 5% 2W MO TC=0+-200	28480	0698-3634
A3A3R59	0698-3162	0	2	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4642-F
A3A3R60	0757-0416	7	18	RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A3R61	0698-3631	8	1	RESISTOR 330 5% 2W MO TC=0+-200	28480	0698-3631
A3A3RT1	0837-0126	6	1	THERMISTOR DISC 1K-OHM TC=-4.4%/C-DEG	28480	0837-0126
A3A3TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3U1	1826-0161	7	1	IC OP AMP GP QUAD 14-DIP-P PKG	04713	MLM324P
A3A3U2	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A3U3	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A3VR1	1902-3171	7	2	DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%	28480	1902-3171
A3A3VR2	1902-0686	3	2	DIODE-ZNR 6.2V 2% DO-7 PD=.4W TC=+.002%	04713	1N825
A3A3VR3	1902-3252	5	1	DIODE-ZNR 22.6V 2% DO-35 PD=.4W	28480	1902-3252
A3A3VR4	1902-0049	2	2	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A3A3VR5	1902-0686	3		DIODE-ZNR 6.2V 2% DO-7 PD=.4W TC=+.002%	04713	1N825
A3A3VR6	1902-3082	9		DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A3A3XF1	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A3A3XF2	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
				A3A3 MISCELLANEOUS		
	0520-0128	7		SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0014	1		WASHER-LK INTL T NO. 2 .089-IN-ID	78189	1902-00-00-2580
	2190-0027	6	1	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0027
	2950-0051	8	1	NUT-HEX-DBL-CHAM 1/4-28-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
	86701-20036	8	1	MOUNTING BLOCK, DIODE	28480	86701-20036
A3A4	86701-60078	2	1	NEGATIVE REGULATOR ASSEMBLY	28480	86701-60078
A3A4C1	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A4C2	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A4C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A4C4	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A4C5	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A4C6	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A4C7	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A4C8	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A4C9	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A4C10	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A4C11	0160-0127	2		CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-0127
A3A4C12	0160-0575	4	2	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3A4C13	0160-0127	2		CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-0127
A3A4C14	0160-0127	2		CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-0127
A3A4C15	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A4C16	0180-0100	3	1	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A3A4CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A4CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A4CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A4CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A4CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A4CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A4CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A4CR8	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A4CR9	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A4CR10	1990-0404	8		LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A3A4CR11	1990-0404	8		LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A3A4CR12	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A4CR13	1990-0404	8		LED-LAMP LUM-INT=500UCD IF=50MA-MAX	28480	HLMP-1000
A3A4CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A4CR15	1901-0159	3	2	DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A3A4CR16-A3A4CR24				NOT ASSIGNED		
A3A4CR25	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A4CR26	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A4CR27	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A4F1	2110-0083	6	1	FUSE 2.5A 250V NTD 1.25X.25 UL	28480	2110-0083
A3A4F2	2110-0043	8	1	FUSE 1.5A 250V NTD 1.25X.25 UL	28480	2110-0043
A3A4F3	2110-0010	9	1	FUSE 5A 250V NTD 1.25X.25 UL	75915	312005
A3A4K1	0490-0916	6	1	RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-0916
A3A4Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A4Q2	1854-0441	5		TRANSISTOR NPN SI PD=5.8W FT=800KHZ	28480	1854-0441
A3A4Q3	1853-0001	1	1	TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
A3A4Q4	1853-0007	7	6	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A4Q5	1854-0271	9	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A3A4Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A4Q7	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A4R1	0812-0020	7	2	RESISTOR .39 5% 3W PW TC=0+-90	91637	CW2B1-3-T2-39/100-J
A3A4R2	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A4R3	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A4R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A4R5	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R6	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R7	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R8	0683-0275	9		RESISTOR 2.7 5% .25W CF TC=0-400	01121	CB27G5
A3A4R9	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A3A4R10	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A4R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A4R12	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A3A4R13	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	CT4-1/8-T0-422R-F
A3A4R14	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A3A4R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A4R16	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A3A4R17	0811-1665	6	1	RESISTOR .82 5% 2W PW TC=0+-800	75042	BWH2-82/100-J
A3A4R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A4R19	0698-3449	6		RESISTOR 28.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2872-F
A3A4R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A4R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A4R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A4R23	0812-0020	7		RESISTOR .39 5% 3W PW TC=0+-90	91637	CW2B1-3-T2-39/100-J
A3A4R24	0698-8464	5		RESISTOR 12.6K .5% .125W F TC=0+-50	28480	0698-8464
A3A4R25	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A4R26	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R27	0683-0275	9		RESISTOR 2.7 5% .25W CF TC=0-400	01121	CB27G5
A3A4R28	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	CT4-1/8-T0-316R-F
A3A4R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A4R30	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A4R31	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A4R32	0812-0066	1	3	RESISTOR .33 5% 2W PW TC=0+-800	75042	BWH2-33/100-J
A3A4R33	0812-0066	1		RESISTOR .33 5% 2W PW TC=0+-800	75042	BWH2-33/100-J
A3A4R34	0812-0066	1		RESISTOR .33 5% 2W PW TC=0+-800	75042	BWH2-33/100-J
A3A4R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A4R36	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8251-F
A3A4R37	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R38	0698-7050	3	1	RESISTOR 4.48K .5% .125W F TC=0+-50	28480	0698-7050
A3A4R39	0698-6853	2	1	RESISTOR 7.68K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-7681-D
A3A4R40	0683-0275	9		RESISTOR 2.7 5% .25W CF TC=0-400	01121	CB27G5
A3A4R41	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8251-F
A3A4R42	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3162-F
A3A4R43	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A4R44	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A4R45	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A4R46	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A4R47	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A4R48	0757-0401	0	25	RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A4TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4U1	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4U2	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4U3	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4VR1	1902-0025	4	2	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A3A4VR2	1902-3171	7		DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%	28480	1902-3171
A3A4VR3	1902-3330	0	1	DIODE-ZNR 44.2V 2% DO-35 PD=.4W	28480	1902-3330
A3A4VR4	1902-0049	2		DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A3A4XF1	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A3A4XF2	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A3A4XF3	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
				A3A4 MISCELLANEOUS		
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
A3A5	86701-60015	7	1	DIGITAL-TO-ANALOG CONVERTER ASSEMBLY	28480	86701-60015
A3A5C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C2	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A5C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C4	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A3A5C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C6	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A5C7	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A5C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C9	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A5C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C11	0180-2141	6	1	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A3A5C12	0160-0160	3	1	CAPACITOR-FXD 8200PF +-10% 200VDC POLYE	28480	0160-0160
A3A5L1	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A5L2	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A5L3	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A5Q1	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A5Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q3	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A5Q5	1854-0712	3	3	TRANSISTOR-DUAL NPN PD=1.8W	06665	MAT-01GH

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A5Q6	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q7	1854-0474	4	1	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A3A5Q8	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A5Q9	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q10	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q11	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A5Q12	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5R1	0811-3404	5	1	RESISTOR 3.55K .1% .05W PWW TC=0+-5	28480	0811-3404
A3A5R2	0811-3358	8	1	RESISTOR 7.2K .1% .05W PWW TC=0+-5	28480	0811-3358
A3A5R3	2100-1654	8	2	RESISTOR-TRMR 100 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-101
A3A5R4	2100-1448	8	1	RESISTOR-TRMR 200 5% WW SIDE-ADJ 22-TRN	32997	3057Y-1-201
A3A5R5	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	CT4-1/8-T0-422R-F
A3A5R6	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A5R7	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1472-F
A3A5R8	0757-0290	5	3	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-6191-F
A3A5R9	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A5R10	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A5R11	0811-3357	7	2	RESISTOR 6.25K .1% .05W PWW TC=0+-5	28480	0811-3357
A3A5R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A5R13	2100-1657	1	1	RESISTOR-TRMR 1K 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-102
A3A5R14	0811-3359	9	5	RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R15	0811-3357	7		RESISTOR 6.25K .1% .05W PWW TC=0+-5	28480	0811-3357
A3A5R16	0699-0271	8	1	RESISTOR 715 .1% .125W F TC=0+-25	28480	0699-0271
A3A5R17	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R18	2100-1654	8		RESISTOR-TRMR 100 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-101
A3A5R19	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R20	2100-1656	0	4	RESISTOR-TRMR 500 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-501
A3A5R21	0811-3360	2	1	RESISTOR 25K .1% .05W PWW TC=0+-5	28480	0811-3360
A3A5R22	2100-1656	0		RESISTOR-TRMR 500 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-501
A3A5R23	0811-3361	3	1	RESISTOR 50K .1% .05W PWW TC=0+-5	28480	0811-3361
A3A5R24	2100-1658	2	1	RESISTOR-TRMR 2K 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-202
A3A5R25	0811-2919	5	1	RESISTOR 100K .1% .125W PWW TC=0+-5	54294	SP70-1/16-C-1003-B
A3A5R26	0811-2037	8	1	RESISTOR 2.4K 1% .25W PWW TC=0+-10	20940	143-D-2401-F
A3A5R27	0811-3235	0	1	RESISTOR 7.5K 1% .05W PWW TC=0+-10	20940	140-1/20-7501-F
A3A5R28	0698-6358	2	1	RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A3A5R29	2100-1656	0		RESISTOR-TRMR 500 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-501
A3A5R30	0811-1185	5	1	RESISTOR 10K .01% .05W PWW TC=0+-10	20940	140-1/20-1002-T
A3A5R31	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R32	0811-3138	2	1	RESISTOR 25K .1% .125W PWW TC=0+-10	20940	114-1/16-2502-B
A3A5R33	0811-0647	2	1	RESISTOR 50K .1% .125W PWW TC=0+-10	28480	0811-0647
A3A5R34	0698-8319	9	1	RESISTOR 10K 1% .1W F TC=0+-10	19701	5023Z1/8-T13-1002-F
A3A5R35	0811-3362	4	1	RESISTOR 825 .1% .05W PWW TC=0+-10	28480	0811-3362
A3A5R36	0698-3193	7	1	RESISTOR 10K .25% .125W F TC=0+-50	28480	0698-3193
A3A5R37	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R38	0698-3235	8	1	RESISTOR 25K .25% .125W F TC=0+-50	03888	PME55-1/8-T2-2502-C
A3A5R39	0698-3220	1	1	RESISTOR 50K .25% .125W F TC=0+-50	28480	0698-3220
A3A5R40	0698-3190	4	1	RESISTOR 100K .25% .125W F TC=0+-50	28480	0698-3190
A3A5R41	0698-3237	0	1	RESISTOR 5K .25% .125W F TC=0+-50	28480	0698-3237
A3A5R42	2100-1656	0		RESISTOR-TRMR 500 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-501
A3A5R43	0811-2895	6	1	RESISTOR 422 .1% .2W PWW TC=0+-10	14140	1350-1/16-L3-422R-B
A3A5R44	0698-3153	9	3	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3831-F
A3A5R45	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A5R46	0757-0458	7	6	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A3A5R47	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A5R48	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A5R49	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A5R50	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A3A5R51	0811-3356	6	1	RESISTOR 5.9K .1% .125W PWW TC=0+-5	28480	0811-3356
A3A5R52	0698-6360	6	1	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3A5R53	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A3A5R54	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A5R55	0811-3325	9	1	RESISTOR 312 .1% .125W PWW TC=0+-10	28480	0811-3325
A3A5R56	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A5R57	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A5R58	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-6191-F
A3A5R59	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2873-F
A3A5R60	0698-3454	3	1	RESISTOR 215K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2153-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A5R61	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A3A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5U1	1826-0092	3		IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A5U2	1826-0013	8	4	IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3A5U3	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3A5U4	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3A5U5	1901-1011	8	3	DIODE-ARRAY 25MA VF DIFF=5MV	28480	1901-1011
A3A5U6	1901-1011	8		DIODE-ARRAY 25MA VF DIFF=5MV	28480	1901-1011
A3A5U7	1901-1011	8		DIODE-ARRAY 25MA VF DIFF=5MV	28480	1901-1011
A3A5U8	1820-0668	7	3	IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A3A5U9	1820-0668	7		IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A3A5U10	1820-0668	7		IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A3A5VR1	1902-0692	1	1	DIODE-ZNR 6.3V 1% DO-7 PD=.4W TC=+.001%	28480	1902-0692
A3A5VR2	1902-0244	9	1	DIODE-ZNR 30V 5% PD=1W IR=5UA	28480	1902-0244
				A3A5 MISCELLANEOUS		
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
A3A6	86701-60016	8	2	YTO DRIVER ASSEMBLY	28480	86701-60016
A3A6C1	0160-3451	1	7	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C2	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A6C3	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A6C4	0160-0574	3	6	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A6C5	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A6C6	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C7	0180-2139	2	1	CAPACITOR-FXD 10UF+-20% 60VDC TA	56289	109D106X0060C2
A3A6C8	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C9	0160-3452	2	1	CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3452
A3A6C10	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A3A6C11	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C12	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A6C14	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A6C15	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A6C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C17	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A6C18	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C19	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A3A6CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR2	1901-0040	1	16	DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A6CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A6CR4				NOT ASSIGNED		
A3A6CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A6CR9	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A3A6CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A6Q1	1854-0237	7	1	TRANSISTOR NPN SI TO-66 PD=20W FT=10MHZ	28480	1854-0237
A3A6Q2	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A6Q3	1854-0022	8	2	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A3A6Q4	1854-0232	2	1	TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
A3A6Q5	1853-0038	4	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A3A6Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A6Q7	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A6Q8	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A3A6Q9	1854-0712	3		TRANSISTOR-DUAL NPN PD=1.8W	06665	MAT-01GH
A3A6Q10	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A6Q11	1853-0050	0	2	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A3A6Q12	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A6Q13	1853-0050	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A3A6R1				NOT ASSIGNED		
A3A6R2				NOT ASSIGNED		
A3A6R3	0757-0456	5	1	RESISTOR 43.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4322-F
A3A6R4	0698-4492	1	1	RESISTOR 32.4K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3242-F
A3A6R5	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A3A6R6	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A3A6R7	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A6R8	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A3A6R9	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A6R10	0757-0465	6	4	RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A3A6R11	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1962-F
A3A6R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A6R13	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A3A6R14	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A6R15	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A6R16	0811-3440	9	1	RESISTOR 125 1% 25W PW TC=0+-2	28480	0811-3440
A3A6R17	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A3A6R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A6R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A6R20	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A3A6R21	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A3A6R22	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	5033R-1/8-T0-6191-F
A3A6R23	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A6R24	0811-2936	6	1	RESISTOR 15 .1% .5W PWW TC=0+-5	14140	1251-1/4-C-15R-B
A3A6R25	2100-0635	3	2	RESISTOR-TRMR 2K 10% C SIDE-ADJ 20-TRN	28480	2100-0635
A3A6R26	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A6R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A6R28	0757-0467	8	2	RESISTOR 121K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1213-F
A3A6R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A6R30	0698-8025	4	1	RESISTOR 1.91K .25% .125W F TC=0+-50	19701	5033R-1/8-T2-1911-C
A3A6R31	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	CT4-1/8-T0-111-F
A3A6R32	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A3A6R33	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1621-F
A3A6R34	2100-0635	3		RESISTOR-TRMR 2K 10% C SIDE-ADJ 20-TRN	28480	2100-0635
A3A6R35	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3831-F
A3A6R36	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	CT4-1/8-T0-422R-F
A3A6R37	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A3A6R38	0698-5673	2	1	RESISTOR 3.9K 1% .125W F TC=0+-25	28480	0698-5673
A3A6R39	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A3A6R40	0698-8420	3	1	RESISTOR 4.22K 1% .125W F TC=0+-25	19701	5033R-1/8-T9-4221-F
A3A6R41	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-T0-101-F
A3A6R42	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6U1	1826-0092	3		IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A6VR1	1902-0680	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A3A6VR2	1902-3404	9		DIODE-ZNR 82.5V 5% DO-7 PD=.4W TC=+.082%	28480	1902-3404
A3A6VR3	1902-3323	1	1	DIODE-ZNR 42.2V 5% DO-35 PD=.4W TC=+.08%	28480	1902-3323
A3A6VR4	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
				A3A6 MISCELLANEOUS		
	1205-0085	8	1	HEAT SINK TO-66-CS	28480	1205-0085
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
	2200-0107	6	2	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0143	0	2	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	2190-0003	8	4	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0003
	2260-0001	5	4	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
A3A7	08671-60017	8	1	YTO HF DRIVER BD	28480	08671-60017
A3A7C1	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A7C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C3	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A7C4	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A7C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C6	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A7C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C8	0180-0234	4	1	CAPACITOR-FXD 33UF+-20% 75VDC TA	56289	109D336X0075F2
A3A7C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C10	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 50VDC CER	28480	0160-0174
A3A7C11	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A3A7C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C13	0180-1719	2	1	CAPACITOR-FXD 22UF+-10% 25VDC TA	56289	109D226X9025C2
A3A7C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A7C16	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A7C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C22	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C24	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C25	0160-2202	8	1	CAPACITOR-FXD 75PF +-5% 300VDC MICA	28480	0160-2202
A3A7C26	0140-0194	1	2	CAPACITOR-FXD 110PF +-5% 300VDC MICA	72136	DM15F111J0300WV1CR
A3A7CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A7CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A7CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A7CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A7L1	9100-2259	8		INDUCTOR RF-CH-MLD 1.5UH 10%	28480	9100-2259
A3A7Q1	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A7Q2	1855-0020	8	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A3A7Q3	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A7Q4	1854-0023	9	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A3A7Q5	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A7Q6	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A7Q7	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A7Q8	1854-0401	7	1	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0401
A3A7Q9	1854-0013	7	1	TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	04713	2N2218A
A3A7Q10	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A7R1	0757-0447	4	2	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1622-F
A3A7R2	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A7R3	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1102-F
A3A7R4	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A3A7R5	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1003-F
A3A7R6	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R7	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R8	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R9	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R10	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R11	0698-7277	6	1	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A3A7R12†	0698-7236	7	5	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A7R13	0698-7258	3	1	RESISTOR 8.25K 1% .05W F TC=0+-100	24546	C3-1/8-T0-8251-F
A3A7R14	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A7R15	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A7R16	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A3A7R17	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3831-F
A3A7R18	0698-3152	8	2	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3481-F
A3A7R19	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A7R20	0698-3427	0	1	RESISTOR 13.3 1% .125W F TC=0+-100	03888	PME55-1/8-T0-13R3-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A7R21	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A7R22	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2371-F
A3A7R23	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	CT4-1/8-T0-287R-F
A3A7R24	0686-1525	0	1	RESISTOR 1.5K 5% .5W CC TC=0+647	01121	EB1525
A3A7R25	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	CT4-1/8-T0-147R-F
A3A7R26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A7R27	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A7R28	0698-6113	7	1	RESISTOR 1.82K .25% .125W F TC=0+-100	28480	0698-6113
A3A7R29	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	CT4-1/8-T0-751-F
A3A7R30	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	CT4-1/8-T0-751-F
A3A7R31	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	CT4-1/8-T0-751-F
A3A7R32	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	CT4-1/8-T0-422R-F
A3A7R33	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A7R34	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8251-F
A3A7R35	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1622-F
A3A7R36	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R37	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R38	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R39	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A7R40	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-8251-F
A3A7R41	0757-0802	5	2	RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A3A7R42	0757-0802	5		RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A3A7R43	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A7TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A7TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A7U1	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
	1200-0173	5	6	INSULATOR-XSTR DAP-GL	28480	1200-0173
	1205-0011	0	4	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
	1205-0037	0	2	HEAT SINK TO-18-CS	28480	1205-0037
	5000-9043	6		PIN	28480	5000-9043
	5040-6843	2		EXTRACTOR	28480	5040-6843
A3A8	10811-60102	7	1	10MHZ REFERENCE OSCILLATOR ASSEMBLY	28480	10811-60102
	1520-0094	7	3	SHOCK MOUNT .45-EFF-HGT 1-LB-LOAD-CAP	28480	1520-0094
	86701-00042	4	1	SUPPORT BOTTOM SHOCK MOUNT	28480	86701-00042
	86701-00043	5	1	SUPPORT TOP SHOCK MOUNT	28480	86701-00043
	2420-0001	5	2	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
	2200-0147	4	2	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0018	5	2	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
A3A8P1				NSR, P/O A3A8		
A3A8W1				NSR, P/O A3A8		
A3A9C1	0160-3036	8	6	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C2	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C3	0160-4748	1	3	CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4748
A3A9C4	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C5	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C6	0160-4748	1		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4748
A3A9C7	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C8	0160-4748	1		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4748
A3A9C9	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9J1	1250-0691	7	6	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J2	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J3	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J4	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J5	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J6	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
	86701-00010	6	1	COVER, SAMPLER	28480	86701-00010
	86701-00011	7	1	COVER, PHASE LOCK	28480	86701-00011
A3A9U1	86701-67001	5	1	SAMPLER, 2-6.5 GHZ	28480	86701-67001

See introduction to this section for ordering information
***Indicates factory selected value**
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9W1	86701-20064	2	1	CABLE ASSEMBLY, YTO OUTPUT	28480	86701-20064
A3A9W2	86701-20066	4	1	CABLE ASSEMBLY, ATTENUATOR OUTPUT	28480	86701-20066
A3A9W3	86701-20065	3	1	CABLE ASSEMBLY, FILTER INPUT	28480	86701-20065
A3A9W4	86701-60052	2	1	CABLE ASSEMBLY, COAX, BLACK	28480	86701-60052
A3A9A1	0955-0098	1	1	DIRECTIONAL COUPLER ASSEMBLY	28480	0955-0098
A3A9A2	86701-60025	9	1	ASSEMBLY, YTO INTERCONNECT	28480	86701-60025
A3A9A2J1	1250-0543	8	1	CONNECTOR-RF SM-SNP M PC 50-OHM	28480	1250-0543
A3A9A2W1	86701-60010	2	1	CABLE ASSEMBLY, YTO LOOP RIBBON	28480	86701-60010
A3A9A2W2	86701-60009	9	1	CABLE ASSEMBLY, YTO LOOP RIBBON	28480	86701-60009
A3A9A3	5086-7131	9	1	2-6.2 GHZ YTO ASSEMBLY	28480	5086-7131
A3A9A4	86701-60016	8		ASSEMBLY, YTO PHASE DETECTOR	28480	86701-60016
A3A9A4C1	0160-2307	4	2	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A3A9A4C2	0160-2307	4		CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A3A9A4C3	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C4	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A4C6	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C7				NOT ASSIGNED		
A3A9A4C8				NOT ASSIGNED		
A3A9A4C9	0160-3538	5	2	CAPACITOR-FXD 750PF +-5% 100VDC MICA	28480	0160-3538
A3A9A4C10	0160-3538	5		CAPACITOR-FXD 750PF +-5% 100VDC MICA	28480	0160-3538
A3A9A4C11	0160-0165	8	1	CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A3A9A4C12	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3A9A4C13	0160-3874	2	2	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A9A4C14	0160-2453	1	1	CAPACITOR-FXD .22UF +-10% 80VDC POLYE	28480	0160-2453
A3A9A4C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A4C16	0160-0168	1	1	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3A9A4C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A4C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A4C19	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A9A4C20	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A9A4C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A9A4C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A4C23	0160-3874	2		CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A9A4C24	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C25	0140-0190	7		CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3A9A4C26	0160-3490	8	1	CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-3490
A3A9A4C27	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C28	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A9A4C29	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A9A4C30	0160-2200	6	1	CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
A3A9A4C31	0160-2264	2	1	CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A3A9A4C32	0140-0194	1		CAPACITOR-FXD 110PF +-5% 300VDC MICA	72136	DM15F111J0300WV1CR
A3A9A4C33	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A9A4CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A9A4CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A9A4CR3	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A3A9A4CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A9A4CR5	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3A9A4CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A9A4CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A9A4CR8-A3A9A4CR10				NOT ASSIGNED		
A3A9A4CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3A9A4CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A9A4CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A9A4CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3A9A4L1	9100-2254	3		INDUCTOR RF-CH-MLD 390NH 10%	28480	9100-2254
A3A9A4L2	9100-1620	5		INDUCTOR RF-CH-MLD 15UH 10%	28480	9100-1620
A3A9A4L3	9100-1620	5		INDUCTOR RF-CH-MLD 15UH 10%	28480	9100-1620
A3A9A4L4	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A9A4L5	9100-1620	5		INDUCTOR RF-CH-MLD 15UH 10%	28480	9100-1620

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9A4L6	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5%	28480	9100-1641
A3A9A4L7	9100-0368	6		INDUCTOR RF-CH-MLD 330NH 10%	28480	9100-0368
A3A9A4L8	9140-0179	1	2	INDUCTOR RF-CH-MLD 22UH 10%	28480	9140-0179
A3A9A4L9	9100-2254	3		INDUCTOR RF-CH-MLD 390NH 10%	28480	9100-2254
A3A9A4L10	9100-0368	6		INDUCTOR RF-CH-MLD 330NH 10%	28480	9100-0368
A3A9A4L11	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10%	28480	9140-0179
A3A9A4Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A9A4Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A9A4Q3	1855-0395	0	1	TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	17856	FN2645
A3A9A4Q4	1854-0712	3		TRANSISTOR-DUAL NPN PD=1.8W	06665	MAT-01GH
A3A9A4Q5	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A9A4R1	0698-7288	9	1	RESISTOR 147K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1473-F
A3A9A4R2	0757-0464	5	1	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-9092-F
A3A9A4R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A9A4R4	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A9A4R5	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A9A4R6	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A9A4R7	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A9A4R8	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A9A4R9	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A9A4R10	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A9A4R11	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A9A4R12	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A3A9A4R13	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A3A9A4R14	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A3A9A4R15	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4641-F
A3A9A4R16	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A9A4R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A9A4R18	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A9A4R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A9A4R20*	0757-0421	4	9	RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A9A4R21	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1471-F
A3A9A4R22	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-3481-F
A3A9A4R23				NOT ASSIGNED		
A3A9A4R24	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1962-F
A3A9A4R25	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A9A4R26	0698-4020	1	1	RESISTOR 9.53K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-9531-F
A3A9A4R27	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A3A9A4R28	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A9A4R29	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A9A4R30	2100-3212	8	1	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A3A9A4R31	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A9A4R32	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7501-F
A3A9A4R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A9A4R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A9A4R35	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A9A4R36	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5111-F
A3A9A4R37	0757-0422	5	8	RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A9A4R38	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	CT4-1/8-T0-909R-F
A3A9A4R39	0757-0467	8		RESISTOR 121K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1213-F
A3A9A4R40				NOT ASSIGNED		
A3A9A4R41				NOT ASSIGNED		
A3A9A4R42				NOT ASSIGNED		
A3A9A4R43	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-5112-F
A3A9A4R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A3A9A4R45	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2610-F
A3A9A4R46	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2610-F
A3A9A4R47	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CT4-1/8-T0-511R-F
A3A9A4R48	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A9A4R49	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6811-F
A3A9A4R50	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A3A9A4R51	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A9A4R52	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A9A4R53	2100-1986	9	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A3A9A4R54	0698-7245	8	1	RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-F
A3A9A4R55	0698-7242	5	1	RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-F

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9A4R56	0698-7253	8	1	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A3A9A4R57	0757-0418	9	3	RESISTOR 619 1% .125W F TC=0+-100	24546	CT4-1/8-T0-619R-F
A3A9A4R58	0698-3451	0	1	RESISTOR 133K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1333-F
A3A9A4TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4U1	1826-0092	3		IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A9A4U2	1826-0026	3	1	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A3A9A4U3	1826-0044	5	1	IC OP AMP GP DUAL 14-DIP-C PKG	07263	UA739DC
A3A9A4U4	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A3A9A4U5	1820-1344	8		IC PL LOOP 14-DIP-C PKG	04713	MC12040L
A3A9A4U6	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A9A4U7	1820-0817	8	2	IC FF ECL D-M/S DUAL	04713	MC10131P
A3A9A4U8	1810-0204	6		NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3A9A4U9	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A3A9A4VR1	1902-1260	1	2	DIODE-ZNR 1N5525C 6.2V 2% DO-7 PD=.4W	04713	1N5525C
A3A9A4VR2	1902-1260	1		DIODE-ZNR 1N5525C 6.2V 2% DO-7 PD=.4W	04713	1N5525C
A3A9A4VR3	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A3A9A4VR4	1902-3104	6	1	DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A3A9A5	86701-60089	5	1	ASSEMBLY, SAMPLER	28480	86701-60089
A3A9A5C1	0121-0046	2	2	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	73899	DV11PS35D
A3A9A5C2	0121-0046	2		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	73899	DV11PS35D
A3A9A5C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A9A5C4	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A9A5C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C6	0160-2150	5	1	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A3A9A5C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A9A5C9	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A9A5C10	0160-2265	3	1	CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
A3A9A5C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A9A5C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C13	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A9A5C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C16				NOT ASSIGNED		
A3A9A5C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C18	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A9A5C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5C20	0160-0939	4	1	CAPACITOR-FXD 430PF +-5% 300VDC MICA	28480	0160-0939
A3A9A5C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C22*	0140-0196	3	2	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A3A9A5C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C24	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A9A5C25	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A9A5C26	0160-2308	5	1	CAPACITOR-FXD 36PF +-5% 300VDC MICA	28480	0160-2308
A3A9A5C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C29	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5C30	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5C31	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C32	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5E1				NOT ASSIGNED		
A3A9A5J1	1251-3172	7		CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A3A9A5J2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A5L1				NSR, P/O CIRCUIT BOARD		
A3A9A5L2	9140-0144	0	1	INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0144
A3A9A5L3	9100-1623	8	1	INDUCTOR RF-CH-MLD 27UH 5%	28480	9100-1623
A3A9A5L4	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10%	28480	9100-2251
A3A9A5L5	9100-2258	7	2	INDUCTOR RF-CH-MLD 1.2UH 10%	28480	9100-2258

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9A5L6	9100-2258	7		INDUCTOR RF-CH-MLD 1.2UH 10%	28480	9100-2258
A3A9A5L7	9100-2891	4		INDUCTOR RF-CH-MLD 50NH 10%	28480	9100-2891
A3A9A5L8				NSR, P/O CIRCUIT BOARD		
A3A9A5L9				NSR, P/O CIRCUIT BOARD		
A3A9A5L10	9140-0539	7	1	INDUCTOR RF-CH-MLD 3UH 5% .105DX.26LG	28480	9140-0539
A3A9A5L11	9100-0368	6		INDUCTOR RF-CH-MLD 330NH 10%	28480	9100-0368
A3A9A5L12	9100-2249	6		INDUCTOR RF-CH-MLD 150NH 10%	28480	9100-2249
A3A9A5L13	9100-2250	9	1	INDUCTOR RF-CH-MLD 180NH 10%	28480	9100-2250
A3A9A5L14	9100-2249	6		INDUCTOR RF-CH-MLD 150NH 10%	28480	9100-2249
A3A9A5Q1	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A3A9A5Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A9A5Q3	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A9A5Q4	1855-0235	7	1	TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	04713	U310(SELECTED)
A3A9A5Q5	1853-0015	7		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A3A9A5Q6	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A9A5Q7	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A9A5Q8	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A3A9A5R1	2100-3383	4	1	RESISTOR-TRMR 50 10% C TOP-ADJ 1-TRN	28480	2100-3383
A3A9A5R2	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A9A5R3	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	CT4-1/8-T0-196R-F
A3A9A5R4	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A3A9A5R5	0757-0424	7	3	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1101-F
A3A9A5R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A9A5R7	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A3A9A5R8	0757-0796	6	1	RESISTOR 82.5 1% .5W F TC=0+-100	28480	0757-0796
A3A9A5R9	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	CT4-1/8-T0-82R5-F
A3A9A5R10	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3A9A5R11	0757-0470	3	1	RESISTOR 162K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1623-F
A3A9A5R12				NOT ASSIGNED		
A3A9A5R13	0698-7216	3	1	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A3A9A5R14				NOT ASSIGNED		
A3A9A5R15	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1101-F
A3A9A5R16	0757-0398	4	1	RESISTOR 75 1% .125W F TC=0+-100	24546	CT4-1/8-T0-75R0-F
A3A9A5R17	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1101-F
A3A9A5R18	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	CT4-1/8-T0-681R-F
A3A9A5R19	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A9A5R20	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A3A9A5R21	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A9A5R22	0698-7195	7	1	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T0-19R6-F
A3A9A5R23	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1961-F
A3A9A5R24	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2151-F
A3A9A5R25	0698-0082	7	2	RESISTOR 464 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4640-F
A3A9A5R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A9A5R27	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A9A5R28	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	CT4-1/8-T0-4640-F
A3A9A5R29	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A9A5R30	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A9A5R31	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	CT4-1/8-T0-751-F
A3A9A5R32	0698-3439	4	2	RESISTOR 178 1% .125W F TC=0+-100	24546	CT4-1/8-T0-178R-F
A3A9A5R33	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	28480	0757-0346
A3A9A5R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3A9A5R35	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	CT4-1/8-T0-178R-F
A3A9A5R36	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A9A5R37	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A9A5R38	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6192-F
A3A9A5R39	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	CT4-1/8-T0-6192-F
A3A9A5R40	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3A9A5R41	0698-7196	8	1	RESISTOR 21.5 1% .05W F TC=0+-100	24546	C3-1/8-T0-21R5-F
A3A9A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
				A3A9A5 MISCELLANEOUS		

See introduction to this section for ordering information
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†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
	1205-0037	0		HEAT SINK TO-18-CS	28480	1205-0037
	1251-3172	7	2	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A3A9A6	0955-0090	3	1	ATTENUATOR ASSEMBLY, 15 DB	28480	0955-0090
A3A9A7	9135-0040	4	1	6.2 GHZ LOW PASS FILTER ASSEMBLY	28480	9135-0040
A3A10	86701-60093	1	1	MOTHER BOARD ASSEMBLY	28480	86701-60093
A3A10CR1	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A3A10CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3A10CR3	1990-0517	4	1	LED-LAMP LUM-INT=3MCD IF=20MA-MAX BVR=5V	28480	5082-4655
A3A10J1				NSR, P/O A3W11		
A3A10J2	1251-3905	4	1	CONN-POST TYPE .100-PIN-SPCG 20-CONT	28480	1251-3905
A3A10J3	1252-0473	7	1	CONN-POST TYPE .100-PIN-SPCG 5-CONT	28480	1252-0473
A3A10J4	1251-0555	4	1	CONNECTOR-PC EDGE 30-CONT/ROW 2-ROWS	28480	1251-0555
A3A10K1	0490-0618	5	1	RELAY 2C 24VDC-COIL 5A 115VAC	28480	0490-0618
A3A10R1	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	CT4-1/8-T0-825R-F
A3A10R2	0687-3321	0	1	RESISTOR 3.3K 10% .5W CC TC=0+647	01121	EB3321
A3A10R3	0683-7515	4	1	RESISTOR 750 5% .25W CF TC=0-400	01121	CB7515
A3A10R4	0686-7525	2	1	RESISTOR 7.5K 5% .5W CC TC=0+647	01121	EB7525
A3A10R5	0683-2225	3	1	RESISTOR 2.2K 5% .25W CF TC=0-400	01121	CB2225
A3A10XA3A2	1251-2026	8	4	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A3A10XA3A3	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A3A10XA3A4	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A3A10XA3A5	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A3A10XA3A6	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A3A10XA3A7	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
				A3A10 MISCELLANEOUS		
	0380-0667	1	1	STANDOFF-HEX .312-IN-LG 6-32-THD	00000	ORDER BY DESCRIPTION
	0380-0076	6	4	SPACER-RVT-ON .5-IN-LG .152-IN-ID	28480	0380-0076
	0380-0659	1	2	SPACER-RVT-ON .375-IN-LG .152-IN-ID	28480	0380-0659
	0380-0884	4	5	STANDOFF-RVT-ON .156-IN-LG 4-40-THD	28480	0380-0884
	0590-0526	6		THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A3A11	86701-60070	4	1	POWER LINE MODULE(DOES NOT INCLUDE A3F1)	28480	86701-60070
A3A11TB1	5020-8122	2	1	LINE VOLTAGE SELECTOR CARD	28480	5020-8122

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				A3 CHASSIS PARTS		
A3AT1	86701-60066	8	2	TERMINATION, 50 OHM	28480	86701-60066
A3AT2	86701-60066	8		TERMINATION, 50 OHM	28480	86701-60066
A3B1	3160-0296	9	1	FAN-SKL 72-CFM 115V 50/60-HZ 3.875-OD	28480	3160-0296
A3C1	0180-0452	8	1	CAPACITOR-FXD .013F+75-10% 25VDC AL	28480	0180-0452
A3C2	0180-0454	0	1	CAPACITOR-FXD 4200UF+75-10% 75VDC AL	28480	0180-0454
A3C3	0180-0453	9	1	CAPACITOR-FXD 8700UF+75-10% 40VDC AL	28480	0180-0453
A3C4	0180-2798	9	1	CAPACITOR-FXD .03F+100-10% 20VDC AL	28480	0180-2798
A3C6	0160-4065	5	1	CAPACITOR-FXD .1UF +-20% 250VAC(RMS)	28480	0160-4065
A3F1	2110-0003	0	1	FUSE 3A 250V NTD 1.25X.25 UL (100/120 VAC)	75915	312003
A3F1	2110-0043	8	1	FUSE 1.5A 250V NTD 1.25X.25 UL (220/240 VAC)	28480	2110-0043
A3J1				NSR (P/O A3W11)		
A3J2				NSR (P/O A3W10)		
A3J3				NSR (P/O A3W10)		
A3J4-A3J6				NOT ASSIGNED		
A3J7				NSR; P/O A3W7		
A3J8				NSR; P/O A3W5		
A3J9				NSR; P/O A3W2		
A3J10				NSR; P/O A3W3		
A3Q1	1854-0618	8	2	TRANSISTOR NPN SI DARL TO-3 PD=150W	04713	MJ3000
A3Q2	1854-0294	6	1	TRANSISTOR NPN SI TO-3 PD=115W FT=500KHZ	28480	1854-0294
A3Q3	1854-0618	8		TRANSISTOR NPN SI DARL TO-3 PD=150W	04713	MJ3000
A3Q4	1854-0679	1	1	TRANSISTOR NPN 2N5885 SI TO-3 PD=200W	04713	2N5885
A3S1	3101-0070	3	1	SWITCH-SL DPDT MINTR .5A 125VAC/DC (FREQ. STD. INT/EXT SWITCH)	28480	3101-0070
A3T1	86701-60032	8	1	TRANSFORMER	28480	86701-60032
A3W1	86701-60046	4	1	CABLE ASSEMBLY,FM INPUT (BROWN)	28480	86701-60046
A3W2	86701-60007	7	1	CABLE ASSEMBLY,FREQ.STD.OUTPUT(GRA/VIO)	28480	86701-60007
A3W3	86701-60063	5	1	CABLE ASSEMBLY,FREQ. REF. (GRAY)	28480	86701-60063
A3W4	86701-60039	5	1	CABLE ASSEMBLY,YTM TUNE(YELLOW)	28480	86701-60039
A3W5	86701-60005	5	1	CABLE ASSEMBLY, 10 MHZ OUTPUT(GRA/BLU)	28480	86701-60005
A3W6	86701-60049	7	1	CABLE ASSEMBLY, 10 MHZ OUTPUT (BLUE)	28480	86701-60049
A3W7	86701-60004	4	1	CABLE ASSEMBLY, 100 MHZ OUTPUT(GRA/GRN)	28480	86701-60004
A3W8	86701-60053	3	1	CABLE ASSEMBLY,M/N OUTPUT(WHT/ORG)	28480	86701-60053
A3W9	86701-60064	6	2	CABLE ASSEMBLY	28480	86701-60064
A3W10	86701-60064	6		CABLE ASSEMBLY-A1 TO A2 INTERCONNECT (INCLUDES A3J2 AND A3J3)	28480	86701-60064
A3W11	86701-60050	0	1	CABLE ASSEMBLY (A1 INTERCONNECT) (INCLUDES A3J1 AND A3A10J1)	28480	86701-60050
A3W12				NOT ASSIGNED		
A3W13	86701-60006	6	1	CABLE ASSEMBLY,FREQ.STD. INPT(GRA/BLK)	28480	86701-60006
A3W14	86701-60056	6	1	CABLE ASSEMBLY,20/30MHZ OUTPUT (GREEN)	28480	86701-60056
A3W15	86701-60033	9	1	CABLE ASSEMBLY,FM TUNE (VIOLET)	28480	86701-60033
A3W16	86701-60055	5	1	CABLE ASSEMBLY,YTO TUNE (GRAY)	28480	86701-60055
A3W17	86701-60054	4	1	CABLE ASSEMBLY,INTEGRATED FM OUT(WHITE)	28480	86701-60054
A3W18	5060-9462	9	1	HP-IB ADAPTER	28480	5060-9462

See introduction to this section for ordering information
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†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				MISCELLANEOUS PARTS (SEE FIGURE 6-1)		
MP1	1460-1345	5	2	TILT STAND SST	28480	1460-1345
MP2	5040-7201	8	4	FOOT	28480	5040-7201
MP3	5041-6819	4	2	HANDLE, CAP-FRONT	28480	5041-6819
MP4	5001-0439	8	2	TRIM, FRONT SIDE	28480	5001-0439
MP5	5060-9805	4	2	STRAP HANDLE 21 IN	28480	5060-9805
MP6	0515-1132	4	2	SCREW-MACH M5 X 0.8 10MM-LG	28480	0515-1132
MP7	5041-6820	7	2	HANDLE, CAP-REAR	28480	5041-6820
MP8	5060-9938	4	2	SIDE COVER	28480	5060-9938
MP9	0515-1232	5	4	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
MP10	5040-7221	2	4	STANDOFF, REAR PANEL	28480	5040-7221
MP11	0515-1245	0	1	SCREW-SPCL M3.5 X 0.6 12MM-LG	00000	ORDER BY DESCRIPTION
MP12	0510-0043	4	1	RETAINER-RING E-R EXT .141-IN-DIA STL	28480	0510-0043
MP13	5061-9436	9	1	COVER TOP 21 IN	28480	5061-9436
MP14	5040-7202	9	1	TRIM, TOP	28480	5040-7202
MP15	5061-9448	3	1	COVER BOTTOM 21 IN	28480	5061-9448
MP16-MP20				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-2)		
MP21	5021-5803	2	1	FRAME-FRONT	28480	5021-5803
MP22	2360-0334	9	4	SCREW-MACH 6-32 .312-IN-LG 100 DEG	28480	2360-0334
MP23	86701-20001	7	1	FRAME SUPPORT	28480	86701-20001
MP24	2360-0333	8	16	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
MP25	86701-20003	9	1	GUIDE PIN	28480	86701-20003
MP26	0520-0166	3	3	SCREW-MACH 2-56 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP27	86701-00003	7	1	CHASSIS RF MODULE DIV	28480	86701-00003
MP28	0515-1331	5	12	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
MP29	0515-1055	0	4	SCREW-MACH M4 X 0.7 6MM-LG 90-DEG-FLH-HD	28480	0515-1055
MP30	86701-00062	8	1	STRUT LOWER LEFT	28480	86701-00062
MP31	2360-0115	4	14	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP32	5021-5883	8	2	STRUT, UPPER CORNER	28480	5021-5883
MP33	2360-0195	0	5	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP34	0360-0268	6	3	TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	28480	0360-0268
MP35	0515-0896	5	4	SCREW-MACH M4 X 0.7 10MM-LG	28480	0515-0896
MP36	2420-0001	5	3	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
MP37	1400-0619	8	1	CABLE CLAMP-HFCL .312-DIA .5-WD	28480	1400-0619
MP38	3050-0227	3	3	WASHER-FL MTLC NO. 6 .149-IN-ID	28480	3050-0227
MP39	2190-0018	5	18	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP40	2360-0197	2	3	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP41	0520-0166	3		SCREW-MACH 2-56 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP42	0590-0106	8	2	NUT-HEX-PLSTC LKG 2-56-THD .143-IN-THK	00000	ORDER BY DESCRIPTION
MP43	86701-20007	3	1	FRAME-REAR	28480	86701-20007
MP44	2360-0333	8		SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
MP45	08671-00057	0	1	DIVIDER CENTER	28480	08671-00057
MP46	86701-20005	1	1	GUIDE-P.C. BOARD (REAR)	28480	86701-20005
MP47	86701-20006	2	1	GUIDE-P.C. BOARD (FRONT)	28480	86701-20006
MP48	2190-0017	4	19	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
MP49	2580-0002	4	3	NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
MP50	86701-00002	6	1	CHASSIS CONT MODULE DIV	28480	86701-00002
MP51	5001-8232	5	1	GUSSET, SIDE	28480	5001-8232
MP52	86701-00063	9	1	STRUT LOWER RIGHT	28480	86701-00063
MP53-MP70				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-4)		
MP71	5040-6927	3	2	DIVIDER STRIP	28480	5040-6927
MP72	1460-0553	5	8	CLIP, WINDOW	28480	1460-0553
MP73	08671-20009	4	1	WINDOW, RF	28480	08671-20009
MP74	08672-00064	0	2	RFI SCREEN	28480	08672-00064
MP75	08640-40044	2	1	SCREW, METER ZERO	28480	08640-40044

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP76	1460-0553	5		CLIP, WINDOW	28480	1460-0553
MP77	1460-0553	5		CLIP, WINDOW	28480	1460-0553
MP78	08671-20010	7	1	WINDOW-CONTROLLER	28480	08671-20010
MP79	08672-00064	0		RFI SCREEN	28480	08672-00064
MP80	1460-0553	5		CLIP, WINDOW	28480	1460-0553
MP81	5040-6927	3		DIVIDER STRIP	28480	5040-6927
MP82	08731-210	2	1	NUT, KNURLED, RF OUTPUT	28480	08731-210
MP83	0370-2389	7	2	KNOB, RANGE	28480	0370-2389
MP84	0590-1011	6		INSULATOR	28480	0590-1011
MP85	0370-0584	0	1	KNOB, VERNIER	28480	0370-0584
MP86	08671-00012	7	1	PANEL-FRONT-RF	28480	08671-00012
MP87	08672-00002	6	1	PANEL-FRONT-CONTROLLER	28480	08672-00002
MP88	08672-40005	3	4	PUSHBUTTON	28480	08672-40005
MP89	0370-2389	7		KNOB, TUNING	28480	0370-2389
MP90	00310-48801	0	2	WASHER, SHOULDERED INSULATING	28480	00310-48801
MP91-MP100				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-5)		
MP101	1460-0553	5		STAMPING-BE-CU CLIP-WINDOW	28480	1460-0553
MP102	2200-0142	9	9	SCREW-MACH 4-40 .312-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP103	08672-20037	9	4	SUPPORT FRONT PANEL	28480	08672-20037
MP104	08672-00035	5	1	METER SPACE	28480	08672-00035
MP105	08672-00050	4	1	METER CLAMP	28480	08672-00050
MP106	2200-0105	4	31	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP107				NOT ASSIGNED		
MP108				NOT ASSIGNED		
MP109	08672-20057	3	1	HEAT SINK	28480	08672-20057
MP110	08672-20056	2	1	LED PAD	28480	08672-20056
MP111	2200-0143	0	11	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP112	2190-0019	6	44	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP113	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP114	08672-00037	7	1	SUB PANEL	28480	08672-00037
MP115	2200-0137	2	5	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP116	2190-0017	4		WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
MP117	2950-0030	3	2	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
MP118	2190-0016	3	2	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
MP119				NOT ASSIGNED		
MP120	1400-0017	0	2	CLMP-CA .312-DIA .375-WD NYL	28480	1400-0017
MP121	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP122	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP123	3050-0105	6	24	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
MP124	3130-0517	4	1	SHAFT & INDEX ASSEMBLY 1.250 STRUT CTR	28480	3130-0517
MP125	2190-0022	1	1	WASHER-LK INTL T 3/8 IN .384-IN-ID	28480	2190-0022
MP126	2950-0030	3		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
MP127	08672-00034	4	1	POT BRACKET	28480	08672-00034
MP128	2950-0072	3	1	NUT-HEX-DBL-CHAM 1/4-32-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
MP129	2190-0124	4	7	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
MP130	2190-0104	0	1	WASHER-LK INTL T 7/16 IN .439-IN-ID	28480	2190-0104
MP131	2950-0132	6	1	NUT-HEX-DBL-CHAM 7/16-28-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
MP132	08672-20083	5	2	PANEL BUSHING	28480	08672-20083
MP133	5020-0446	7	2	HEX NUT	28480	5020-0446
MP134	2190-0067	4	2	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0067
MP135	2200-0155	4	6	SCREW-MACH 4-40 1-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP136	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP137	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
MP138	08672-40006	4	1	LAMP HOUSING, LONG	28480	08672-40006
MP139	08672-40007	5	1	LAMP HOUSING, SHORT	28480	08672-40007
MP140	08672-40008	6	1	LIGHT BAR, LONG	28480	08672-40008
MP141	08672-40009	7	1	LIGHT BAR, SHORT	28480	08672-40009
MP142	08672-40010	0	1	LIGHT PLUG	28480	08672-40010
MP143-MP150				NOT ASSIGNED		

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				MISCELLANEOUS PARTS (SEE FIGURE 6-6)		
MP151	1460-0553	5		STAMPING-BE-CU CLIP-WINDOW	28480	1460-0553
MP152	2200-0142	9		SCREW-MACH 4-40 .312-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP153	08672-20037	9		SUPPORT, FRONT PANEL	28480	08672-20037
MP154	08672-40001	9	1	LAMP HOUSING	28480	08672-40001
MP155	08672-40002	0	1	LIGHT BAR	28480	08672-40002
MP156				NOT ASSIGNED		
MP157				NOT ASSIGNED		
MP158	08672-20032	4	1	LED HEATSINK	28480	08672-20032
MP159	2200-0142	9		SCREW-MACH 4-40 .312-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP160	08672-20037	9		SUPPORT, FRONT PANEL	28480	08672-20037
MP161	2200-0137	2		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP162	2190-0017	4		WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
MP163				NOT ASSIGNED		
MP164				NOT ASSIGNED		
MP165	2950-0001	8	2	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
MP166	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
MP167	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
MP168	08672-00001	5	1	SUB PANEL	28480	08672-00001
MP169	0510-1148	2	1	RETAINER-PUSH ON KB-TO-SHFT EXT	28480	0510-1148
MP170	2200-0143	0		SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP171	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP172	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
MP173-MP200				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-7)		
MP201	2360-0192	7	13	SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP202	4320-0002	6		MOLDING COMPOUND POLYC GRA	72799	LEXAN101-7081
MP203	2360-0113	2	3	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP204	08672-00028	6		SUPPORT, PC FRONT	28480	08672-00028
MP205	08672-00032	2		SHIELD, ALC BOARD	28480	08672-00032
MP206	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP207				NOT ASSIGNED		
MP208	08672-00029	7		SUPPORT, PC REAR	28480	08672-00029
MP209	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP210	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
MP211	2200-0103	2	22	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP212	08671-00011	6		RF TOP COVER	28480	08671-00011
MP213	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP214				NOT ASSIGNED		
MP215	08672-00026	4		SUPPORT, REAR	28480	08672-00026
MP216	08672-00042	4		SPACER, MICROCIRCUIT	28480	08672-00042
MP217	08671-00014	9		SPACER, MICROCIRCUIT	28480	08671-00014
MP218	2360-0201	9		SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP219	08672-00039	9		DECK, RF OUTPUT ASSEMBLY	28480	08672-00039
MP220	3050-0010	2	3	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
MP221	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP222	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP223	2360-0205	3		SCREW-MACH 6-32 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP224-MP230				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-8)		
MP231	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP232				NOT ASSIGNED		
MP233	2200-0149	6	2	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP234	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP235	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP236	3050-0066	8	2	WASHER-FL MTLC NO. 6 .147-IN-ID	73734	1451
MP237	1400-0017	0		CLMP-CA .312-DIA .375-WD NYL	28480	1400-0017
MP238	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP239	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
MP240	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP241	2200-0143	0		SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP242	2200-0142	9		SCREW-MACH 4-40 .312-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP243	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP244				NOT ASSIGNED		
MP245	08672-00048	0	1	TIE BAR	28480	08672-00048
MP246				NOT ASSIGNED		
MP247	08672-00038	8	1	GUSSET, HINGE PLATE	28480	08672-00038
MP248	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP249	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP250	1400-0755	3	2	CLIP-CMPNT .25-DIA .75-WD PVC	28480	1400-0755
MP251	08672-00031	1	1	BRACKET, ATTENUATOR	28480	08672-00031
MP252	1400-0755	3		CLIP-CMPNT .25-DIA .75-WD PVC	28480	1400-0755
MP253	0520-0127	6	1	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP254	2190-0890	1	1	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0890
MP255	08672-20113	2	1	SHIELD, ATTENUATOR	28480	08672-20113
MP256	08672-00061	7	1	ISOLATOR, BRACKET	28480	08672-00061
MP257	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
MP258	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP259	2200-0143	0		SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP260	08672-20112	1	1	ISOLATOR SHIELD	28480	08672-20112
MP261	1200-0081	4	1	INSULATOR-FLG-BSHG NYLON	28480	1200-0081
MP262	3050-0066	8		WASHER-FL MTLC NO. 6 .147-IN-ID	73734	1451
MP263	08672-00040	2	2	RIGHT GUSSET	28480	08672-00040
MP264				NOT ASSIGNED		
MP265				NOT ASSIGNED		
MP266	2420-0001	5		NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
MP267	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP268	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP269	0520-0163	0	1	SCREW-MACH 2-56 .188-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP270	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP271	2360-0190	5	2	SCREW-MACH 6-32 .188-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP272	2360-0334	9		SCREW-MACH 6-32 .312-IN-LG 100 DEG	28480	2360-0334
MP273	08672-00075	3	1	TIE BAR	28480	08672-00075
MP274-MP300				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-9)		
MP301	86701-00016	2	1	SUPPORT-CAPACITOR	28480	86701-00016
MP302	1400-0673	4	1	CLMP-CA 2-DIA .5-WD SST	28480	1400-0673
MP303	3050-0227	3		WASHER-FL MTLC NO. 6 .149-IN-ID	28480	3050-0227
MP304	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP305	2360-0107	4	1	SCREW-MACH 6-32 1.875-IN-LG PAN-HD-PHL	00000	ORDER BY DESCRIPTION
MP306	2190-0011	8	8	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
MP307	2680-0099	1	8	SCREW-MACH 10-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP308	0360-0268	6		TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	28480	0360-0268
MP309	86701-00004	8	1	SUPPORT-PC GUIDE	28480	86701-00004
MP310	2190-0017	4		WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
MP311	2510-0101	7	5	SCREW-MACH 8-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP312	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP313	2360-0196	1	6	SCREW-MACH 6-32 .375-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP314	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP315	2360-0196	1		SCREW-MACH 6-32 .375-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP316	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP317	2510-0196	0	2	SCREW-MACH 8-32 .5-IN-LG BDG-HD-SLT	00000	ORDER BY DESCRIPTION
MP318	2190-0017	4		WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
MP319	2510-0101	7		SCREW-MACH 8-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP320				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-10)		
MP321	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP322	2200-0155	4		SCREW-MACH 4-40 1-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP323	2200-0139	4	6	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP324	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP325	86701-00030	0	1	BAFFLE, AIR, BOTTOM	28480	86701-00030

See introduction to this section for ordering information
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†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP326	86701-00024	2	1	SCOOP, AIR	28480	86701-00024
MP327	8671-00029	3	1	BAFFLE, AIR, TOP	28480	8671-00029
MP328	0570-0632	3	1	SCREW-SPCL 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP329	85660-20090	2	4	STEP WASHER	28480	85660-20090
MP330	5021-3208	7	1	HOUSING-REF BLK	28480	5021-3208
MP331	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP332	86701-40001	9	1	EXTRACTOR, PC	28480	86701-40001
MP333-MP350				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-11)		
MP351	2360-0117	6	7	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP352	2360-0117	6		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP353	86701-00028	6	1	SPRING, FLAT	28480	86701-00028
MP354	2360-0117	6		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP355	0360-0260	8	1	TERMINAL-SLDR LUG PL-MTG FOR-#5-SCR	28480	0360-0260
MP356	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP357	2360-0117	6		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP358	2360-0117	6		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP359	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP360	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP361	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP362	08672-00020	8	1	PANEL, REAR, HP-IB	28480	08672-00020
MP363	08672-00013	9	1	PANEL, REAR, SUB	28480	08672-00013
MP364	08672-00018	4	1	PLATE, REAR GUIDE	28480	08672-00018
MP365-MP370				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-12)		
MP371	1200-0147	3	8	INSULATOR-FLG-BSHG NYLON	28480	1200-0147
MP372	1200-0043	8		INSULATOR-XSTR ALUMINUM	28480	1200-0043
MP373	2190-0102	8	4	WASHER-LK INTL T 15/32 IN .472-IN-ID	28480	2190-0102
MP374	2950-0035	8	1	NUT-HEX-DBL-CHAM 15/32-32-THD	00000	ORDER BY DESCRIPTION
MP375	6960-0121	8	1	HOLE PLUG DOME HD, FOR .625 D-HOLE BRS	28480	6960-0121
MP376	6960-0111	6	1	PLUG-HOLE DOME-HD FOR .531-D-HOLE BRS	28480	6960-0111
MP377	86701-00087	7	1	PANEL-REAR	28480	86701-00087
MP378	2200-0111	2	9	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP379	2200-0115	6	9	SCREW-MACH 4-40 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP380	86701-20004	0	1	HEAT SINK	28480	86701-20004
MP381-MP400				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-13)		
MP401	1520-0065	2	4	SHOCK MOUNT .5-EFF-HGT 6-LB-LOAD-CAP	28480	1520-0065
MP402	86701-00017	3	1	DISK- FAN SHIELD	28480	86701-00017
MP403	3050-0139	6	1	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0139
MP404	2190-0010	7	2	WASHER-LK EXT T NO. 8 .168-IN-ID	28480	2190-0010
MP405	86701-00044	6	2	SNUBBER	28480	86701-00044
MP406	1400-0249	0	9	CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
MP407	2190-0017	4		WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
MP408	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
MP409	2360-0219	9	2	SCREW-MACH 6-32 1.375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP410	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP411	86701-00007	1	1	GUARD FAN	28480	86701-00007
MP412	08671-00013	8	1	COVER GUARD	28480	08671-00013
MP413	3030-0152	1	3	SCREW-SET 4-40 .312-IN-LG SMALL CUP-PT	28480	3030-0152
MP414	86701-20002	8	1	COWLING FAN	28480	86701-20002
MP415-MP430				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				MISCELLANEOUS PARTS (SEE FIGURE 6-14)		
MP431	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP432	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP433	08672-00004	8	1	GUSSET, RIGHT DCU	28480	08672-00004
MP434	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP435	08672-60003	3	1	GUSSET, CENTER DCU	28480	08672-60003
MP436- MP450				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-15)		
MP451	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP452- MP454				NOT ASSIGNED		
MP455	85660-00054	6	1	CLAMP BATTERY	28480	85660-00054
MP456				NOT ASSIGNED		
MP457				NOT ASSIGNED		
MP458	0624-0097	9	1	SCREW-TPG 4-40 .188-IN-LG PAN-HD-POZI	28480	0624-0097
MP459	08672-60029	3	1	BATTERY HOLDER ASSEMBLY	28480	08672-60029
MP460	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP461	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP462	2510-0121	1	3	SCREW-MACH 8-32 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP463- MP465				NOT ASSIGNED		
MP466	08672-20146	1	1	MOUNTING BLOCK	28480	08672-20146
MP467	0624-0268	6	2	SCREW-TPG 4-24 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP468	08672-00005	9	1	LEFT GUSSET	28480	08672-00005
MP469				NOT ASSIGNED		
MP470				NOT ASSIGNED		
MP471	0624-0268	6		SCREW-TPG 4-24 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP472	08672-20120	1	1	STEP WASHER	28480	08672-20120
MP473	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP474	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP475	3050-0010	2		WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
MP476				NOT ASSIGNED		
MP477	08672-20142	7	1	AMPLIFIER HOUSING	28480	08672-20142
MP478				NOT ASSIGNED		
MP479	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP480	2510-0121	1		SCREW-MACH 8-32 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
~~MP481~~	~~2190-0019~~	~~6~~		~~WASHER-LK HLCL NO. 4 .115-IN-ID~~	~~28480~~	~~2190-0019~~
MP482	2200-0137	2		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP483	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP484	2360-0192	7		SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP485	2360-0334	9		SCREW-MACH 6-32 .312-IN-LG 100 DEG	28480	2360-0334
MP486	08672-00015	1	1	SUPPORT-FRONT DCU	28480	08672-00015
MP487	08672-00006	0	1	TIE BAR	28480	08672-00006
MP488	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP489- MP500				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 6-16)		
MP501	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP502	86701-00011	7	1	COVER-PHASE LOCK	28480	86701-00011
MP503	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP504	86701-20009	5	1	HOUSING-CASTING	28480	86701-20009
MP505	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP506	86701-00054	8	1	SPACER-SAMPLER	28480	86701-00054
MP507	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
MP508	2200-0138	3	1	SCREW-MACH 4-40 .188-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP509	2200-0111	2		SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP510	86701-00010	6	1	COVER-SAMPLER	28480	86701-00010
MP511	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
MP512	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP513	0520-0247	1	2	SCREW-MACH 2-56 .625-IN-LG PAN-HD-POZI	28480	0520-0247
MP514	2360-0117	6		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP515	2360-0117	6		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
***Indicates factory selected value**
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP516	2360-0197	2		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP517	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP518	3050-0010	2		WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
MP519	1400-0024	9	1	CLMP-CA .25-DIA .5-WD NYL	28480	1400-0024
MP520	86701-00058	2	1	DECK-YTO PHASE LOCK	28480	86701-00058
MP521- MP660				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 8-131)		
MP661	1400-0082	9	2	CLMP-CA .125-DIA .375-WD NYL	28480	1400-0082
MP662	2190-0891	2	2	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	2190-0891
MP663	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP664	2200-0141	8	2	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP665	2360-0333	8		SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
MP666	08672-00012	8	1	COVER, CONTROLLER	28480	08672-00012
MP667- MP680				NOT ASSIGNED		
				MISCELLANEOUS PARTS (SEE FIGURE 8-133)		
MP681	2200-0151	0	2	SCREW-MACH 4-40 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP682	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP683	0570-0034	9	5	SCREW-MACH 4-40 .25-IN-LG RD-HD-SLT	00000	ORDER BY DESCRIPTION
MP684	1400-0618	7	1	CABLE CLAMP-HFCL .125-DIA .5-WD	28480	1400-0618
MP685	3050-0227	3		WASHER-FL MTLC NO. 6 .149-IN-ID	28480	3050-0227
MP686	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP687	2360-0197	2		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

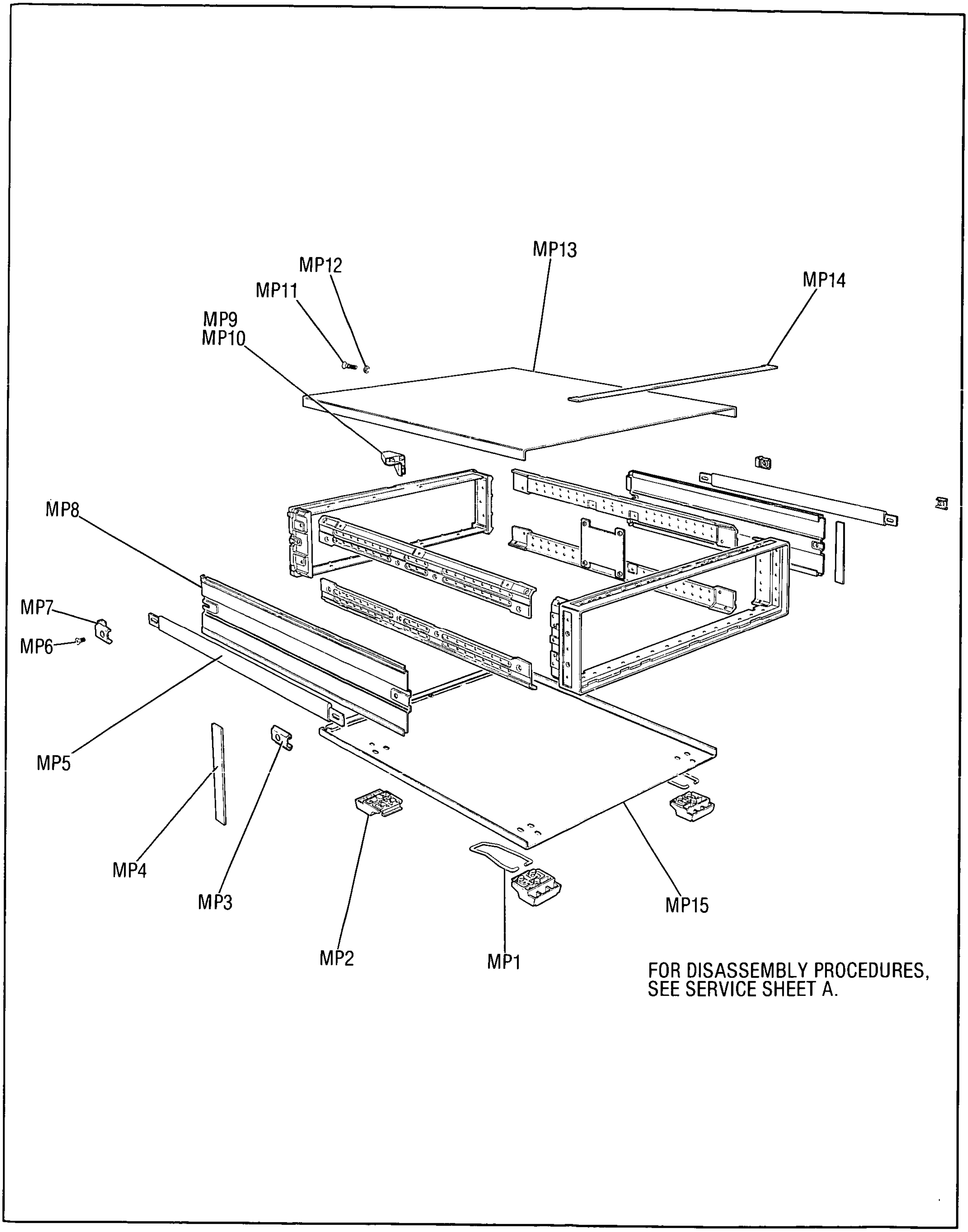


Figure 6-1. Cabinet Illustrated Parts Breakdown

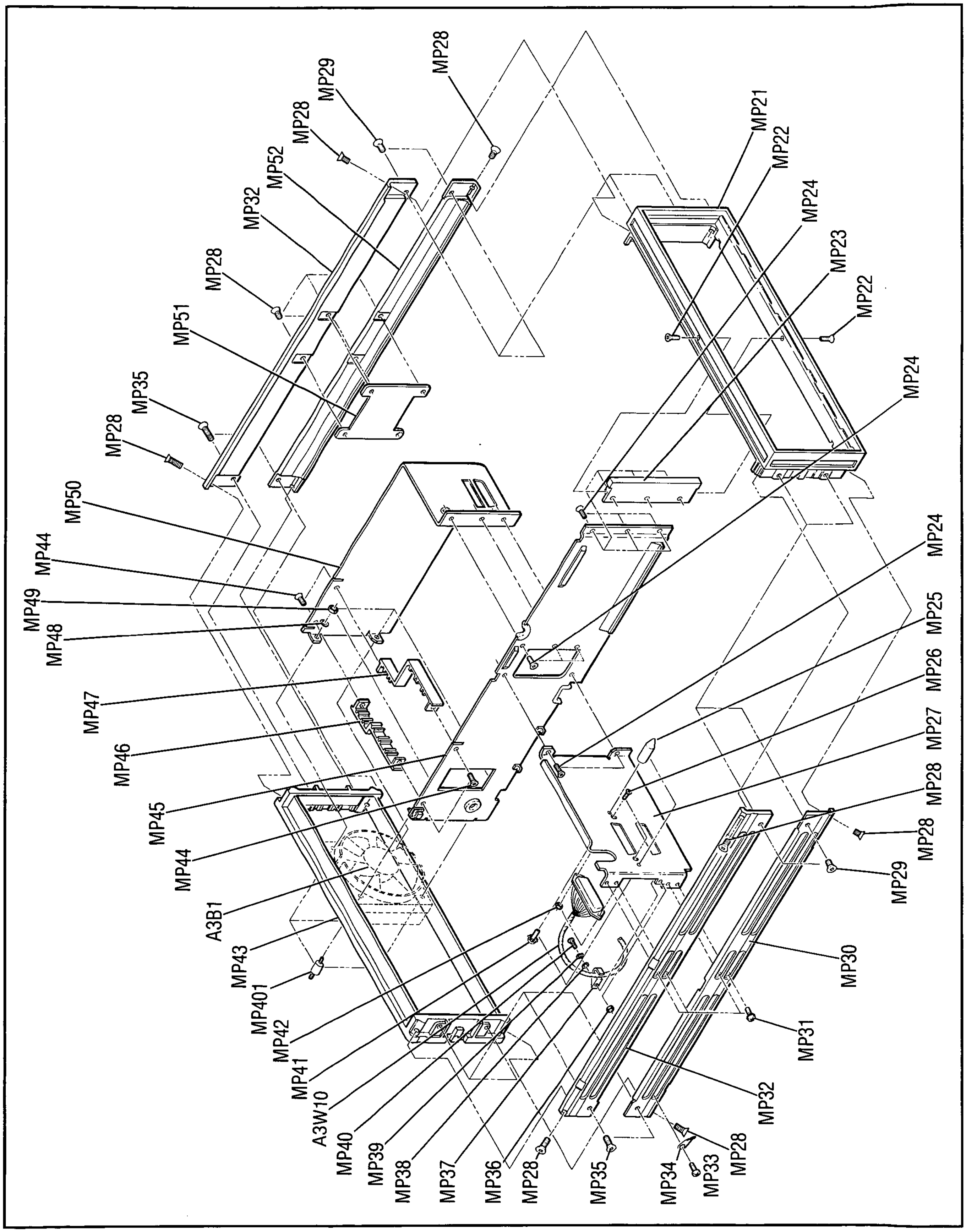


Figure 6-2. Cabinet and Frame Illustrated Parts Breakdown

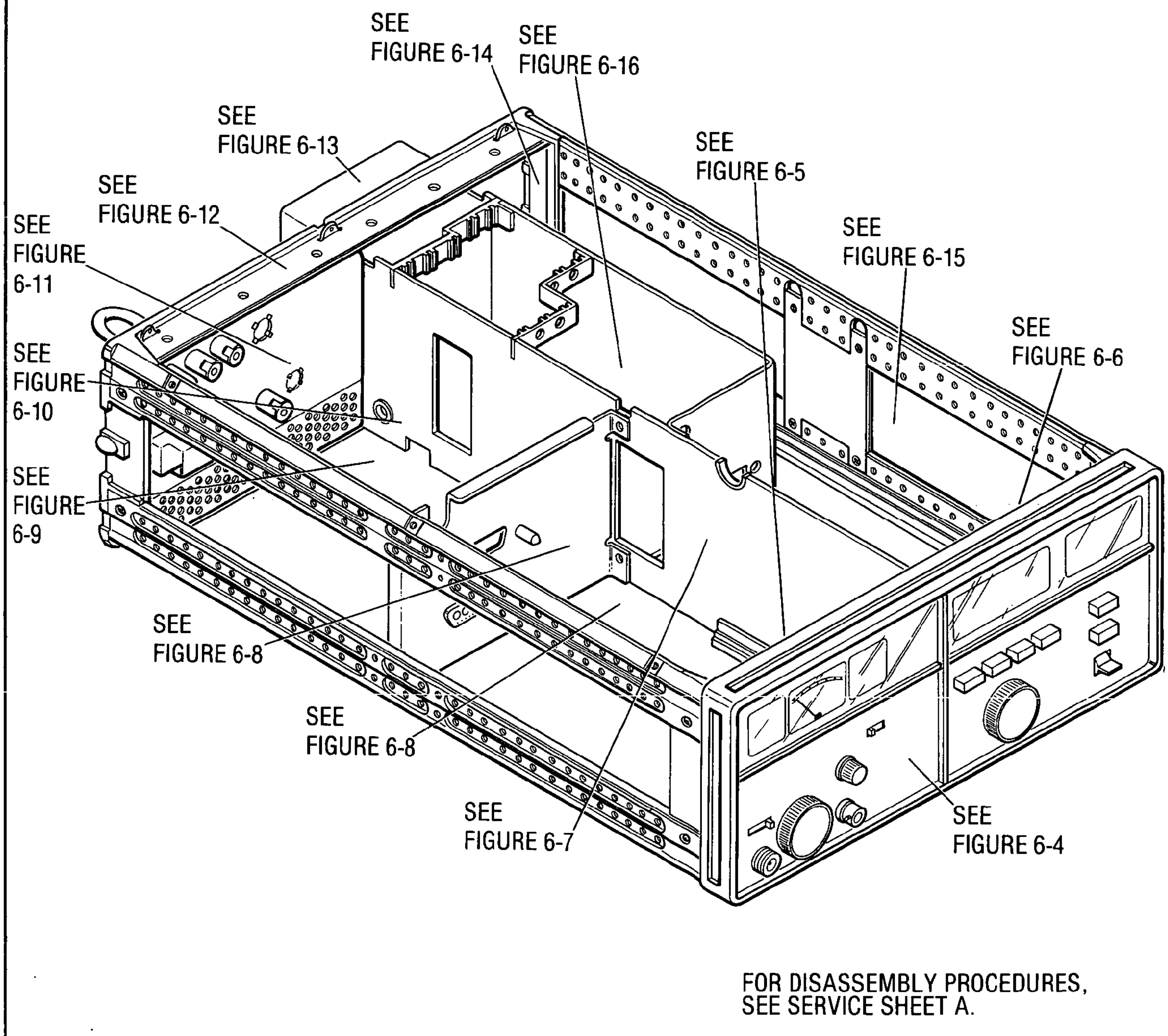


Figure 6-3. Overall Illustrated Parts Breakdown

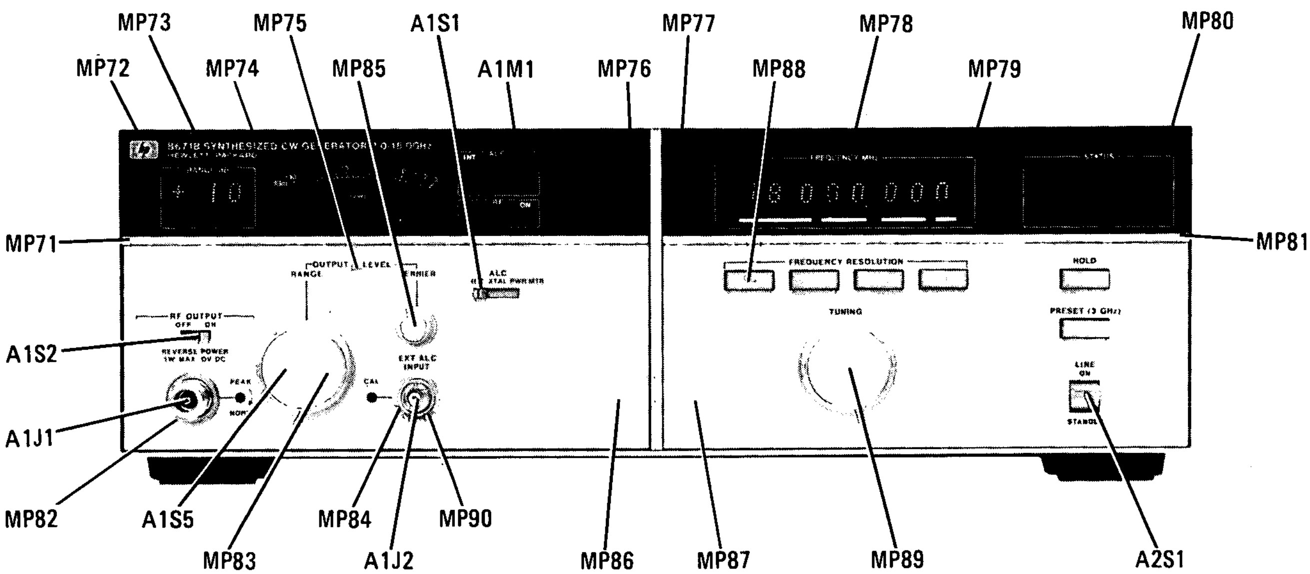


Figure 6-4. Front Panel Photo, Front View

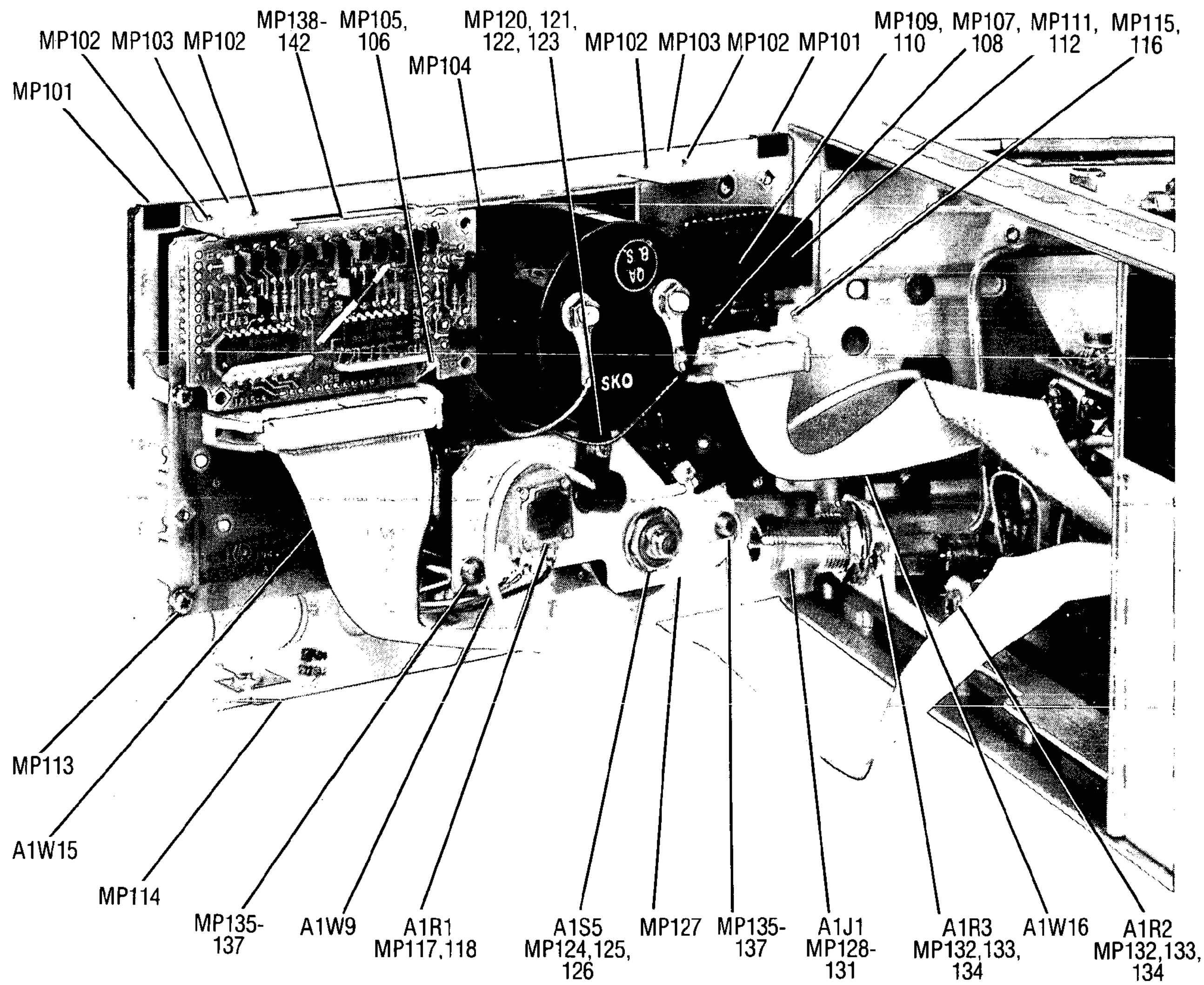


Figure 6-5. RF Front Panel, Inside View (Left Side)

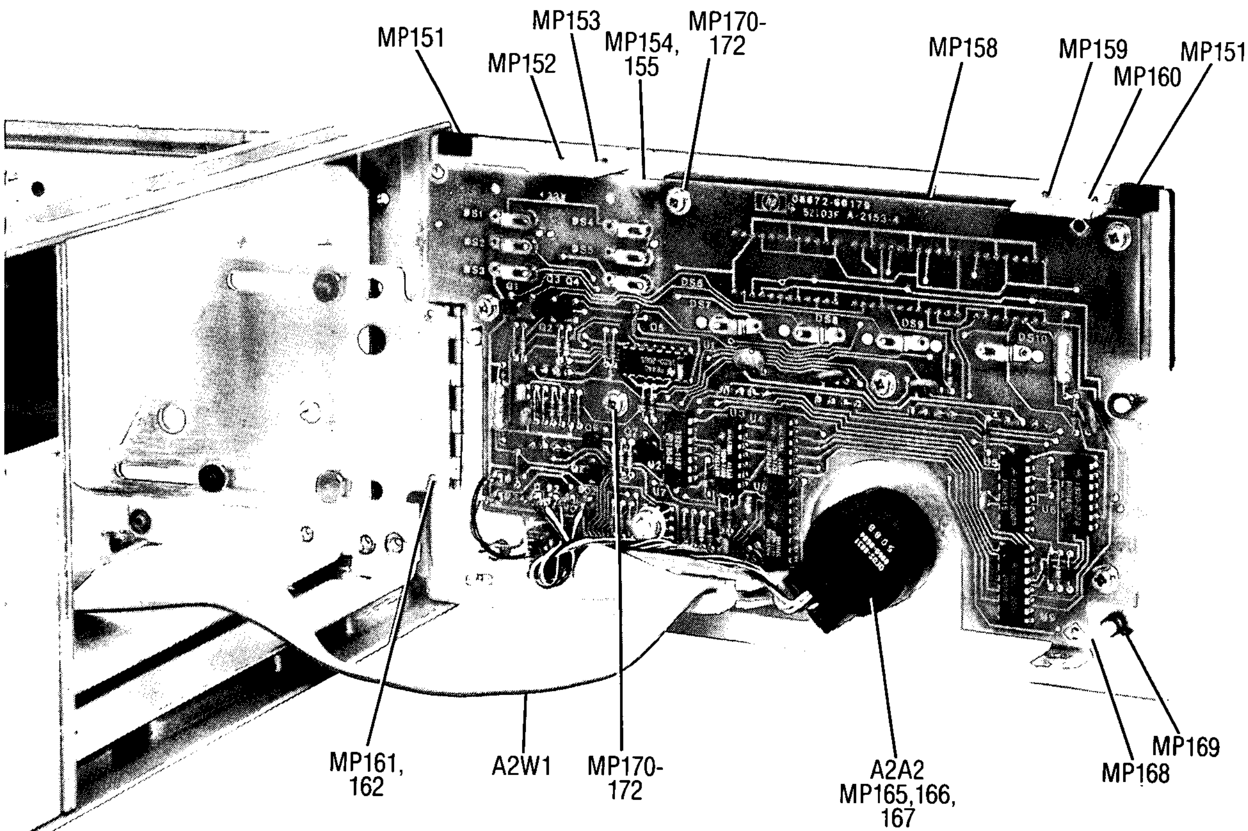


Figure 6-6. DCU Front Panel, Inside View (Right Side)

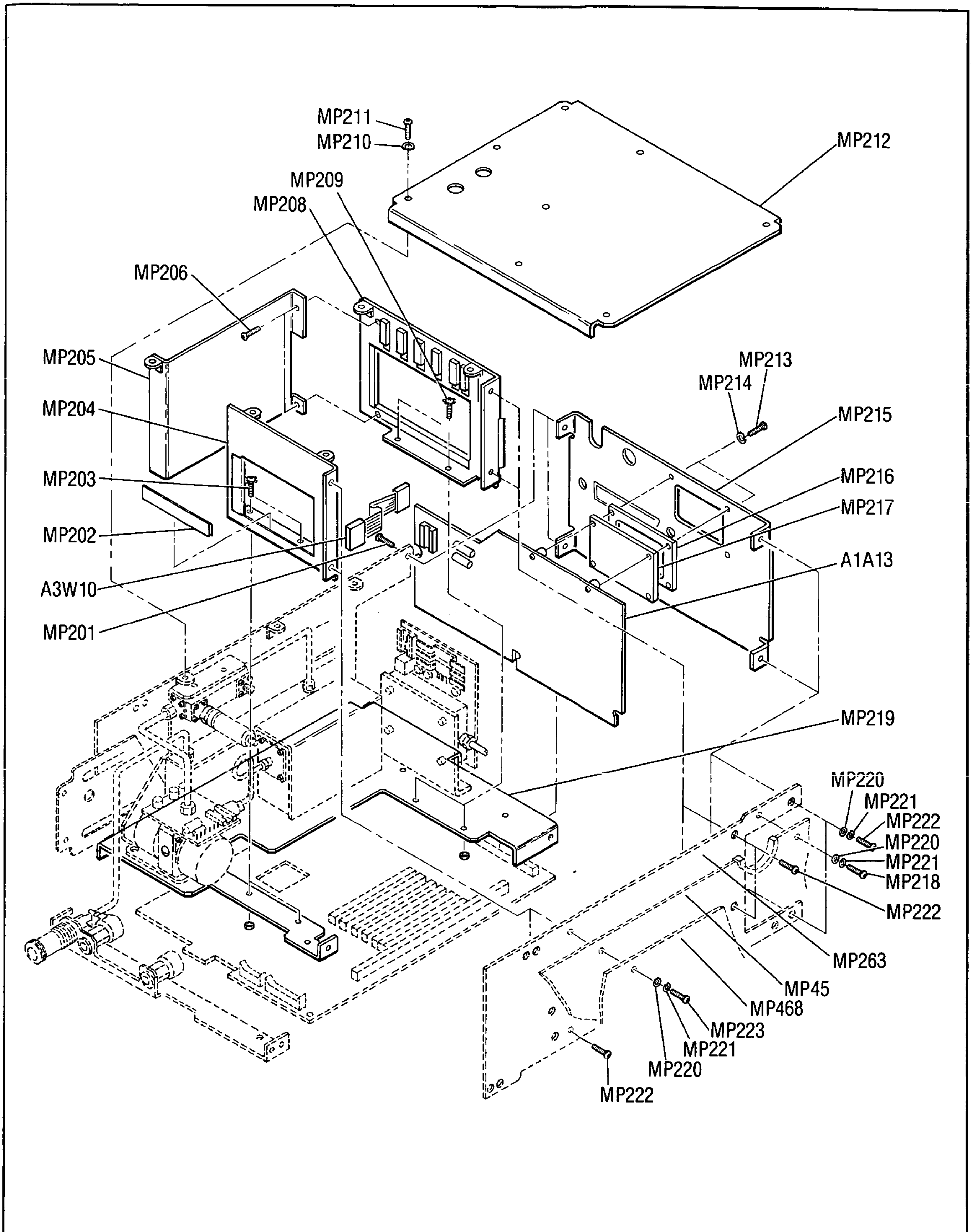


Figure 6-7. A1 Card Cage Illustrated Parts Breakdown

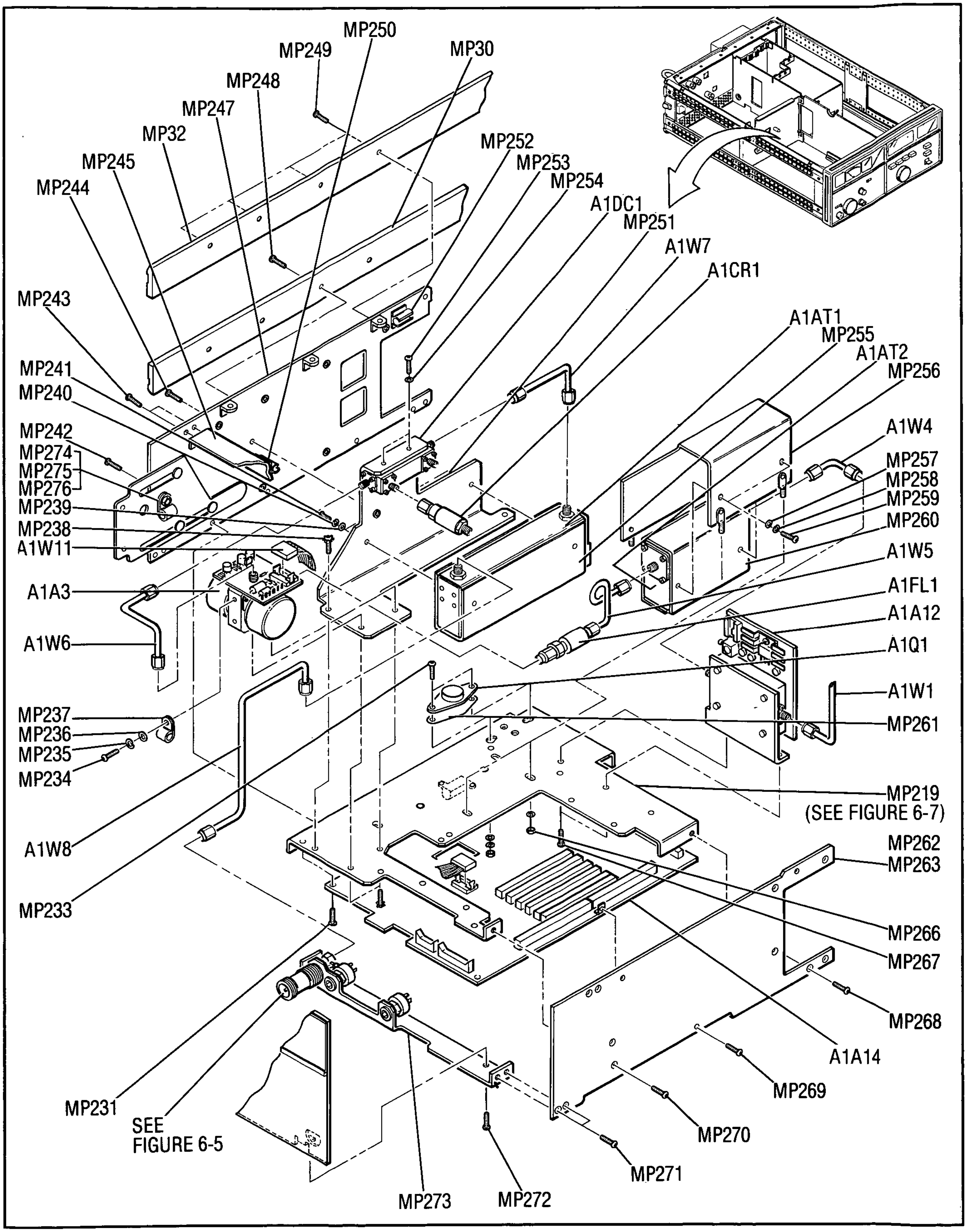


Figure 6-8. A1 Microwave Circuits Illustrated Parts Breakdown

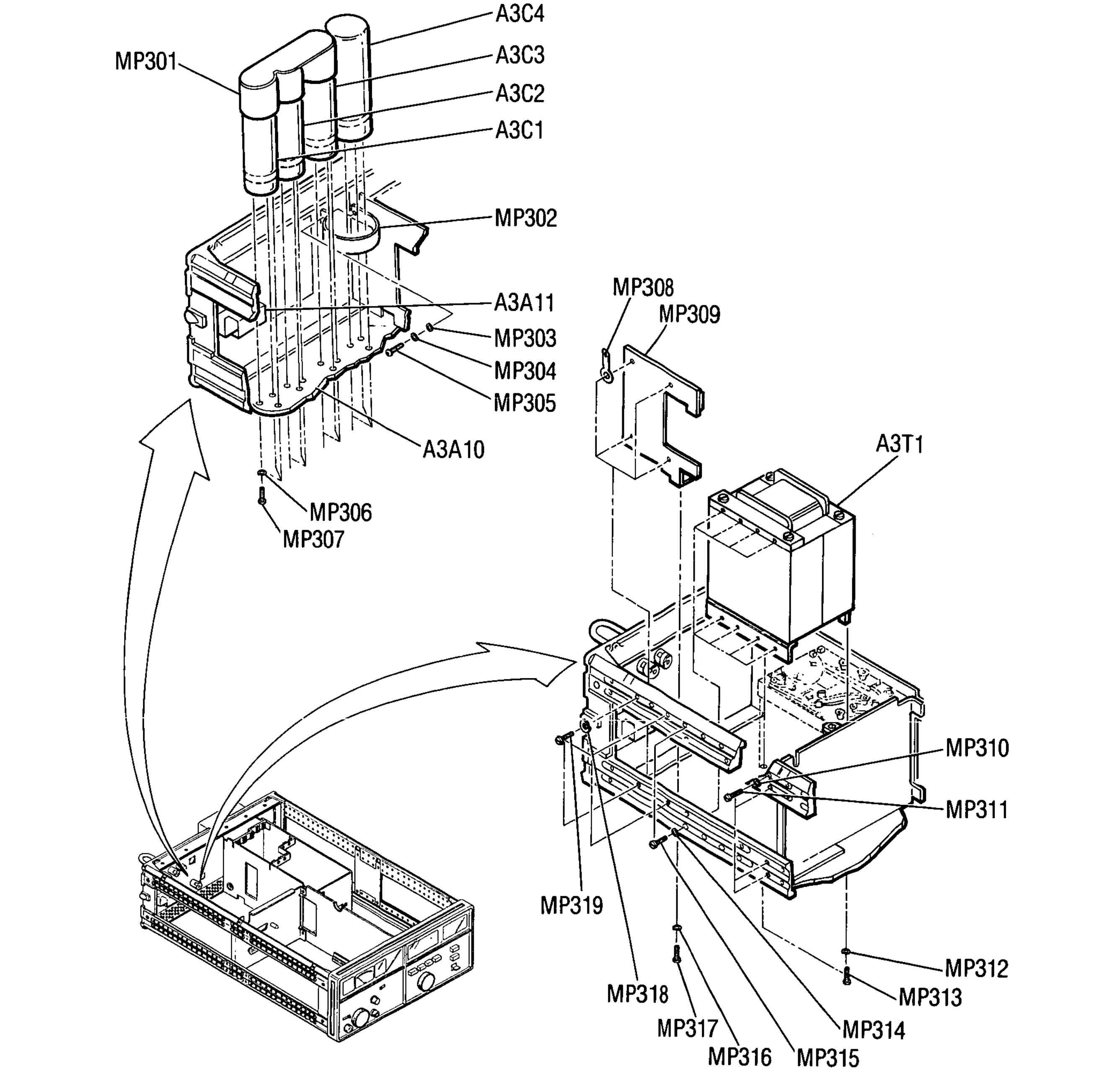


Figure 6-9. A3 Power Supply and RF Source Illustrated Parts Breakdown

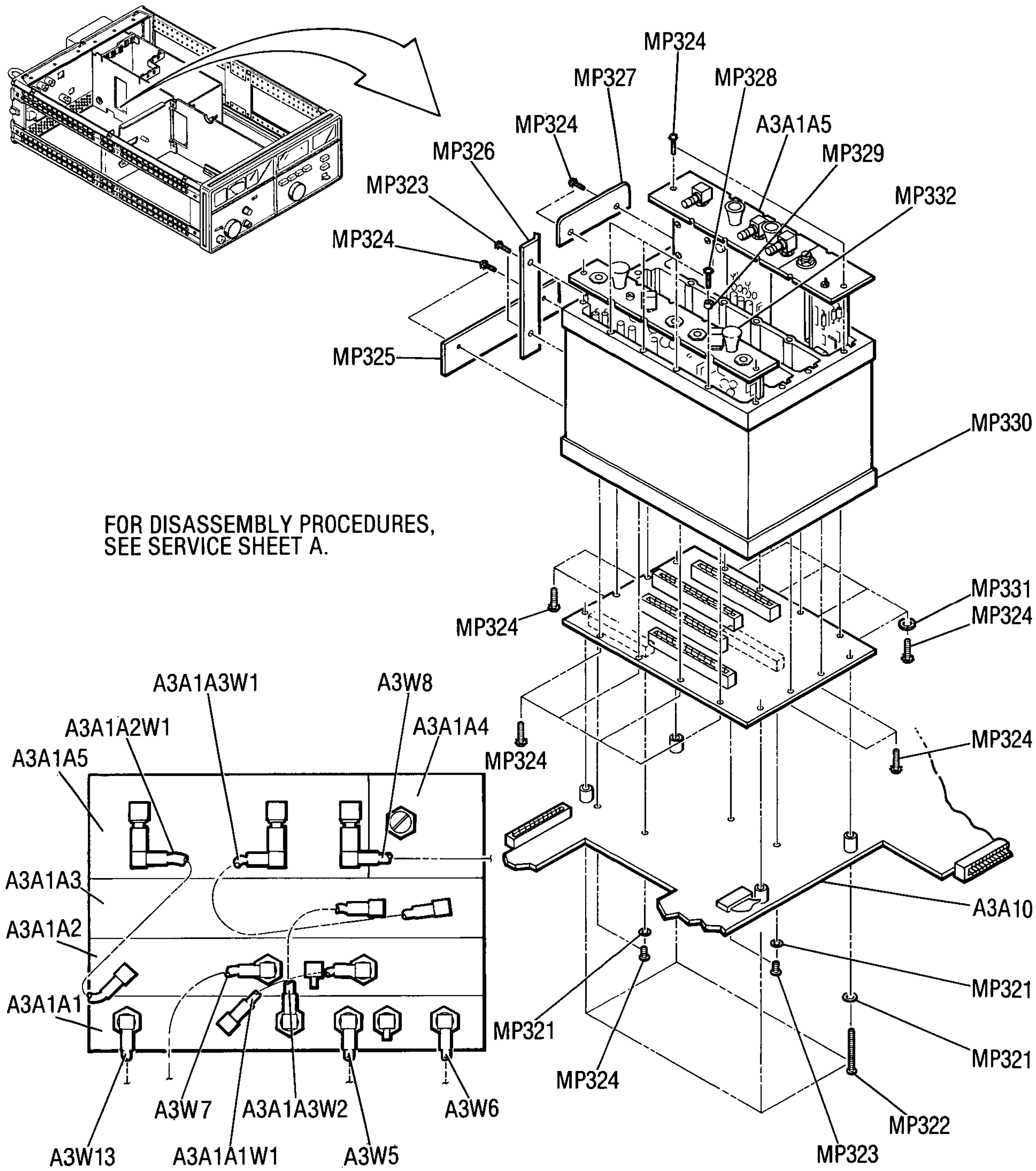


Figure 6-10. A3 RF Source Illustrated Parts Breakdown

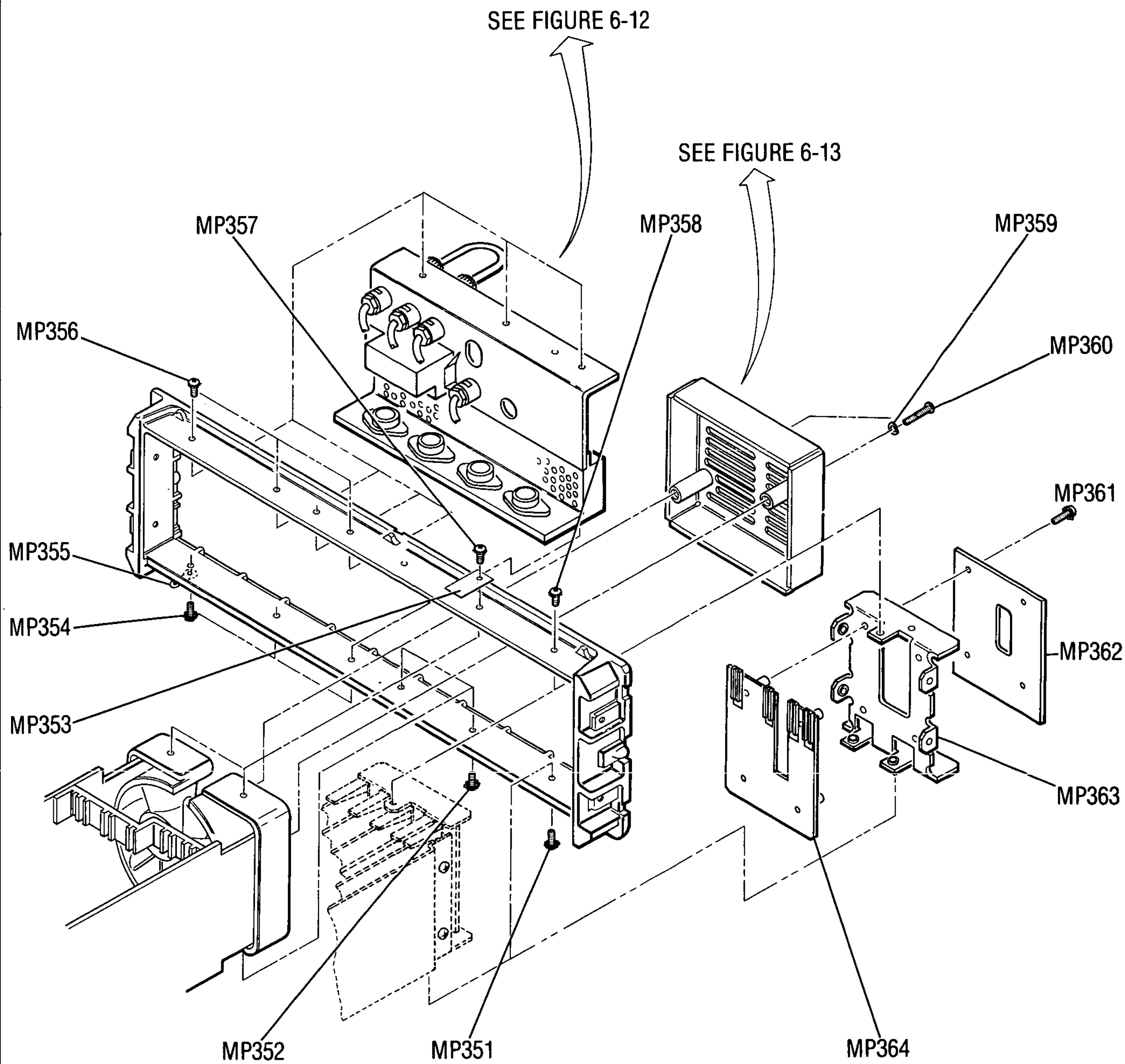


Figure 6-11. A3 Rear Panel Illustrated Parts Breakdown

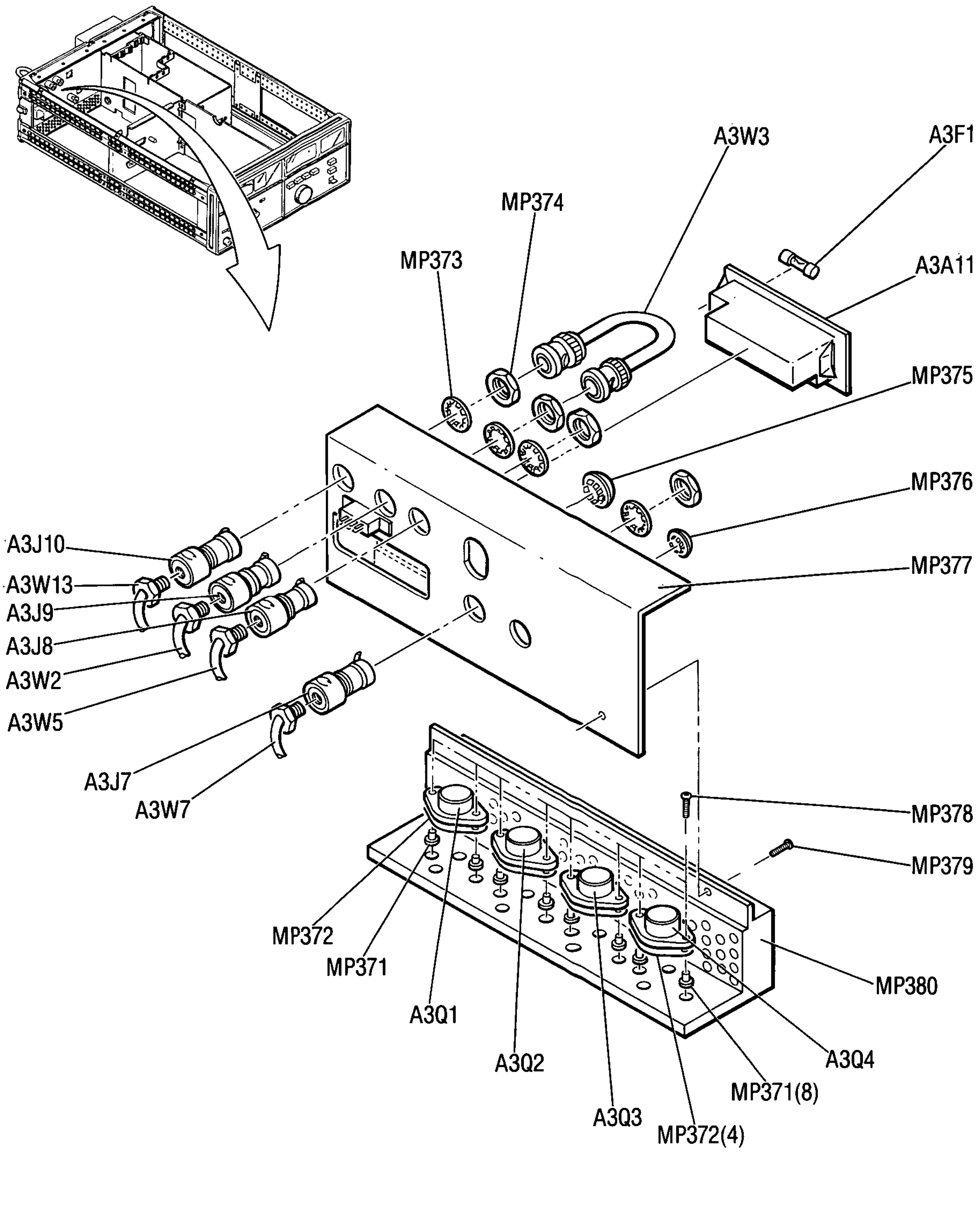


Figure 6-12. A3 Power Supply and Rear Panel Illustrated Parts Breakdown

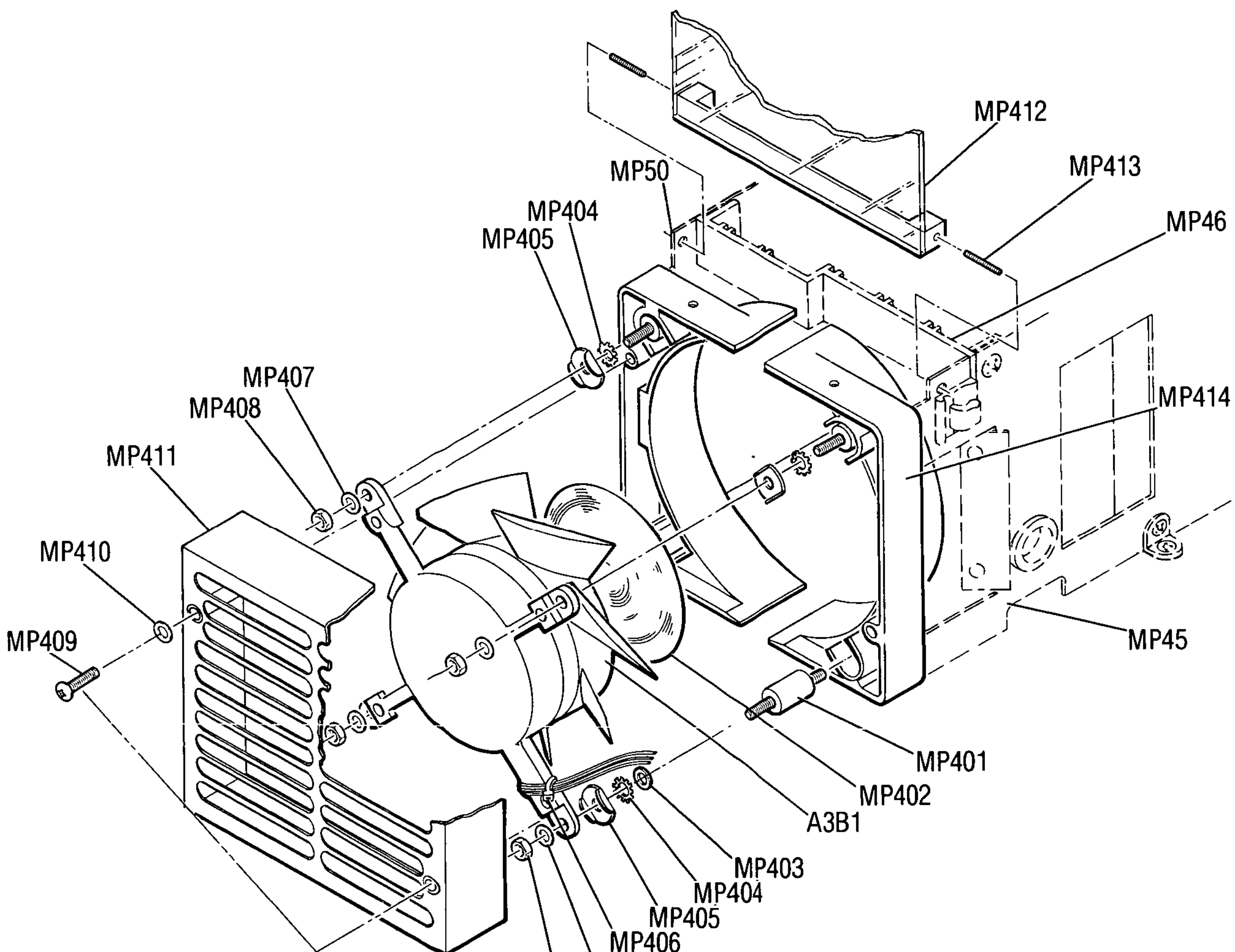


Figure 6-13. A3 Fan Assembly Illustrated Parts Breakdown

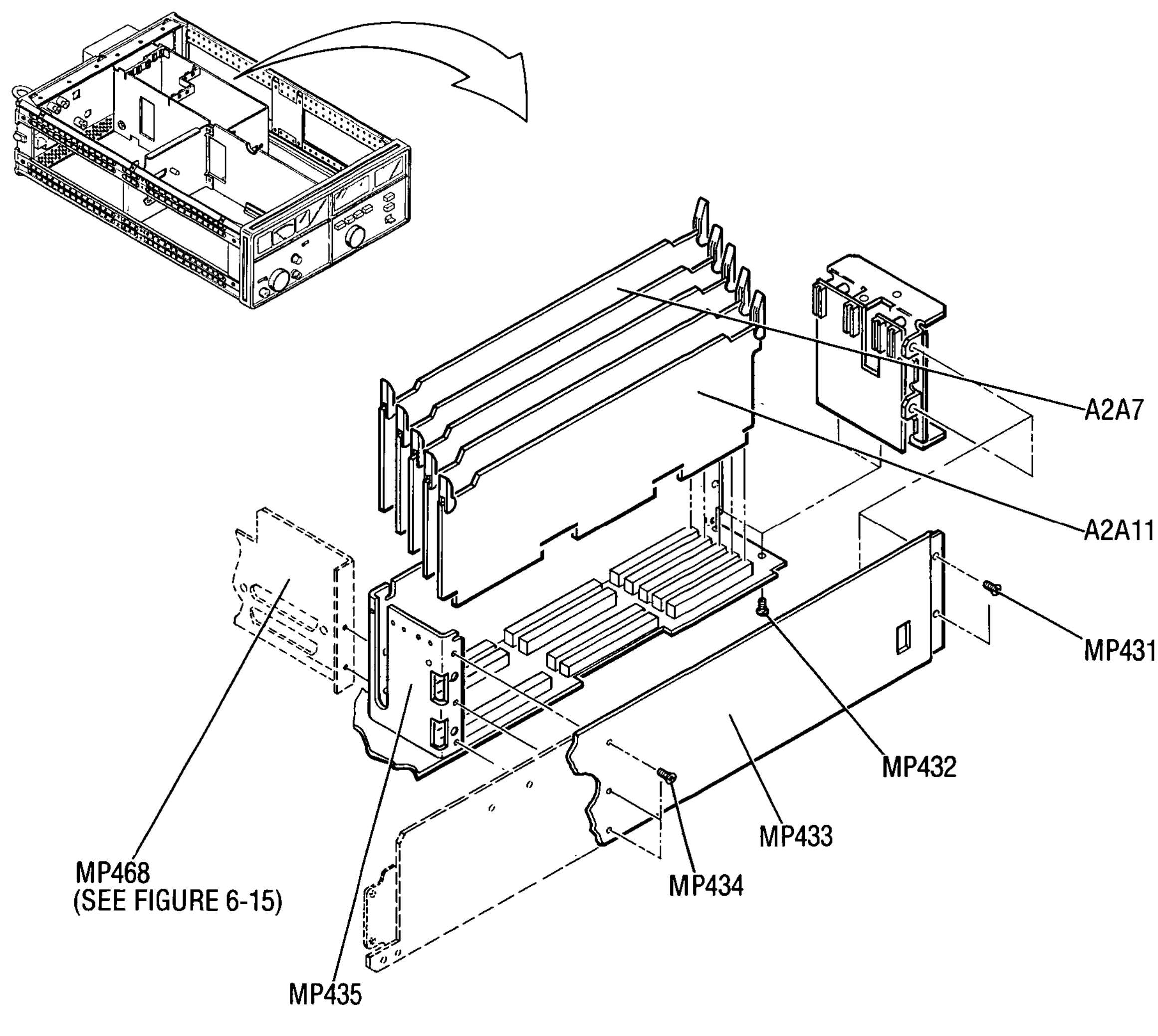


Figure 6-14. P/O A2 Controller Assembly and Rear Panel Illustrated Parts Breakdown

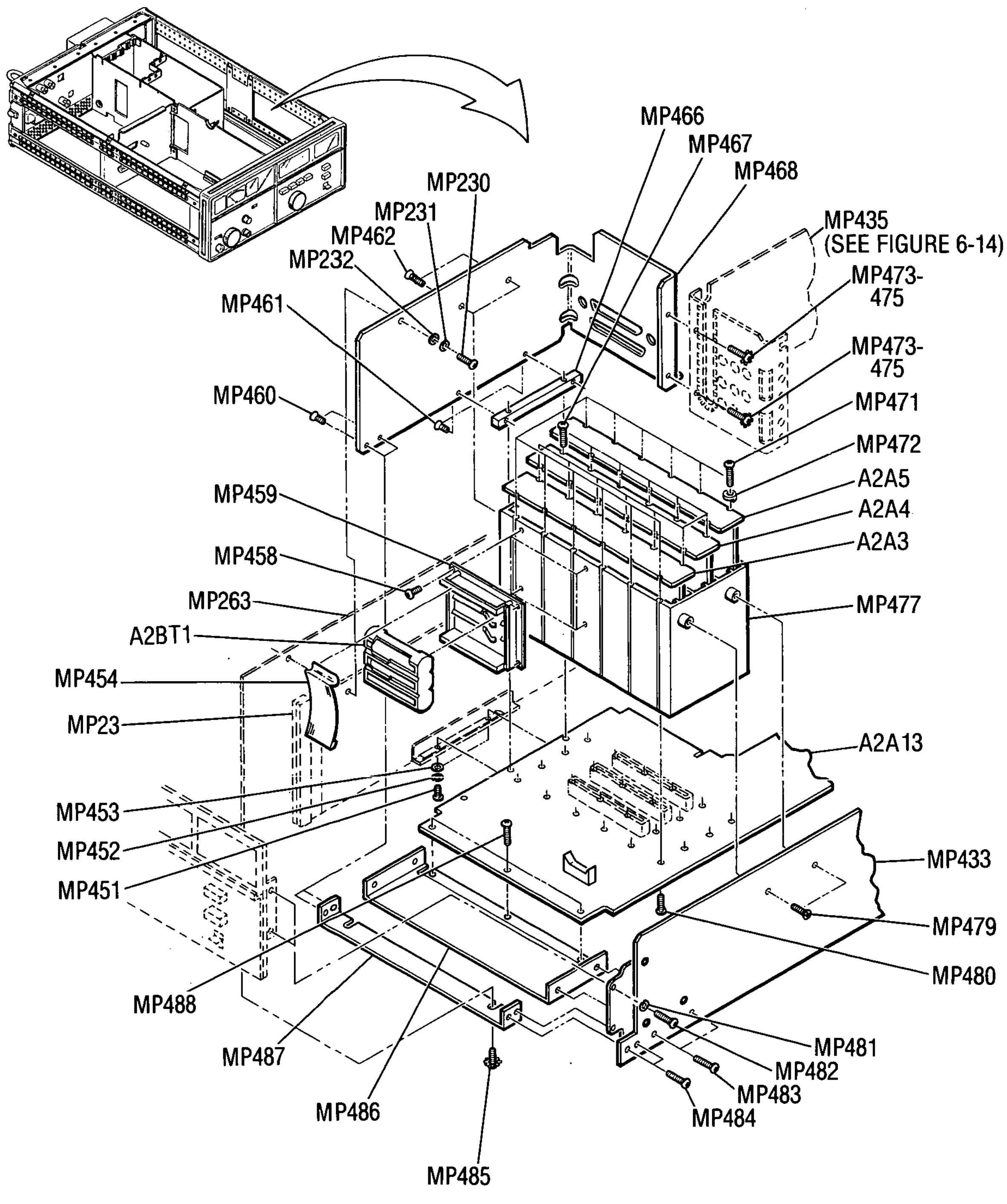


Figure 6-15. P/O A2 Controller Assembly Illustrated Parts Breakdown

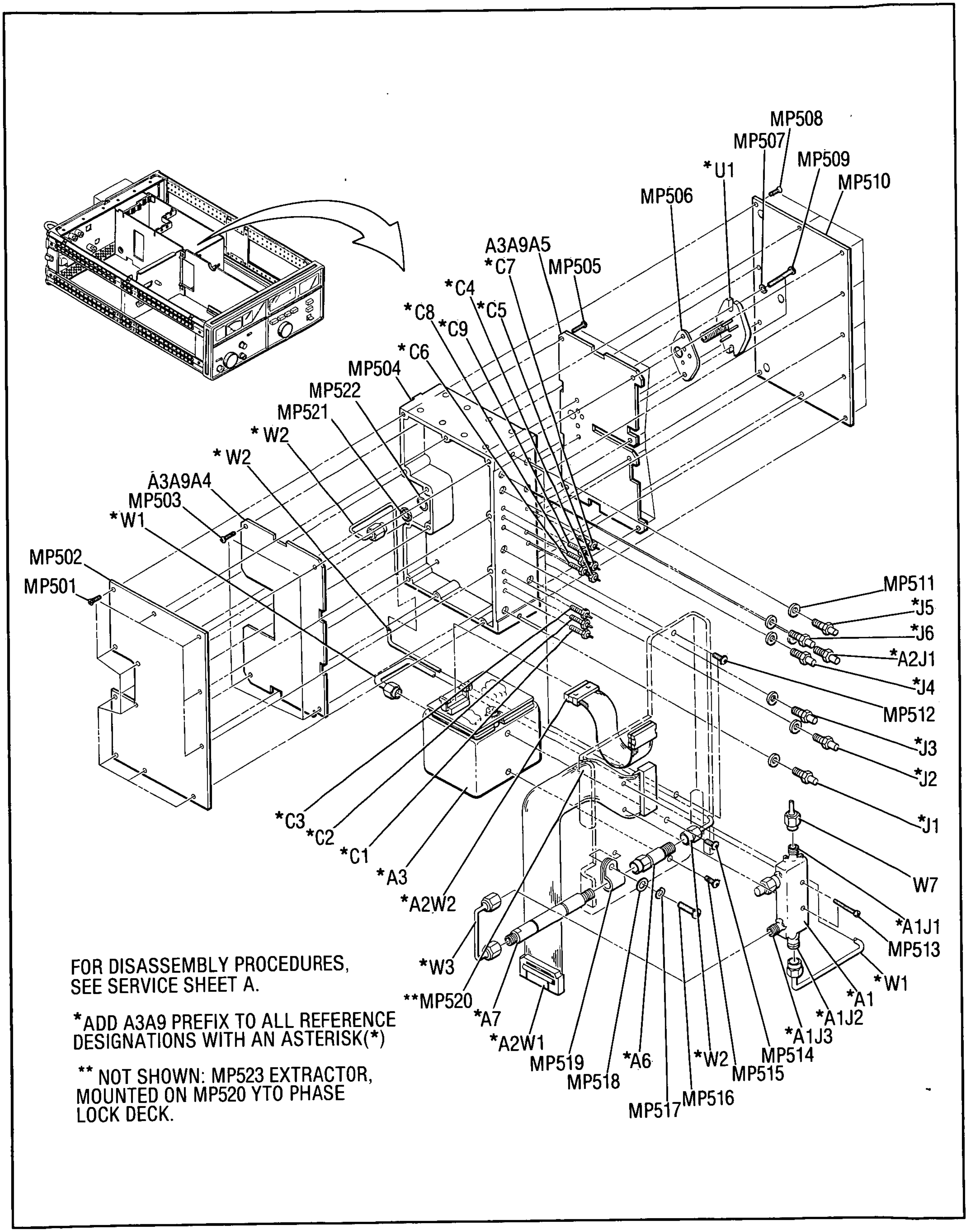


Figure 6-16. A3A9 YTO and Reference Oscillator Illustrated Parts Breakdown

Table 6-4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
S0545	NEC ELECTRONICS LTD	MTN VIEW CA US	94043
00000	ANY SATISFACTORY SUPPLIER		
00115	ACE GLASS INC	VINELAND NJ	08360
01121	ALLEN-BRADLEY CO INC	EL PASO TX US	79935
01295	TEXAS INSTRUMENTS INC	DALLAS TX US	75265
03508	GE CO SEMICONDUCTOR PROD DEPT	AUBURN NY US	13201
03888	K D I PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA INC SEMI-COND PROD	PHOENIX AZ US	85008
05820	EG & G WAKEFIELD ENGR INC	WAKEFIELD MA US	01880
06665	PRECISION MONOLITHICS INC.	SANTA CLARA CA	95050
07088	KELVIN ELECTRIC CO	VAN NUYS CA	91401
07263	FAIRCHILD CORP	MOUNTAIN VIEW CA US	94042
07707	EMHART POP FASTENER DIV	SHELTON CT US	06484
1F556	PRECISION LAMP INC	COTATI CA	94040
11236	CTS CORP BERNE DIV	BERNE IN US	46711
14140	EDISON ELEK DIV MCGRAW-EDISON	MANCHESTER NH	03130
17856	SILICONIX INC	SANTA CLARA CA	95054
18324	SIGNETICS CORP	SUNNYVALE CA US	94086
19701	MEPCO/ELECTRA INC	MINERAL WELLS TX US	76067
2M627	ROHM CORP	IRVINE CA US	92716
20932	EMCON DIV ITW	SAN DIEGO CA	92129
20940	MICRO-OHM CORP	EL MONTE CA US	91731
24546	CORNING ELECTRONICS	SANTA CLARA CA US	95050
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA US	95052
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
3L585	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	
3L680	BEMAN MFG INC	ETTERS PA	17319
32997	BOURNS INC	RIVERSIDE CA US	92507
52648	PLESSEY SEMICONDUCTORS	SANTA ANA CA	92705
54294	SHALLCROSS INC	SELMA NC	27576
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
72136	ELECTRO MOTIVE CORP	FLORENCE SC	06226
72799	GE CO PLASTICS GROUP	PITTSFIELD MA US	01201
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE PA	16512
73138	BECKMAN INDUSTRIAL CORP	FULLERTON CA US	92632
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
73899	J F D ELECTRONICS CORP	BROOKLYN NY	11219
74970	EF JOHNSON CO	WASECA MN US	56093
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA PA	19108
75915	LITTELFUSE INC	DES PLAINES IL US	60016
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN IL	60126
9D949	ALLIED AMPHENOL PRODUCTS	LISLE IL US	60532
9N171	UNITRODE CORP	LEXINGTON MA US	02173
91637	DALE ELECTRONICS INC	EL PASO TX US	79936
98291	SEALECTRO CORP	MAMARONECK NY	10544

VII Manual Changes

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

This section normally contains information for adapting the manual to older instruments, and for making modifications to improve instrument performance.

If your instrument's serial number or prefix is not listed on the title page of this manual or in Table 7-1, it may be documented in a separate MANUAL CHANGES supplement. For more information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in Section I.

If your instrument has a serial number with prefix 2545A, and the last three digits 101 through 107 or 109, A3A7R12 was originally 100 ohms. However, the part already listed in Table 6-3 is the preferred replacement. Therefore, no change to the table is recommended.

7-2. INSTRUMENT IMPROVEMENT MODIFICATIONS

The instruments listed in the paragraph above may exhibit spurious oscillations at or near 3 GHz. These oscillations can be eliminated by changing this resistor to 1000 ohms, HP part number 0698-7236.

VIII Service Introduction

SECTION VIII
SERVICE

8-1. INTRODUCTION

This section contains information for troubleshooting and repairing the CW Generator. Included are block diagrams, schematic diagrams, principles of operation, and procedures for troubleshooting, repair, disassembly, and reassembly.

8-2. FAILURE MODES AND SERVICE STRATEGY

8-3. General

Instrument problems usually fall into four general categories: turn-on errors, operator errors, instrument performance out of specification and catastrophic failures. The troubleshooting strategy is different for each category.

8-4. Turn-on Errors

If the FREQUENCY MHz display indicates an out-of-range frequency or an unstable display when the CW Generator is first turned on, press the PRESET (3 GHz) key. The display should change to 3000.000 MHz and remain stable. If the frequency doesn't change to 3000.000 MHz, go to Service Sheet BD1 to begin troubleshooting. If the instrument did not operate properly at first, but presets to 3 GHz, turn the instrument off and wait for five minutes before turning the instrument back on. The FREQUENCY MHz display should still indicate 3000.000 MHz. If the frequency display is incorrect, go to Service Sheet BD1 to begin troubleshooting.

8-5. Operator Errors

Apparent failures can result from operator errors and may take one of two forms: invalid front panel settings and HP-IB errors. Invalid front panel settings for performance outside of specifications may cause the LVL UNCAL annunciator to light. The annunciator may light in INT ALC mode when the instrument is set for an output level of more than +8 dBm. Using external ALC modes with no input at the external ALC input will also light the LVL UNCAL annunciator.

Invalid HP-IB program codes can cause the instrument to malfunction. Setting the line switch to off and then on will clear the problem and return the instrument to local operation. The instrument may also be cleared remotely and then reprogrammed with the correct codes. The instrument will accept out-of-range frequencies when remotely programmed. The front panel and status byte will indicate that the frequency is out of range and the NOT PHASE LOCKED annunciator may light. Preset the instrument or reprogram a frequency within the specified frequency range.

8-6. Instrument Performance Out of Specification

Two levels of testing can be performed to verify that the instrument is operating normally and within specification. The first level of testing is the Abbreviated Performance Tests in Section IV. These tests involve the least amount of time and can reveal much about overall operation. For a complete test, perform the full Performance Tests The specifications are listed in Table 1-1.

If a parameter is only slightly out of limits, it can often be brought into specification by an adjustment. The procedures for all adjustments are in Section V. A cross-reference table for performance tests and adjustment procedures is also included. If the adjustment fails to bring the parameter into specification, use the troubleshooting procedures starting on Service Sheet BD1.

8-7. Catastrophic Failures

When a catastrophic failure occurs, begin troubleshooting on Service Sheet BD1. The information there is used to quickly isolate the problem to one of the major functional sections of the instrument. Troubleshooting catastrophic failures in the CW Generator is structured into three levels:

a. The overall troubleshooting level, where problems are isolated to the power supply or one of the functional sections. This level of troubleshooting is supported by Service Sheet BD1, which includes diagrams, theory of operation, and troubleshooting information.

b. The functional level of troubleshooting isolates the malfunction to a circuit or circuit board.

Catastrophic Failures (cont'd)

This level of troubleshooting is supported by Service Sheets BD2 through BD10, which include diagrams, theory of operation, and troubleshooting information.

c. Circuit level troubleshooting isolates the problem to a stage within the circuits shown on the schematic. This level of troubleshooting is supported by Service Sheets 1-35, which include circuit level block diagrams, schematics, theory of operation, and troubleshooting information. It is expected that further troubleshooting, to the component level, depends on the skill and experience of the troubleshooter.

8-8. SERVICE SHEETS

The foldout pages in the last part of this section are the service sheets. They consist of block diagrams, circuit schematic diagrams, supplemental diagrams, troubleshooting information, internal views, and disassembly procedures. Table 8-1 summarizes the symbology used on the service sheets.

8-9. MANUAL BACKDATING (†)

A dagger (†) by an item of service information means that the information is different for instruments with serial number prefixes lower than the one shown on the manual's title page. Table 7-1, Manual Changes by Serial Number lists the backdating changes and their related serial number prefix. The backdating changes are contained in Section VII.

8-10. MANUAL UPDATING (Manual Changes Supplement)

Production changes to the instrument made after the publication date of this manual are indicated by a change in the serial number prefix. Changes to this manual are identified by serial number prefix on the Manual Changes supplement. Errors are also noted in the ERRATA portion of the Manual Changes supplement.

Keep this manual up to date by periodically requesting the latest supplement from your Hewlett-Packard office.

8-11. SAFETY CONSIDERATIONS

8-12. Before Applying Power

Verify that the instrument is set to match the available line voltage and that the correct fuse is installed. An uninterrupted safety earth ground must be provided from the main power source to the instrument input wiring terminals, power cable, or supplied power cable set.

8-13. Warnings and Cautions

Pay attention to WARNINGS and CAUTIONS. They must be followed for your protection and to avoid damage to the equipment.

WARNINGS

Maintenance described herein is performed with power supplied to the instrument and with protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power supplied, the power should be removed.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between this instrument and any other equipment used in conjunction with it prior to energizing any of the units.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure that the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many

(continued)

Warnings and Cautions (cont'd)

WARNINGS (cont'd)

points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

CAUTION

Do not disconnect or remove any boards in the CW Generator unless the instrument is turned off or unplugged. Some boards contain devices that can be damaged if the board is removed when the power is on. Many components, including MOS devices, can be damaged by electrostatic discharge. Use conductive foam and grounding straps when servicing is required on sensitive components. Use care when unplugging ICs from high-grip sockets.

8-14. After Service Safety Checks

Visually inspect interior of instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy the cause of any such condition.

Using a suitable ohmmeter, check resistance from instrument enclosure to ground pin on power cable plug. The reading must be less than one ohm. Flex the power cable while making this measurement to determine whether intermittent discontinuities exist.

Check any indicated front or rear panel ground terminals that are marked, using the above procedures.

Check resistance from instrument enclosure to line and neutral (tied together) with the power switch on and the power source disconnected. The minimum acceptable resistance is two megohms. Replace any component that results in a failure.

Check line fuse to verify that a correctly rated fuse is installed.

8-15. RECOMMENDED TEST EQUIPMENT

Test equipment and accessories required to maintain the CW Generator are listed in Table 1-3, Recommended Test Equipment. Equipment other than that listed may be used if it meets the critical specifications listed in the table.

8-16. SERVICE TOOLS, AIDS, AND INFORMATION

8-17. Service Accessories

HP 11712-60001	Output Register Test Board
HP 08672-60016	Special Extender Board

8-18. Pozidriv Screwdrivers

Many screws in the CW Generator appear to be Phillips type, but are not. To avoid damage to the screw head slots, Pozidriv screwdrivers should be used. HP 8710-0899 is the No. 1 Pozidriv. HP 8710-0900 is the No. 2 Pozidriv.

8-19. Tuning Tools

For adjustments requiring non-metalic tuning tools, use the HP 8710-0033 blade tuning tool or the HP 8710-1010 (JFD Model No. 5284) hex tuning tool. For other adjustments an ordinary small screwdriver or suitable tool is sufficient. No matter which tool is used, never force any adjustment control. This is especially critical when adjusting variable inductors or capacitors.

8-20. Hardware

The CW Generator has a mixture of Unified National (inch) and metric screws. The metric screws are defined in Industrial Fasteners publication (IFI 500) and are identified in the replaceable parts list as M (metric). Metric screws have a shiny silver appearance and are used throughout the instrument. The Unified National screws have a dull steel-gray appearance. Do not use a metric screw in a Unified National nut; thread damage will result.

8-21. Assembly Locations

Assemblies in the CW Generator are numbered in groups, both by function and by location. Refer to lettered service sheet(s) for identification of assemblies. In addition, each tab has major assem-

Table 8-1. Schematic Diagram Notes (1 of 8)

Test point symbols. Stars are numbered or lettered for easy correlation of schematic diagrams, procedures, and locator illustrations.

Arrow connecting star to measurement point signifies no measuring aid provided.

Star shown connected to circuit signifies measuring aid (metal post, circuit pad, etc.) provided.

Interconnection information.

The letter inside the rectangle indicates circuit path continues on another schematic diagram. Look for the same rectangle on service sheet indicated by adjacent bold number (3, in this example.)

Plug-in connection information. Socket designation for A2 assembly.

Number indicates pin of socket (XA2).

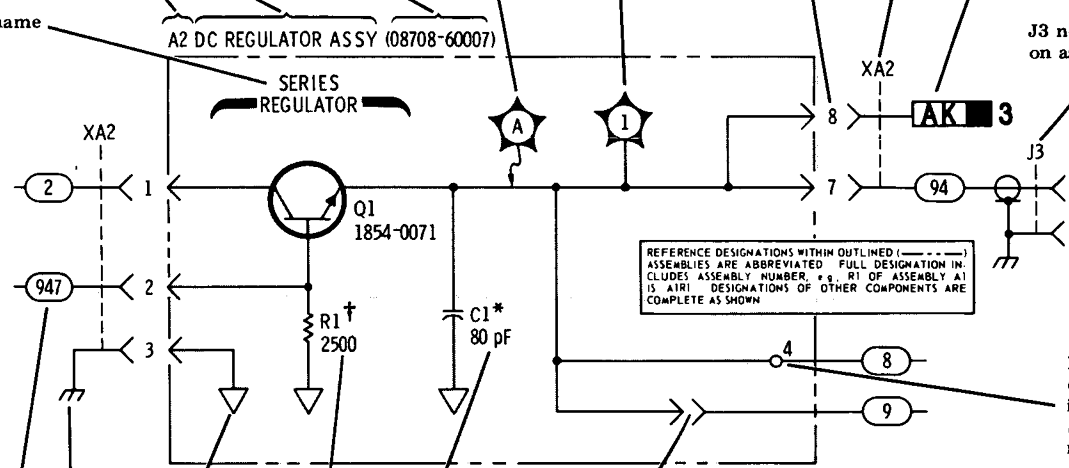
Assembly part number

Assembly name

Assembly designation

Stage name

J3 not mounted on assembly A2.



Non-plug-in connection information. Solder point named.

Circuit board common

Dagger indicates circuit change. See section VII.

Conducting connection to chassis or frame.

Connector symbols within the borderlines of circuit assemblies signify connections to the assembly which are separate from those made through the integral plug part of the assembly.

REFERENCE DESIGNATION

NO PREFIX	A2 ASSY
A2 J3 XA2	C1 Q1 R1

NOT ASSIGNED

2

A2

Asterisk indicates factory selected components. (See section V).

Value selected for best operation. Value shown is average or most commonly selected value.

Wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number the narrower stripe.

Example: (947) denotes white base, yellow wide stripe, violet narrow stripe.

Reference designators deleted by circuit changes are listed here.

List of all the reference designations on the diagram.

Assembly reference designator(s).

Large numbers in lower right corners of schematic diagrams are service sheet numbers. They are provided for convenience in tracing interconnections.

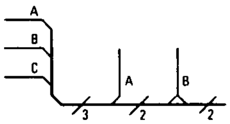
Table 8-1. Schematic Diagram Notes (2 of 8)

SCHEMATIC DIAGRAM NOTES

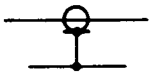
*	Asterisk denotes a factory-selected value. Value shown is typical.
†	Dagger indicates circuit change. See Section VII.
	Tool-aided adjustment.
O	Manual control.
	Encloses front-panel designation.
	Encloses rear-panel designation.
	Circuit assembly borderline.
	Other assembly borderline.
	Heavy line with arrows indicates path and direction of main signal.
	Heavy dashed line with arrows indicates path and direction of main feedback.
	Indicates stripline (i.e., RF transmission line above ground).
CW	Wiper moves toward cw with clockwise rotation of control (as viewed from shaft or knob).
1	Numbered Test Point measurement aid provided.
	Encloses wire or cable color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, and the third number identifies the narrower stripe, e.g., denotes white base, yellow wide stripe, violet narrow stripe.
	A direct conducting connection to earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).
	A conducting connection to a chassis or frame.
	Common connections. All like-designation points are connected.
AK 12	Letters = off-page connection, e.g., AK Number = Service Sheet number for off-page connection, e.g., 12
1 THIS PAGE	Number (only) = on-page connection.

Table 8-1. Schematic Diagram Notes (3 of 8)

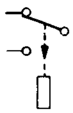
SCHEMATIC DIAGRAM NOTES



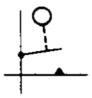
Indicates multiple paths represented by only one line. Letters or names identify individual paths. Numbers indicate number of paths represented by the line.



Coaxial or shielded cable.



Relay. Contact moves in direction of arrow when energized.



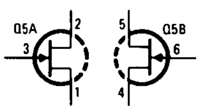
Indicates a pushbutton switch with a momentary (ON) position.

Indicates a PIN diode.

Indicates a current regulation diode.

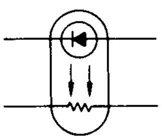
Indicates a voltage regulation diode.

Indicates a Schottky (hot-carrier) diode.



Multiple transistors in a single package—physical location of the pins is shown in package outline on schematic.

Identification of logic families as shown (in this case, ECL).

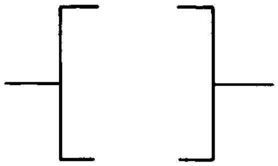


Indicates an opto-isolator of a LED and a photoresistor packaged together. The resistance of the photoresistor is a function of the current flowing through the LED.

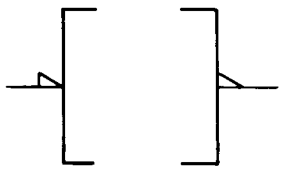
Table 8-1. Schematic Diagram Notes (4 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

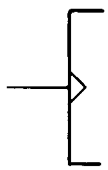
Input and Output Indicators



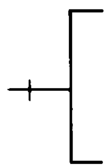
Implied Indicator—Absence of polarity indicator (see below) implies that the active state is a relative high voltage level. Absence of negation indicator (see below) implies that the active state is a relative high voltage level at the input or output.



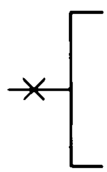
Polarity Indicator—The active state is a relatively low voltage level.



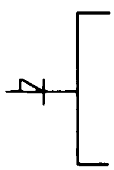
Dynamic Indicator—The active state is a transition from a relative low to a relative high voltage level.



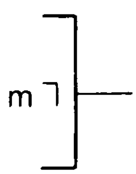
Inhibit Input—Input that, when active, inhibits (blocks) the active state outputs of a digital device.



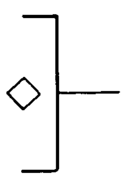
Analog Input—Input that is a continuous signal function (e.g., a sine wave).



Polarity Indicator used with Inhibit Indicator—Indicates that the relatively low level signal inhibits (blocks) the active state outputs of a digital device.



Output Delay—Binary output changes state only after the referenced input (m) returns to its inactive state (m should be replaced by appropriate dependency or function symbols).



Open Collector Output—Output that must form part of a distributed connection.

Table 8-1. Schematic Diagram Notes (5 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Input and Output Indicators (Cont'd)

3-STATE	Three-state Output—Indicates outputs that can have a high impedance (disconnect) state in addition to the normal binary logic states.

Combinational Logic Symbols and Functions

&	AND—All inputs must be active for the output to be active.
≥1	OR—One or more inputs being active will cause the output to be active.
≥m	Logic Threshold—m or more inputs being active will cause the output to be active (replace m with a number).
=1	EXCLUSIVE OR—Output will be active when one (and only one) input is active.
=m	m and only m—Output will be active when m (and only m) inputs are active (replace m with a number).
=	Logic Identity—Output will be active only when all or none of the inputs are active (i.e., when all inputs are identical, output will be active).
▷	Amplifier—The output will be active only when the input is active (can be used with polarity or logic indicator at input or output to signify inversion).
X/Y	Signal Level Converter—Input level(s) are different than output level(s).
←→	Bilateral Switch—Binary controlled switch which acts as an on/off switch to analog or binary signals flowing in both directions. Dependency notation should be used to indicate affecting/affected inputs and outputs. Note: amplifier symbol (with dependency notation) should be read to indicate unilateral switching.
X→Y	Coder—Input code (X) is converted to output code (Y) per weighted values or a table.
(Functional Labels)	The following labels are to be used as necessary to ensure rapid identification of device function.
MUX	Multiplexer—The output is dependent only on the selected input.
DEMUX	Demultiplexer—Only the selected output is a function of the input.
CPU	Central Processing Unit
PIO	Peripheral Input/Output
SMI	Static Memory Interface

Table 8-1. Schematic Diagram Notes (6 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions

1 	Monostable—Single shot multivibrator. Output becomes active when the input becomes active. Output remains active (even if the input becomes inactive) for a period of time that is characteristic of the device and/or circuit.
G 	Oscillator—The output is a uniform repetitive signal which alternates between the high and low state values. If an input is shown, then the output will be active if and only if the input is in the active state.
FF	Flip-Flop—Binary element with two stable states, set and reset. When the flip-flop is set, its outputs will be in their active states. When the flip-flop is reset, its outputs will be in their inactive states.
T	Toggle Input—When active, causes the flip-flop to change states.
S	Set Input—When active, causes the flip-flop to set.
R	Reset Input—When active, causes the flip-flop to reset.
J	J Input—Analogous to set input.
K	K Input—Analogous to reset input.
D	Data Input—Always enabled by another input (generally a C input—see Dependency Notation). When the D input is dependency-enabled, a high level at D will set the flip-flop; a low level will reset the flip-flop. Note: strictly speaking, D inputs have no active or inactive states—they are just enabled or disabled.
m	Count-Up Input—When active, increments the contents (count) of a counter by "m" counts (m is replaced with a number).
−m	Count-Down Input—When active, decrements the contents (count) of a counter by "m" counts (m is replaced with a number).
→m	Shift Right (Down) Input—When active, causes the contents of a shift register to shift to the right or down "m" places (m is replaced with a number).
←m	Shift Left (Up) Input—When active, causes the contents of a shift register to shift to the left or up "m" places (m is replaced with a number).

NOTE

For the four functions shown above, if m is one, it is omitted.

(Functional Labels)	The following functional labels are to be used as necessary in symbol build-ups to ensure rapid identification of device function.

Table 8-1. Schematic Diagram Notes (7 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions (Cont'd)

mCNTR	Counter—Array of flip-flops connected to form a counter with modulus m (m is replaced with a number that indicates the number of states: 5 CNTR, 10 CNTR, etc.).
REG	Register—Array of unconnected flip-flops that form a simple register or latch.
SREG	Shift Register—Array of flip-flops that form a register with internal connections that permit shifting the contents from flip-flop to flip-flop.
ROM	Read Only Memory—Addressable memory with read-out capability only.
RAM	Random Access Memory—Addressable memory with read-in and read-out capability.

Dependency Notation

mAm	Address Dependency—Binary affecting inputs of affected outputs. The m prefix is replaced with a number that differentiates between several address inputs, indicates dependency, or indicates demultiplexing and multiplexing of address inputs and outputs. The m suffix indicates the number of cells that can be addressed.
Gm	Gate (AND) Dependency—Binary affecting input with an AND relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or letter (the identifier).
Cm	Control Dependency—Binary affecting input used where more than a simple AND relationship exists between the C input and the affected inputs and outputs (used only with D-type flip-flops).
Vm	OR Dependency—Binary affecting input with an OR relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or the letter (the identifier).
Fm	Free Dependency—Binary affecting input acting as a connect switch when active and a disconnect when inactive. Used to control the 3-state behavior of a 3-state device.

NOTE

The identifier (m) is omitted if it is one—that is, when there is only one dependency relationship of that kind in a particular device. When this is done, the dependency indicator itself (G, C, F, or V) is used to prefix or suffix the affected (dependent) input or output.

Table 8-1. Schematic Diagram Notes (8 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Miscellaneous

	Schmitt Trigger—Input characterized by hysterisis; one threshold for positive going signals and a second threshold for negative going signals.
Active	Active State—A binary physical or logical state that corresponds to the true state of an input, an output, or a function. The opposite of the inactive state.
Enable	Enabled Condition—A logical state that occurs when dependency conditions are satisfied. Although not explicitly stated in the definitions listed above, functions are assumed to be enabled when their behavior is described. A convenient way to think of it is as follows: A function becomes active when: • it is enabled (dependency conditions—if any—are satisfied) • and its external stimulus (e.g., voltage level) enters the active state.

Assembly Locations (cont'd)

bly location figures. Also, each tab has a table listing the Service Sheets where each major assembly is found.

8-22. Parts and Cable Locations

The location of individual components mounted on printed circuit boards or other assemblies are shown near the schematic diagram. The part reference designator is the assembly designator plus the part designator. For example, A2A3R9 is R9 on the A2A3 assembly. For specific component descriptions and ordering information, refer to Table 6-3, Replaceable Parts, in Section VI. Chassis and frame parts, as well as mechanical parts (MP) and cables (W), are identified on illustrated parts breakdowns (IPB) in Section VI, or in this section on the lettered diagrams.

8-23. Test Points and Adjustment Locations

Most test points and adjustments are indicated on circuit board assemblies. Test points and adjustments can also be found on the component locator figure near the assembly's schematic diagram. Test points identified on block diagrams are also shown on the lettered service sheets following the schematic diagram foldouts.

8-24. Service Aids on Printed Circuit Boards

Service aids on printed circuit boards include test points, indicators, some reference designations, adjustment names, and assembly part numbers.

8-25. Other Service Documents

Service Notes, Manual Change Supplements, and other service literature are available through Hewlett-Packard. For further information, contact your nearest Hewlett-Packard office. Service information should be filed in Section VIII for easy reference.

8-26. REPAIR AND REPLACEMENT

8-27. After Repair Adjustment Procedure

After repairs are made, adjustments may be needed to assure optimum performance. Refer to Table 5-3, Post Repair Adjustments in Section V of this volume to determine what, if any, adjustments are needed after any repair is made.

8-28. Disassembly and Reassembly Procedures

Disassembly and reassembly procedures begin on Service Sheet A. Top and bottom cover removal procedures are described there and also in the following paragraph.

8-29. Top and Bottom Cover Removal

1. Place the instrument with the appropriate cover up.

2. Remove the appropriate rear panel standoffs MP9.

3. Loosen the captive screw securing the cover to the frame.

4. Slide the cover to the rear and remove.

5. For replacement, follow the above steps in the inverse order.

8-30. Etched Circuits (Printed Circuit Boards)

The etched circuit boards in the CW Generator have plated through holes which make a solder path through to both sides of the insulating material. Soldering can be done from either side of the board with equally good results. When soldering to any circuit board, keep in mind the following recommendations:

1. Avoid unnecessary component unsoldering and soldering. Excessive replacement can result in damage to the circuit board and/or adjacent components.

2. Do not use a high power soldering iron on etched circuit boards. A 35-watt soldering iron is recommended. Excessive heat may lift a conductor or damage the board.

CAUTION

Do not use a sharp metal object such as an awl or twist drill in the following step. Sharp objects may damage the plated through conductor.

3. Use a suction device or wooden toothpick to remove solder from component mounting holes. When using a suction device make sure that equipment is properly grounded to prevent electrostatic discharge from damaging MOS devices. Refer to Table 8-2, Etched Circuit Soldering Equipment, for information on available tools for working on etched circuit boards.

Table 8-2. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended	HP Part No.
Soldering Tool	Soldering, Heat Staking	Wattage: 35W Tip Temp.: 390—440°C (735—825°F)	*Ungar No. 135 *Ungar Division Eldon Ind. Corp. Compton, CA 90220	8690-0167
Soldering Tip	Soldering, Unsoldering	Shape: Chisel	*Ungar PL113	8690-0007
De-Solder Aid	To remove molten solder from connection	Suction Device	Soldapullt by Edsyn Co., Van Nuys, CA 91406	8690-0060
Rosin (flux) Solvent	To remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board.	Freon TF	8500-0232
Solder	Component replacement; Circuit Board repair wiring	Rosin (flux core, high tin content (63/37 tin/lead), 18 gauge (AWG) 0.040 in. diameter preferred.		8090-0607

*For working on circuit boards; for general purpose work, use No. 555 Handle (8690-0261) and No. 4037 Heating Unit 47½ — 56½ W (HP 8690-0006); tip temperature of 850 — 900°F; and Ungar No. PL113 ⅛" chisel tip.

8-31. Electrostatic Discharge (ESD) Precautions

Electrostatic discharge (ESD) can cause damage to certain devices in the CW Generator. The damage can range from slight degradation of a parameter to catastrophic failures.

MOS, CMOS, and other static sensitive devices are used in this instrument. They are prone to damage from both static electricity and transient signals. They must be handled carefully. When working on the CW Generator, keep in mind the following recommendations to avoid damaging these sensitive components.

1. Use a static-free work station with a pad of conductive rubber or similar material.
2. Do not remove any assembly unless the CW Generator has been turned off or unplugged.
3. After removing assemblies from the CW Generator, be sure that they are placed on a conductive surface to guard against ESD damage. Do not stack boards.
4. When removing a MOS or CMOS device from a high grip socket, be careful not to damage it. Avoid removing devices from these sockets with pullers. Instead, use a small screwdriver to pry the device up from one end, slowly pulling it up one pair of pins at a time.
5. Once a MOS or CMOS device has been removed from an assembly, immediately stick it into a pad of conductive foam or other suitable holding medium.
6. When replacing a MOS or CMOS device, ground the foam on which it resides to the instrument before removing it. If a device requires soldering, make sure that the assembly is lying on a pad of conductive material, and that the pad, soldering iron tip, and personnel, are grounded to the assembly. Apply as little heat as possible.

Electrostatic Discharge (ESD) Precautions (cont'd

7. Before turning the instrument off, remove any large ac sources that may be driving MOS switches.

8-33. Module Exchange Program

Table 6-1 lists assemblies that are available on an exchange basis. Refer to the table, and the EXCHANGE ASSEMBLIES paragraph in Section VI for further information.

8-33. Non-Repairable Assemblies

The following assemblies are not factory repairable and must be discarded.
A1AT2 Isolator
A1CR1 Crystal Detector
A1FL1 High Pass Filter
A2A2 Rotary Pulse Generator
A3A9A1 Directional Coupler
A3A9A6 Attenuator
A3A9A7 Low Pass Filter
A3A9U1 Sampler

8-34. Factory Selected Components (*)

Some component values are selected at the factory to provide optimum compatibility with associated components. These components are identified on individual schematics and the replaceable parts list by an asterisk (*). Refer to Table 5-1, Factory Selected Components, for the selection procedures.

8-35. CLEANING

8-36. Cleaning Intervals

Hewlett-Packard recommends a 6-month interval between cleaning for some parts of the CW Generator and a 12-month interval for other parts. However, cleaning intervals are mostly dependent upon where the CW Generator is used. The CW Generator should be cleaned more often if it is used in a dusty or very humid area.

8-37. Cleaning Solution

Hewlett-Packard recommends using either of two cleaning solutions on printed circuit (pc) board edge connectors. For best cleaning results, we recommend an ammonium hydroxide solution (NH_4OH, 29.5% NH_3 by weight). However, using concentrated solutions of ammonia requires using gloves, eye goggles, and proper ventilation. The second recommendation is an 80:20 solution of isopropyl alcohol and water (IPA/H_2O). This should serve as a satisfactory cleaner where one would rather not use ammonium hydroxide.

8-38. Top Cover Removal and Replacement

1. At the rear corners of the top cover, remove the two plastic standoffs.
2. At the center-rear of the top cover, loosen the captive screw securing the cover to the frame.
3. Slide the cover to the rear and remove it.
4. When the cleaning is completed, position the cover on top of the Generator and gently slide it as far forward as possible.
5. Secure the cover to the frame by tightening the captive screw at the center-rear of the cover.
6. Replace the two plastic standoffs to the rear corners of the CW Generator.

8-39. 6-Month Cleaning

WARNING

Before cleaning, make sure the CW Generator is disconnected from the power source This is to eliminate the possiblity of electrical shock.

CAUTION

In procedures that call for a vacuum cleaner to remove dust, do not use a blower or compressed air. Doing so will cause the dust to be transferred throughout the CW Generator.

Fan.

1. At the rear of the CW Generator, remove two screws and lock washers that secure the fan cover.
2. Remove the fan cover.
3. Using a vacuum cleaner and a soft-bristle brush, remove dust from the fan and its cover.
4. Replace the fan cover.

Vents.

1. Locate the ventilation holes at the rear of the CW Generator (in the lower right corner as viewed from the rear).

2. Using a vacuum cleaner and a soft-bristle brush, remove dust from the ventilation holes.

Power Supply Filter Capacitors.

1. Inside the CW Generator, locate the power supply filter capacitor area (just forward and to the right of the fan as viewed from the rear).

2. Using a vacuum cleaner and a soft-bristle brush, remove dust from the entire area.

Area in Front of Fan.

1. Locate the hinged plastic cover just forward of the fan.

2. Raise the plastic cover into its upright position.

3. Using the plastic-loop pc board extractors, remove all of the boards.'

NOTE

As you remove each board, locate its silkscreened reference designation. (The reference designations are A3A3, A3A4, A3A5, A3A6, and A3A7.) When you return the boards, you can identify the proper slot by matching reference designations on the pc board, the mother board, and the plastic cover.

4. Using a vacuum cleaner and a soft-bristle brush, remove dust from the fan and the entire area forward of it.

5. Using a vacuum cleaner and a soft-bristle brush, remove dust from each of the pc boards.

CAUTION

In the next step, do not let the cleaning solution touch circuit portions of the pc board. This could cause residual flux on solder connections to liquify and contaminate the edge connectors.

6. Using a lint-free cloth saturated with cleaning solution, rub each pc board edge connector 3 or 4 times to remove any foreign material.

7. Rinse the pc board edge connectors with deionized water and wipe them dry.

NOTE

Before returning the pc boards to their their normal places, it is a good idea to inspect them for heat damage. The pc boards that are mounted directly in front of the fan, produce relatively high amounts of heat. Heat discoloration of the pc board material can be a sign that the fan is not working properly.

8. Carefully insert the pc boards into their guides and mother board connectors. (The component side of each pc board faces right when viewed from the rear of the CW Generator.)

9. Lower the hinged plastic cover into its normal position.

8-40. 12-Month Cleaning

WARNING

Before cleaning, make sure the CW Generator is disconnected from the power source. This is to eliminate the possiblity of electrical shock.

CAUTION

In procedures that call for a vacuum cleaner to remove dust, do not use a blower or compressed air. Doing so will cause the dust to be transferred throughout the CW Generator.

Digital Control Unit (DCU) Area.

1. Just forward and to the left of the fan (as viewed from the rear), locate the long aluminum cover over the DCU assembly.

2. Remove the screw and lock washer located at the rear of the cover.

3. Remove the cover by sliding it to the rear and up.

NOTE

Before removing any pc board, notice that each board in the DCU has a unique set of color coded plastic extractors.

12-Month Cleaning (cont'd)

NOTE (cont')

At the forward end, these extractors match the colors of the guides on the aluminum frame.

4. Remove all five pc boards. To remove each board, grasp both of its extractors. Then, by pulling up on the extractors, the board will gently pry itself from its mother board connectors.

CAUTION

In the next step, do not use a vacuum cleaner to remove dust from the A2 Assembly pc boards. The boards have static sensitive devices that can be damaged by a vacuum cleaner.

5. Using a vacuum cleaner and a soft-bristle brush only, remove dust from the pc boards.
6. Using a vacuum cleaner and a soft-bristle brush, remove dust from the entire DCU area (especially from the mother board connectors).

CAUTION

In the next step, do not let the cleaning solution touch circuit portions of the pc board. This could cause residual flux on solder connections to liquify and contaminate the edge connectors.

7. Using a lint-free cloth saturated with cleaning solution, rub each pc board edge connector 3 or 4 times to remove any foreign material.
8. Rinse the pc board edge connectors with deionized water and wipe them dry.

CAUTION

The next step requires care to ensure that pc board edge connectors are properly aligned with the mother board connectors. When properly aligned, the pc board will press snuggly into the mother board connectors. However, if they are not properly aligned, pressure on the pc board can damage the mother board and its connector.

9. Carefully insert the pc boards into their guides and mother board connectors. Ensure that the extractors match the colors on their plastic guides.
10. Install the DCU cover by tilting its front-end down and into the locking slots provided for the cover's front tabs. Then, lower the cover into place and secure it with its screw and lock washer.

Battery, Contacts.

1. Locate the battery pack in the general area of the forward-right corner of the CW Generator (as viewed from the front).
2. With your fingers, remove the spring retaining clip that holds the battery pack in its plastic holder. Remove the battery.

CAUTION

In the next two steps, be careful not to bend the spring-contacts in the battery holder.

3. Using a lint-free cloth saturated with cleaning solution, rub each contact on the battery pack and holder 3 or 4 times to remove any foreign matter.
4. Using a lint-free cloth saturated with deionized water, rinse the contacts. Then wipe them dry.
5. Position the battery pack so that its contacts are on the right side and facing to the rear. Place the battery pack into its holder.

NOTE

The next step refers to the top and bottom of the spring retaining clip. The bottom of the clip is identified by a single bend of metal; the top is identified by a double bend.

6. Slip the bottom end of the spring retaining clip under the bottom lip of the plastic battery holder. Snap the top end of the clip over the top of the holder.

8-41. SCHEMATIC SYMBOLOGY

8-42. Basic Logic Symbology

The logic symbols used in this manual are based on the American National Standards Institute (ANSI) Y32.14-1973, "Graphic Symbols for Logic Diagrams (Two State Devices)." A summary of this symbology is provided to aid in interpreting these symbols.

Basic Logic Symbology (cont'd)

Power supply and ground connections are not shown on the symbols. This information is tabulated on the right margins of the service sheets.

Gates and Qualifiers. This section includes a brief description of the basic logic symbols used on the service sheets, a summary of indicator symbols, a discussion of contiguous blocks, control blocks, and dependency notation, and a summary of symbology for some of the more complex devices.

Qualifiers are that portion of a device symbol that denotes the logic function. For example, "&" denotes the AND function. See Figure 8-1 for a summary of the basic logic symbols and their qualifiers.

Indicator Symbols. Indicator symbols identify the active state of a device's input or output, as shown in Figure 8-2.

Contiguous Blocks. Two symbols may share a common boundary, parallel or perpendicular to the direction of the signal flow. Note that in the examples shown in Figure 8-3, there is generally no logic connection across a horizontal line, but there is always an implied logic connection across a vertical line. Notable exceptions to this rule are the horizontal lines beneath control blocks and between sections of shift registers and counters (dividers).

Dependency Notation. Dependency notation simplifies symbols for complex integrated circuit elements by defining the relationship between inputs and outputs without actually showing all the elements and connections involved (see Figures 8-4 through 8-6). The following examples use the letter A for address, C for control, G for AND, V for OR, and F for free dependencies. The dependent input or output is labeled with a number that is either prefixed (e.g.,1X) or subscripted (e.g.,X_1). They both mean the same thing. Note that many times a controlled line may already be labeled with a number that indicates input or output weighting (for example, in a coder). In this case, the controlling or gating input will be labeled with a letter.

Common Control Block. The control block is used in conjunction with an array of related symbols in order to group common logic lines. Figure 8-7 shows how the control block is usually represented. Figure 8-8 shows a quad D-type flip-flop with reset. This can be redrawn as shown in Figure 8-9. Note that the representation shown in Figure 8-9 can be used when the flip-flops are functionally scattered around the schematic (i.e., not used as a quad unit).

8-43. Complex Device Symbology

Figures for complex device symbology show how the basic symbols can be combined to illustrate the behavior of fairly complex devices.

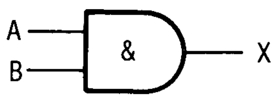
Shift Register. The shift register (see Figure 8-10) control block shows common inputs to a bidirectional shift register. Notice that ">m" means shift the contents to the right or down by "m" units. And "<m" means shift the contents to the left or up by "m" units. Note: If m=1, then "m" may be omitted. Inputs "a" and "b" are each single IC pins that have two functions. Input "a" enables one of the inputs to the top D-type flip-flop (1D) and also shifts the register contents down "m" units. Input "b" enables one of the inputs to the bottom flip-flop (2D), and also shifts the register contents up "m" units. Input "c" loads all four flip-flops in parallel (3D). Input "d" is a common reset. The output delay indicator is used because these are master-slave flip-flops.

AND-OR Selector. The selector control block simplifies the AND portion of a quad AND-OR select gate (see Figure 8-11). When G1 is high, the data presented at the "1" inputs is gated through. When G2 is high, the data presented at the "2" inputs is gated through.

UP-DOWN Counter. The counter control block shows comon inputs to a Prresettable Decade. UP-DOWN Counter (see Figure 8-12). Notice that "+m" means count up (increment the count) by "m"; "−m" means count down by "m." Note: if m=1, then "m" may be omitted. Since the D-type flip-flops are master-slave, the output delay indicator is used. The "=9, +1" and "=0, −1" notation defines when the carry and borrow outputs are generated. They also define it as a decade counter; a binary counter would have the carry indicated with "=15, +1." Flip-flop weighting is indicated in parentheses. Input "C1" allows all four "D1" flip-flops to be preset in parallel.

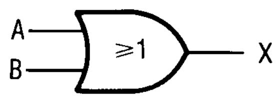
Quad D-Type Latch. The register control block illustrates a quad D-type latch (see Figure 8-13). There is a common active-low reset (R), and a common edge triggered control input (C). Since there is only one dependency relationship, the controlling input is not numbered and the controlled functions (D) are subscripted with a C.

AND GATE



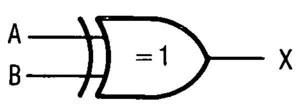
A	B	X
H	H	H
H	L	L
L	H	L
L	L	L

OR GATE



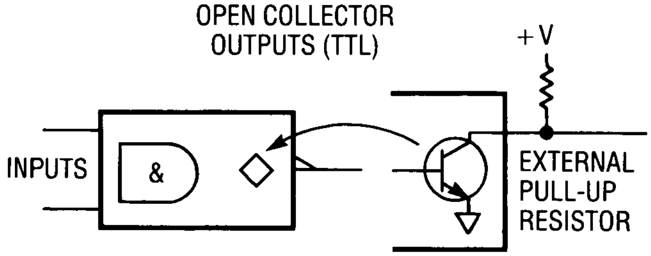
A	B	X
H	H	H
H	L	H
L	H	H
L	L	L

EXCLUSIVE-OR GATE

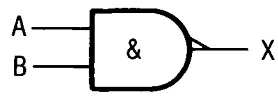


A	B	X
H	H	L
H	L	H
L	H	H
L	L	L

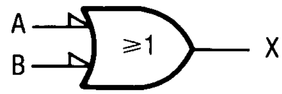
OPEN COLLECTOR OUTPUTS (TTL)



NAND GATE

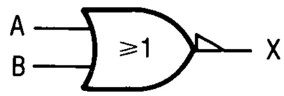


OR GATE WITH INVERTED INPUTS

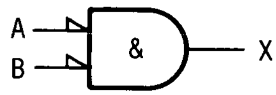


A	B	X
H	H	L
H	L	H
L	H	H
L	L	H

NOR GATE

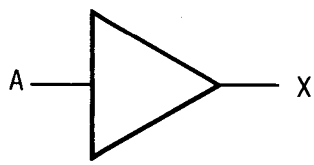


AND GATE WITH INVERTED INPUTS

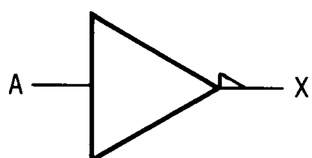


A	B	X
H	H	L
H	L	L
L	H	L
L	L	H

BUFFER



A	X
H	H
L	L



INVERTER

A	X
H	L
L	H

OPEN EMITTER OUTPUTS (ECL)

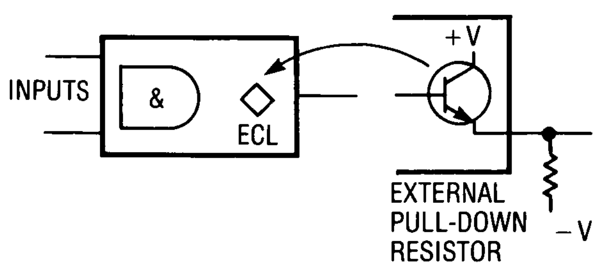


Figure 8-1. Basic Logic Symbols and Qualifiers

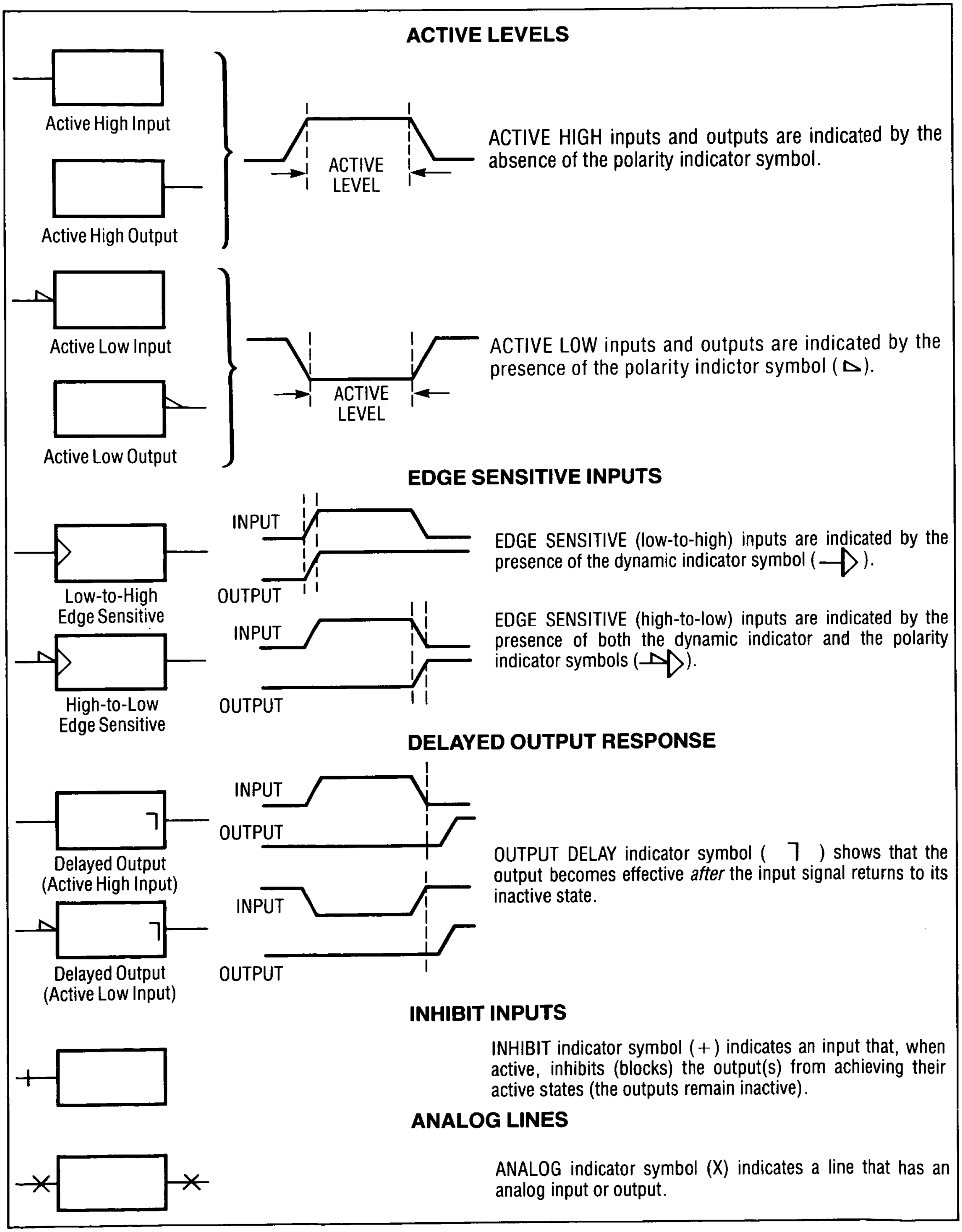


Figure 8-2. Indicator Symbols

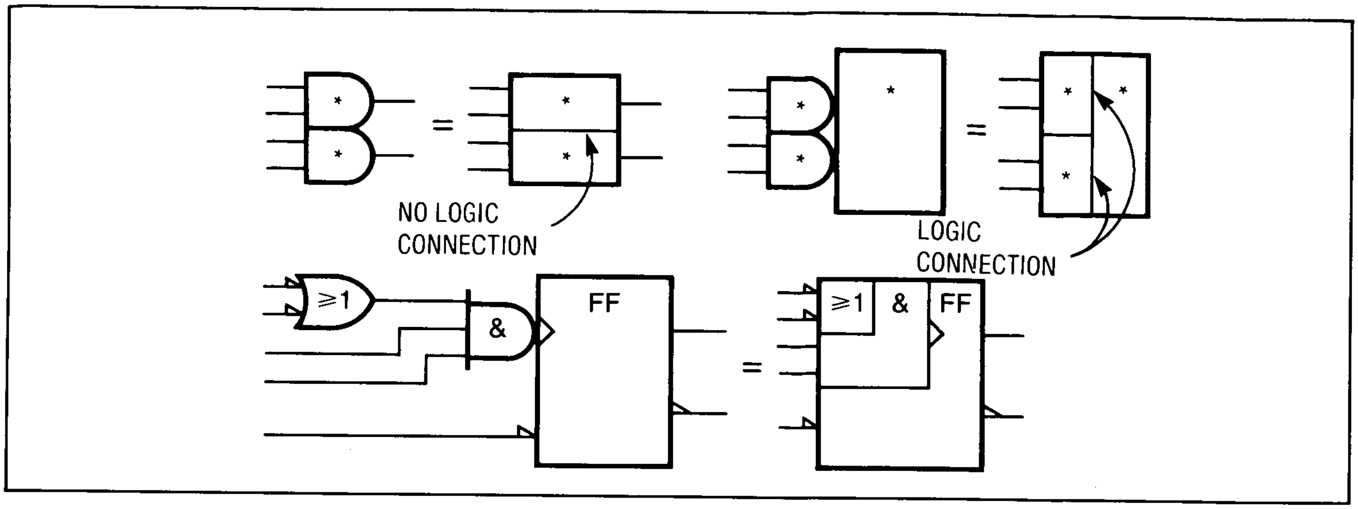


Figure 8-3. Contiguous Blocks

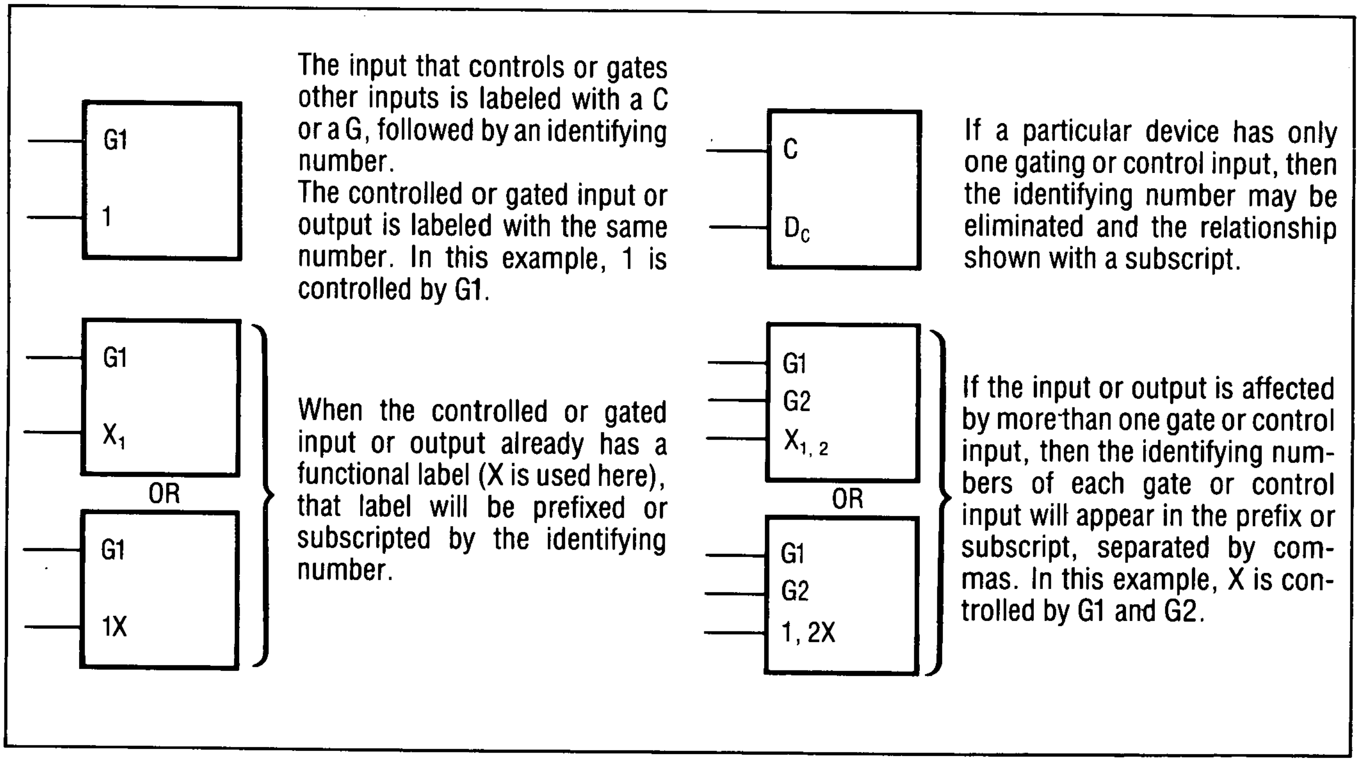


Figure 8-4. AND Dependency Notation

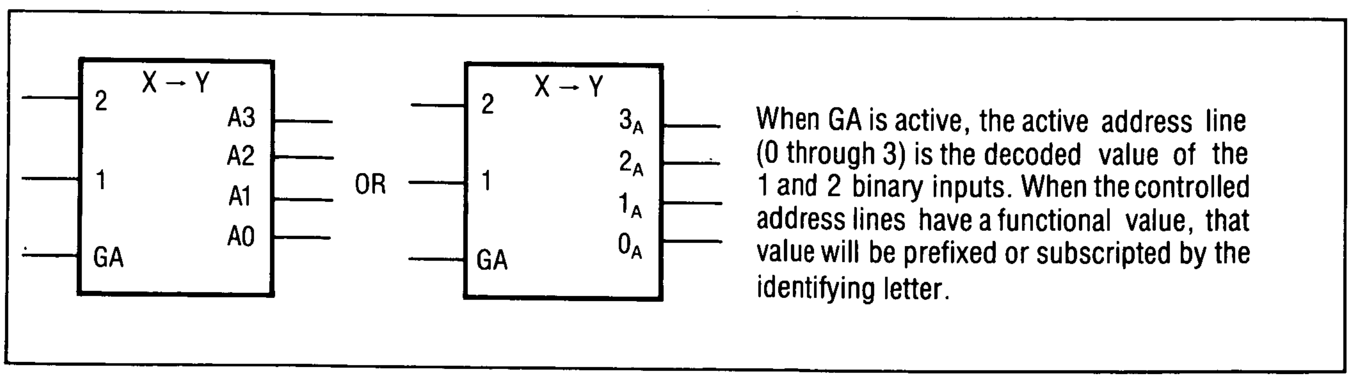
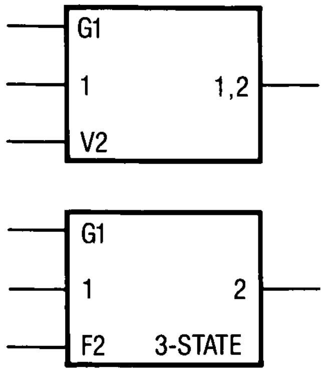


Figure 8-5. Address Dependency Notation



When a V input is active, the output will be in its active state. With the V input inactive, the device functions as if the V input doesn't exist.

When an F input is active, the output is enabled to function normally. When an F input is inactive, the output becomes a high impedance, effectively removing that device from the circuit.

The 3-STATE label is sometimes used with the free dependency notation.

Figure 8-6. OR and Free Dependency Notation

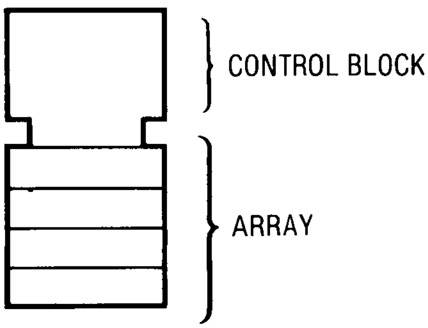


Figure 8-7. Common Control Block

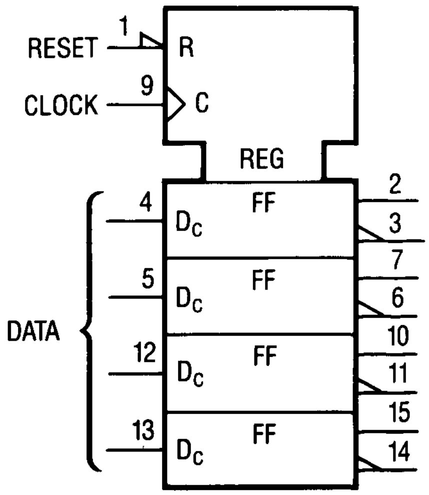


Figure 8-8. Quad D-Type Latch (Combined)

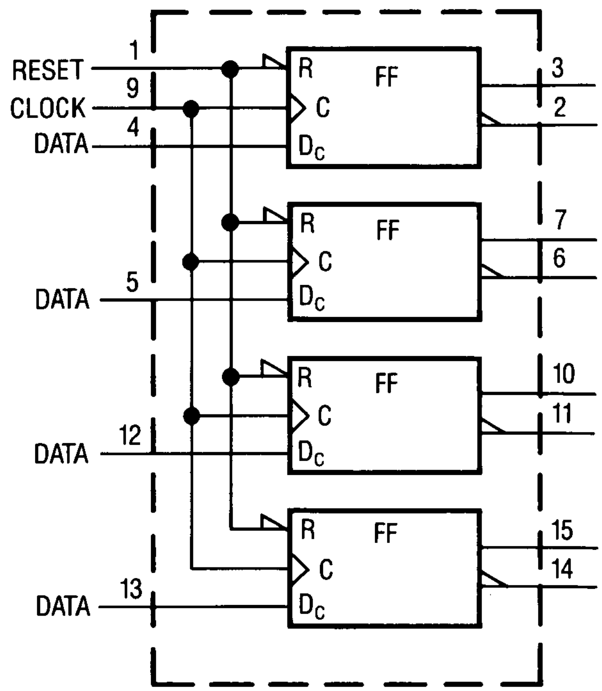


Figure 8-9. Quad D-Type Latch (Individual)

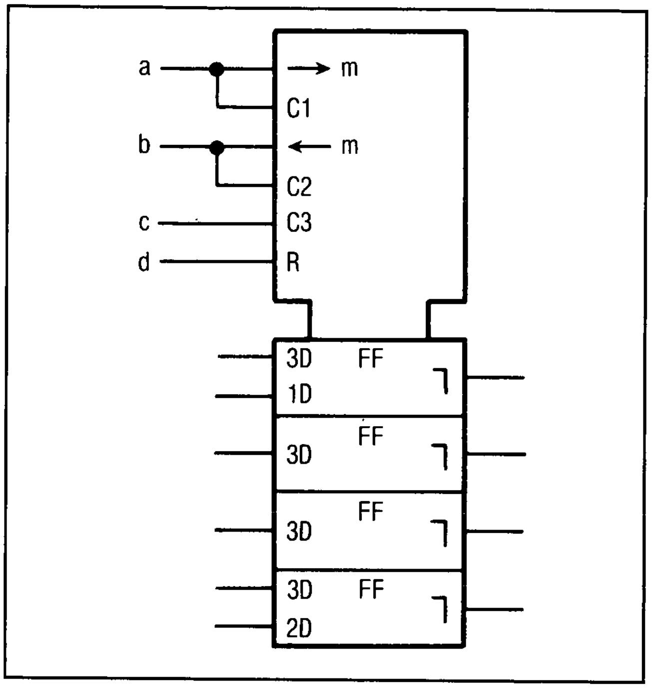


Figure 8-10. Shift Register

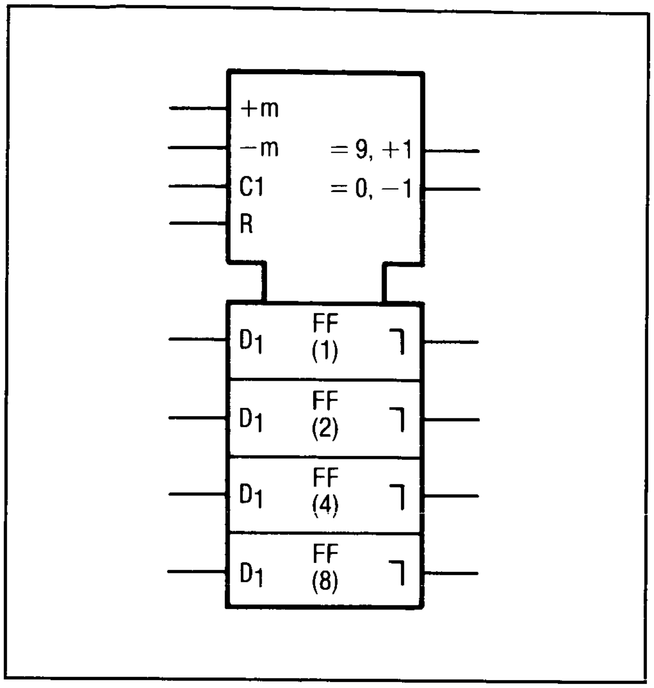


Figure 8-12. UP-DOWN Counter

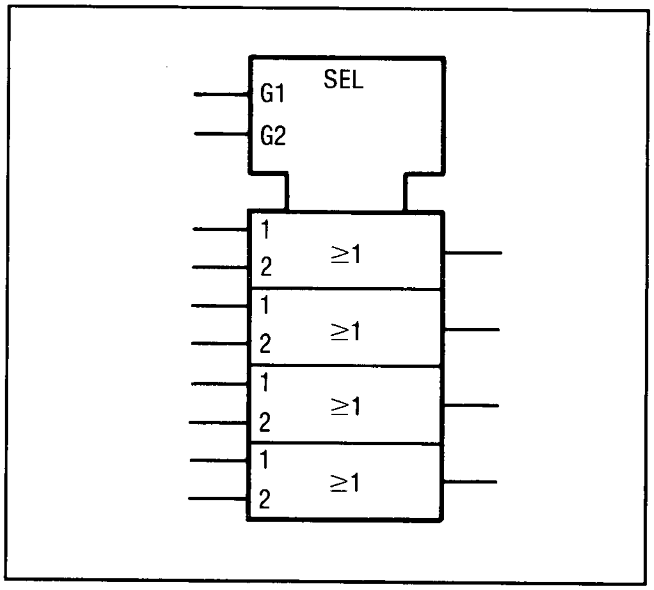


Figure 8-11. AND-OR Selector

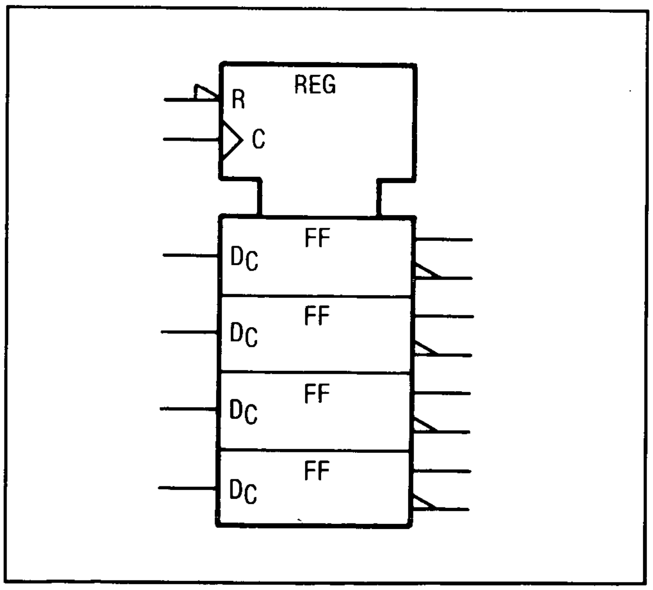
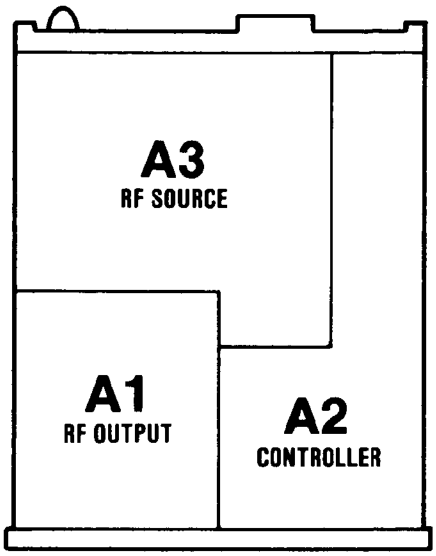


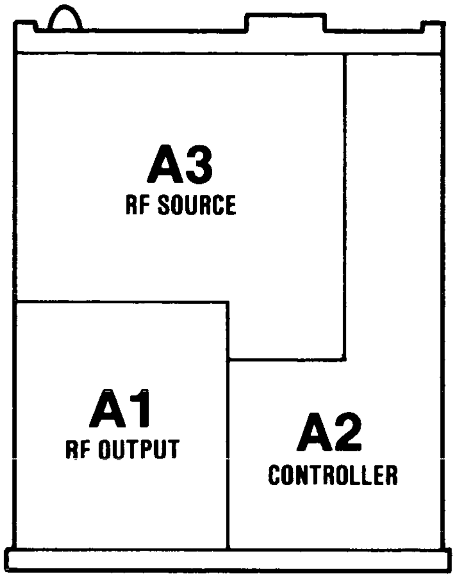
Figure 8-13. Quad D-Type Latch



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35

SERVICE SHEET BD1

OVERALL BLOCK DIAGRAM AND TROUBLESHOOTING

REFERENCES

Servicing Strategy
.... Beginning of Section VIII
Operator's Checks .... Section III
Disassembly Procedures ...... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB)
.... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

Major Assemblies

The CW Generator consists of three major assemblies as listed below:

- A1 RF Output Assembly
- A2 Digital Control Unit Assembly
- A3 RF Source Assembly

These assemblies are shown in Figure 8-14 with their associated subsystems. Each is discussed briefly below:

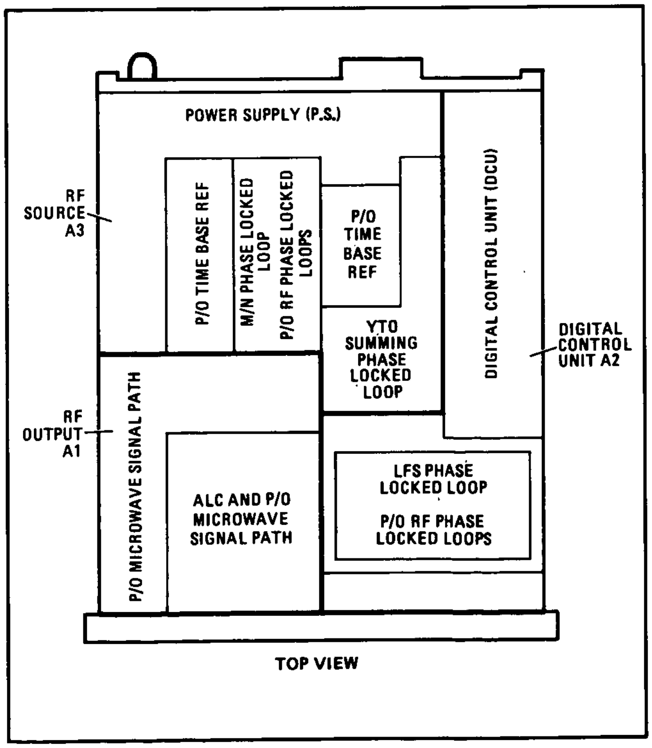


Figure 8-14 Major Assemblies

A1 RF Output Assembly. This assembly amplifies and levels baseband (2 to 6.2 GHz) frequencies. For frequencies above 6.2 GHz, the RF output assembly provides frequency multiplication as well as amplification and leveling. The RF output can be leveled between −10 and +13 dBm with additional dynamic range provided by a 110 dB step attenuator. The subsystems of the RF Output Assembly are:

- Microwave Signal Path Circuits
- ALC Circuits

A2 Digital Control Unit Assembly. The Digital Control Unit is a digital state machine that controls the entire operation of the CW Generator. Part of the RF Phase Locked Loops subsystem is also contained in the Digital Control Unit assembly. The subsystems of the Digital Control Unit assembly are:

- DCU Remote/Local Interface
- DCU Frequency Control

A3 RF Source Assembly. The RF Source assembly contains four phase locked loops and an internal 10 MHz reference oscillator. The phase locked loops are tuned by the Digital Control Unit (DCU) to produce frequencies between 2 and 6.2 GHz with 1 kHz resolution. The phase locked loops are phase locked to the 10 MHz internal reference oscillator or an external 5 or 10 MHz frequency reference. The subsystems of the RF Source are:

- Time Base Reference
- Part of the RF Phase Locked Loops
- YIG Tuned Oscillator (YTO)

Functional Description

Functionally, the CW Generator can be divided into nine electrical subsystems. The nine subsystems are listed below with the major assemblies of which they are a part:

- Time Base Reference, A3
- RF Phase Locked Loops, A2 and A3
- YTO Summing Phase Locked Loop, A3
- Microwave Signal Path, A1
- Automatic Level Control (ALC), A1
- DCU Remote/Local Interface, A2
- DCU HP-IB Interface, A2
- DCU Frequency Control, A2
- Power Supplies, A3

The electrical subsystems are illustrated in the block diagram of BD1. Each block of BD1

SERVICE SHEET BD1 (cont'd)
Functional Description (cont'd)
is further detailed by the block diagram indicated in the lower right hand corner of each block on BD1. The following description is referenced to BD1. A more detailed description of each block accompanies the associated block diagram, BD2—BD10.

Time Base Reference. The Time Base Reference generates precise reference signals of 10, 20, 100 and 400 MHz. These frequencies are derived from an internal 10 MHz reference oscillator or from an external 5 or 10 MHz frequency source. The Time Base Reference subsystem consists of the following :

- 10 MHz Reference Oscillator
- Reference Phase Locked Loop

RF Phase Locked Loops. The two RF Phase Locked Loops are used to phase lock the YTO Summing Phase Locked Loop output frequency to the reference signals of the Time Base Reference. The RF Phase Locked Loops subsystem consists of the following:

- Low Frequency Source (LFS) Phase Locked Loop
- M/N Phase Locked Loop

The LFS phase locked loop controls the 1 kHz through 1 MHz digits of the YIG Tuned Oscillator (YTO) Summing phase locked loop. The M/N phase locked loop controls the 10 MHz to 1 GHz digits of the YTO Summing phase locked loop. The RF Phase Locked Loops subsystem is located in the A3 RF Source major assembly (M/N phase locked loop) and the A2 Digital Control Unit major assembly (LFS phase locked loop).

YIG Tuned Oscillator (YTO) Summing Phase Locked Loop. The YTO Summing phase locked loop generates baseband frequencies of 2.0 to 6.2 GHz directly using a YIG Tuned Oscillator (YTO). The YTO is phase locked to reference frequencies from the Low Frequency Source (LFS) phase locked loop and the M/N phase locked loop.

The output of the YTO is downconverted to a frequency between 20 and 30 MHz using a harmonic of the M/N frequency reference. This intermediate frequency is then phase compared to the output of the LFS phase locked loop and the YTO frequency is adjusted until the two frequencies are equal. Because the YTO output is downconverted instead of divided, a 1 kHz change in the reference signal from the LFS phase locked loop will change the output frequency of the YTO by 1 kHz.

The M/N phase locked loop output signal is used to tune the YTO output in 10 MHz steps and the LFS output signal is used to fine tune the YTO output over a 10 MHz range. Together, the M/N and LFS output signals control the YTO output frequency from 2 to 6.2 GHz in 1 kHz steps.

The YTO Summing Loop consists of the following assemblies:

- Digital to Analog Converter
- YIG Tuned Oscillator (YTO) Driver
- YTO Sampler
- YTO Phase Detector
- YTO High Frequency Driver

Microwave Signal Path. The Microwave Signal Path performs four basic functions:

- Multiplies the 2 to 6.2 GHz baseband signal from the YTO Summing phase locked loop to generate frequencies from 6.2 to 18 GHz.

- Amplifies the 2 to 6.2 GHz baseband signal to produce the specified power levels over the 2 to 18 GHz frequency range.

- Provides step attenuation (10 dB/step) to increase the dynamic range of the leveled RF output.

- Detects the output level to provide a feedback signal to the ALC circuitry.

The microwave signal path is contained in the A1 RF Output major assembly. The Microwave Signal Path consists of:

- RF Amplifier
- YIG Tuned Multiplier
- SRD Control
- Part of ALC Detector
- Part of RF Output Level Control

Automatic Level Control. The primary function of the ALC circuitry is to provide accurate calibrated output power over the CW Generator's 2 to 18 GHz frequency range. In addition, an external ALC input makes it possible to automatically control the level at a remote load.

SERVICE SHEET BD1 (cont'd)
Functional Description (cont'd)

Internal ALC detects the level at the output of the YIG Tuned Multiplier (YTM) using a directional coupler and a crystal detector. The output of the YTM is leveled over a −10 to +13 dBm range by the ALC circuitry. Additional dynamic range is provided by a 110 dB step attenuator to achieve leveled output as low as −120 dBm.

External ALC modes use an external crystal detector or a power meter's recorder output instead of the internal crystal detector to provide the feedback. During external leveling, the output power of the YTM should be kept within a −10 to +3 dBm range if possible. Setting the attenuation in the signal path too high may cause an unleveled condition if the output power available from the YTM is not enough to overcome the attenuation setting and the losses in the external signal path.

Crystal leveling requires the crystal detector to be operating in the square law region (the output of the detector is proportional to the detected power in watts). Operation outside the square law region will not allow the vernier to be calibrated over the 13 dB range.

Power meter leveling is slower than crystal detector leveling but has the advantages of temperature compensation and a much wider dynamic range (limited only by the power sensor). With automatic ranging power meters, the range must be held to prevent oscillations in the output level. The oscillations occur when the CW Generator responds to the range change (which rescales the feedback voltage) while the power meter settles. The result is that the power meter is continually trying to settle by changing ranges while the CW Generator is responding to each range change by setting the level outside of the new range.

DCU Remote/Local Interface. The DCU processes inputs from the front panel in local mode and the HP-IB in remote mode. In local mode, the operator enters data with the front panel switches and the TUNING knob. The TUNING knob is a Rotary Pulse Generator (RPG) which provides continuous control of frequency tuning. Selectable tuning resolution coupled with the RPG provides convenient control when setting output frequency.

DCU HP-IB Interface. Remote mode uses a combination of special ASCII program codes and arguments to simulate the front panel controls. The HP-IB Address assembly is used to decode the information on the HP-IB and to generate control signals for managing the input data. The HP-IB Interface assembly is used to decode the program codes and arguments so the DCU Frequency Control subsystem can alter the frequency setting of the instrument.

DCU Frequency Control. The DCU produces tuning information and frequency band related information based on the current front panel frequency. Tuning information comes from the DCU Remote/Local Interface as tuning and resolution for local mode, or actual frequency information for remote mode.

Each frequency change requires a cycling of the frequency data through three registers. Register 1 holds the front panel frequency, rounds the desired frequency according to the frequency resolution and decodes the appropriate frequency band. Register 2 divides the Register 1 frequency by 1, 2 or 3 to produce a baseband frequency and indicates whether the frequency is evenly divisible. Register 3 generates the tuning information for the phase locked loops to generate the appropriate baseband frequency.

Power Supplies. The power supplies supply all of the dc operating voltages required by the instrument. The +22 volt regulator is activated whenever power is supplied to the CW Generator. The reference oscillator's oven is powered by this supply to keep the crystal at operating temperature whenever the instrument is connected to line mains. The remaining voltage regulators are are not enabled until the front panel LINE switch is set to ON. The power supplies are located in the A3 RF Source major assembly.

TROUBLESHOOTING PROCEDURES

General

If the instrument is not operating properly in local mode, use the following Overall Level Procedure to isolate the problem to one of the nine subsystems. The appropriate Functional Level Procedures (associated with BD2—BD10) and Circuit Level Procedures (associated with Service Sheets 1—47) should then be followed to isolate the problem to the defective assembly within the subsystem, and then to the defective component within the defective assembly.

SERVICE SHEET BD1 (cont'd)

General (cont'd)

Once the defective component has been replaced, perform the Overall Level Procedure again to check for other possible malfunctions.

When the Overall Level Procedure can be performed with no failures, do the Abbreviated Performance Test procedures in Section IV before placing the instrument back into service.

Overall Level Procedure

The Overall Level Procedure is divided into seven checks, as follows:

Turn-On Check ⟨√1⟩

Power Supply Checks ⟨√2⟩

Front Panel Checks ⟨√3⟩

Baseband (2—6.2 GHz) Checks ⟨√4⟩ and ⟨√5⟩

- YTO Frequency Check ⟨√4a⟩
- Reference Phase Locked Loop Check ⟨√4b⟩
- LFS Phase Locked Loop Check ⟨√4c⟩
- M/N Phase Locked Loop Check ⟨√4d⟩
- YTO Power Check ⟨√5⟩

Output Level Check ⟨√6⟩

ALC Check ⟨√7⟩

The seven checks should be run in sequence because each check assumes that previous checks have been performed and no malfunctions have occurred. Also, because of the interrelationship of the various subsystems of the CW Generator, it is difficult to determine which subsystem is at fault without performing the checks in the order indicated. If a remote programming problem is suspected, do the seven checks. If no problems are found, begin the remote programming troubleshooting with Service Sheet BD7.

Troubleshooting Hints

Before troubleshooting power problems, ensure that the output frequency is correct. Incorrect frequency tuning can cause severe power holes due to internal filtering. In addition, a phase locked loop can phase lock on an incorrect frequency if the tuning data is incorrect. Therefore, always perform the frequency checks before attempting to troubleshoot power problems.

Power problems can be caused by a mistuned YTM. If the LVL UNCAL annunciator is on, adjust the CW Generator's PEAK/NORM control. If adjusting the control extinguishes the annunciator, the problem is probably an adjustment problem. Drift problems in the YTM will show up as power problems either immediately after tuning to a frequency above 16 GHz or after a settling period of about 10 minutes. A test for correct adjustment to minimize the effects of YTM drift is found on BD5.

Test Equipment:

Frequency Counter	HP 5343A
Digital Voltmeter	HP 3456A
Power Meter	HP 436A
Oscilloscope	HP 1980B

Turn-On Check ⟨√1⟩

1. Set the LINE switch to STANDBY. Remove all external cables from the front and rear panels of the CW Generator, including the line cord.

2. Set the rear panel FREQ STANDARD INT /EXT switch to INT and connect the short jumper (A3W3) between A3J9 and A3J10.

3. After the line cord has been disconnected from the CW Generator for at least one minute, reconnect the line cord and check for the following indications:

   The front panel STANDBY and OVEN annunciators should be lighted. The fan should be off. All of these indications are controlled by the +22V power supply which is on whenever the line cord is connected.

   If the above indications are correct, proceed with Step 6.

   If any of the above indications are incorrect, proceed with with Step 4.

4. Remove the top cover and observe the +22V indicator on A3A2 Rectifier assembly.

   If the +22V indicator is on and the STANDBY and/or OVEN annunciators are off, check the associated incandescent bulb and proceed with Step 6.

   If the indicator is off, proceed with Step 5.

5. Observe the Primary "ON" indicator. This indicator is located on the A3 motherboard

SERVICE SHEET BD1 (cont'd)
Turn-On Check (cont'd)

and can be checked by removing the CW Generator's bottom cover.

If this indicator is ON, the transformer is on and there is power at the input of the +22 volt regulator. Go to BD10 to further isolate the problem.

If the indicator is off, check that the fuse is not open and that the Voltage Selection Card is properly installed. See Section II for the Voltage Selection Card installation procedure.

NOTE

An improper voltage selection can cause all supplies to be on, but too low in voltage. This is indicated by dim front panel displays.

Once the repair or adjustments have been completed, repeat steps 1 through 5.

6. Leave the LINE switch set to STANDBY until the OVEN annunciator turns off. This should occur within 15 minutes or less depending on how long the CW Generator was disconnected from main power.

   Once the OVEN annunciator turns off, set the LINE switch to ON.

   NOTE

   The OVEN annunciator may flicker on and off temporarily just as the oven stabilization temperature is reached. This is normal.

   The FREQUENCY MHz display should show a frequency between 2.0 and 18.599 997 GHz. If frequency is not within these limits or the display is not stable, press the PRESET (3 GHz) key.

   If the display is within the given range or can be preset to 3 GHz, proceed with step 7 to confirm proper operating voltages.

   If the display indicates a frequency outside the given range or cannot be stabilized, proceed with step 7 to check the power supply voltages. If the voltages are correct, go to BD9 to troubleshoot the frequency control portion of the Digital Control Unit (DCU).

Power Supply Checks ⟨√2⟩

7. An improper operating voltage can manifest itself in unpredictable ways. Therefore, check the power supply voltages before continuing with any troubleshooting.

   Remove the top cover and check the voltages at the following test points.

Test Point	Voltage
A3A3TP1	+22 ± 0.2 Vdc
A3A3TP6	+11 ± 1.1 Vdc
A3A3TP5	+20 ± 0.002 Vdc
A3A3TP2	+5.2 ± 0.1 Vdc
A3A4TP5	−5.2 ± 0.05 Vdc
A3A4TP1	−40.0 +0.6, −1.0 Vdc
A3A4TP4	−10.0 ± 0.2 Vdc

   If any voltage is incorrect, proceed to Power Supply adjustments in Section V and attempt to adjust the faulty output to the correct voltage.

   If the voltage cannot be adjusted, proceed to BD10 to isolate the power supply fault.

   If any adjustments or repairs are required, repeat this procedure from Step 1 after making the appropriate adjustments or repairs.

   If all voltages are correct, proceed with Step 8.

Front Panel Checks ⟨√3⟩

8. Press PRESET (3 GHz) to set the CW Generator's frequency to 3 GHz. Set the remainder of the front panel controls as follows:

RF OUTPUT	OFF
PEAK-NORM	NORM (in detent)
RANGE	fully counter-clockwise
VERNIER	fully counter-clockwise
ALC	INT
ALC CAL	fully clockwise

9. Press the HOLD key. Verify that the CW Generator's displays indicate the following conditions:

RANGE dB	−110 dB
Meter	<−10 dBm
ALC	INT and LVL UNCAL
RF	OFF
FREQUENCY	3000.000 MHz
RESOLUTION	All four segments extinguished
STATUS	OVEN may be lighted. NOT PHASE LOCKED should be lighted. All others should be extinguished.

SERVICE SHEET BD1 (cont'd)
Front-Panel Checks (cont'd)

If the displays are correct, proceed with step 10.

If any display is incorrect, proceed to BD7 to isolate the problem to either the front panel or the DCU.

10. Set the ALC selector to XTAL and then PWR MTR while observing the ALC annunciators.

    The XTAL and P MTR annunciators should light when the ALC selector is in the corresponding position. The LVL UNCAL annunciator should remain on.

    If the indication is correct, set the ALC selector to INT and continue with step 11.

    If any or all indications are incorrect, go to BD7 to isolate the problem to the front panel or the DCU.

11. Set the RF OUTPUT switch to on.

    The RF ON annunciator should light and the RF OFF annunciator should extinguish. In addition, the LVL UNCAL annunciator in the ALC block and the NOT PHASE LOCKED annunciator in the STATUS block should also extinguish.

    If the RF annunciator indication is correct, continue with step 12. The LVL UNCAL and NOT PHASE LOCKED annunciators will be checked in subsequent steps.

    If the RF annunciator indication is not correct, proceed to BD7 to isolate the problem to the front panel or the DCU.

13. Press the rightmost FREQUENCY RESOLUTION key and verify that all of the segments under the FREQUENCY MHz display light.

    If the indication is correct, proceed with step 14.

    If the indication is not correct, go to Service Sheet 31 to troubleshoot the frequency resolution circuitry.

14. Press each of the remaining FREQUENCY RESOLUTION keys in a right to left sequence. Verify that each subsequent key lights the segment above the key and all segments to the left of the key. The segments to the right of the key should extinguish.

    If the indication is correct, proceed with step 15.

    If the indication is not correct, go to Service Sheet 31 to troubleshoot the frequency resolution circuitry.

15. Press the HOLD key and verify that all the lighted segments under the FREQUENCY MHz display are extinguished.

    If all of the segments extinguish, proceed with step 16.

    If the segments do not extinguish, go to Service Sheet 31 to troubleshoot the frequency resolution circuitry.

16. Press the rightmost FREQUENCY RESOLUTION key. Tune the frequency using the TUNING knob. The frequency should increment in 1 kHz steps when the TUNING knob is turned clockwise, and decrement in 1 kHz steps when turned counter-clockwise. Do not tune above 6 GHz in this step to avoid changing frequency resolution.

    If the frequency can be tuned in 1 kHz steps, proceed with step 17.

    If the frequency cannot be tuned, go to BD9 to troubleshoot the DCU frequency control circuitry.

17. Repeat step 16 for the other three FREQUENCY RESOLUTION keys. Each key should allow tuning of the digit over the rightmost lighted segment.

    If the frequency can be tuned using all available tuning resolutions, proceed with the Baseband Check beginning with step 18.

    If the frequency cannot be tuned for one or all selected tuning resolutions, go to Service Sheet 31 to troubleshoot the frequency resolution circuitry.

SERVICE SHEET BD1 (cont'd)
Baseband Checks

YTO Frequency Check ⟨√4a⟩

18. Disconnect the semi-rigid coax from the output of coupler A3A9J1 (BD1 TPH), and connect the frequency counter in its place. Connect the frequency reference (10 MHz) output of the frequency counter to A3J10 on the CW Generator's rear panel. Set the FREQ STANDARD INT/EXT switch to EXT. With a common timebase, the frequency counter will agree with the CW Generator's front panel frequency within ± 1 count for any selected frequency counter resolution.

19. Set the frequency to each of the frequencies listed below.

    The CW Generator should remain phase locked at each frequency and the frequency counter should agree with the CW Generator's frequency display ± 1 count.

Frequency (MHz)	LFS Divider Number (N1)
2 000.000	3000.0
2 000.001	2999.9
2 001.112	2888.8
2 002.223	2777.7
2 003.334	2666.6
2 004.445	2555.5
2 005.556	2444.4
2 006.667	2333.3
2 007.778	2222.2
2 008.889	2111.1
2 009.999	2000.1

If the instrument remains phase locked for all of the frequencies, proceed with step 20.

If the frequency is not correct or the NOT PHASE LOCKED annunciator is lighted at any or all frequencies, proceed with the Reference Phase Locked Loop check beginning with step 21.

20. Set the CW Generator frequency to each of the frequencies listed below.

    The CW Generator should remain phase locked at each frequency and the frequency counter should agree with the CW Generator's frequency display ± 1 count.

Frequency (MHz)	M/N Divider Numbers	
	M	N
2 090.000	8	11
2 280.000	9	12
2 470.000	10	13
2 660.000	11	14
2 850.000	12	15
3 040.000	13	16
3 230.000	14	17
3 420.000	15	18
3 610.000	16	19
3 800.000	17	20
3 990.000	18	21
4 180.000	19	22
4 370.000	20	23
4 560.000	21	24
4 750.000	22	25
4 940.000	23	26
5 130.000	24	27
5 320.000	25	28
5 510.000	26	29
5 700.000	27	30
5 900.000	27	31
6 100.000	27	32

If the instrument remains phase locked for all of the frequencies, proceed with the YTO Power Check beginning with step 26.

If the frequency is not correct or the NOT PHASE LOCKED annunciator is lighted at any or all frequencies, proceed with the Reference Phase Locked Loop check beginning with step 21.

Reference Phase Locked Loop Check ⟨√4b⟩

21. With the frequency counter and CW Generator using a common timebase (see step 18), check the frequency at the following test points.

Test Point	Frequency
TPA	100 MHz
TPB	10 MHz
TPD	10 MHz
TPE	400 MHz
TPC	20 MHz

SERVICE SHEET BD1 (cont'd)

Reference Phase Locked Loop Check (cont'd)

If the frequency counter agrees with the values indicated ± 1 count, proceed with the LFS Phase Locked Loop check beginning with step 22.

If any or all of the frequencies are incorrect, go to BD2 to isolate the problem.

LFS Phase Locked Loop Check (√4c)

22. Disconnect the green cable from A2A3J1 (BD1 TPF) and connect the frequency counter in its place.

23. Set the CW Generator frequency to each of the frequencies listed below.

    The CW Generator should remain phase locked at each frequency and the frequency counter should agree with the given frequency ± 1 count.

CW Generator Frequency (MHz)	LFS Output (MHz)
2 000.000	30.000
2 000.001	29.999
2 001.112	28.888
2 002.223	27.777
2 003.334	26.666
2 004.445	25.555
2 005.556	24.444
2 006.667	23.333
2 007.778	22.222
2 008.889	21.111
2 009.999	20.001

If the frequencies are correct, proceed with step 24, M/N Phase Locked Loop Check.

If one or more of the frequencies are incorrect, proceed to BD3 to isolate the problem within the LFS Phase Locked Loop.

M/N Phase Locked Loop Check (√4d)

24. Reconnect the green cable to A2A3J1 and disconnect the white/orange cable from A3A1A5J3 (TPG). Connect the frequency counter to A3A1A5J3.

25. Set the CW Generator frequency to each of the frequencies listed below.

    The CW Generator should remain phase locked at each frequency and the frequency counter should agree with the given frequency within ± 1 count.

CW Generator Frequency (MHz)	M/N Frequency (MHz)
2 090.000	192.727273
2 280.000	192.500000
2 470.000	192.307692
2 660.000	192.142857
2 850.000	192.000000
3 040.000	191.875000
3 230.000	191.764706
3 420.000	191.666667
3 610.000	191.578947
3 800.000	191.500000
3 990.000	191.428571
4 180.000	191.363636
4 370.000	191.304348
4 560.000	191.250000
4 750.000	191.200000
4 940.000	191.153846
5 130.000	191.111111
5 320.000	191.071429
5 510.000	191.034483
5 700.000	191.000000
5 900.000	191.290323
6 100.000	191.562500

If the frequencies are correct, the YTO Summing phase locked loop is at fault. Go to to BD4 to isolate the problem.

If any frequency is not correct, go to to BD3 to isolate the problem in the M/N phase locked loop.

When the problem has been corrected, repeat the procedure from Step 1.

YTO Power Check (√5)

26. Disconnect the frequency counter and connect the power meter to BD1 TPH.

27. Tune the Signal Generator from 2 000.000 MHz to 6 100.000 MHz, in 100 MHz steps and verify that the power is greater than +14 dBm for each frequency.

    If the level is correct, reconnect the cable to BD1 TPH and proceed with the output level check beginning with step 28.

SERVICE SHEET BD1 (cont'd)

YTO Power Check (cont'd)

If the level is low at any or all points, proceed to BD4 to isolate the problem.

Output Level Check (✓8)

28. Connect the power meter to the CW Generator's RF OUTPUT connector.

29. Set the CW Generator's ALC selector to XTAL. Set the RANGE to 0 dB and remove the input (if any) from the external ALC input.

30. Tune the CW Generator from 2 to 18 GHz in 100 MHz steps. With no feedback at the external ALC input, the CW Generator will deliver maximum available output power.

    The power should not drop below +8 dBm for any frequency.

    If the power does not drop below +8 dBm for any frequency, proceed with the ALC Check beginning with step 31.

    If the output level is low at any or all frequencies, go to BD5 to isolate the problem.

ALC Check (✓7)

31. Set the CW Generator to 2 GHz and set the ALC selector to INT. Set the RANGE to 0 dB and adjust the VERNIER for a +3 dBm indication on the CW Generator's front panel meter.

    The power meter should indicate +3 dBm ± 2 dB.

    If the power is correct, proceed with step 32.

    If the LVL UNCAL annunciator is on, go to BD6 to isolate the problem in the ALC circuitry.

    If the level is incorrect, attempt the ALC adjustments in Section V. If the level cannot be adjusted, go to BD5 to isolate the problem.

32. Tune from 2 to 18 GHz in 100 MHz steps.

    The output level should remain fairly constant and the LVL UNCAL annunciator should remain off.

    If the indication is correct, proceed with step 33.

    If the LVL UNCAL annunciator lights at any frequency, go to BD6 to isolate the problem.

    If the level changes more than 3 dB for any frequency, attempt the Flatness adjustment in Section V. If the flatness cannot be adjusted, go to BD6 to isolate the problem.

33. If a power problem is still suspected, go to BD6 to check the ALC circuitry.

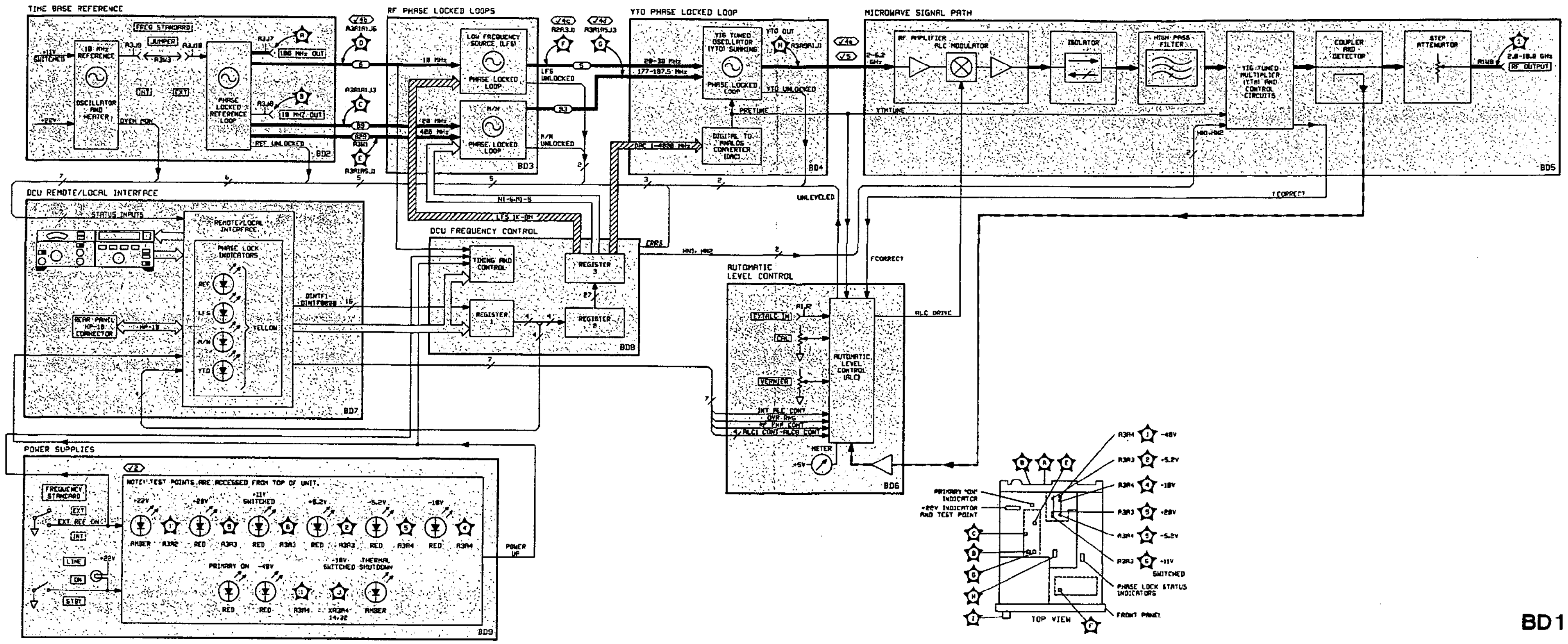


Figure 8-15. Overall Troubleshooting Block Diagram

SERVICE SHEET BD2

TIME BASE REFERENCE

REFERENCES

- Overall Block Diagram .... Service Sheet BD1
- Disassembly Procedures .... Service Sheet A
- Interior Views .... Service Sheet B
- Replaceable Parts List .... Section VI
- Illustrated Parts Breakdown (IPB) .... Section VI
- Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

The Time Base Reference generates precise reference signals of 10, 20, 100 and 400 MHz. These frequencies are derived from an internal oven controlled 10 MHz crystal oscillator or from an external 5 or 10 MHz frequency source. The 10, 20 and 400 MHz reference signals are used as frequency references for the M/N Phase Locked Loop, the Low Frequency Source (LFS) Phase Locked Loop and the Digital Control Unit (DCU). Two reference frequencies (10 and 100 MHz) are available on the rear panel of the instrument.

The Time Base Reference consists of two sections:

- Reference Phase Locked Loop Phase Detector, Service Sheet 1
- Reference Phase Locked Loop Oscillator and Frequency Multiplier, Service Sheet 2

The Reference Phase Locked Loop Oscillator and Frequency Multiplier section contains a 100 MHz voltage controlled crystal oscillator (VCXO) which is phase locked to the 10 MHz Reference Oscillator (or external 5 or 10 MHz frequency source). The output of the 100 MHz VCXO is routed to the rear panel for use as an external frequency reference and to the Reference Phase Detector and the quadrupler.

The quadrupler produces a 400 MHz reference that is used in the M/N Phase Locked Loop for downconversion of the M/N VCO output. The level of the 400 MHz reference is critical for suppression of spurious mixing products and is adjusted for a −10 to −13 dBm level (see Section V, Adjustments).

The Reference Phase Detector divides the 100 MHz VCXO output by 5 to produce the 20 MHz reference signal and then divides the 20 MHz reference by 2 to produce three 10 MHz reference signals. One of the 10 MHz reference signals is routed to the rear panel for use as an external reference and a second is terminated inside the instrument. The third is used by the phase detection circuitry to generate the tuning voltage for the 100 MHz VCXO.

All three reference signals are phase locked to the internal 10 MHz crystal oscillator signal which produces reference frequencies with accuracy comparable to the internal 10 MHz crystal oscillator.

SERVICE SHEET BD2 (cont'd)

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet BD1 has been used to isolate a malfunction to the Time Base Reference, BD2. The following troubleshooting procedure can be used to further isolate the problem to one of the following assemblies:

- 10 MHz Reference Oscillator
- Reference Phase Detector
- 100 MHz VCXO

Test Equipment Required

Frequency Counter	HP 5343A
Variable Power Supply	HP 6200B
Digital Voltmeter	HP 3456A
Spectrum Analyzer	HP 8566B

Troubleshooting Procedure

This procedure is divided into two separate checks:

Reference Oscillator Check ✓1
100 MHz VCXO Check ✓2

If the Reference Oscillator and the 100 MHz VCXO are operating normally, then the problem is probably in the Reference Phase Detector.

Reference Oscillator Check ✓1

1. Remove the gray jumper (8) from A3J9 on the rear panel and connect the frequency counter in its place.

   Verify that the frequency counter reads 10 MHz ±30 Hz.

   If the frequency is incorrect, the Reference Oscillator is defective or requires adjustment. Proceed to the 10 MHz Reference Oscillator Adjustment procedure in Section V and attempt to adjust it. If it cannot be adjusted, replace the Reference Oscillator assembly.

   If the frequency is correct, proceed with Step 2.

2. Remove the frequency counter and connect the spectrum analyzer to A3J9.

   Verify that the spectrum analyzer shows a 10 MHz signal at a level of at least +7 dBm.

   If the power is not correct, the reference oscillator is defective, or requires adjustment. Proceed to the 10 MHz Reference Oscillator Adjustment procedure in Section V and attempt to adjust the

Overall Block Diagram and Troubleshooting SERVICE SHEET BD1

SERVICE SHEET BD3
RF PHASE LOCKED LOOPS
REFERENCES

- Overall Block Diagram .... Service Sheet BD1
- Disassembly Procedures .... Service Sheet A
- Interior Views .... Service Sheet B
- Illustrated Parts Breakdown (IPB) .... Section VI
- Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The two RF Phase Locked Loops are used to phase lock the YTO Summing phase locked loop output frequency to the reference signals of the Time Base Reference (BD2). The two RF Phase Locked Loops are:

- The Low Frequency Source (LFS) phase locked loop, which is used to control the 1 kHz through 1 MHz digits of the YIG Tuned Oscillator (YTO) Summing phase locked loop output frequency.
- The M/N phase locked loop, which controls the 10 MHz to 1 GHz digits of the YTO Summing phase locked loop output frequency.

Low Frequency Source (LFS) Phase Locked Loop

The LFS phase locked loop synthesizes the 1 MHz, 100 kHz, 10 kHz and 1 kHz digits of the YTO Summing phase locked loop output frequency. The LFS phase locked loop synthesizes an output frequency that can be set between 20.001 MHz and 30.000 MHz with 1 kHz resolution. The Digital Control Unit (DCU) decodes the four least significant digits of the desired YTO Summing phase locked loop frequency and sends tuning data to the LFS phase locked loop as 16 bits, LFS 1K—8M. The data sets the LFS phase locked loop output frequency. The LFS phase locked loop output frequency is given by the following equation:

$f_{LFS} = 30 - x.xxx$ MHz

where:
f_{LFS} = the LFS phase locked loop output frequency, and x.xxx signifies the four least significant digits of the YTO Summing phase locked loop frequency.

The YTO Summing phase locked loop frequency can be calculated from the instrument's output frequency by using the following equations:

Band 1 (2—6.2 GHz) $f_{YTO}=f_{OUT}$

Band 2 (6.2—12.4 GHz) $f_{YTO}=f_{OUT/2}$

Band 3 (12.4—18 GHz) $f_{YTO}=f_{OUT/3}$

where:
f_{YTO} = the YTO Summing phase locked loop output frequency f_{OUT} = the instrument's output frequency.

The LFS phase locked loop consists of three assemblies:

SERVICE SHEET BD3 (cont'd)

- 20/30 Divider
- 20/30 Phase Detector
- 160—240 MHz VCO

Inputs to the 20/30 MHz Divider are the 10-MHz reference signal from the Time Base Reference (BD2), and 16 bits of digital information (LFS 1K—8M) from the A2A8 Output Register assembly. A feedback signal from the 160—240 MHz VCO Assembly is also an input to the 20/30 MHz Divider assembly.

The divide by 10/11 prescaler output, in conjunction with a programmable divider, generates a nominal 80 kHz output when the LFS phase locked loop is locked. In the 20/30 Phase Detector Assembly, this signal is phase compared to the 80 kHz reference signal (10 MHz divided by 125) to generate a pulse whose width is proportional to the phase difference (error) between the two signals at the input of the phase detector.

The error signal is integrated to obtain a dc tuning voltage, which keeps the VCO frequency tuned to produce a minimum error. If the error signal indicates a large phase error, the Phase Lock Detector will light the NOT PHASE LOCKED status annunciator on the front panel.

The 160-240 MHz VCO Assembly contains a voltage controlled oscillator that is controlled by the TUNE OUT signal from the 20/30 Phase Detector. The VCO can be tuned from 160.008 to 240 MHz with 1 kHz resolution. The oscillator output is routed to the 20/30 Divider assembly after being filtered and is used as the feedback signal for the LFS phase locked loop.

The 160-240 MHz VCO output is also divided by eight and filtered to obtain a relatively clean signal between 20.001 MHz and 30.000 MHz. This signal is used as a reference for the YTO Summing phase locked loop.

M/N Phase Locked Loop

The M/N phase locked loop synthesizes the 10 MHz through 1 GHz digits of the YTO Summing phase locked loop output frequency. The output of the M/N phase locked loop is a signal between 177 and 197.5 MHz. The DCU decodes the four most significant digits of the YTO Summing phase locked loop frequency and sends tuning data to the M/N phase locked loop as two binary numbers (M and N). The data sets the output of the M/N phase locked loop which is used as a reference for the YTO Summing phase locked loop. The M/N phase locked loop output frequency is given by the following equation:

$f_{M/N}=[200-10(M/N)]$ MHz

where:
$f_{M/N}$ = M/N frequency out
M = M number
N = N number

A single step in the tuning of the M/N phase locked loop produces a 10 MHz step in the output frequency of the YTO Summing phase

SERVICE SHEET BD3 (cont'd)

locked loop. Smaller steps are controlled by the LFS phase locked loop and together the RF Phase Locked Loops control the YTO Summing phase locked loop over a 2000.000 to 6199.999 MHz range with 1 kHz resolution.

The M/N phase locked loop consists of three assemblies:

- M/N Phase Detector
- M/N Voltage Controlled Oscillator (VCO)
- M/N Output

Inputs to the M/N Phase Detector are a 20 MHz reference signal from the Time Base Reference (BD2), and 11 bits of information from the A2A8 Output Register assembly. A feedback signal from the M/N VCO is downconverted using the 400 MHz reference from the Time Base Reference and is the other input to the M/N Phase Detector.

The M divider and N divider are used to scale the two phase detector input frequencies for phase comparison by the phase/frequency detector. Using two dividers in the M/N Phase Detector gives the phase locked loop a larger range than using a single divider. The output of the phase/frequency detector is integrated to generate a tuning voltage for the M/N VCO. The VCO is tuned to produce a minimum phase/frequency error between the outputs of the two dividers. If a large error is detected, the Unlock Detector lights the front panel NOT PHASE LOCKED annunciator on the front panel.

The M/N VCO assembly contains a voltage controlled oscillator that is controlled by the TUNE signal from the M/N Phase Detector. The VCO can be tuned from 355 to 495 MHz and is set so that the Nth harmonic of the M/N phase locked loop frequency is within 20 to 30 MHz of the desired YTO Summing phase locked loop frequency.

The M/N Output assembly splits the M/N VCO output into two paths. One path serves as the feedback path to the M/N Phase Detector. The M/N VCO output is downconverted to a 5 to 45 MHz signal by mixing the signal with the 400 MHz reference from the Time Base Reference. The amplitude of the 400 MHz reference signal is critical in this process to minimize spurious mixing products which would otherwise create spurious signals in the M/N phase locked loop output. The other path divides the M/N VCO output by two and amplifies it for use in the YTO Summing phase locked loop.

Table 8-3 lists the M and N numbers, M/N output frequencies and YTO frequencies for all valid M/N phase locked loop output frequencies.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet BD1 was used to isolate the problem to either or both of the following:

SERVICE SHEET BD3 (cont'd)

- LFS Phase Locked Loop
- M/N Phase Locked Loop

When troubleshooting the phase locked loops, always ensure that the reference frequencies used by the phase locked loop in question are correct. Signal level and frequency are important for correct operation of the phase locked loop. The following troubleshooting procedures can be used to further isolate the problem to one of the following subassemblies:

LFS Phase Locked Loop
- 20/30 Divider
- 20/30 Phase Detector
- 160—240 MHz VCO

M/N Phase Locked Loop
- M/N Phase Detector
- M/N VCO
- M/N Output

Test Equipment Required

Frequency Counter .... HP 5343A
Oscilloscope .... HP 1980B
Digital Voltmeter .... HP 3456A
Spectrum Analyzer .... HP 8566B

Troubleshooting Procedures

The following procedures are divided into ten checks, as follows:

LFS Phase Locked Loop Checks
- 10 MHz Reference Check (✓1)
- 160—240 MHz VCO Check (✓2)
- 20/30 Divider Check (✓3)
- 20/30 Phase Detector Check (✓4)

M/N Phase Locked Loop Checks
- 20 MHz Reference Check (✓5)
- 400 MHz Reference Check (✓6)
- M/N Phase Detector Check (✓7)
- 200 kHz Filter Check (✓8)
- M/N VCO Check (✓9)
- M/N Output Check (✓10)

LFS Phase Locked Loop Troubleshooting

10 MHz Reference Check (✓1)

1. Remove blue (6) cable from J2 of A2A12 motherboard and connect it to the frequency counter.

   The frequency should be 10 MHz ±30 Hz. If the frequency is correct, proceed with step 2.

   If the frequency is not correct, the Time Base Reference is at fault. Proceed to BD2 to troubleshoot the Time Base Reference.

SERVICE SHEET BD3 (cont'd)

160—240 MHz VCO Check (✓2)

2. Reconnect the blue cable to A2A12J2.

3. Remove A2A3 160—240 MHz VCO, set the A2A3S1 Test Switch to Test High Freq, and replace A2A3. This opens the LFS phase locked loop by placing a fixed voltage on the VCO control input.

4. Disconnect the red (2) cable from A2A3J2 160-240 MHz OUTPUT (TPA) and connect the frequency counter in its place.

   The frequency should be greater than 240 MHz.

   If the frequency is correct, proceed with step 5.

   If the frequency is not correct, A2A3 160—240 MHz VCO is at fault. Go to Service Sheet 8 to isolate the problem.

5. Remove A2A3 160—240 MHz VCO, set the Test Switch to TEST LO FREQ, and replace A2A3 160—240 MHz VCO.

   The frequency counter should read a frequency less than 160 MHz.

   If the frequency is correct, reconnect the red (2) cable to A2A3J2 and proceed with step 6.

   If the frequency is not correct, A2A3 160—240 MHz VCO is at fault. Go to Service Sheet 8 to isolate the problem.

6. Disconnect the green (5) cable from A2A3J1 (TPG) and connect the frequency counter in its place.

   The frequency should be less than 20 MHz.

   If the frequency is correct, proceed with step 7.

   If the frequency is not correct, A2A3 160—240 MHz VCO is at fault. Go to Service Sheet 8 to troubleshoot.

7. Remove A2A3 160—240 MHz VCO, set the Test Switch to TEST HIGH FREQUENCY, and replace A2A3 160—240 MHz VCO.

   The frequency counter should indicate a frequency greater than 30 MHz.

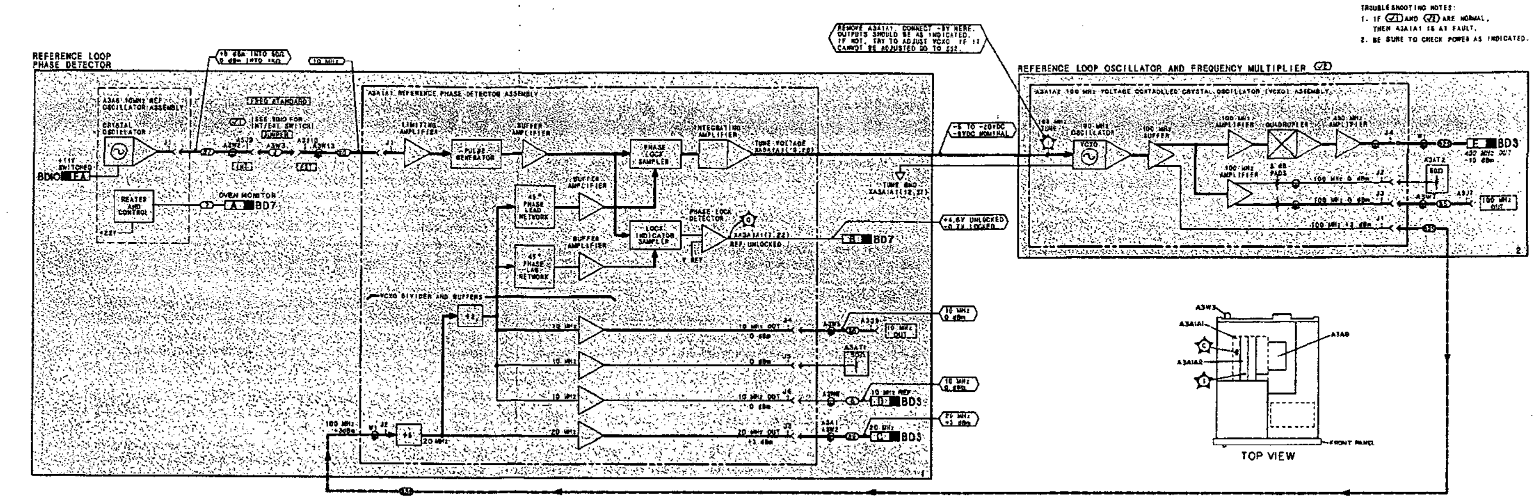
   If the frequency is correct, reconnect the green (5) cable and proceed with (✓3) 20/30 Divider Check beginning with step 8.

   If the frequency is not correct, A2A3 160—240 MHz VCO is at fault. Go to Service Sheet 8 to troubleshoot.

Time Base Reference SERVICE SHEET BD2

Table 8-3. M and N Numbers and Resulting Frequencies (1 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
2000	17	11	184.545455	2500	27	14	180.714286
2010	16	11	185.454545	2510	26	14	181.428571
2020	15	11	186.363636	2520	25	14	182.142857
2030	14	11	187.272727	2530	24	14	182.857143
2040	13	11	188.181818	2540	23	14	183.571429
2050	12	11	189.090909	2550	22	14	184.285714
2060	11	11	190.000000	2560	21	14	185.000000
2070	10	11	190.909091	2570	20	14	185.714286
2080	9	11	191.818182	2580	19	14	186.428571
2090	8	11	192.727273	2590	18	14	187.142857
2100	27	12	177.500000	2600	17	14	187.857143
2110	26	12	178.333333	2610	16	14	188.571429
2120	25	12	179.166667	2620	15	14	189.285714
2130	24	12	180.000000	2630	14	14	190.000000
2140	23	12	180.833333	2640	13	14	190.714286
2150	22	12	181.666667	2650	12	14	191.428571
2160	21	12	182.500000	2660	11	14	192.142857
2170	20	12	183.333333	2670	10	14	192.857143
2180	19	12	184.166667	2680	9	14	193.571429
2190	18	12	185.000000	2690	8	14	194.285714
2200	17	12	185.833333	2700	27	15	182.000000
2210	16	12	186.666667	2710	26	15	182.666667
2220	15	12	187.500000	2720	25	15	183.333333
2230	14	12	188.333333	2730	24	15	184.000000
2240	13	12	189.166667	2740	23	15	184.666667
2250	12	12	190.000000	2750	22	15	185.333333
2260	11	12	190.833333	2760	21	15	186.000000
2270	10	12	191.666667	2770	20	15	186.666667
2280	9	12	192.500000	2780	19	15	187.333333
2290	8	12	193.333333	2790	18	15	188.000000
2300	27	13	179.230769	2800	17	15	188.666667
2310	26	13	180.000000	2810	16	15	189.333333
2320	25	13	180.769231	2820	15	15	190.000000
2330	24	13	181.538462	2830	14	15	190.666667
2340	23	13	182.307692	2840	13	15	191.333333
2350	22	13	183.076923	2850	12	15	192.000000
2360	21	13	183.846154	2860	11	15	192.666667
2370	20	13	184.615385	2870	10	15	193.333333
2380	19	13	185.384615	2880	9	15	194.000000
2390	18	13	186.153846	2890	8	15	194.666667
2400	17	13	186.923077	2900	27	16	183.125000
2410	16	13	187.692308	2910	26	16	183.750000
2420	15	13	188.461538	2920	25	16	184.375000
2430	14	13	189.230769	2930	24	16	185.000000
2440	13	13	190.000000	2940	23	16	185.625000
2450	12	13	190.769231	2950	22	16	186.250000
2460	11	13	191.538462	2960	21	16	186.875000
2470	10	13	192.307692	2970	20	16	187.500000
2480	9	13	193.076923	2980	19	16	188.125000
2490	8	13	193.846154	2990	18	16	188.750000



BD2

Figure 8-16. Time Base Reference Block Diagram

Table 8-3. M and N Numbers and Resulting Frequencies (2 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
3000	17	16	189.375000	3520	25	19	186.842105
3010	16	16	190.000000	3530	24	19	187.368421
3020	15	16	190.625000	3540	23	19	187.894737
3030	14	16	191.250000	3550	22	19	188.421053
3040	13	16	191.875000	3560	21	19	188.947368
3050	12	16	192.500000	3570	20	19	189.473684
3060	11	16	193.125000	3580	19	19	190.000000
3070	10	16	193.750000	3590	18	19	190.526316
3080	9	16	194.375000	3600	17	19	191.052632
3090	8	16	195.000000	3610	16	19	191.578947
3100	27	17	184.117647	3620	15	19	192.105263
3110	26	17	184.705882	3630	14	19	192.631579
3120	25	17	185.294118	3640	13	19	193.157895
3130	24	17	185.882353	3650	12	19	193.684211
3140	23	17	186.470588	3660	11	19	194.210526
3150	22	17	187.058824	3670	10	19	194.736842
3160	21	17	187.647059	3680	9	19	195.263158
3170	20	17	188.235294	3690	8	19	195.789474
3180	19	17	188.823529	3700	27	20	186.500000
3190	18	17	189.411765	3710	26	20	187.000000
3200	17	17	190.000000	3720	25	20	187.500000
3210	16	17	190.588235	3730	24	20	188.000000
3220	15	17	191.176471	3740	23	20	188.500000
3230	14	17	191.764706	3750	22	20	189.000000
3240	13	17	192.352941	3760	21	20	189.500000
3250	12	17	192.941176	3770	20	20	190.000000
3260	11	17	193.529412	3780	19	20	190.500000
3270	10	17	194.117647	3790	18	20	191.000000
3280	9	17	194.705882	3800	17	20	191.500000
3290	8	17	195.294118	3810	16	20	192.000000
3300	27	18	185.000000	3820	15	20	192.500000
3310	26	18	185.555556	3830	14	20	193.000000
3320	25	18	186.111111	3840	13	20	193.500000
3330	24	18	186.666667	3850	12	20	194.000000
3340	23	18	187.222222	3860	11	20	194.500000
3350	22	18	187.777778	3870	10	20	195.000000
3360	21	18	188.333333	3880	9	20	195.500000
3370	20	18	188.888889	3890	8	20	196.000000
3380	19	18	189.444444	3900	27	21	187.142857
3390	18	18	190.000000	3910	26	21	187.619048
3400	17	18	190.555556	3920	25	21	188.095238
3410	16	18	191.111111	3930	24	21	188.571429
3420	15	18	191.666667	3940	23	21	189.047619
3430	14	18	192.222222	3950	22	21	189.523810
3440	13	18	192.777778	3960	21	21	190.000000
3450	12	18	193.333333	3970	20	21	190.476190
3460	11	18	193.888889	3980	19	21	190.952381
3470	10	18	194.444444	3990	18	21	191.428571
3480	9	18	195.000000	4000	17	21	191.904762
3490	8	18	195.555556	4010	16	21	192.380952
3500	27	19	185.789474	4020	15	21	192.857143
3510	26	19	186.315789	4030	14	21	193.333333

Table 8-3. M and N Numbers and Resulting Frequencies (3 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
4050	12	21	194.285714	4550	22	24	190.833333
4060	11	21	194.761905	4560	21	24	191.250000
4070	10	21	195.238095	4570	20	24	191.666667
4080	9	21	195.714286	4580	19	24	192.083333
4090	8	21	196.190476	4590	18	24	192.500000
4100	27	22	187.727273	4600	17	24	192.916667
4110	26	22	188.181818	4610	16	24	193.333333
4120	25	22	188.636364	4620	15	24	193.750000
4130	24	22	189.090909	4630	14	24	194.166667
4140	23	22	189.545455	4640	13	24	194.583333
4150	22	22	190.000000	4650	12	24	195.000000
4160	21	22	190.454545	4660	11	24	195.416667
4170	20	22	190.909091	4670	10	24	195.833333
4180	19	22	191.363636	4680	9	24	196.250000
4190	18	22	191.818182	4690	8	24	196.666667
4200	17	22	192.272727	4700	27	25	189.200000
4210	16	22	192.727273	4710	26	25	189.600000
4220	15	22	193.181818	4720	25	25	190.000000
4230	14	22	193.636364	4730	24	25	190.400000
4240	13	22	194.090909	4740	23	25	190.800000
4250	12	22	194.545455	4750	22	25	191.200000
4260	11	22	195.000000	4760	21	25	191.600000
4270	10	22	195.454545	4770	20	25	192.000000
4280	9	22	195.909091	4780	19	25	192.400000
4290	8	22	196.363636	4790	18	25	192.800000
4300	27	23	188.260870	4800	17	25	193.200000
4310	26	23	188.695652	4810	16	25	193.600000
4320	25	23	189.130435	4820	15	25	194.000000
4330	24	23	189.565217	4830	14	25	194.400000
4340	23	23	190.000000	4840	13	25	194.800000
4350	22	23	190.434783	4850	12	25	195.200000
4360	21	23	190.869565	4860	11	25	195.600000
4370	20	23	191.304348	4870	10	25	196.000000
4380	19	23	191.739130	4880	9	25	196.400000
4390	18	23	192.173913	4890	8	25	196.800000
4400	17	23	192.608696	4900	27	26	189.615385
4410	16	23	193.043478	4910	26	26	190.000000
4420	15	23	193.478261	4920	25	26	190.384615
4430	14	23	193.913043	4930	24	26	190.769231
4440	13	23	194.347826	4940	23	26	191.153846
4450	12	23	194.782609	4950	22	26	191.538462
4460	11	23	195.217391	4960	21	26	191.923077
4470	10	23	195.652174	4970	20	26	192.307692
4480	9	23	196.086957	4980	19	26	192.692308
4490	8	23	196.521739	4990	18	26	193.076923
4500	27	24	188.750000	5000	17	26	193.461538
4510	26	24	189.166667	5010	16	26	193.846154
4520	25	24	189.583333	5020	15	26	194.230769
4530	24	24	190.000000	5030	14	26	194.615385
4540	23	24	190.416667	5040	13	26	195.000000

Table 8-3. M and N Numbers and Resulting Frequencies (4 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
5050	12	26	195.384615	5550	22	29	192.413793
5060	11	26	195.769231	5560	21	29	192.758621
5070	10	26	196.153846	5570	20	29	193.103448
5080	9	26	196.538462	5580	19	29	193.448276
5090	8	26	196.923077	5590	18	29	193.793103
5100	27	27	190.000000	5600	17	29	194.137931
5110	26	27	190.370370	5610	16	29	194.482759
5120	25	27	190.740741	5620	15	29	194.827586
5130	24	27	191.111111	5630	14	29	195.172414
5140	23	27	191.481481	5640	13	29	195.517241
5150	22	27	191.851852	5650	12	29	195.862069
5160	21	27	192.222222	5660	11	29	196.206897
5170	20	27	192.592593	5670	10	29	196.551724
5180	19	27	192.962963	5680	9	29	196.896552
5190	18	27	193.333333	5690	8	29	197.241379
5200	17	27	193.703704	5700	27	30	191.000000
5210	16	27	194.074074	5710	26	30	191.333333
5220	15	27	194.444444	5720	25	30	191.666667
5230	14	27	194.814815	5730	24	30	192.000000
5240	13	27	195.185185	5740	23	30	192.333333
5250	12	27	195.555556	5750	22	30	192.666667
5260	11	27	195.925926	5760	21	30	193.000000
5270	10	27	196.296296	5770	20	30	193.333333
5280	9	27	196.666667	5780	19	30	193.666667
5290	8	27	197.037037	5790	18	30	194.000000
5300	27	28	190.357143	5800	17	30	194.333333
5310	26	28	190.714286	5810	16	30	194.666667
5320	25	28	191.071429	5820	15	30	195.000000
5330	24	28	191.428571	5830	14	30	195.333333
5340	23	28	191.785714	5840	13	30	195.666667
5350	22	28	192.142857	5850	12	30	196.000000
5360	21	28	192.500000	5860	11	30	196.333333
5370	20	28	192.857143	5870	10	30	196.666667
5380	19	28	193.214286	5880	9	30	197.000000
5390	18	28	193.571429	5890	8	30	197.333333
5400	17	28	193.928571	5900	27	31	191.290323
5410	16	28	194.285714	5910	26	31	191.612903
5420	15	28	194.642857	5920	25	31	191.935484
5430	14	28	195.000000	5930	24	31	192.258065
5440	13	28	195.357143	5940	23	31	192.580645
5450	12	28	195.714286	5950	22	31	192.903226
5460	11	28	196.071429	5960	21	31	193.225806
5470	10	28	196.428571	5970	20	31	193.548387
5480	9	28	196.785714	5980	19	31	193.870968
5490	8	28	197.142857	5990	18	31	194.193548
5500	27	29	190.689655	6000	17	31	194.516129
5510	26	29	191.034483	6010	16	31	194.838710
5520	25	29	191.379310	6020	15	31	195.161290
5530	24	29	191.724138	6030	14	31	195.483871
5540	23	29	192.068966	6040	13	31	195.806452

Table 8-3. M and N Numbers and Resulting Frequencies (5 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
6050	12	31	196.129032	6130	24	32	192.500000
6060	11	31	196.451613	6140	23	32	192.812500
6070	10	32	196.774194	6150	22	32	193.125000
6080	9	31	197.096774	6160	21	32	193.437500
6090	8	31	197.419355	6170	20	32	193.750000
6100	27	32	191.562500	6180	19	32	194.062500
6110	26	32	191.187500	6190	18	32	194.375000
6120	25	32	192.187500				

SERVICE SHEET BD3 (cont'd)

20/30 Divider Check ⟨✓3⟩

8. Connect the oscilloscope to A2A5TP2, 80 kHz REF. The waveform should be as shown in Figure 8-17.

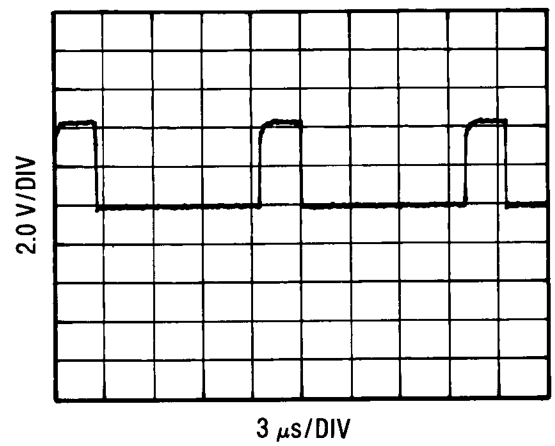


Figure 8-17. 80 kHz Reference, A2A5TP2

If the waveform is correct, proceed with step 9.

If the waveform is not as shown, the divide by 125 circuit is at fault. Use Service Sheet 6 for troubleshooting.

9. Remove A2A3 160—240 MHz VCO, set the A2A3S1 Test Switch to Test High Freq, and replace A2A3.

10. Press PRESET (3 GHz) and connect the oscilloscope to A2A5TP3. The waveform should be as shown in Figure 8-18.

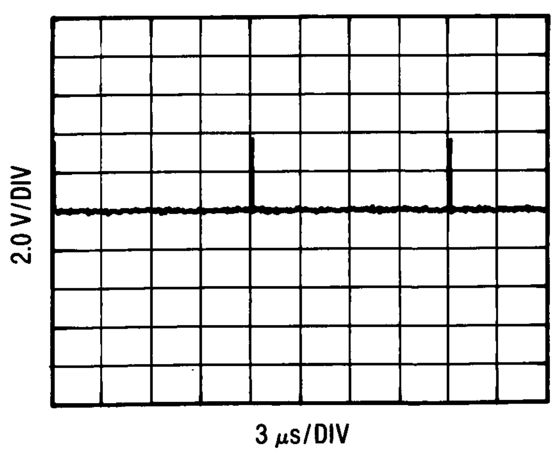


Figure 8-18. A2A5TP3, A2A3S1 Test Switch HIGH

If the waveform is as shown, proceed with the phase detector check beginning with step 15.

If the waveform is not as shown, proceed with step 11 to see if the problem is with A2A5 20/30 Divider or with faulty outputs of the Digital Control Unit (DCU).

11. Remove A2A5 20/30 Divider and place it on an extender board.

12. Set the CW Generator to the frequencies shown in Table 8-4 and check the edge connector pins for the logic levels given. The built-in logic tester on A2A8 may be used for this testing.

    If all the edge connector pins are at the correct levels, the A2A5 20/30 Divider assembly is defective. Go to Service Sheet 6 to isolate the problem.

    If any of the edge connector pins are incorrect, the appropriate output pins on A2A8 Output Register assembly should be checked to ensure that the problem is not on the motherboard. Proceed with step 13.

13. Remove A2A8 and place it on the special extender board (P/N 08672-60016). (Three 30 pin extender boards may be used if the special extender is not available.)

14. Set the CW Generator to the frequencies shown in Table 8-5 and check the edge connector pins for the logic levels given.

    If all the edge connector pins are correct, there is a problem on the motherboard between A2A8 and A2A5.

    If any of the edge connector pins are incorrect, the problem is on A2A8. Proceed to Service Sheet 30 to isolate the problem.

20/30 Phase Detector Check ⟨✓4⟩

15. Remove A2A3 160—240 MHz VCO, set the A2A3S1 Test Switch to TEST HIGH FREQ, and replace A2A3.

16. Connect the voltmeter to A2A4TP4, TUNE OUT. This is the tuning voltage for the VCO.

    The voltage should be less than +4 Vdc.

    If the voltage is correct, proceed with step 17.

SERVICE SHEET BD3 (cont'd)

Table 8-4. LFS 1K—8M Inputs

Frequency (MHz)	XA2A5-															
	11 (8 MHz)	12 (2 MHz)	13 (4 MHz)	14 (1 MHz)	15 (800 kHz)	16 (200 kHz)	17 (400 kHz)	18 (100 kHz)	29 (8 kHz)	30 (2 kHz)	31 (4 kHz)	32 (1 kHz)	33 (80 kHz)	34 (20 kHz)	35 (40 kHz)	36 (10 kHz)
3339.999	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
3336.666	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0

Table 8-5. LFS 1K—8M Outputs

Frequency (MHz)	XA2A8A-										XA2A8B-					
	3 (1 kHz)	6 (20 kHz)	10 (40 kHz)	14 (100 kHz)	15 (8 kHz)	17 (10 kHz)	22 (2 kHz)	26 (4 kHz)	29 (8 kHz)	30 (1 MHz)	2 (200 kHz)	7 (400 kHz)	10 (8 MHz)	18 (2 MHz)	23 (4 MHz)	25 (800 kHz)
3339.999	1	0	0	1	1	1	0	0	1	1	0	0	1	0	0	1
3336.666	0	1	1	0	0	0	1	1	0	0	1	1	0	1	1	0

20/30 Phase Detector Check (cont'd)

If the voltage is not correct, A2A4 20/30 Phase Detector is at fault. Use Service Sheet 7 for troubleshooting.

17. Remove A2A3 160—240 MHz VCO, set the Test Switch to TEST LO FREQ, and replace A2A3.

    The voltage should be greater than +14 Vdc.

    If the voltage is correct, the LFS phase locked loop is working normally. Remove A2A3 160—240 MHz VCO, set the Test Switch to NORMAL, replace A2A3 160—240 MHz VCO, and proceed with M/N Troubleshooting.

    If the voltage is not correct, A2A4 20/30 Phase Detector is at fault. Go to Service Sheet 7 to troubleshoot.

M/N Phase Locked Loop Troubleshooting

20 MHz Reference Check (√5)

1. Connect the frequency standard output from the frequency counter to A3J10 on the CW Generator's rear panel. Set the FREQ STANDARD switch on the CW Generator's rear panel to EXT.

2. Disconnect the gray/white (89) cable from A3A1A1J3 20 MHz OUT (TPF) and connect the frequency counter in its place.

   The frequency should be 20 MHz ±one count.

   If the frequency is not correct, the problem is in the Time Base Reference. Proceed to BD2 to isolate the problem.

   If the frequency is correct, replace the gray/white (89) cable and proceed with step 3.

400 MHz Reference Check (√6)

Initial Conditions: Frequency counter connected to CW Generator as in step 1.

3. Remove the gray/red/white (829) cable from A3A1A5J1 400 MHz IN (TPD) and connect the cable to the frequency counter.

4. The frequency should be 400 MHz ± one count.

   If the frequency is not correct, the problem is in the Time Base Reference. Proceed to BD2 to isolate the problem.

   If the frequency is correct, replace the gray/red/white (829) cable and proceed with step 5.

SERVICE SHEET BD3 (cont'd)

M/N Phase Detector Check ⟨√7⟩

5. Disconnect white/red (92) cable from A3A1A5J2 IF OUT (TPE).

6. Place A3A1A3 on an extender board and connect the voltmeter to A3A1A3TP5.

   The voltage should be approximately −0.5V.

   If the voltage is correct, proceed with step 7.

   If the voltage is not correct, proceed with step 9 to check the M and N digital inputs to A3A1A3.

7. Remove the gray/white (89) cable from the 20 MHz OUT connector of A3A1A1 and connect the white/red (92) cable (previously disconnected from the A3A1A5J2 IF OUT connector) in its place.

8. Connect the voltmeter to A3A1A3TP5. The voltage should be approximately −38V.

   If the voltage is correct, replace A1A3A3 and proceed with ⟨√8⟩ 200 kHz Filter Check, beginning with step 11.

   If the voltage is not correct, proceed with step 9 to see if the problem is on the A2A8 Output Register assembly (or motherboard) or the M/N phase detector.

9. Set the CW Generator to each frequency shown in Table 8-6 and check for the corresponding logic level on each A3A1A3 edge connector pin shown. The built-in logic tester on A2A8 may be used to check the logic levels.

Table 8-6. M1—M5 and N1—N6 Inputs

(Freq. MHz)	XA3A1A3-										
	8 N1	9 N5	10 N3	13 M1	14 M3	15 M5	23 N2	24 N6	25 N4	28 M2	29 M4
6180	0	0	0	1	0	1	0	1	0	1	0
6050	1	1	1	0	1	0	1	0	1	0	1

   If all of the edge connector pins are correct, A2A1A3 is at fault. Proceed to Service Sheet 3 to isolate the problem.

   If any of the edge connector pins are incorrect, proceed with step 10 to see if the problem is with the A2A8 Output Register assembly or the motherboard.

10. Set the CW Generator to each frequency shown in Table 8-7 and check for the corresponding logic level on each edge connector pin shown.

Table 8-7. M1—M5 and N1—N6 Outputs

Freq. (MHz)	XA2A8B-				XA2A8C-						
	14 N6	26 N5	27 N2	28 N1	4 N3	6 N5	10 M5	12 M2	25 M4	26 M1	27 M3
6180	1	0	0	0	0	0	1	1	0	1	0
6050	0	1	1	1	1	1	0	0	1	0	1

   If all the edge connector pins are correct, there is a problem with the motherboard.

   If any of the edge connector pins are not correct, the problem is on the A2A8 Output Register assembly. Go to Service Sheet 30 to isolate the problem.

200 kHz Filter Check ⟨√8⟩

Initial Conditions: White/red (92) cable connected to 20 MHz OUT connector of A3A1A1 and gray/white (89) cable disconnected.

11. Connect the voltmeter to A3A1A4TP1 TUNE.

    The voltage should be approximately −38V.

    If the voltage is correct, proceed with step 12.

    If the voltage is not correct, The Low Pass Filter on A3A1A5 is defective, proceed to Service Sheet 3 to troubleshoot.

M/N VCO Check ⟨√9⟩

Initial Conditions: White/red (92) cable connected to 20 MHz OUT connector of A3A1A1 and gray/white (89) cable disconnected.

12. Place A3A1A5 on an extender board and disconnect the white (9) VCO output cable from A3A1A5J4 (TPB).

13. Connect the white cable to the spectrum analyzer.

The frequency should be approximately 396 MHz at a power level of at least 0 dBm.

SERVICE SHEET BD3 (cont'd)

M/N VCO Check (cont'd)

If the frequency and power are correct, leave the white cable connected to the spectrum analyzer and proceed with step 14.

If the frequency and/or power are not correct, the VCO is either defective or requires adjustment. Proceed to the M/N adjustment procedure in Section V and attempt to adjust the VCO. If it cannot be adjusted, replace it.

14. Disconnect the white/red (92) cable from the 20 MHz OUT connector of A3A1A1 and connect the gray/white (89) cable in its place. This should tune the VCO to its lowest frequency.

    The spectrum analyzer should indicate a signal with a frequency of approximately 342 MHz at a power level of at least 0 dBm.

    If the frequency and power are correct, reconnect the white cable to A3A1A5J4 and proceed with ⟨√ 10⟩ M/N Output check beginning with step 15.

    If the frequency and/or power is not correct, the VCO is either defective or requires adjustment. Proceed to the M/N adjustment procedure in Section V and attempt to adjust the VCO. If it cannot be adjusted, replace it.

M/N Output Check ⟨√ 10⟩

Initial Conditions: Gray/white (89) cable connected to 20 MHz OUT connector of A3A1A1 and white/red (92) cable disconnected.

15. Disconnect the white/orange (93) cable from A3A1A5J3 M/N OUT (TPC) and connect the frequency counter in its place.

    The frequency should be approximately 171 MHz.

    If the frequency is correct, reconnect the white/orange cable to M/N out and proceed with step 16.

    If the frequency is the same as noted in step 14, the divide by two circuit on A1A3A5 is at fault or the M/N VCO output level is too low. Verify that the M/N VCO output level is at least 0 dBm (see M/N VCO check ⟨√ 9⟩).

    If the level is correct, proceed to Service Sheet 5 to troubleshoot the divide by two circuit.

    If the VCO level is not correct, proceed to the M/N adjustments in Section V and attempt to adjust the VCO. If it cannot be adjusted, replace it.

    If no signal is present, proceed to Service Sheet 5 to troubleshoot the divide by two circuit and the output amplifier.

16. Connect the frequency counter to A3A1A5J2 IF OUT (TPE).

    The frequency should be approximately 58 MHz.

    If the frequency is correct, the M/N phase locked loop is functioning normally.

    If the frequency is not correct, A3A1A5 is at fault. Proceed to Service Sheet 5 to troubleshoot.

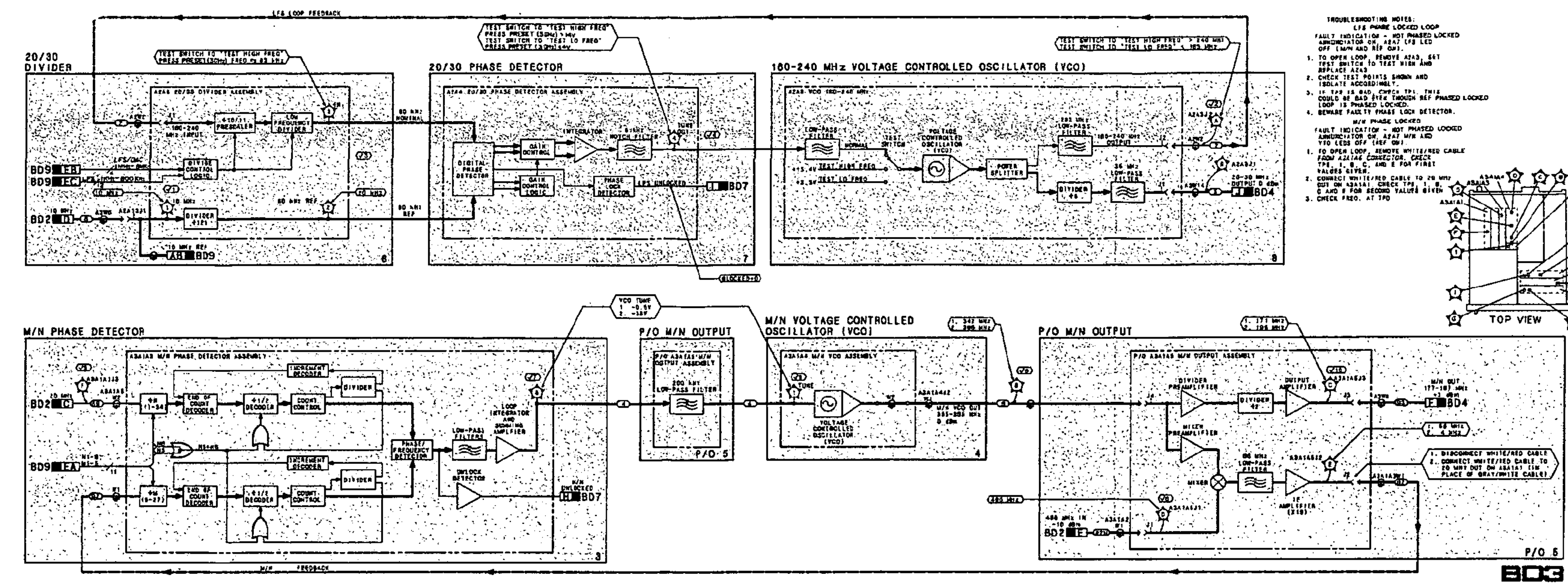


Figure 8-19. RF Phase Locked Loops Block Diagram

SERVICE SHEET BD4

YTO SUMMING PHASE LOCKED LOOP

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The YTO Summing phase locked loop generates baseband frequencies from 2.0—6.2 GHz directly using a YIG Tuned Oscillator (YTO). The YTO is phase locked to reference frequencies from the Low Frequency Source (LFS) phase locked loop and the M/N phase locked loop.

The output of the YTO is downconverted to a frequency between 20 and 30 MHz using a harmonic of the M/N frequency reference. This intermediate frequency is then phase compared to the output of the LFS phase locked loop and the YTO frequency is adjusted until the two frequencies are equal. Because the YTO output is downconverted instead of divided, a 1 kHz change in the reference frequency of the LFS phase locked loop will change the output frequency of the YTO by 1 kHz.

The M/N phase locked loop reference frequency is used to step the YTO output in 10 MHz steps and the LFS phase locked loop reference is used to control the YTO output in 1 kHz steps over a 10 MHz range. Together, the M/N phase locked loop and the LFS phase locked loop control the YTO output frequency from 2 to 6.2 GHz in 1 kHz steps.

The 2 to 6.2 GHz baseband signal is multiplied by two or three to produce frequencies from 6.2 to 18 GHz. Multiplying the baseband frequency causes the frequency resolution to be multiplied as well. For example, the baseband frequency is doubled to obtain frequencies between 6.2 and 12.4 GHz (band 2). A 1 kHz change in the YTO output frequency for an instrument frequency in band 2 will cause a change in the multiplied frequency of 2 kHz.

The YTO Summing phase locked loop consists of the following assemblies:

- Digital to Analog Converter (DAC), Service Sheet 9
- YIG Tuned Oscillator (YTO) Driver, Service Sheet 10
- YTO Sampler, Service Sheet 11
- YTO Phase Detector, Service Sheet 12
- YTO High Frequency Driver, Service Sheet 13

Digital to Analog Converter

The Digital to Analog Converter (DAC) is used to pretune the YTO to within 50 MHz of the desired frequency. The pretuning is required to prevent the YTO Summing phase locked loop to phase lock on the wrong harmonic of the M/N phase locked loop reference frequency. The Digital Control Unit (DCU) controls the DAC with the DAC 1—4800 MHz control lines. The DAC output, YTO PRETUNE, is used as an input to the YTO Driver.

SERVICE SHEET BD4 (cont'd)

Yig Tuned Oscillator (YTO) Driver

The YTO Driver combines the YTO PRETUNE voltage from the Digital to Analog Converter with the low frequency components (<100 Hz) of the correction signal from the phase detector. The combined signal is used to drive the main coil of the YTO. The main coil of the YTO is used for large changes of the YTO frequency. A smaller coil, the high frequency coil is driven by the higher frequency components of the phase detector error voltage.

YTO Sampler

The sampler assembly is used to downconvert the microwave output of the YTO to an RF frequency between 20 and 30 MHz. A harmonic generator is used to produce harmonics of the 177.5 to 197.5 MHz M/N phase locked loop reference which are mixed with the output of the YTO. The M/N phase locked loop is tuned by setting the M and N dividers so that the Nth harmonic of the M/N phase locked loop output will be within 30 MHz of the YTO output frequency.

The IF frequency is buffered and filtered to remove unwanted mixing products and the resulting IF signal is routed to the phase detector to be compared with the 20 to 30 MHz output of the LFS phase locked loop.

YTO Phase Detector

This phase detector compares the IF frequency from the Sampler assembly and the LFS phase locked loop output in a phase/frequency detector. The output of the phase/frequency detector is integrated to generate a tune signal that is used to fine tune the YTO. A phase lock detector monitors the YTO TUNE 1 tuning signal to detect when the YTO Summing phase locked loop is not phase locked.

YTO High Frequency Driver

The YTO High Frequency Driver amplifies the YTO TUNE 1 signal and sends the amplified signal to a crossover network consisting of a 100 Hz high pass filter in the YTO High Frequency Driver Assembly and a 100 Hz low pass filter in the YTO Driver Assembly. This network separates the main tuning information (low frequency components) to the main coil and the error correction components (high frequency components) to the high frequency coil.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet 1 was used to isolate a YTO Summing phase locked loop malfunction. The following troubleshooting information can be used to further isolate the problem to one of the following YTO assemblies:

- Digital to Analog Converter Assembly
- YTO Driver Assembly
- YTO High Frequency Driver Assembly

SERVICE SHEET BD4 (cont'd)

General (cont'd)

- Sampler Assembly
- YTO Loop Assembly

Test Equipment Required:

Frequency Counter .... HP 5343A
Signal Generator .... HP 8656A
Digital Voltmeter .... HP 3456A
Oscilloscope .... HP 1980B

Troubleshooting Procedures

The following procedures are divided into eight checks as follows:

YTO Check ✓1
DAC Check ✓2 YTO Driver Check (not phase locked) ✓3
Sampler Input Check ✓4
Sampler Output Check ✓5
YTO Phase Detector Check ✓6
YTO High Frequency Driver Check ✓7
YTO Driver Check (phase locked) ✓8

YTO Summing phase locked loop Checks

YTO Check ✓1

1. Press PRESET (3 GHz) and ground A3A6TP1 YTO TUNE 2. This removes the feedback from the YTO Summing phase locked loop phase detector which unlocks the phase locked loop to facilitate troubleshooting.

2. Disconnect the cable from J1 of directional coupler A3A9A1 (TPA) and connect the frequency counter in its place.

   The frequency should be 3000 ±20 MHz.

   If the frequency is correct proceed with Step 7.

   If the frequency is not correct, continue with Step 3.

DAC Check ✓2

3. Connect the voltmeter to A3A5TP3 YTO PRETUNE. Set the CW Generator to 2.000 GHz and then to 6.199 GHz and record the voltmeter indication for each frequency. The voltages should be as follows:

   2.000 GHz −6.00 Vdc
   6.199 GHz −18.60 Vdc

   If the voltages are correct, proceed with Step 7.

   If either or both of the voltages are not correct, proceed with Step 4 to check the DAC inputs.

4. Set the CW Generator to the frequencies shown in Table 8-8 and check the edge connector pins for the indicated logic level. The

SERVICE SHEET BD4 (cont'd)

DAC Check (cont'd)

logic probe circuit on A2A8 Output Register assembly may be used for this testing.

Table 8-8. DAC 1 — 4800 MHz Inputs

(Freq. GHz)	XA3A5-													
	8	8	9	10	11	12	13	25	26	27	28	29	30	31
5.799	1	0	1	0	0	1	1	0	0	1	1	0	0	1
3.866	0	1	0	1	1	0	0	1	1	0	0	1	1	0

If all the input levels are as indicated, then DAC A3A5 is defective or requires adjustment. Perform the Digital to Analog Converter adjustment in Section V. If the DAC cannot be adjusted, go to Service Sheet 9 to isolate the problem.

If any of the levels are not as indicated, proceed with Step 5 to check the output data from the DCU to ensure that the problem is not on the motherboard.

5. Remove A2A8 Output Register assembly and place it on the special extender board (P/N 08672-60016). Three 30 pin extender boards may be used if the special extender board is not available.

6. Set the CW Generator to the frequencies shown in Table 8-9 and check the edge connector pins for the logic levels given.

   If all the levels are as indicated, there is a problem on the motherboard between A2A9 and A3A5.

   If any of the levels are not as indicated, the problem is in A2A8. Proceed to Service Sheet 29 to isolate the problem.

Table 8-9. DAC 1 — 4800 MHz Outputs

Freq. (GHz)	XA2A8-													
	A-		B-									C-		
	13	30	3	8	10	13	18	23	24	29	2	3	5	19
5.799	1	1	0	0	1	1	0	0	1	0	1	1	0	0
6050	0	0	1	1	0	0	1	1	0	1	0	0	1	1

SERVICE SHEET BD4 (cont'd)

YTO Driver Check (not phase locked) ✓3

Initial Conditions: A3A6TP1 grounded.

7. Connect the voltmeter to A3A6TP2 YTO COIL and set the CW Generator to 2.000 GHz and then to 6.199 GHz and record the voltmeter indication for each frequency.

   The voltages should be as follows:
   2.0 GHz −37.5 ±.5 Vdc
   6.199 GHz −32.0 ±.5 Vdc

   If the voltages are correct, the YTO Assembly or the directional coupler is defective. Proceed to Service Sheet 13 for troubleshooting.

   If the voltages are not correct, the YTO Driver Assembly is defective or requires adjustment. Perform the YTO Driver Adjustments in Section V. If A3A6 cannot be properly adjusted, proceed to Service Sheet 10 for troubleshooting.

Sampler Input Check ✓4

Initial Conditions: A3A6TP1 grounded.

8. Disconnect semirigid coaxial cable A3A9W2 from attenuator A3A9A6 (TPB) and connect the frequency counter in its place.

   The frequency should be within ±20 MHz of the frequency displayed on the front panel.

   If the frequency is correct, proceed with Step 9.

   If the frequency is not correct (cannot be measured), either coupler A3A9A1, low pass filter A3A9A7 or attenuator A3A9A6 is defective. Proceed to Service Sheet 13 to troubleshoot.

Sampler Output Check ✓5

9. Reconnect A3A9W2, then disconnect the black cable (A3A9W4) from A3A9J2 (TPE) and connect the counter in its place. Press PRESET (3 GHz).

RF Phase Locked Loops SERVICE SHEET BD3

SERVICE SHEET BD4 (cont'd)

Sampler Output Check (cont'd)

If the frequency is correct, replace the black cable and proceed with Step 11.

If the frequency is not correct, proceed with Step 10.

10. Disconnect the white/orange cable from the M/N IN connector A3A9J5 (TPC) and connect the cable to the counter.

    The frequency should be 189.375 ±1 MHz. If the frequency is correct, the Sampler Assembly is faulty. Go to Service Sheet 11 for troubleshooting.

11. Disconnect the green cable from the 20—30 MHz connector A3A9J3 (TPD), and connect the cable to the counter.

    The frequency should be 30.000 ±.001 MHz.

    If the frequency is correct, leave the green cable disconnected and continue with Step 12.

    If the frequency is not correct, the LFS phase locked loop is defective. Proceed to BD-3 for troubleshooting.

YTO Phase Detector Check ✓6

Initial condition: Green (5) cable disconnected from A3A9J3.

12. Remove the ground from A3A6TP1 and connect the voltmeter to A3A7TP2 YTO TUNE 1.

    The voltage should be greater than +5 Vdc.

    If the voltage is correct, continue with Step 13.

    If the voltage is not correct, A3A9A4 is defective, proceed to Service Sheet 12 for troubleshooting.

13. Reconnect the green (5) cable to A3A9J3 and disconnect the black (1) cable from A3A9J1.

    The voltage at A3A7TP2 should be less than −5 Vdc.

    If the voltage is correct, proceed with Step 14.

    If the voltage is not correct, A3A9A4 is defective, proceed to Service Sheet 12 for troubleshooting.

Coil Driver Check ✓7

Initial Conditions: Black cable disconnected from A3A9J1 (TPE)

14. Connect the voltmeter to A3A6TP1 YTO TUNE 2.

    The voltage should be less than −5 Vdc. If the voltage is correct, proceed with Step 15.

    If the voltage is not correct, the phase lock amplifier of A3A7 is defective. Proceed to Service Sheet 13 for troubleshooting.

15. Reconnect the black cable to A3A9J1 (TPE) and disconnect the green cable from A3A9J3.

    The voltage at A3A7TP2 should be greater than 6 Vdc.

    If the voltage is correct, proceed with Step 16.

    If the voltage is not correct, the phase lock amplifier of A3A7 is defective. Proceed to Service Sheet 13 for troubleshooting.

YTO Driver Check ✓8

Initial Conditions: Green cable disconnected from A3A9J3 (TPD)

16. Connect the voltmeter to A3A6TP2 YTO COIL record the voltmeter indication. Disconnect the black cable from A3A9J1 and reconnect the green cable to A3A9J3.

    The voltmeter indication should decrease by about .05 Vdc.

    If the voltage change is correct, the YTO Summing phase locked loop is working normally. Reconnect the black cable to A3A9J3 (TPE).

    If the voltage change is not correct, A3A6 is defective or requires readjustment. Perform the YTO Driver Adjustment procedure in Section V. If A3A6 cannot be adjusted, proceed to Service Sheet 10 for troubleshooting.

SERVICE SHEET BD5

MICROWAVE SIGNAL PATH

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The Microwave Signal Path performs four basic functions:

- Multiplies the 2 to 6.2 GHz baseband signal from the YTO Summing phase locked loop to generate frequencies from 6.2 to 18 GHz.
- Amplifies the 2 to 6.2 GHz baseband signal to produce the specified power levels over the 2 to 18 GHz frequency range.
- Provides step attenuation (10 dB/step) to increase the dynamic range of the leveled RF output.
- Detects the output level to provide a feedback signal to the ALC circuitry.

The Microwave Signal Path is functionally divided into the following assemblies:

- RF Amplifier, part of the RF Amplifier and ALC Assembly, Service Sheet 14
- YIG Tuned Multiplier (YTM) Control Assembly, Service Sheet 15
- SRD Control Assembly, Service Sheet 16
- ALC Detector Assembly, Service Sheet 17
- RF Output Level Control Assembly, Service Sheet 18

RF Amplifier

The RF amplifier is used to amplify the 2 to 6.2 GHz baseband signal to a level high *enough to drive the Step Recovery Diode (SRD) in the YTM assembly.* The RF amplifier also contains the ALC modulator that is controlled by the ALC circuitry to maintain a constant RF output signal level. This is discussed more fully under ALC operation, Service Sheet BD6.

YTM Control and SRD Control

The YIG Tuned Multiplier (YTM) is a broadband frequency multiplier with an input frequency range of 2.0 to 6.2 GHz and an output frequency range of 2.0 to 18.0 GHz. This range is divided into three bands which correspond to frequency multiplication factors of 1 through 3. The three bands and the associated YTM input and output frequency ranges are listed in Table 8-10.

Table 8-10. Frequency Bands

Band Number	Input Frequency Range (GHz)	Output Frequency Range (GHz)
1	2.0 to <6.2	2.0 to <6.2
2	3.1 to <6.2	6.2 to <12.4
3	4.1 to <6.2	12.4 to <18.6

SERVICE SHEET BD5 (cont'd)

The YTM uses a Step Recovery Diode (SRD) (see Figure 8-21) to produce a harmonically rich comb spectrum. The desired output frequency is selected by tuning a filter to the desired harmonic. The filter also suppresses the undesired harmonics.

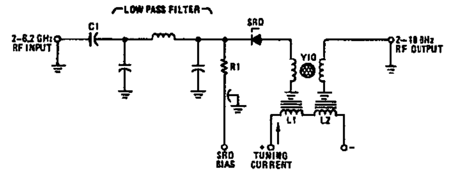


Figure 8-21. YTM Simplified Schematic

In band 1 (2—6.2 GHz), the Step Recovery Diode (SRD) is forward biased to prevent harmonic generation and to pass the fundamental signal with very little loss. The YIG Tuned Filter (YTF) in the YTM assembly is tuned to the input signal frequency and the overall effect is that the amplifier output signal is passed directly to the output of the YTM.

In the multiplied bands (6.2—18 GHz), the SRD is biased to act as a charge controlled switch. Proper biasing of the SRD produces a very narrow, pulse when the diode is switched from forward to reverse bias by the RF input signal. The pulse width is determined by the circuit inductance and the diode capacitance. Narrow pulse widths (<100 ps) are required to obtain high conversion efficiency to 18 GHz. The proper timing of the switching action is controlled by the dc voltage bias level.

The SRD in the YTM is forward biased by the SRD Control assembly whenever the CW Generator's output frequency is in band 1 (2 to 6.2 GHz). For frequencies in the multiplied bands, the SRD Control assembly supplies a fixed dc bias.

The YIG Tuned Filter (YTF) within the YTM assembly is tuned by varying the magnetic current around the YIG sphere. The variation in magnetic field is controlled by varying the current in a tuning coil near the YIG. The tuning current is supplied by the YTM Control assembly. The tracking of the YTF filter is critical to minimize attenuation of the desired signal. In addition, the YIG sphere is temperature sensitive and can cause tuning drift due to large frequency changes. The drift problem is most evident for frequency changes above 16 GHz and does not affect most applications.

SERVICE SHEET BD5 (cont'd)

ALC Detector Assembly

The ALC Detector assembly senses the output power from the YTM. A crystal detector is connected to the coupled port of a directional coupler to provide a dc voltage that is proportional to the YTM output power in watts. The ALC circuitry uses this voltage to control the output level from −10 to +13 dBm. This is discussed more fully under ALC operation on BD6.

RF Output Level Control

The RF Output Level Control assembly drives a 110 dB step attenuator to increase the dynamic range of the instrument. The output of the YTM will always be between −10 and +13 dBm for a leveled output and the attenuator is used to attenuate the YTM output signal in 10 dB steps to give a possible output level range of −120 to +13 dBm. If the output level is set higher than the maximum power available from the YTM, the ALC circuitry will indicate that the output level is uncalibrated and the meter will indicate the approximate power available.

TROUBLESHOOTING

General

It is assumed that the troubleshooting procedures associated with BD1 have been used to isolate a problem to the Microwave Signal Path, illustrated on BD5.

The following procedure is designed to:

1. Verify that the microwave signal path is capable of delivering the specified power, and
2. Isolate any problems encountered.

Some of the following steps may be skipped, but only if you have experience with the CW Generator and with these procedures. For anyone lacking this experience, all steps should be performed.

Troubleshooting Hints

Squegging. Squegging is an unstable YTM output caused by too much power being applied to the YIG sphere. Squegging causes erratic power changes in the output level and spurious sidebands on the carrier. See Figure 8-22 for an example of squegging. This condition occurs primarily in Band 1 because the RF input signal (rather than some harmonic of the RF signal) is applied to the YTF. Squegging can occur in Band 1 when using external leveling due to compensation of the internal circuitry for external losses in the signal path. To prevent squegging when externally leveling, the input level to the YTM is clamped to a safe power level at the input to the YTM. If squegging occurs during external leveling, first try to readjust the clamp circuit.

Programmable Attenuator. The microwave signal path is checked using no attenuation. If the troubleshooting indicates that the micro-

SERVICE SHEET BD5 (cont'd)

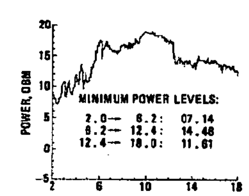


Figure 8-22. Band 1 Squegging

wave chain is working correctly but power problems are symptoms of the failure, check the programmable attenuator. See check 4 for more information regarding troubleshooting the attenuator.

Test Equipment Required

Power Meter .... HP 436A
Power Sensor .... HP 8481A
Digital Voltmeter .... HP 3456A

Troubleshooting Procedures

The troubleshooting procedure is divided into the following checks:

Microwave Signal Path Input Power Check (✓1)
YTM Checks (✓2)
Final Output Power Check (✓3)
Programmable Output Attenuator Check (✓4)

If a check indicates a problem, procedures are provided to isolate the problem to a service sheet.

Microwave Signal Path Input Power Check (✓1)

1. Remove the cable from the input of the RF amplifier assembly and connect the power meter to the cable.
2. Set the CW Generator frequency to 2.0 GHz and select 100 MHz tuning resolution.
3. Tune from 2.0 to 6.1 GHz while observing the power meter.

   The power should not drop below +11.5 dBm at any frequency.

   If the power is correct, reconnect the cable to the input of the RF amplifier and proceed with step 4, YTM Checks.

   If the power drops below +11.5 dBm, the YIG Tuned Oscillator is defective. Go to Service Sheet 13 to troubleshoot.

YTM Checks (✓2)

4. Disconnect A1W6 from the YTM output connector. Connect the power sensor to the output of the YTM.

SERVICE SHEET BD5 (cont'd)

5. Disconnect the blue cable from A1A12J3. This disables the ALC modulator and prevents the ALC circuitry from attenuating the RF signal.
6. Set the CW Generator frequency to 6.2 GHz and select 100 MHz tuning resolution.
7. Slowly tune from 6.2 to 18.0 GHz while observing the power meter.

   The output level should not drop below +9 dBm at any frequency. A typical plot of output level versus frequency is shown in Figure 8-23.

   NOTE

   Ignore the unstable output (squegging) in band 1. Squegging occurs due to the directional coupler being disconnected in step 4 and the ALC modulator being disabled in step 5.

   If the power does not drop below +9 dBm, proceed with the Final Output Check beginning with step 19.

   If the power drops below +9 dBm, proceed with the YTM Control checks beginning with step 8.

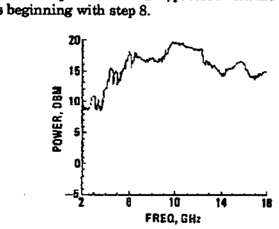


Figure 8-23. Typical YTM Output Power

YTM Control Checks (✓2a)

8. Connect the voltmeter to A1A8TP1 SENSE. This test point is a direct measure of the tuned frequency of the YTF in the YTM assembly. Set the CW Generator frequency to 2 GHz.

   The voltage should be −1 ± .5 Vdc.

   If the voltage is correct, proceed with step 9.

   If the voltage is not correct, proceed with step 11 to check the inputs to the A1A8 YTM Control assembly.

9. Set the CW Generator frequency to 10.0 GHz.

   The voltmeter should indicate a voltage of −5.3 ± .5 Vdc.

YTO Summing Phase Locked Loops SERVICE SHEET BD4

SERVICE SHEET BD5 (cont'd)

YTM Control Checks (cont'd)

If the voltage is correct, proceed with step 10.

If the voltage is not correct, proceed with step 11 to check the inputs to the YTM Control assembly.

10. Set the CW Generator frequency to 18.0 GHz.

    The voltmeter should indicate a voltage of −9.5 ± .5 Vdc.

    If the voltage is correct, proceed with SRD Control checks beginning with step 13.

    If the voltage is not correct, proceed with step 11 to check the inputs to the YTM Control assembly.

11. Remove A1A8 YTM Control and replace it on a 36 pin extender card. Using a voltmeter, check the following edge connector pins for the indicated dc level.

Table 8-11. YTM Control Inputs

Frequency (GHz)	XA1A8-		
	6	10	13
2.0	−6	<1	<.1
10.0	−15	>3.5	<.1
18.0	−18	>3.5	>11

If all of the voltages are correct, proceed with step 12.

If XA1A8-6 YTM TUNE is incorrect at any or all frequencies, use Service Sheets 9 and 16 to troubleshoot the problem to the Digital to Analog Converter (Service Sheet 9) or the motherboard between the DAC and the A1A8 YTM Control.

If XA1A8-10 NBAND1 or XA1A8-13 BP are incorrect at any or all frequencies, use Service Sheets 15 and 16 to troubleshoot the problem to the A1A7 SRD Control (Service Sheet 15) or the motherboard between the SRD Control and the A1A8 YTM Control.

12. Using the voltmeter, check the following edge connector pins for the indicated logic levels.

Table 8-12. YTM Control Band Inputs

Frequency GHz	XA1A8-						
	8	9	11	12	14	15	16
10.0	H1	L1	H2	L2	H3	L3	H3
18.0	L1	H1	L2	H2	H3	H3	L3
	H1 >−5 L1 <−28		H2 >11 L2 <1		H3 >−13 L3 <−28		

If all of the voltages are correct, the YTM Control assembly is defective or requires adjustment. Perform the YTM adjustments in Section V. If the YTM cannot be adjusted, use Service Sheet 15 to troubleshoot.

If any or all of the voltages are incorrect, use Service Sheets 15 and 16 to isolate the problem to the A1A7 SRD Control (Service Sheet 15) or the motherboard between the SRD Control and the A1A8 YTM Control.

SRD Control Checks (✓2b)

13. Connect the voltmeter to A1A7TP2 SRD BIAS. Set the CW Generator frequency to 3 GHz and set the RF output switch to off.

    The voltage should be −6.5 ± .1 Vdc.

    If the voltage is correct, proceed with step 14.

    If the voltage is not correct, proceed with step 15 to check the inputs to the A1A7 SRD Control assembly.

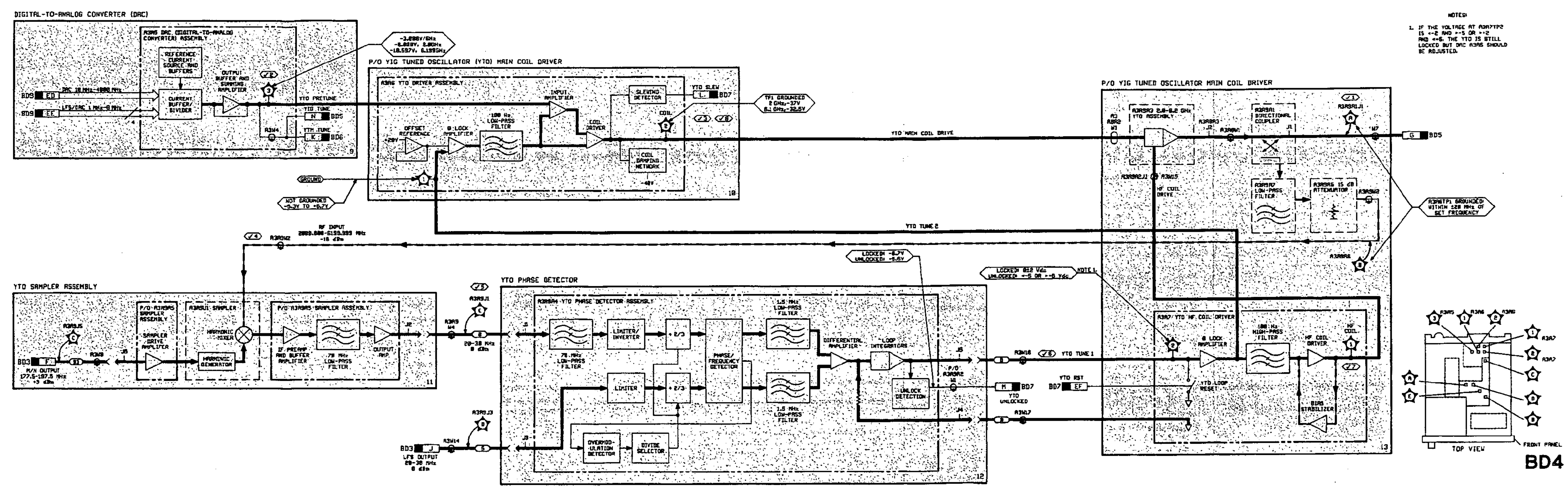
14. Set the CW Generator frequency to 7.0 GHz. The RF output switch must be set to the off position for this check.

    The voltmeter should indicate a voltage of −.5 ± .05 Vdc.

    If the voltage is correct, the SRD Control assembly is working correctly. Proceed with the YTM input check beginning with step 16.

    If the voltage is not correct, proceed with step 15 to check the inputs to the SRD Control assembly.

15. Remove A1A7 SRD Control and replace it on a 36 pin extender card. Using a voltmeter or



NOTES:

1. IF THE VOLTAGE AT A3A7TP2 IS <-2 AND >-5 OR >+2 AND <+5, THE YTO IS STILL LOCKED BUT DAC A3A5 SHOULD BE ADJUSTED.

BD4

Figure 8-20. YTO Summing Loop Block Diagram

SERVICE SHEET BD5 (cont'd)

YTM Control Checks (cont'd)

the built-in logic probe circuit on A2A8, check the logic levels (XA1A7 pins 8 and 9) for the following frequencies.

Table 8-13. HN1 and HN2 Inputs

Frequency GHz	XA1A7-	
	8	9
7.0	H	L
15.0	L	H

If the levels are correct, A1A7 SRD Control assembly is defective. Go to Service Sheet 14 to troubleshoot.

If any logic level is incorrect, the problem is on A2A10 Register 1 assembly or on the motherboard. Go to Service Sheet 26 to troubleshoot.

YTM Input Check ⟨√2c⟩

16. Disconnect the cable (A1W5) and high pass filter (A1FL1) between the A1AT2 isolator and A1A3 YTM assembly. Connect a 10 dB attenuator and the cable and high pass filter to the output of the isolator. Connect the power sensor to the output of the attenuator/cable/filter assembly.

17. Set the CW Generator frequency to 2 GHz and the output level range to 0 dB. Tune the CW generator in 100 MHz steps from 2 to 6.2 GHz and verify that the minimum power for each frequency range listed below is above the level indicated. Note that the levels indicated do not take into account the attenuator added in the test setup. The actual power meter readings will be less than the actual level by the value of the attenuator.

    2—4 GHz >+18 dBm
    4—5.5 GHz >+19 dBm
    5.5—6.2 GHz >+20 dBm

    If the level is correct, the input level to the YTM is sufficient. Reconnect the cable and high pass filter and proceed with the final output power check beginning with step 19.

    If the level is not sufficient, proceed with step 18.

18. Connect at least a 10 dB attenuator to the output of the RF amplifier and connect the power meter to the attenuator. Verify that the output level is above the levels indicated below. Note that the indicated levels do not take into account the attenuator connected between the power sensor and the output of the RF amplifier. The power meter will indicate a level that is lower than the actual level by the value of the attenuator.

    2—4 GHz >21 dBm
    4—5.5 GHz >22 dBm
    5.5—6.2 GHz >23 dBm

If the output level is sufficient, check the loss in the associated cables (<.5 dB each), the isolator (<2 dB), and the high pass filter (<1 dB). If any component shows excessive loss, replace it.

If the level is not sufficient, the amplifier is defective and must be replaced.

Final Output Power Check ⟨√3⟩

This procedure checks the output of the CW Generator for power problems due to the A1DC1 Directional Coupler, the A1AT1 Programmable Attenuator, connector and cable failures, and YTM adjustment problems.

19. Replace the YTM output cable (A1W6) and connect the power meter to the output of the CW Generator.

20. Set the CW Generator to 2.0 GHz at an output level of 0 dBm. Set the ALC switch to XTAL leveling.

21. Slowly tune from 2 to 6.2 GHz and observe the power meter.

    The power should be greater than +9 dBm.

    If the power is correct, proceed with step 24.

    If the power is less than +9 dBm at any baseband frequency, proceed with step 22.

22. Adjust the PEAK/NORM control on the front panel at the each low power frequency to maximize the output level.

SERVICE SHEET BD5 (cont'd)

Final Output Power Checks (cont'd)

If the power can be adjusted to more than +9 dBm, the YTM requires adjustment. Perform the YTM adjustments in Section V.

If the output power cannot be adjusted for more than +9 dBm at the lower power frequencies, verify that adjusting the PEAK/NORM control varies the voltage at A1A8TP4—C.S. The voltage should vary approximately .9 volts at a 7 GHz output frequency. If the voltage does vary proceed with step 23. Otherwise, use Service Sheet 16 to troubleshoot the PEAK/NORM control.

23. Check the interconnecting RF cables after the YTM, directional coupler, attenuator (with 0 dB attenuation) and the output connector. Use the power meter to measure the input and output level of each of these components. There should be no more than about 1 dB of loss through these components at 3 GHz. If excessive loss (>1 dB) is found in any of these components, replace the component.

24. Slowly tune the CW Generator from 6.1 to 18 GHz and observe the power meter. Tuning slowly minimizes the effect of YTM drift due to self-heating of the YIG sphere.

    The power should be greater than +9 dBm.

    If the power is correct, proceed with step 25 to verify the YTM adjustment.

    If there are any power holes noted, there is a problem with a connector or cable. If there are two power holes that are in different bands, the connector problem is before or at the input of the YTM. If there is a single power hole, the problem is between the output of the YTM and the output connector. Use the power meter to isolate where the problem occurs by tracing back at each connection until the power hole cannot be detected. The component previously tested should be the problem.

    If the power level is low over large portions of the band, attempt to adjust the YTM using the YTM adjustment procedure in Section IV. If the YTM cannot be adjusted, replace it.

25. Set the CW Generator to 2 GHz at +13 dBm and INT leveling. Replace the instrument covers and wait 30 minutes. This wait is required to allow the YIG sphere in the YTM to temperature stabilize.

26. Set the CW Generator to 18 GHz and monitor the power meter.

    The output power should be at least 4.5 dBm immediately after tuning, at least +8 dBm after 30 seconds and greater than +8 dBm after 5 minutes. Verify that after 30 minutes the output level is still greater than +8 dBm. The output power should increase to a maximum value and then remain at that value as the YTM stabilizes.

    If maximum power is reached and then stays at the maximum level, the YTM is adjusted properly.

    If maximum power is reached and then the power level decreases, the YTM requires adjustment. Perform the YTM adjustments in Section IV and then recheck the adjustment using steps 25 and 26.

Programmable Output Attenuator Check ⟨√5⟩

All of the checks in this procedure set the programmable attenuator for zero attenuation. Therefore, if power problems are a symptom of the failure, it is possible that the programmable attenuator is defective. To check the attenuator, perform the Output Level, High Level Accuracy and Flatness test in Section IV followed by the Low Level Accuracy test. These two tests check the attenuator's full attenuation range.

SERVICE SHEET BD6

AUTOMATIC LEVEL CONTROL (ALC)

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The primary function of the ALC circuitry is to provide accurately calibrated output power over the CW Generator's 2 to 18 GHz frequency range. In addition, an external ALC input makes it possible to automatically control the level at a remote load.

Internal ALC detects the level at the output of the YIG Tuned Multiplier (YTM) using a directional coupler and a crystal detector. The output of the YTM is leveled over a −10 to +13 dBm range by the ALC circuitry. Additional dynamic range is provided by a 110 dB step attenuator to achieve leveled output as low as −120 dBm.

External ALC modes use an external crystal detector or a power meter's recorder output instead of the internal crystal detector to provide the feedback signal. During external leveling, the output power of the YTM should be kept within a −10 to +3 dBm range if possible. Setting the attenuation in the signal path too high may cause an unleveled condition if the output power available from the YTM is not enough to overcome the attenuation setting and the losses in the external signal path.

Crystal leveling requires the crystal detector to be operating in the square law region *(the output of the detector is proportional to the detected power in watts).* Operation outside the square law region will not allow the vernier to be calibrated over the 13 dB range.

Power meter leveling is slower than crystal detector leveling but has the advantages of temperature compensation and a much wider dynamic range (limited only by the power sensor). With automatic ranging power meters, the range must be held to prevent oscillations in the output level. The oscillations occur when the CW Generator responds to the range change (which rescales the feedback voltage) while the power meter settles. The result is that the power meter is continually trying to settle by changing ranges and the CW Generator is responding to each range change by setting the level outside of the new range.

Internal ALC

During internal ALC, the inputs to the Reference Amplifier on A1A5 ALC assembly are:

- F Correct
- ALC Reference

The F Correct signal is used to compensate for losses after the directional coupler. This includes losses from the output port of the directional coupler,

SERVICE SHEET BD6 (cont'd)

cabling, the attenuator and the output connector. These losses are frequency dependent and F Correct is adjusted for the best compromise over the entire frequency range.

The ALC Reference input is the reference voltage produced from the front panel vernier or the remote reference digital to analog converter. The detected output level is adjusted to equal the sum of the two Reference Amplifier inputs which allows the vernier setting to control output level. Note that the ALC Reference is a voltage that is linearly proportional to the detected level in dB. This means that a change of a voltage corresponds to a change of power in dB. Another equal change in voltage indicates another (equal) change of detected power in dB.

The detector output is directly proportional to the detected power in watts. To make the detector output proportional to output power in dB (for comparison to the ALC Reference), the detector output is routed through a logarithmic amplifier. The output of the ALC log amp is then compared to the ALC Reference and the F Correct signal.

The ALC circuitry adjusts the output level of the CW Generator so that the magnitude of the ALC log amp output is equal to the sum of the ALC Reference and F Correct. Overrange mode (+10 dB range) amplifies the ALC Reference so the vernier setting corresponds to a range of 0 to +13 dBm.

External ALC

External ALC operation is essentially the same as internal ALC. However, the EXT ALC signal is routed through an absolute value amplifier prior to being applied to the log amplifier. The output of this amplifier is negative regardless of the input polarity. This allows any type of external detector, regardless of polarity, to be used and still get the necessary negative input required by the external ALC circuitry.

When operating in band 1, a power clamp circuit limits the power applied to the YTM to prevent spurious response (squegging). The power clamp is not apparent when using internal ALC because the output level can only be set as high as +13 dBm.

The output of the internal detector's log amp is used as stabilizing feedback for external leveling modes. The signal is coupled to the external ALC feedback signal to aid in suppressing transients. The degree of coupling is different for crystal detector leveling and power meter leveling due to the different reaction times of the detection. The coupling is changed by switching in a different value of capacitance to couple the internally detected signal.

TROUBLESHOOTING

General

It is assumed that the troubleshooting procedures associated with BD1 have been used to isolate a problem to the ALC. These proce-

SERVICE SHEET BD6 (cont'd)

dures assume that the instrument has sufficient power (+8 dBm) over the full frequency range. The following procedures can be used to further isolate the problem to one of the following assemblies:

- ALC Assembly — Service Sheet 14
- Detector Assembly — Service Sheet 17
- Level Control Assembly — Service Sheet 22
- Front Panel Assembly — Service Sheet 20

Test Equipment

Oscilloscope HP1980B
Digital Voltmeter HP3456A
Power Meter .... HP 436A
Power Sensor .... HP 8481A

Troubleshooting Procedure

The following troubleshooting procedure is divided into the following checks:

ALC Reference Check (√1)
F CORRECT Check (√2)
Detector Assembly Check (√3)
ALC Assembly Check (√4)
External ALC Check (√5)
LVL Meter Check (√6)

Troubleshooting Hints

ALC in Remote Mode. If the ALC reference level cannot be controlled in remote mode (but works normally in local mode) the problem is with the Level Control DAC, or the Local/Remote Switch on Service Sheet 18.

Unleveled ALC. Insufficient output power will cause the LVL UNCAL annunciator to light. Ensure that enough power is available before troubleshooting the ALC.

ALC Reference Check (√1)

1. Connect the voltmeter to A1A10 TP "DAC" and turn the front panel Vernier fully clockwise then fully counterclockwise while observing the voltmeter.

NOTE

For remote troubleshooting, program +3 dBm vernier for the clockwise position and −10 dBm vernier for the counterclockwise position.

The voltages should be as follows:

SERVICE SHEET BD6 (cont'd)

Vernier Position	Voltage
fully CW	0.0V
fully CCW	−6.5V (typical)

If the voltages are as shown, proceed with Step 4.

If the voltages are not as shown, proceed with Step 2.

2. Connect the voltmeter to A1A10 TP " −6.2."

   The voltmeter should read −6.2 ± .05 Vdc.

   If the voltage is correct, the negative voltage reference is working. Proceed with step 3.

   If the voltage is not correct, proceed to Service Sheet 18 to troubleshoot the negative voltage reference.

3. Connect the voltmeter to XA1A10-6. Turn the front panel Vernier fully clockwise and then fully counterclockwise while observing the voltmeter.

   The voltage should be 0 Vdc at the fully clockwise position and −6.2 Vdc at the fully counterclockwise position.

   If the voltage is correct, the Local/Remote switch is defective. Go to Service Sheet 18 to troubleshoot.

   If the voltage is not correct, the Vernier is defective or a connection is broken. Go to Service Sheet 18 to troubleshoot.

F CORRECT Check (√2)

4. Remove A1A6 ALC Detector assembly and replace it on a 36 pin extender board. Set the CW Generator's ALC switch to XTAL to isolate the F Correct signal. Set the CW Generator to each of the frequencies listed below and check the voltage at XA1A6-24 (TPA) at each frequency.

   The voltages should be as shown below:

Freq	Voltage
2.0 GHz	+0.005 ±0.005 Vdc
6.2 GHz	+0.035 ±0.01 Vdc
12.4 GHz	+0.475 ±0.05 Vdc
18.0 GHz	+0.575 ±0.05 Vdc

If the voltages are correct, proceed with Step 5.

If the voltage is not correct, the problem may be on the A1A7 SRD Bias assembly, Service Sheet 16, or the A1A6 Detector assembly, Service Sheet 16. To isolate between the two assemblies, remove the A1A6 Detector assembly and check the voltage at XA1A7-15.

SERVICE SHEET BD6 (cont'd)

If the voltage at XA1A7-15 is correct, the A1A7 SRD Bias assembly is functioning normally. Use Service Sheet 16 to troubleshoot the INT ALC/OVERRANGE SELECTOR and Reference amp.

If the voltage at XA1A7-15 is not correct, go to Service Sheet 16 to trace the F Correct signal. Check the input to the Coupler Correct circuit before troubleshooting the circuit.

Detector Assembly Check (√3)

5. Disconnect the blue cable from A1A12J3. This disables the ALC modulator inside the RF amplifier.
6. Connect the power meter to the output of the CW Generator.
7. Set the CW generator to 7.0 GHz with the output range set to 0 dB, the Vernier turned fully clockwise and the ALC switch set to XTAL. This combination of settings turns the RF on, disables the power clamp, sets the attenuator for 0 dB attenuation, and the Vernier to a known position.
8. Connect the voltmeter to A1A6TP5. This test point will follow the detector output if the log amplifier is working.
9. Adjust the PEAK/NORM control on the front panel of the CW Generator.

   The power meter should indicate that the output level varies as the control is adjusted.

   If the control does vary the output level, proceed with step 10.

   If the control does not vary the output level, disconnect the A1CR1 detector from the directional coupler and connect it to a microwave source. The level of the microwave source must be varied for the next step instead of adjusting the PEAK/NORM control. Use an otuput level of +13 dBm and vary the level ±2 dB. Proceed with step 10.

10. Adjust the PEAK/NORM control and observe the voltmeter.

    The voltage should follow the variations displayed by the power meter as the PEAK/NORM control is adjusted. The voltage should be .16 ± .05 Vdc at an output level of +13 dBm.

    If the voltage does follow the variations displayed on the power meter, proceed with step 13.

    If the voltage does not follow the variations displayed on the power meter, proceed with step 11.

11. Connect the voltmeter to A1A6U7-3. This is the actual detector output signal.

Microwave Signal Path SERVICE SHEET BD5

SERVICE SHEET BD6 (cont'd)

Detector Assembly Check (cont'd)

12. Vary the PEAK/NORM adjustment control on the CW Generator front panel while observing the voltmeter.

    The voltage should follow the variations indicated by the power meter. The voltage should be +.16 ± .05 Vdc at an output level of +13 dBm.

    If the voltage varies, the log amplifier is defective. Go to Service Sheet 17 to troubleshoot. If the voltage does not vary, the directional coupler, detector or cabling is defective. Go to Service Sheet 17 to troubleshoot.

13. Connect the voltmeter to A1A6TP3. Set the CW Generator's ALC switch to INT to couple the log amplifier output to the buffer amplifier. Vary the PEAK/NORM control while observing the voltmeter.

    The voltage should vary with the level displayed on the power meter (40 mv/dB). The voltage for a +13 dBm output should be +0.5 ± .1 Vdc.

    If the voltage is correct, the detected level is entering the summing junction. Proceed with step 14.

    If the voltage is not correct, there is a problem with the log amplifier, internal/external switch or buffer amplifier. Go to Service Sheet 17 to troubleshoot.

14. Connect the voltmeter to A1A6TP2. This test point is the sum of the ALC Reference voltage, the F Correct signal and the attenuation due to the Overrange circuit.

    The voltmeter should indicate −.7 ± .05 Vdc.

    If the voltage is correct, proceed with step 15.

    If the voltage is incorrect, the internal ALC/Overrange selector or reference amplifier is defective. Proceed to Service Sheet 18 to troubleshoot.

15. Set the range to +10 dB.

    The voltage should change to −1.9 ± .1 Vdc.

    If the voltage is correct, proceed with step 16.

    If the voltage is not correct, the Internal ALC/Overrange Switch or one of the inputs to the switch is defective. Proceed to Service Sheet 18 to troubleshoot.

16. Set the ALC switch to crystal detector leveling mode (XTAL).

    The voltage should be −1.4 ± .1 Vdc.

    If the voltage is correct, proceed with step 17.

    If the voltage is not correct, the Internal ALC/Overrange Switch or one of the inputs to the switch is defective. Proceed to Service Sheet 18 to troubleshoot.

17. Connect the oscilloscope to A1A6TP7 and select 100 MHz tuning resolution on the CW Generator. Set the oscilloscope for 20 millisecond sweep time. Quickly tune the CW Generator from 2 to 18 GHz while observing the oscilloscope.

    The oscilloscope display should indicate narrow (4 ms) negative going pulses as the tune knob is turned.

    If the pulses are present, the ALC holdoff circuitry is working normally. Proceed with step 18.

    If the pulses are not present, troubleshoot the ALC holdoff circuitry using Service Sheet 18.

ALC Assembly Check (√4)

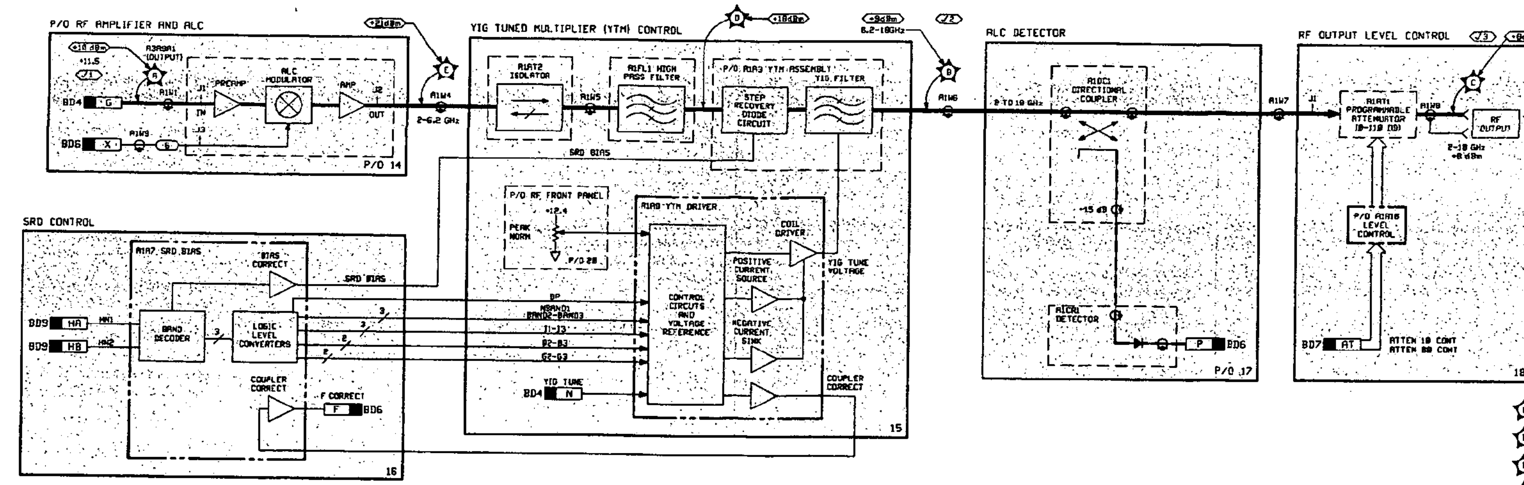
Initial Conditions: Blue cable disconnected from A1A12J3 RF Amplifier assembly.

18. Connect the voltmeter to A1A5TP1. This test point represents the error voltage from the A1A6 ALC Detector assembly. Remove A1A6 ALC Detector assembly from the instrument to isolate the effects of the error voltage from the unused AM circuitry on the CW Generator's ALC assembly.

    The voltage should be 0 ± .025 Vdc.

    If the voltage is correct, the AM circuitry is disabled. Proceed with step 18.

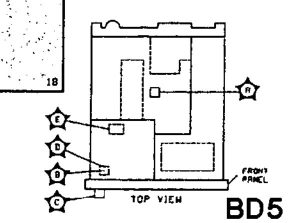
    If the voltage is incorrect, the AM circuitry is interfering with the ALC circuitry. Use Ser-



TROUBLESHOOTING NOTES:

FAULT INDICATION: NO OR LOW POWER:

1. MEASURE POWER AT TEST POINTS IN ORDER SHOWN UNTIL LOW POWER IS FOUND.
2. IF TP B INDICATES LOW POWER TROUBLESHOOT SERVICE SHEET 16 THEN 15.



BD5

Figure 8-24. Microwave Signal Path Block Diagram

SERVICE SHEET BD6 (cont'd)

ALC Assembly Check (cont'd)

vice Sheet 14 to troubleshoot the AM circuitry. A1A5TP5 should be 0 ± .025 Vdc with the AM circuitry disabled.

19. Replace the A1A6 ALC Detector assembly. Set the CW Generator to 7 GHz, 0 dB range, Vernier fully clockwise and ALC switch to INT. Set the RF output switch to OFF to eliminate the effects of the feedback signal.

    The voltage should be .4 ± .2 Vdc.

    If the voltage is correct, proceed with step 20.

    If the voltage is not correct, the signal from A1A6 ALC Detector assembly is not correct. Use Service Sheets 14 and 17 to isolate the problem to the ALC Detector assembly or the ALC assembly.

20. Connect the voltmeter to A1A5TP6. This test point represents the modulator drive signal. Set the RF output switch to ON (ALC switch to INT).

    The voltage should be greater than 5 Vdc.

    If the voltage is correct, proceed with step 21.

    If the voltage is not correct, use Service Sheet 14 to troubleshoot the integrator and modulator driver.

21. Set the ALC switch to XTAL leveling mode. Switching from INT to XTAL mode has the effect of changing the error from positive (too much power) to negative (too little power) because there is no feedback signal at the EXT ALC input.

    The voltage should be less than −4 Vdc.

    If the voltage is correct, proceed with step 22.

    If the voltage is not correct, use Service Sheet 14 to troubleshoot the integrator and modulator driver.

22. Reconnect the blue modulator drive cable to A1A12J3. Set the ALC switch to XTAL.

    The voltage should be less than −4 Vdc.

    If the voltage is correct, proceed with step 23.

    If the voltage is incorrect, the modulator or cabling is defective. Use Service Sheet 14 to troubleshoot.

23. Set the ALC switch to INT and set the RF output switch to OFF. This should turn on the modulator to reduce the output level.

    The voltage should be greater than +1 Vdc.

    If the voltage is correct, proceed with step 23.

    If the voltage is not correct, use Service Sheet 14 to troubleshoot the modulator and modulator drive circuitry.

24. If the preceding checks are correct, but the CW Generator still does not level, use Service Sheet 14 to troubleshoot the ALC assembly. When the CW Generator is leveled, A1A5TP1 should be 0 ± .05 Vdc.

    If the output is leveled (as indicated by the power meter) but the LVL UNCAL annunciator is lighted, troubleshoot the unleveled detector using Service Sheet 14.

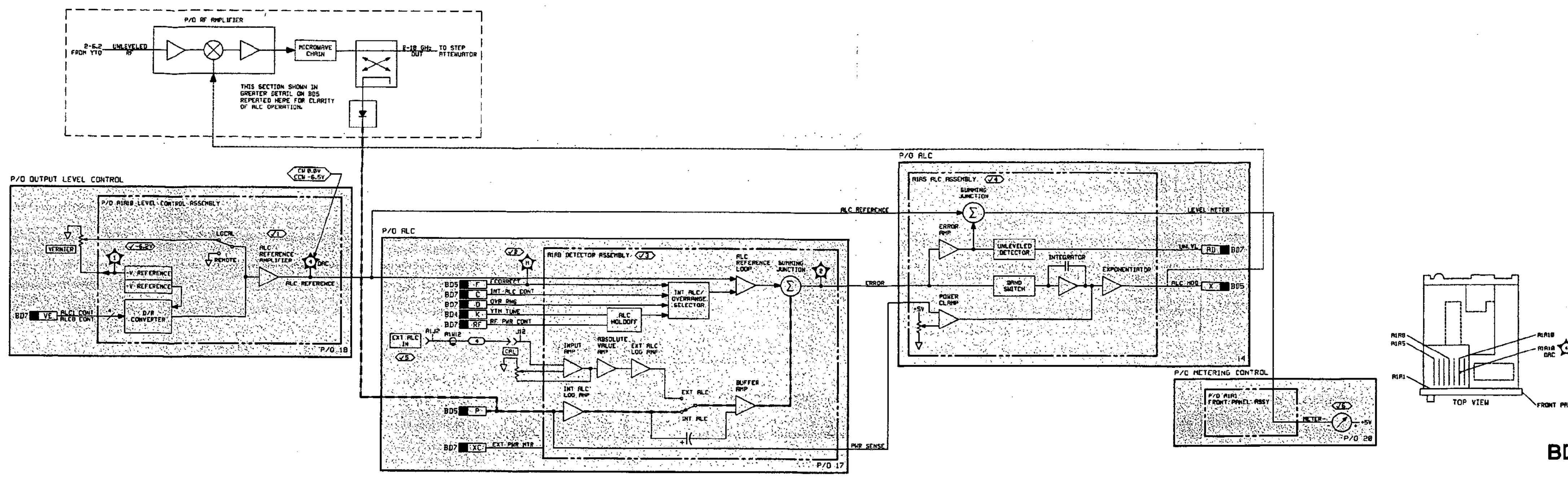
External ALC Check (✓8)

If the CW Generator is operating normally in internal ALC mode but will not level in external ALC mode, the problem is limited to the front panel connector and cable, or the external ALC circuitry on the ALC Detector assembly.

Use Service Sheet 18 to troubleshoot the external ALC input. A1A6TP6 can be used to monitor the feedback signal after the external ALC input amplifier.

LVL Meter Check (✓9)

If the CW Generator is leveling properly but the meter does not work or is reading incorrectly, use Service Sheet 14 to check the meter drive circuitry. The meter drive signal is a combination of the error voltage and the ALC Reference signal.



BD6

Figure 8-25. ALC Block Diagram

SERVICE SHEET BD7
DCU REMOTE/LOCAL INTERFACE

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The Digital Control Unit (DCU) is divided into three sections:

- DCU Remote/Local Interface
- DCU HP-IB Interface
- DCU Frequency Control

DCU Remote/Local Interface. The DCU processes inputs from the front panel in local mode and the HP-IB in remote mode. In local mode, the operator enters data with the front panel switches and the TUNING knob. The TUNING knob is a Rotary Pulse Generator (RPG) which provides continuous control of frequency tuning. Selectable tuning resolution coupled with the RPG provides convenient control of setting frequency.

Remote mode uses a combination of special ASCII program codes and arguments to simulate the front panel controls. The HP-IB Address assembly is used to decode the information on the HP-IB and generate control signals for managing the input data. The HP-IB Interface assembly is used to decode the program codes and arguments so the DCU Frequency Control subsystem can alter the frequency setting of the instrument.

DCU Frequency Control. The DCU produces tuning information and frequency band related information based on the current front panel frequency. Tuning information comes from the DCU Remote/Local Interface as tuning and resolution *for local mode, or actual frequency information for remote mode.*

Each frequency change requires a cycling of the frequency data through three registers. Register 1 holds the front panel frequency, rounds the desired frequency according to the frequency resolution and decodes the appropriate frequency band. Register 2 divides the Register 1 frequency by 1, 2 or 3 to produce a baseband frequency and indicates whether the frequency is evenly divisible. Register 3 generates the tuning information for the phase locked loops to generate the appropriate baseband frequency.

The baseband (band 1) and the multiplied band frequencies are:

Band 1: 2—6.2 GHz
Band 2: 6.2—12.4 GHz
Band 3: 12.4—18 GHz

Remote operation loads frequency data directly into the first register to be processed by registers 2 and 3. Local control indicates tuning direction and resolution for incrementing or decrementing the Register 1 frequency.

DCU Remote/Local Interface

The DCU Remote/Local Interface consists of four assemblies:

SERVICE SHEET BD7 (cont'd)

- HP-IB Address
- RF Front Panel
- DCU Front Panel
- Digital Processor
- P/O HP-IB Interface

The DCU Remote/Local Interface is made up of the RF Front Panel, DCU Front Panel, Digital Processor and part of the HP-IB interface assembly. The DCU HP-IB Interface is made up of the HP-IB Address and part of the HP-IB interface assembly. The DCU Remote/Local Interface is discussed below.

RF Front Panel. The RF Front Panel contains the controls for controlling the level of the output signal. The controls on the RF Front Panel are:

- Peak/Norm control (see BD5)
- RF Output On/Off switch
- Output Level Range Selector
- Output Level Vernier (see BD6)
- ALC Selector
- External ALC Input and CAL Control (see BD6)

The data from the various switches and selectors is routed to the Digital Processor assembly or the related circuitry.

The RF Front Panel displays include the RANGE dB display, the level meter, the ALC status annunciators and the RF output status annunciators. The RANGE dB display indicates the range selected by the range selector in local mode or the programmed range in remote mode. The INT, XTAL and P MTR ALC status annunciators and the ON and OFF RF output status annunciators also indicate the front panel settings when in local mode and the programmed settings in remote mode. The remaining annunciator, LVL UNCAL, is used to indicate that output level is no longer calibrated.

DCU Front Panel. The DCU Front Panel assembly displays frequency related information and instrument status. The frequency tuning controls and the line switch are also located on the DCU Front Panel assembly.

Digital Processor. The Digital Processor assembly selects the information from the HP-IB Interface assembly in remote mode or the RF Front Panel controls in local mode. The Digital Processor latches the remote data when programmed and also latches the local data during the local to remote transition to prevent the front panel settings from changing. The vernier level will change due to the change from a variable voltage source to a DAC.

The range data from the output level range selector is encoded to match the data format of the remote programmed data. The local or remote data (depending on the instrument mode) is then decoded for the RANGE dB display. If the range data is not within the instrument's range, the decoder will light the LVL UNCAL annunciator

SERVICE SHEET BD7 (cont'd)

on the front panel. As with the other front panel controls, the local range data is latched on the local to remote transition to avoid resetting the attenuator.

P/O HP-IB Interface. The HP-IB Interface contains the phase lock indicators for the four phase locked loops. The indicators are used to indicate which phase locked loop is not locked. In addition, a reset circuit for the YTO Summing Phase Locked Loop is included on this assembly to reset the loop if it is unlocked or if the YTO is slewing excessively.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet BD1 was used to isolate the problem to the DCU Remote/Local Interface or there is a problem involving only one mode (local or remote) but not the other. The following troubleshooting procedures can be used to further isolate the problem to one of the following subassemblies:

- RF Front Panel Assembly — Service Sheet 20
- DCU Front Panel Assembly — Service Sheet 31, 32
- Digital Processor Assembly — Service Sheet 19

Test Equipment Required

Digital Voltmeter .... HP 3456A
Controller .... HP 85B or HP 9826/36A

NOTE

The CW Generator has a built-in logic probe on the A2A8 Output Register Assembly. To use the probe, connect a clip lead to A2A8TP2. The other end of the clip lead can then be used to probe logic levels and can also be used for checking for pulse activity. The indicator near the test point will light for a logic high, extinguish for a logic low and will pulse if repetitive pulses are present. If the logic probe is used, the voltmeter is not required.

Troubleshooting Procedures

The following procedures are divided into four checks, as follows:

Local Digital Processor Assembly Checks (✓1)
Remote Digital Processor Assembly Checks (✓2)
Frequency Controls Check (✓3)

Local Digital Processor Assembly Checks (✓1)

1. Set the CW Generator to the following conditions:

RF OUTPUT .... On
RANGE Control .... Fully counter-clockwise

SERVICE SHEET BD7 (cont'd)

VERNIER .... Fully counter-clockwise
ALC .... set to INT
Frequency .... 3000.000 MHz

2. Set the RANGE selector to each position shown below and check for the corresponding logic level at each test point shown. Position 1 of the RANGE selector corresponds to the selector being fully counter-clockwise and position 13 corresponds to the fully clockwise position.

RANGE Selector Position	RANGE dB Display	A1A11TP-				
		80	40	20	10	OVR RNG
2	−100	1	0	1	0	0
7	− 50	0	1	0	1	0
13	+ 10	0	0	0	0	1

If all of the logic levels are correct, proceed with step 3.

If the logic levels are correct but the RANGE dB display is not correct, use service sheet 19 and 20 to troubleshoot the Display Decoder and Range Displays.

If any or all of the logic levels are incorrect, use service sheet 19 and 20 to isolate the problem to the RANGE selector, Range Encoder, or Local/Remote Range Selector circuit. If the problem was with the OVR RNG signal, troubleshoot the Local/Remote AM Range and OVR RNG selector in addition to the other circuits.

3. Set the RF output switch to OFF. Verify that the RF ON annunciator extinguishes and the RF OFF annunciator lights.

If the indication is correct, proceed with step 4.

If the indication is not correct, use Service Sheet 19 and 20 to troubleshoot the RF output switch, Local/Remote ALC/RF PWR Selector and RF On/Off status annunciators.

4. Set the ALC selector to each of the 3 modes while observing the ALC status annunciators. The INT, XTAL and P MTR annunciators should light for the INT, XTAL and PWR MTR selector positions respectively.

If the indication is correct, continue with step 5.

If the indication is not correct, use Service Sheet 19 and 20 to troubleshoot the ALC selector, Local/Remote ALC/RF PWR Selector and ALC status annunciators.

SERVICE SHEET BD7 (cont'd)

Remote Digital Processor Assembly Checks (✓2)

5. Set the CW Generator to the following conditions using the front panel controls.

RF OUTPUT .... ON
VERNIER .... Fully counter-clockwise
ALC .... set to INT
Frequency .... 3000.000 MHz

6. Connect the controller to the CW Generator. Set the CW Generator to remote mode with the command:

```
REMOTE 719
```

Verify that the REMOTE annunciator in the STATUS block lights. The front panel annunciators should now indicate:

RF OUTPUT .... ON
RANGE .... −110 dB
LEVEL .... <−10 dBm
ALC .... INT
Frequency .... 3000.000 MHz

If all indications are correct, proceed with step 7.

If the REMOTE annunciator does not light, check the HP-IB cable and verify that the CW Generator is set to the correct HP-IB address. If the problem cannot be corrected, go to Service Sheet BD8 to check the DCU HP-IB interface assembly.

If the REMOTE annunciator does light, but the front panel annunciators have changed, use service sheet 19 to troubleshoot the appropriate Local/Remote Selector. The local data should be latched at the Local/Remote Selector on the local to remote transition.

Automatic Level Control (ALC) SERVICE SHEET BD6

SERVICE SHEET BD7 (cont'd)

Remote Digital Processor Assembly Checks (cont'd)

7. Execute the following statement on the controller.

```
OUTPUT 719;"K:"
```

The RANGE dB display should indicate −100 dB.

If the indication is correct, proceed with step 8.

If the indication is not correct, go to service sheet BD8 and begin the DCU HP-IB Interface troubleshooting.

8. Execute the following statements on the controller. Verify that the RANGE dB display agrees with the indicated range.

```
OUTPUT 719;"K5" −50 dB Range
OUTPUT 719;"K0" 0 dB Range
```

If the RANGE dB display indicates the correct value for each programming statement, proceed with step 9.

If any or all indications are incorrect, go to service sheet BD8 to begin the DCU HP-IB Interface troubleshooting.

9. Connect the voltmeter to A1A11 TP OVR RNG. Execute the following statement on the controller.

```
OUTPUT 719;"K?0;"
```

The RANGE dB display should indicate −140 dB and the LVL UNCAL annunciator should be lighted. In addition, the voltmeter should indicate a high logic level.

If the indication is correct, proceed with step 10.

If the indication is not correct, go to service sheet BD8 to begin troubleshooting the DCU HP-IB Interface.

10. Enter the following program into the controller and then execute the program.

```
10 FOR I=1 TO 13
20 OUTPUT 719;"O"&CHR$(I+47)
30 NEXT I
40 GOTO 10
50 END
```

The RANGE dB display should alternate between two adjacent ranges, each ALC annunciator should light in the sequence INT, XTAL, INT, P MTR and the RF annunciators should alternate between OFF and ON. The NOT PHASE LOCKED annunciator should also flash.

This check tests the overrange, RF On/Off, and the three ALC modes to see if they can be remotely programmed. The 10 dB alternation in the RANGE dB display is due to selecting overrange. The ALC annunciators indicate the changing ALC programming code argument and the RF On/Off annunciators are due to the RF output being part of the ALC programming code. The NOT PHASE LOCKED annunciator lights when RF is off and extinguishes when RF output is turned back on.

If the indications are correct, proceed with the Frequency Controls Check beginning with step 11.

If any or all indications are incorrect, go to service sheet BD8 to begin troubleshooting the DCU HP-IB Interface.

Frequency Controls Check (✓3)

11. Place the CW Generator in local mode by setting the line switch to off and then on. Press the PRESET (3 GHz) key and verify that the FREQUENCY MHz display indicates 3000.000 MHz.

12. Press each of the keys under the FREQUENCY RESOLUTION display. Each key should light the corresponding light bar above the key and all bars to the left of the key.

If the indication is correct, proceed with step 13.

If any or all keys do not work, use Service Sheet 32 to troubleshoot the Tuning Resolution Selector, Tuning Resolution Latch and Frequency Resolution Indicators.

13. Press the HOLD key and verify that all Frequency Resolution indicators (light bars) are extinguished.

SERVICE SHEET BD8

DCU HP-IB INTERFACE

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The Digital Control Unit (DCU) is divided into three sections:

- DCU Remote/Local Interface
- DCU HP-IB Interface
- DCU Frequency Control

DCU Remote/Local Interface. The DCU processes inputs from the front panel in local mode and the HP-IB in remote mode. In local mode, the operator enters data with the front panel switches and the TUNING knob. The TUNING knob is a Rotary Pulse Generator (RPG) which provides continuous control of frequency tuning. Selectable tuning resolution coupled with the RPG provides convenient control of setting frequency.

DCU HP-IB Interface. Remote mode uses a combination of special ASCII program codes and arguments to simulate the front panel controls. The HP-IB Address assembly is used to decode the information on the HP-IB and generate control signals for managing the input data. The HP-IB Interface assembly is used to decode the program codes and arguments so the DCU Frequency Control subsystem can alter the frequency setting of the instrument.

DCU Frequency Control. The DCU produces tuning information and frequency band related information based on the current front panel frequency. Tuning information comes from the DCU Remote/Local Interface as tuning and resolution for local mode, or actual frequency information for remote mode.

Each frequency change requires a cycling of the frequency data through three registers. Register 1 holds the front panel frequency, rounds the desired frequency according to the frequency resolution and decodes the appropriate frequency band. Register 2 divides the Register 1 frequency by 1, 2 or 3 to produce a baseband frequency and indicates whether the frequency is evenly divisible. Register 3 generates the tuning information for the phase locked loops to generate the appropriate baseband frequency.

The baseband (band 1) and the multiplied band frequencies are:

Band 1: 2—6.2 GHz
Band 2: 6.2—12.4 GHz
Band 3: 12.4—18 GHz.

SERVICE SHEET BD8 (cont'd)

Remote operation loads frequency data directly into the first register to be processed by registers 2 and 3. Local control indicates tuning direction and resolution for incrementing or decrementing the Register 1 frequency.

DCU HP-IB Interface

The DCU HP-IB Interface consists of two assemblies:

- HP-IB Address
- P/O HP-IB Interface

The Remote/Local Interface is made up of the RF Front Panel, DCU Front Panel, Digital Processor and part of the HP-IB Interface assembly. The DCU HP-IB Interface is made up of the HP-IB Address and part of the HP-IB Interface assembly. The DCU HP-IB Interface is discussed below.

HP-IB Address. The HP-IB Address assembly receives characters from the HP-IB data lines under control of 3 handshake lines. The 5 HP-IB control lines are decoded to determine whether the character received is an HP-IB address, bus command or a data character. If the character is an address and the address matches the CW Generator's talk or listen address, the CW Generator will switch to talk or listen mode.

If the character received is a command (e.g. the serial poll bus command) the CW Generator will decode the command and perform the required function. Table 3-3 lists all of the bus commands that the CW Generator can process.

If the character received is a data character and the CW Generator has been addressed to listen, the HP-IB Address assembly will instruct the HP-IB Interface assembly to determine whether the data character is a programming code or an argument and to process the data appropriately.

P/O HP-IB Interface. The HP-IB Interface assembly decodes the data from the HP-IB Address assembly into programming codes and arguments. Each programming code corresponds to an address within the CW Generator that holds the data for a specific function.

The program string (data input) is processed in a left to right sequence. The first character of the program string must be a program code so that the first argument will be placed in the correct data latch. As each new argument is received, the address set by the first program code is incremented. This allows the first programming code to be specified and the remaining program codes to be left out to produce an abbreviated program string (see Section III). Specifying another programming code within the program string will reset the internal address and the remaining arguments will again be placed at successive addresses.

SERVICE SHEET BD8 (cont'd)

The HP-IB Interface assembly will recognize programming codes for AM and FM modulation. However, the information stored in the respective data latches will not be used by the internal circuitry of the CW Generator. This capability allows identical programs to be used for the CW Generator and the HP 8672A Synthesized Signal Generator. The programs should only program AM and FM off since modulation is not available on the CW Generator.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet BD1 was used to isolate the problem to the DCU Remote/Local Interface or there is a problem involving only one mode (local or remote) but not the other. The following troubleshooting procedures can be used to further isolate the problem to one of the following subassemblies:

- HP-IB Address Assembly — Service Sheet 22, 23
- HP-IB Interface Assembly — Service Sheet 24, 25

Test Equipment Required

Controller .... HP 85B or HP 9826/36A
Digital Voltmeter .... HP 3456A
Oscilloscope .... HP 1980B

NOTE

The CW Generator has a built-in logic probe on the A2A8 Output Register Assembly. To use the probe, connect a clip lead to A2A8TP2. The other end of the clip lead can then be used to probe logic levels and can also be used for checking for pulse activity. The indicator near the test point will light for a logic high, extinguish for a logic low and will pulse if repetitive pulses are present. If the logic probe is used, the oscilloscope and voltmeter are not required.

Troubleshooting Procedures

The following procedures are divided into three checks, as follows:

Remote, Talk and Listen Checks (√1)
Data Control Checks (√2)
Serial and Parallel Poll Check (√3)

Remote, Talk and Listen Checks (√1)

1. Set the CW Generator to the following conditions using the front panel controls.

◀ DCU Remote/Local Interface SERVICE SHEET 7 BD7

SERVICE SHEET BD8 (cont'd)

Remote, Talk and Listen Checks (cont'd)

RF OUTPUT .... On
RANGE Control .... Fully counter-clockwise
VERNIER .... Fully counter-clockwise
ALC .... set to INT
Frequency .... 3000.000 MHz

2. Connect the controller to the CW Generator. Set the CW Generator to remote mode with the command:

   ```
   REMOTE 719
   ```

   Verify that the REMOTE annunciator in the STATUS block lights. The front panel displays should now indicate:

RF OUTPUT .... ON
RANGE .... −110 dB
LEVEL .... −10 dBm
ALC .... INT
Frequency .... 3000.000 MHz

   If all indications are correct, proceed with step 4.

   If the REMOTE annunciator does not light, check the HP-IB cable and verify that the CW Generator is set to the correct HP-IB address. If the problem cannot be corrected, continue with step 3 to check the remote and listen signals.

   If the REMOTE *annunciator does light*, but the front panel annunciators have changed, use service sheet 19 to troubleshoot the appropriate Local/Remote Selector. The local data should be latched at the Local/Remote Selector on the local to remote transition.

3. Use the voltmeter or the built-in logic probe on A2A8 Output Register assembly to check A2A9U19B-15, Listen, and A2A9U17B-15, Remote. Both signals should be a TTL high.

   If the indication is correct, go to service sheet 24 to trace the Remote signal to the front panel annunciator.

   If the Listen signal is not correct, go to service sheet 22 to troubleshoot the handshake circuits and the Talk, Listen and Remote Decoding circuit.

   If the Remote signal is not correct, use service sheet 22 to troubleshoot the Remote flip-flop and the handshake circuitry. The Listen signal must be correct before the Remote signal can be checked.

4. Enter and run the following program to test the Source Handshake and output data latches.

   ```
   10 REMOTE 719
   20 ENTER 719 USING "#,B";V
   30 DISP V
   40 END
   ```

   The controller should display a zero after the program is executed.

   If the controller displays a zero, proceed with the Data Control Checks beginning with step 10.

   If no number is displayed, go to service sheet 22 to troubleshoot the Source Handshake circuit.

   If the number displayed is not zero, proceed with step 5.

5. Execute a serial poll with the command:

   ```
   SPOLL(719)
   ```

   If the number displayed is the same as the number displayed in step 4, the Source Handshake circuit is working properly. Proceed with step 6.

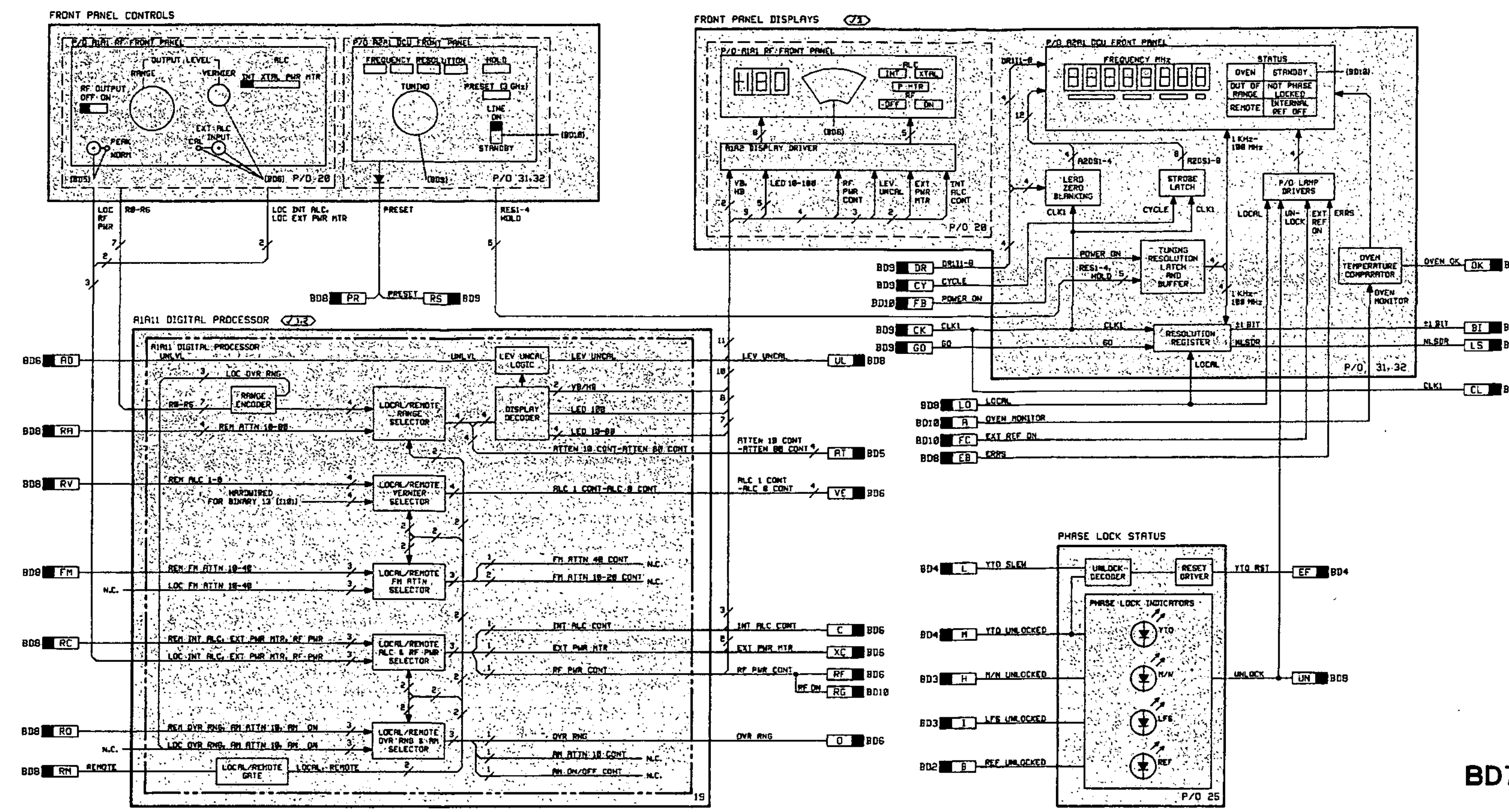
   If the number displayed is not the same as the number displayed in step 4, use service sheet 22 to troubleshoot the Source Handshake circuit and the output data latch.

Data Control Checks (√2)

6. Enter and execute the following program. This program will exercise each of the RF Program Selectors and the Interface Storage Register control lines.

   ```
   10 SEND 7; MTA LISTEN 19
   20 OUTPUT 7;"P1Q1R1S1T1U1V1W1Z1K1L1M1N7O1"
   30 GOTO 20
   40 END
   ```

   Use the oscilloscope or built-in logic probe on the A2A8 Output Register assembly to observe the following signals.



BD7

Figure 8-26. Remote/Local Interface Block Diagram

SERVICE SHEET BD9

DCU FREQUENCY CONTROL

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The Digital Control Unit (DCU) is divided into three sections:

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- DCU Frequency Control

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DCU HP-IB Interface. Remote mode uses a combination of special ASCII program codes and arguments to simulate the front panel controls. The HP-IB Address assembly is used to decode the information on the HP-IB and generate control signals for managing the input data. The HP-IB Interface assembly is used to decode the program codes and arguments so the DCU Frequency Control subsystem can alter the frequency setting of the instrument.

DCU Frequency Control. The DCU produces tuning information and frequency *band related information based on the current front panel frequency.* Tuning information information comes from the DCU Remote/Local Interface as tuning and resolution for local mode, or actual frequency information for remote mode.

The baseband (band 1) and the multiplied band frequencies are:

Band 1: 2—6.2 GHz
Band 2: 6.2—12.4 GHz
Band 3: 12.4—18 GHz.

Each frequency change requires a cycling of the frequency data through three registers. Register 1 holds the front panel frequency, rounds the desired frequency according to the frequency resolution and decodes the appropriate frequency band. Register 2 divides the Register 1 frequency by 1, 2 or 3 to produce a baseband frequency and indicates whether the frequency is evenly divisible. Register 3 generates the tuning information for the phase locked loops to generate the appropriate baseband frequency.

Remote operation loads frequency data directly into the first register to be processed by registers 2 and 3. Local control indicates tuning direction and resolution for incrementing or decrementing the Register 1 frequency.

SERVICE SHEET BD9 (cont'd)

DCU Frequency Control

The DCU Frequency Control section consists of three assemblies:

- Timing and Control
- Register 1
- Output Register

Each is discussed separately below.

Timing and Control. The Timing and Control assembly generates all timing signals for the DCU data cycles. A data cycle consists of changing the CW Generator's frequency by adding or subtracting one to the frequency digit selected by the FREQUENCY RESOLUTION keys. The frequency digits are stored in Register 1. If an error occurs after a single data cycle, the Timing and Control assembly will initiate additional data cycles until the error is corrected.

The ±1 adder is also contained on the Timing and Control assembly. The data stored in Register 1 is shifted (LSB first) through the adder to increment or decrement the frequency stored in Register 1. The RPG circuitry indicates to the ±1 adder whether the frequency should be incremented or decremented by decoding the direction the RPG is turned.

In remote mode, the frequency data is loaded directly into Register 1 via the HP-IB Interface assembly. Once the data is loaded, a data cycle is initiated to display the frequency and retune the instrument's phase locked loops.

Register 1. Register 1 stores the output frequency of the instrument for processing. The register is powered by a battery whenever the line cord is removed from the instrument. The battery is continually *charged whenever the line cord is connected to the instrument.* Register 1 also contains circuitry for error decoding and for band decoding.

The frequency information in Register 1 is processed during data cycles initiated by the Timing and Control assembly. A data cycle begins by shifting the data stored in Register 1 through the ±1 adder on the Timing and Control assembly. The frequency information is modified (incremented or decremented) depending on the direction the RPG was turned and the selected frequency tuning resolution. The output of the ±1 adder is routed back into Register 1, Register 2 and the front panel for the FREQUENCY MHz display.

Once the modified frequency is stored in Register 1, the frequency sto decoded on the Register 1 assembly. The divided frequency is then in Register 2 is divided according to the band dumped into Register 3 where it is decoded to generate tuning information for the phase locked loops.

If the frequency cannot be evenly divided by the frequency band number, additional data cycles are initiated by the Timing and

SERVICE SHEET BD9 (cont'd)

Control assembly to further add or subtract 1 from the data in Register 1. The rounding is random in direction for the first add/subtract and then continues in the same direction until the frequency is evenly divisible.

Register 2. The data stored in Register 1 is copied into Register 2 during the first nine clocks of the data cycle. During the succeeding clocks of the data cycle, the data is divided by the frequency band number. The division takes place by shifting the digits through a divider consisting of several ROMs. If the frequency is not evenly divisible by the band number, a remainder signal is generated by the divider circuitry. The Timing and Control assembly then begins another data cycle to add or subtract one from the frequency stored in Register 1. The direction (add or subtract) depends only on the last process (addition or subtraction) that was done. This results in a random roundoff.

Once the divider indicates that a division occurred with no remainder the entire contents of Register 2 are clocked into Register 3. The parallel load stores the baseband information into Register 3 for use in generating tuning information for the phase locked loops.

Register 3. The data stored in Register 3 is decoded to produce the M and N divider numbers for the M/N phase locked loop. In addition, the stored frequency information is sent to the LFS phase locked loop and to the Digital to Analog Converter for pretuning the YIG tuned oscillator.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with *Service Sheet BD1 was used to isolate the problem to the DCU* Frequency Control. The following troubleshooting procedures can be used to further isolate the problem to one of the following subassemblies:

- Register 1 Assembly - Service Sheet 26
- Timing and Control Assembly - Service Sheet 27,28
- Output Register Assembly - Service Sheet 29,30

Test Equipment Required

Oscilloscope .... HP 1980B
Digital Voltmeter .... HP 3456A

Troubleshooting Procedures

The following procedures are divided into four checks, as follows:

Timing and Control Assembly Checks (✓1)
Register 1 Checks (✓2)
Register 2 Checks (✓3)
Register 3 Checks (✓4)

SERVICE SHEET BD9 (cont'd)

Timing and Control Assembly Checks (✓1)

1. Remove A2A11 Timing and Control assembly and place it on the special extender board (P/N 08672-60016). Three 30 pin extender boards may be used if the the special extender board is not available.
2. Short test point pair A2A11TP1 with an alligator clip. Connecting this test point pair causes the DCU to continually cycle the frequency data.
3. Connect channel 1 of the oscilloscope to A2A11 CLK 1. The waveform should be as shown in Figure 8-28.

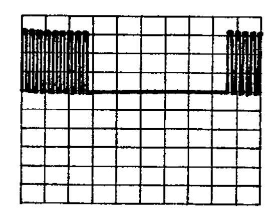


Figure 8-28. A2A11 CLK 1 Test Point

If the waveform is as shown, leave channel 1 connected to A2A11 CLK 1 test point and continue with step 5.

If the waveform is not as shown, continue with step 4.

4. Connect channel 2 of the oscilloscope to XA2A11B-24.

The oscilloscope should indicate a signal at 10 MHz with a level of about 1 volt peak-to-peak.

If the signal is correct, go to Service Sheet 27 to troubleshoot the clock circuitry.

If the frequency is not correct, the Time Base Reference is at fault. Go to Service Sheet BD2 to isolate the problem.

5. Connect channel 2 of the oscilloscope to A2A11 CLK 2. Set the oscilloscope to chop sweep mode to eliminate retrace delays. The waveform should be as shown in Figure 8-29.

If the waveform is correct, proceed with step 6.

If the waveform is not correct, go to Service Sheet 27 to troubleshoot the clock circuitry.

SERVICE SHEET BD9 (cont'd)

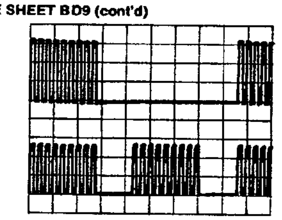


Figure 8-29. A2A11 CLK 2 Test Point

6. Connect channel 2 of the oscilloscope to XA2A11C-7, NCLK 2. The waveform should be as shown in Figure 8-30.

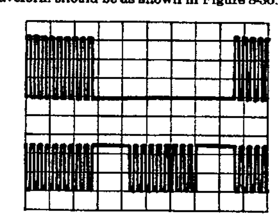


Figure 8-30. XA2A11C-7, NCLK 2

If the waveform is correct, proceed with step 7.

If the waveform is not correct, go to Service Sheet 27 to troubleshoot the clock circuitry.

7. Connect channel 2 of the oscilloscope to XA2A11A-30, NCLK 3. The waveform should be as shown in Figure 8-31.

DCU HP-IB Interface SERVICE SHEET BD8

SERVICE SHEET BD9 (cont'd)

Timing and Control Assembly Checks (cont'd)

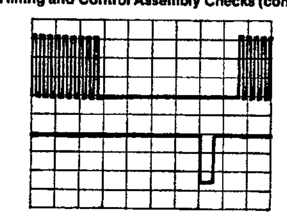


Figure 8-31. XA2A11A-30, NCLK 3

If the waveform is correct, proceed with step 8.

If the waveform is not correct, go to Service Sheet 27 to troubleshoot the clock circuitry.

8. Connect channel 2 of the oscilloscope to XA2A11B-30, LEFT. The waveform should be as shown in Figure 8-32.

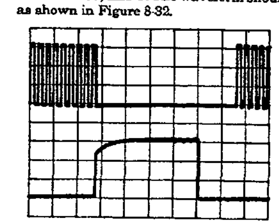


Figure 8-32. XA2A11B-30, LEFT

If the waveform is correct, proceed with step 9.

If the waveform is not correct, go to Service Sheet 27 to troubleshoot the Clock Counter and Left circuitry.

9. Connect channel 2 of the oscilloscope to XA2A11A-19, CYCLE. The waveform should be as shown in Figure 8-33.

If waveform is correct, proceed with step 10.

If the waveform is not correct, go to Service Sheet 27 to troubleshoot the N cycle circuitry.

10. Connect channel 2 of the oscilloscope to XA2A11C-1, GO. The waveform should be as shown in Figure 8-34.

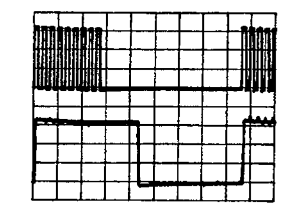


Figure 8-33. XA2A11A-19, CYCLE

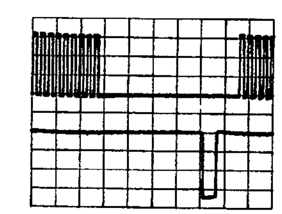


Figure 8-34. XA2A11C-1, GO

If waveform is correct, proceed with step 11.

If the waveform is not correct, go to Service Sheet 27 to troubleshoot the GO circuitry.

11. Connect the oscilloscope to XA2A11B-15, CLK PRTCT. Turn off the instrument and verify that the signal is at +5 volts.

If the voltage is correct, proceed with step 12.

If the voltage is not correct, use Service Sheet 27 to troubleshoot the CLK PRTCT circuit.

12. With the oscilloscope still connected to XA2A11B-15, set the CW Generator's line switch to ON.

After a brief (<1-second) delay, the signal should return to a TTL low (<.7 volts).

If the signal is correct, the CLK PRTCT circuit is functioning normally. Proceed with step 13.

If the signal is not correct, use Service Sheet 27 to troubleshoot the CLK PRTCT circuit.

SERVICE SHEET BD8 (cont'd)

Data Control Checks (cont'd)

Signal	A2A7-
REM 1000 CLK	U3-1
REM FM CNTL	U3-2
REM VERNIER CNTL	U3-3
REM 1 CLK	U3-4
REM 100 CLK	U3-6
REM 10 CLK	U3-7
REM AM CNTL	U3-14
REM ALC CNTL	U3-15
INTF CLK 1	U5-14
INTF CLK 2	U5-15
INTF CLK GO	U6-10
REM ATTN CNTL	U25-3
REG RST	U26-12

Pulse activity should be evident for all of the signals and the front panel should indicate a frequency of 11 111.111 MHz (the 1 kHz digit will be unstable). The RF output should be on and the output level should be -8 dBm. In addition, the ALC mode should be INT.

If there is pulse activity for all of the signals, and the front panel indications are correct, proceed with the Serial and Parallel Poll checks.

If there is pulse activity for all of the signals but the front panel indications are not correct (or the CW Generator does not accept data), proceed to service sheet 24 to troubleshoot the RF Program Selectors and the data being routed through them.

If any or all of the signals do not indicate pulse activity, go to service sheet 24 to troubleshoot the Instruction Decoders and related circuitry.

Serial and Parallel Poll Check (√8)

To determine whether the serial and parallel poll circuits are working correctly, perform the HP-IB portion of the Operator's Checks in Section III of the manual. The checks will also verify the CW Generator's processing of the other HP-IB bus commands.

If any part of the checks fail, go to service sheet 23 to troubleshoot the Bus Command Decoder and/or the serial and parallel poll circuits.

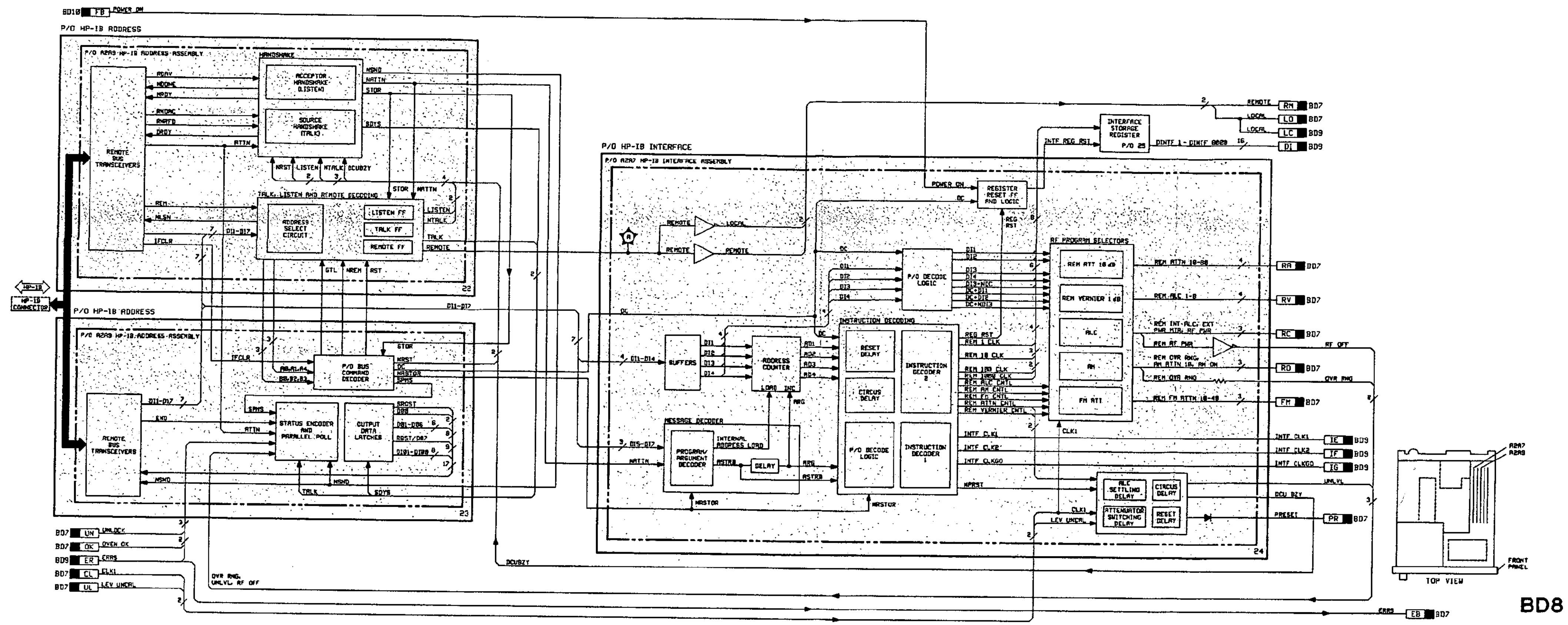


Figure 8-27. DCU HP-IB Interface Block Diagram

SERVICE SHEET BD9 (cont'd)

Timing and Control Assembly Checks (cont'd)

13. Disconnect the short from A2A11TP1 test point pair. Short A2A11TP2 test point pair to suppress frequency limits.

14. Connect the oscilloscope to XA2A11B-1, ERRS. Tune the CW Generator to a frequency less than 2 GHz. If the instrument cannot be tuned, an out of range frequency can be obtained with the following procedure. Short A2A11TP1 test point pair and alternately press the 1 kHz FREQUENCY RESOLUTION key and the PRESET (3 GHz) key until an illegal frequency is obtained (0 GHz). A controller can also be used to directly program an out-of-range frequency.

    The oscilloscope should indicate a TTL low when above 2 GHz and a TTL high when below 2 GHz.

    If the signal is correct, proceed with step 15.

    If the signal is not correct, use Service Sheet 27 to troubleshoot the ERRS circuit.

15. Remove the short from A2A11TP2 test point pair (and A2A11TP1 test point pair if shorted). Connect the oscilloscope to A2A11 RPG SIGN test point.

    The signal should be low when the TUNING knob is turned clockwise and high when the TUNING knob is turned counter-clockwise.

    If the signal is correct, the Timing and Control assembly is nominally working. Proceed with the Register 1 checks beginning with step 16.

    If the signal is not correct, use Service Sheet 27 to troubleshoot the RPG circuits.

Register 1 Checks ⟨√2⟩

Register 1 stores the output frequency information for the instrument. These procedures check that the information in the register can be preset and modified. In addition, the decoding circuitry to detect frequency errors and frequency band information is checked.

Overall Check ⟨√2a⟩

16. Replace A2A11 and place A2A10 Register 1 assembly on the special extender board.

17. Press PRESET (3 GHz) and observe the FREQUENCY MHz display on the CW Generator's front panel.

    The displayed frequency should be 3000.000 MHz.

    If the displayed frequency is correct, proceed with step 18.

    If the displayed frequency is not correct, the data in Register 1 may be incorrect or the frequency display may be at fault. Proceed with Register 1 Data Check beginning with step 25.

18. Select 1 kHz FREQUENCY RESOLUTION and slowly turn the TUNING knob. The frequency display should indicate the 1 kHz digit decrements when the TUNING knob is turned counter-clockwise and increments when the TUNING knob is turned clockwise.

    If the frequency does change, proceed with step 19.

    If the frequency does not change, but the FREQUENCY RESOLUTION indicators light, use Service Sheet 28 to isolate the problem to the ±1 adder or the NLSDR input to the adder.

    If the FREQUENCY RESOLUTION indicators do not light, use Service Sheet 31 to troubleshoot the tuning resolution circuitry.

19. Select the other available FREQUENCY RESOLUTION keys and verify that the least significant digit above the lighted FREQUENCY RESOLUTION indicators can be incremented and decremented.

    If the least significant digits can all be changed, proceed with step 20 to check the remainder of the circuitry on the Register 1 assembly.

    If any tuning resolution does not affect the frequency, go to Service Sheet 31 to troubleshoot the Resolution Register. If the indicator for the selected resolution does not work, troubleshoot the Tuning Resolution Latch.

20. Press PRESET (3 GHz) and set the output of the CW Generator to 3018.012 MHz. Short A2A11TP1 test point pair with an alligator clip to cycle the data through the ±1 adder and through the decoding circuitry.

21. Connect channel 1 of the oscilloscope to A2A11 CLK 1 and connect channel 2 to

SERVICE SHEET BD9 (cont'd)

Overall Check (cont'd)

XA2A10C-20, NERR. The waveform should be as shown in Figure 8-35.

If the waveform is correct, proceed with step 22.

If the waveform is not correct, go to Service Sheet 26 to troubleshoot the Parallel Output Buffer, Combiner, and Decoding ROMs.

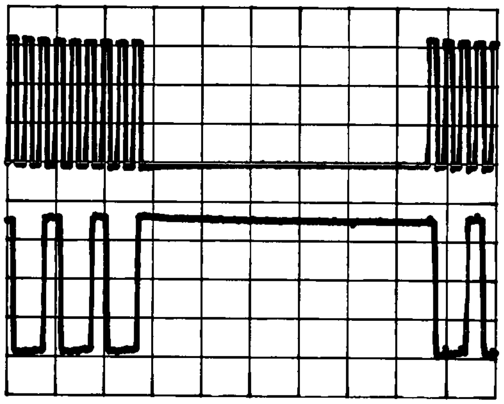


Figure 8-35. XA2A10C-20, NERR

22. Connect channel 2 to A2A10TP HNR1. The waveform should be as shown in Figure 8-36.

If the waveform is correct, proceed with step 23.

If the waveform is not correct, go to Service Sheet 26 to troubleshoot the Parallel Output Buffer, Combiner, and Decoding ROMs.

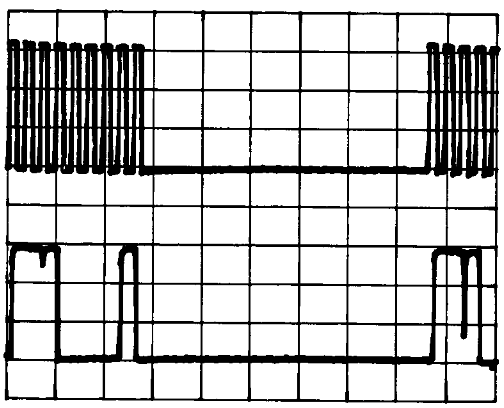


Figure 8-36. A2A10 HNR1 Test Point

23. Connect channel 2 to A2A10TP HNR2. The waveform should be as shown in Figure 8-37.

If the waveform is correct, proceed with step 24.

If the waveform is not correct, go to Service Sheet 26 to troubleshoot the Parallel Output Buffer, Combiner, and Decoding ROMs.

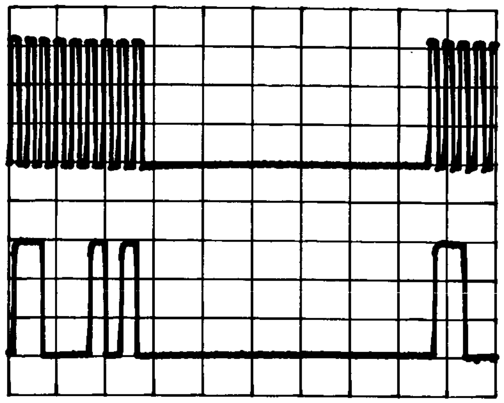


Figure 8-37. A2A10 HNR2 Test Point

24. Remove the short from A2A11TP1 test point pair. Tune to each of the frequencies listed below and check the logic level at the edge connector pins indicated. The logic probe circuitry on A2A8 may be used to check the logic levels.

Table 8-14. Frequency Band Outputs

Frequency MHz	XA2A10B-		XA2A10C-	
	23 HN1	6 HN2	13 HN1	12 HN2
2000.000	L	L	L	L
10000.000	H	L	H	L
18000.000	L	H	L	H

If all of the levels are correct, Register 1 is working correctly. Proceed with Register 2 checks beginning with step 33.

If any or all of the levels are incorrect, go to Service Sheet 27 to troubleshoot the Band Latch.

Register 1 Data Check ⟨✓ 2b⟩

25. Connect channel 1 of the oscilloscope to A2A11 test point CLK 1. Press the PRESET (3 GHz)

SERVICE SHEET BD9 (cont'd)

Register 1 Data Check (cont'd)

key on the front panel to set Register 1 to a known state. Short A2A11TP1 test point pair with an alligator clip. Connect channel 2 of the oscilloscope to XA2A10C-9, DR1O1.

The waveform should be as shown in Figure 8-38. The single TTL high indicates that the 1 GHz bit in the register is set high.

If the waveform is correct, proceed with step 26.

If the waveform is not correct, proceed with step 28 to test the preset circuitry.

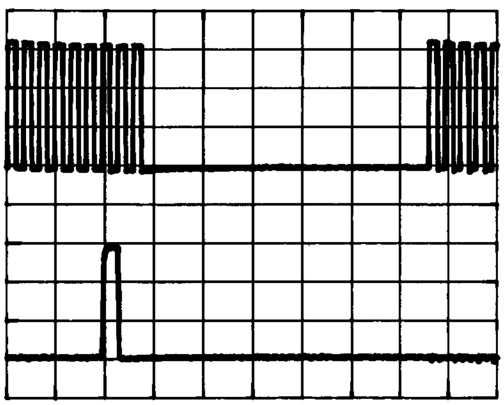


Figure 8-38. DR101, DR102

26. Connect channel 2 of the oscilloscope to XA2A10C-24, DR1O2.

    The waveform should also be as shown in Figure 8-38. The single TTL high indicates that the 2 GHz bit in the register is set high.

    If the waveform is correct, proceed with step 27.

    If the waveform is not correct, proceed with step 28 to test the preset circuitry.

27. Verify that XA2A10C-23, DR1O4, and XA2A10C-22, DR1O8, do not indicate any TTL high signals.

    If the waveform does not indicate any high bits, the data in Register 1 is correct. Go to Service Sheet 32 to troubleshoot the frequency display.

    If the waveform does indicate one or more TTL high bits, proceed with step 28 to test the preset circuitry.

Preset Circuitry Check

28. Connect the oscilloscope to A2A10U24-4, CLEAR. Press the PRESET (3 GHz) key on the CW Generator.

    The oscilloscope should indicate a TTL high when the PRESET (3 GHz) key is pressed and a TTL low when the key is released.

    If the indication is correct, continue with step 29.

    If the indication is not correct, use Service Sheet 27 to isolate the problem to the DCU Front Panel, Service Sheet 31, or the Register Protect Logic on Service Sheet 27.

29. Remove the short from A2A11TP1 test point pair and then press the PRESET (3 GHz) key on the front panel. Remove the blue cable from A3A1J6 to disable the DCU's internal clock and enable single stepping with the switch on A2A11 Timing and Control assembly. Short A2A11TP1 test point pair again to allow stepping through a data cycle.

30. Step the DCU through a data cycle using the switch on A2A11 Timing and Control assembly. Check the following signals at each step to ensure that the register has been preset correctly.

    The data cycle consists of 18 steps. The first nine correspond to the first through ninth time that A2A11 test point CLK 1 is high. To find the beginning of a data cycle, monitor A2A11 test point CLK 1 with the oscilloscope. The beginning of the data cycle is the first time the clock signal goes high after nine steps of being low.

    If the results are not correct, try holding the PRESET (3 GHz) while stepping through an entire data cycle (18 steps). This will force a manual preset and may correct the levels.

    If all of the signals are correct, proceed with step 31 to check the data returned from the ± 1 adder.

    If any or all of the levels are incorrect, use Service Sheet 27 to troubleshoot the preset circuitry and Serial Output Latch. Check the frequency data at the outputs of the shift registers. After a preset, only the 1G (A2A10U19-15) and 2G (A2A10U20-15) bits should be high.

SERVICE SHEET BD9 (cont'd)

Preset Circuitry Check (cont'd)

Table 8-15. Register 1 Serial Output

Step	A2A11TP-				BCD Frequency Value
	DR108	DR104	DR102	DR101	
1	L	L	L	L	0 (1 kHz)
2	L	L	L	L	0 (10 kHz)
3	L	L	L	L	0 (100 kHz)
4	L	L	L	L	0 (1 MHz)
5	L	L	L	L	0 (10 MHz)
6	L	L	L	L	0 (100 MHz)
7	L	L	H	H	3 (1 GHz)
8	L	L	L	L	0 (10 GHz)
9	L	L	L	L	0 (100 GHz)

31. Step through the remaining nine steps of the data cycle to restart the sequence. Press and hold the PRESET (3 GHz) key while stepping through the next 18 steps of the data cycle so that the register is reset to 3 GHz.

32. Step the DCU through another data cycle. Check the following signals at each step to ensure that the data returning from the ±1 Adder is correct.

    If all of the signals are correct, Register 1 is being preset. Replace the blue cable and repeat steps 16 through 19. If the same failure occurs, use Service Sheet 27 to isolate the preset problem.

    If any or all of the levels are incorrect, use Service Sheet 28 to troubleshoot the ±1 Adder and Offset ROM circuits.

Register 2 Checks (√ 3)

Register 2 receives the data from Register 1 and divides the frequency by the band number. If the division leaves a remainder, the frequency is not evenly divisible by the band number and a signal is sent back to the Timing and Control assembly to

Table 8-16. Register 1 Serial Input

Step	XA2A10C-				BCD Frequency Value
	16 (DR108)	17 (DR104)	2 (DR102)	16 (DR101)	
1	L	L	L	L	0 (1 kHz)
2	L	L	L	L	0 (10 kHz)
3	L	L	L	L	0 (100 kHz)
4	L	L	L	L	0 (1 MHz)
5	L	L	L	L	0 (10 MHz)
6	L	L	L	L	0 (100 MHz)
7	L	L	H	H	3 (1 GHz)
8	L	L	L	L	0 (10 GHz)
9	L	L	L	L	0 (100 GHz)

round off the frequency stored in Register 1. The the results of the division are dumped into Register 3 for generation of phase locked loop tuning data.

Data Input Buffer Check (√ 3a)

33. Replace A2A10 in the instrument and place A2A8 on an extender board. Remove the short from A2A11TP1 test point pair and connect channel 1 of the oscilloscope to A2A11TP CLK 1. Press the PRESET (3 GHz) key on the front panel to set Register 1 (and Registers 2 and 3) to a known state.

34. Set the CW Generator to 15 999.999 MHz. If the instrument cannot be tuned, Register 1 is at fault. Return to the Register 1 checks beginning with step 16. Short A2A11TP1 test point pair with an alligator clip. Connect channel 2 of the oscilloscope to XA2A8B-11, NRMDR.

    The waveform should be as shown in Figure 8-39. This signal is used to indicate to the Timing and Control assembly that the division (by three in this case) left a remainder. If a remainder is indicated, another data cycle is initiated and the frequency in Register 1 is incremented or decremented and the process is repeated until the frequency in Register 1 is evenly divisible by the band number.

SERVICE SHEET BD9 (cont'd)

Data Input Buffer Check (cont'd)

If the waveform is correct, proceed with step 35.

If the waveform is not correct, proceed with step 39 to test the input signals from Register 1.

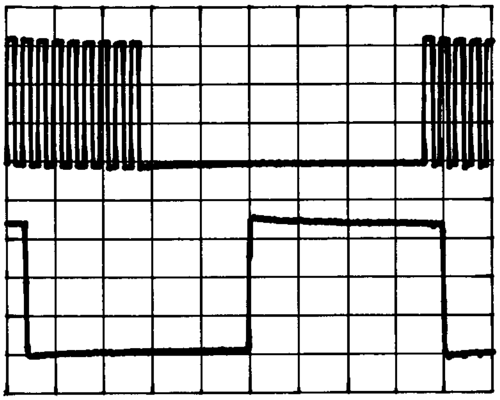


Figure 8-39. XA2A8B-11, NRMDR

35. Connect channel 2 of the oscilloscope to A2A8U23-12. This signal is the BCD 8 output from Register 1 when LEFT is low and is the Register 2 data (being divided) during the time that LEFT is high.

    The waveform should be as shown in Figure 8-40.

    If the waveform is correct, proceed with step 36.

    If the waveform is not correct, proceed with step 39 to test the input signals from Register 1.

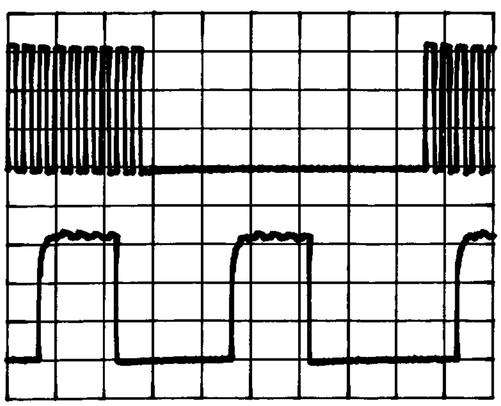


Figure 8-40. A2A8U23-12, BCD 8

36. Connect channel 2 of the oscilloscope to A2A8U23-15. This signal is the BCD 4 digit from Register 1 when LEFT is low and is the Register 2 BCD 4 digit during the time that LEFT is high.

    The waveform should be as shown in Figure 8-41.

    If the waveform is correct, proceed with step 37.

    If the waveform is not correct, proceed with step 39 to test the input signals from Register 1.

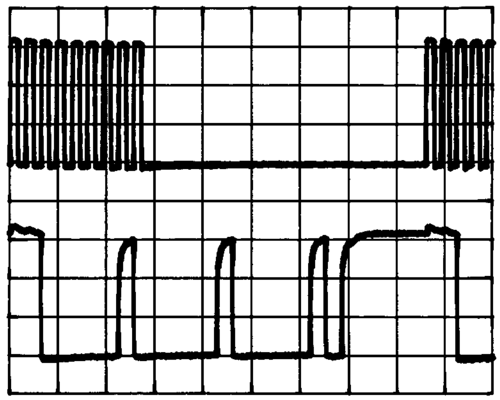


Figure 8-41. A2A8U23-15, BCD 4

37. Connect channel 2 of the oscilloscope to A2A8U23-14. This signal is the BCD 2 digit from Register 1 when LEFT is low and is the Register 2 BCD 2 digit during the time that LEFT is high.

    The waveform should be as shown in Figure 8-42.

    If the waveform is correct, proceed with step 38.

    If the waveform is not correct, proceed with step 39 to test the input signals from Register 1.

38. Connect channel 2 of the oscilloscope to A2A8U23-13. This signal is the BCD 1 digit from Register 1 when LEFT is low and is the Register 2 BCD 1 digit during the time that LEFT is high.

    The waveform should be as shown in Figure 8-43.

SERVICE SHEET BD9 (cont'd)

Data Input Buffer Check (cont'd)

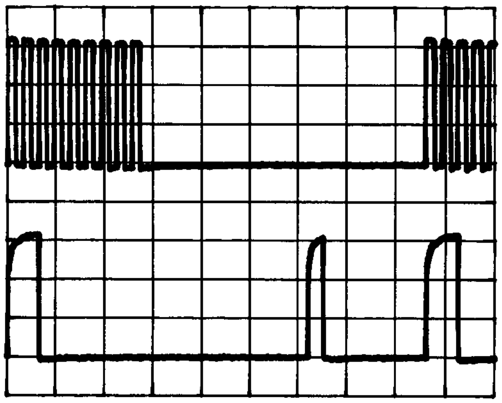


Figure 8-42. A2A8U23-14, BCD2

If the waveform is correct, Register 2 is nominally working. Proceed with Register 3 checks beginning with step 43.

If the waveform is not correct, proceed with step 39 to test the input signals from Register 1.

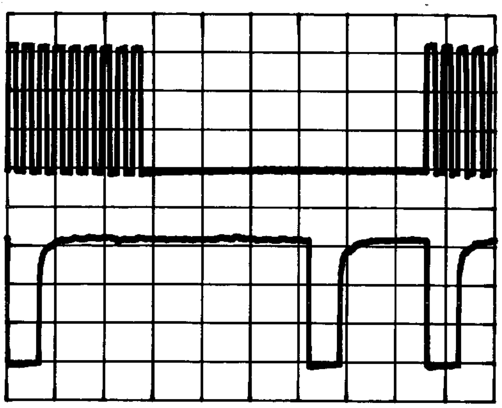


Figure 8-43. A2A8U23-13, BCD1

Register 2 Input Check ⟨√3b⟩

39. Connect channel 2 of the oscilloscope to A2A8U23-7, DR2I8. This signal is the output from Register 1.

    The waveform should be as shown in Figure 8-44.

    If the waveform is correct, proceed with step 40.

    If the waveform is not correct, use Service Sheet 28 and Service Sheet 29 to isolate the problem to the Timing and Control assembly or the motherboard.

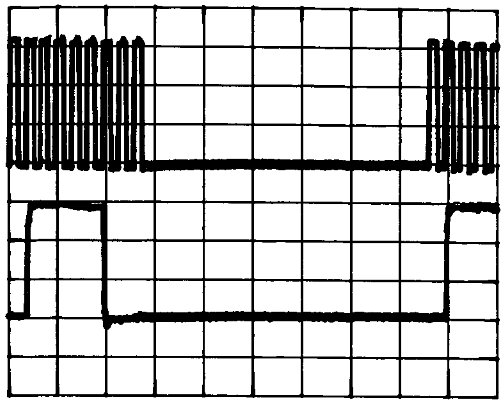


Figure 8-44. A2A8U23-7, DR2I8

40. Connect channel 2 of the oscilloscope to A2A8U23-3, DR2I4. This signal is the BCD 4 digit from Register 1.

    The waveform should be as shown in Figure 8-45.

    If the waveform is correct, proceed with step 41.

    If the waveform is not correct, use Service Sheet 28 and Service Sheet 29 to isolate the problem to the Timing and Control assembly or the motherboard.

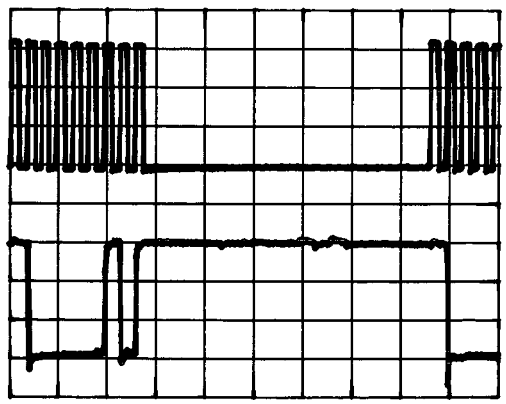


Figure 8-45. A2A8U23-3, DR2I4

41. Connect channel 2 of the oscilloscope to A2A8U23-4, DR2I2. This signal is the BCD 2 digit from Register 1.

    The waveform should be as shown in Figure 8-46.

SERVICE SHEET BD9 (cont'd)

Data Input Buffer Check (cont'd)

If the waveform is correct, proceed with step 42.

If the waveform is not correct, use Service Sheet 28 and Service Sheet 29 to isolate the problem to the Timing and Control assembly or the motherboard.

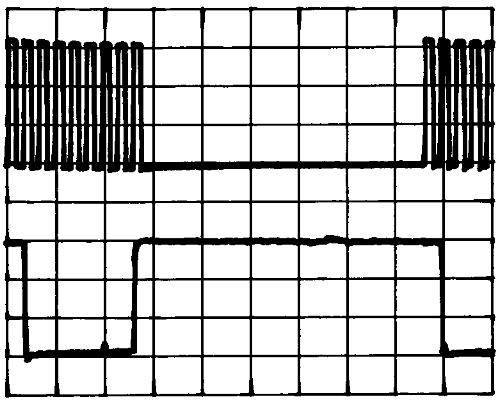


Figure 8-46. A2A8U23-4, DR2I2

42. Connect channel 2 of the oscilloscope to A2A8U23-9, DR2I1. This signal is the BCD 1 digit from Register 1.

    The waveform should be as shown in Figure 8-47.

    If the waveform is correct, the divider or one of the shift registers in Register 2 is at fault. Go to Service Sheet 29 to troubleshoot.

    If the waveform is not correct, use Service Sheet 28 and Service Sheet 29 to isolate the problem to the Timing and Control assembly or the motherboard.

Register 3 Checks (✓4)

43. Remove A2A8 and place it on the special extender board (P/N 08672-60016). Three 30 pin extender boards may be used if the special extender is not available.

44. Set the CW Generator to the frequencies shown in Table 8-18 on the next page. Check the edge connector pins for the logic levels given.

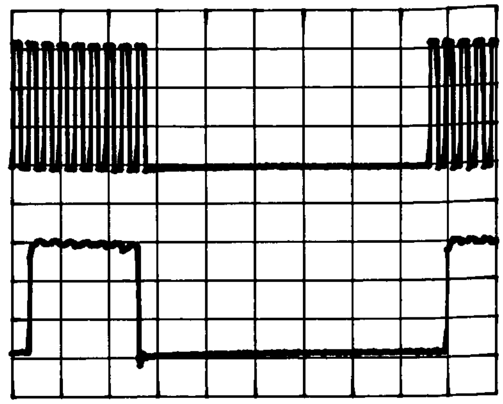


Figure 8-47. A2A8U23-9, DR2I1

If all the edge connector pins are correct, proceed with step 45.

If any of the edge connector pins are incorrect, use Service Sheet 29 and 30 to isolate the problem to the output of Register 2 or Register 3.

45. Set the CW Generator to each frequency listed in Table 8-17 and check for the corresponding logic level on each edge connector pin.

Table 8-17. M1—M5 and N1—N6 Outputs

Freq. (MHz)	XA2A8B-				XA2A8C-						
	14 N6	26 N5	27 N2	28 N1	4 N3	6 N4	10 M5	12 M2	25 M4	26 M1	27 M3
6180	1	0	0	0	0	0	1	1	0	1	0
6050	0	1	1	1	1	1	0	0	1	0	1

If all the edge connector pins are correct, Register 3 is working normally.

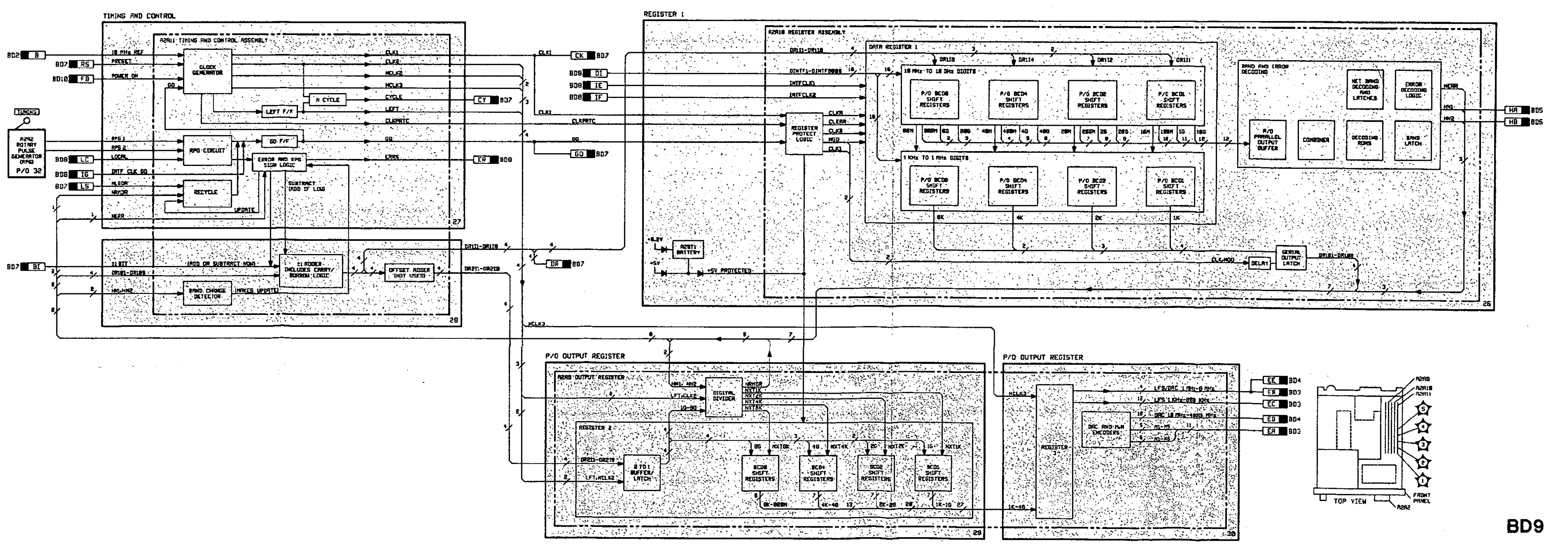
If any of the edge connector pins are not correct, use Service Sheet 29 and 30 to isolate the problem to the output of Register 2 or to Register 3.

SERVICE SHEET BD9 (cont'd)

Register 3 Checks (cont'd)

Table 8-18. LFS 1K—8M Outputs

Frequency (GHz)	XA2A8A-										XA2A8B-					
	3 (1 kHz)	6 (20 kHz)	10 (40 kHz)	14 (100 kHz)	15 (8 kHz)	17 (10 kHz)	22 (2 kHz)	26 (4 kHz)	29 (80 kHz)	30 (1 MHz)	2 (200 kHz)	7 (400 kHz)	10 (8 MHz)	18 (2 MHz)	23 (4 MHz)	25 (800 kHz)
3339.999	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
3336.666	0	1	1	0	0	0	1	1	0	0	1	1	0	1	1	0



BD9

Figure 8-48. DCU Frequency Control Block Diagram

SERVICE SHEET BD10
POWER SUPPLIES
REFERENCES

Overall Block Diagram .... Service Sheet BD1
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The power supplies in the A3 RF Source section of the instrument supply all of the dc operating voltages required by the instrument. Voltages provided are as follows:

+22 Vdc
+20 Vdc
+10 Vdc
+5.2 Vdc
−5.2 Vdc
−10 Vdc
−40 Vdc

The power supply section consists of four parts:

- Mainframe Components
- Rectifier Assembly A3A2
- Positive Regulator Assembly A3A3
- Negative Regulator Assembly A3A4

Mainframe components consist of the input filter, power transformer, series pass transistors, filter capacitors, fan and power-on relay. These components serve to filter and regulate the input power. The relay applies power to the fan when the instrument line switch is ON. An indicator, located on the bottom of the instrument on the A3 motherboard, is lighted whenever ac voltages are present on the motherboard.

Rectifier Assembly A3A2 rectifies all ac secondary voltage inputs to the power supplies. Unregulated dc is then routed to the appropriate regulator assemblies. Regulated +22 Vdc is generated on this assembly.

Positive Regulator Assembly A3A3 contains the +20 Vdc Regulator, its overvoltage protection circuit, the front panel shutdown circuit, 10 MHz oscillator power supply, power up/down detector, and the +5.2 Vdc Regulator and its overvoltage protection circuit. The oscillator power supply is controlled by the rear panel FREQ STANDARD INT/EXT switch.

Negative Regulator Assembly, A3A4, contains the −10 Vdc Regulator, −5.2 Vdc Regulator, Switched −10 Vdc output and the −40 Vdc and its associated overvoltage protection circuits.

SERVICE SHEET BD10 (cont'd)
TROUBLESHOOTING

General

It is assumed that the troubleshooting procedures associated with Service Sheet BD1 have been used to isolate a problem to one of the power supplies. The following troubleshooting procedures can be used to further isolate the problem to one of the following:

Front Panel Assembly — Service Sheet 32
Rectifier Assembly — Service Sheet 33
Positive Regulator Assembly — Service Sheet 34
Negative Regulator Assembly — Service Sheet 35

Test Equipment Required

Digital Voltmeter .... HP 3456A

Procedures

The following procedures are divided into checks as follows:

Rectifier Assembly
(√1) +22 Volt Check

Positive Regulator Assembly
(√2) +20 Volt Check
(√3) +5.2 Volt Check
(√4) +11 Volt Switched Check

Negative Regulator Assembly
(√5) −10 Volt Check
(√6) −5.2 Volt Check
(√7) −40 Volt Check
(√8) −10 Volt Check

Rectifier Assembly Check

Rectifier Assembly A3A2 provides a regulated +22 volts as well as the unregulated voltages for the Positive and Negative Regulators. This procedure checks the +22 Volt regulated output.

+22 Volt Check (√1)

1. Connect the voltmeter to A3A2TP1.

   The voltmeter should indicate +22.00 ±0.02 Vdc

   If the indication is incorrect, attempt to adjust the voltage to +22.00 volts using A3A2R2.

   If the indication is correct, or if the voltage can be adjusted to +22.00 volts, proceed with the next check.

   If the indication is incorrect and cannot be adjusted to +22.00 volts, the Rectifier Assembly is defective. Go to Service Sheet 33 to isolate the problem.

SERVICE SHEET BD10 (cont'd)
Positive Regulator Assembly

Positive Regulator Assembly A3A3 provides the following voltages:

+20 Vdc
+5.2 Vdc
+11 Vdc Switched

Each is checked separately.

+20 Volt Check (√2)

1. Connect the voltmeter to A3A3TP5.

   The voltmeter should indicate +20.000 ±0.002 Vdc.

   If the indication is not correct, attempt to adjust the voltage to +20.000 Vdc using A3A3R50.

   If the voltage is correct, or if it can be adjusted, proceed with Step 4.

   If the voltage cannot be adjusted, proceed with Step 3 to isolate the problem.

2. Connect the voltmeter to A3A3TP4.

   The voltmeter should indicate between 27 and 33 Vdc.

   If the voltmeter indication is not correct, the Rectifier Assembly is defective. Go to Service Sheet 33 to isolate the problem.

   If the voltmeter indication is correct, the +20 Volt Regulator is defective. Go to Service Sheet 34 to isolate the problem.

+5.2 Volt Check (√3)

3. Connect the voltmeter to A3A3TP2.

   The voltmeter should indicate +5.20 ±0.01 Vdc.

   If the voltmeter indication is correct, proceed with Step 6.

   If the voltmeter indication is not correct, proceed with Step 5.

4. Connect the voltmeter to A3A3TP1.

   The voltmeter should indicate between 10 and 15 Vdc.

   If the voltmeter indication is not correct, the Rectifier Assembly is defective. Go to Service Sheet 33 to isolate the problem.

   If the voltmeter indication is correct, the +5.2 Volt Regulator is defective. Go to Service Sheet 33 to isolate the problem.

SERVICE SHEET BD10 (cont'd)
+11 Volts Switched (√4)

5. Ensure that the rear panel INT/EXT switch is set to INT.

6. Connect the voltmeter to A3A3TP6.

   The voltmeter should indicate +11.0 ±1.1 Vdc.

   If the voltmeter indication is correct, proceed with Step 9.

   If the voltmeter indication is not correct, proceed with Step 7.

7. Remove A3A3 and replace it on a 36 pin extender board.

8. Using the ohmmeter, check for continuity (0 ohms) between XA3A3-18 (TPA) and ground.

   If there is continuity, the Oscillator Power Supply is defective. Go to Service Sheet 34 to isolate the problem.

   If there is no continuity, Switch A3S1 or the wiring to it is defective.

Negative Regulator Assembly

Negative Regulator Assembly A3A4 provides the following voltages:

−10 Volts
−5.2 Volts
−40 Volts

Each is checked separately.

-10 Volt Check (√5)

9. Connect the voltmeter to A3A4TP4.

   The voltmeter should indicate −10.0 ±0.2 Vdc.

   If the voltmeter indication is correct, proceed with Step 11.

   If the voltmeter indication is not correct, proceed with Step 10.

10. Leave the voltmeter connected to A3A4TP4 but connect the voltmeter common lead to A3A4TP3.

    The voltmeter should indicate between −15 and −22 volts.

    If the indication is correct, the −10 Volt Regulator is defective. Go to Service Sheet 35 to isolate the problem.

    If the indication is not correct, the Rectifier Assembly is defective. Go to Service Sheet 33 to isolate the problem.

-5.2 Volt Check (√6)

11. Connect the voltmeter to A3A4TP5 with common lead to ground.

SERVICE SHEET BD10 (cont'd)

The voltmeter should indicate −5.20 ±0.05 Vdc.

If the indication is correct, proceed with Step 12.

If the indication is not correct, the −5.2 Volt regulator is defective, go to Service Sheet 35 to isolate the problem.

-40 Volt Check (√7)

12. Connect the voltmeter to A3A4TP1 with the common lead to ground.

    The voltmeter should indicate −40.0 ±0.6 Vdc.

    If the voltmeter indication is correct, proceed with Step 14.

    If the voltmeter indication is not correct, proceed with Step 13.

13. Remove the voltmeter common lead from ground and connect it to A3A4TP2.

    The voltmeter should indicate between −48 and −63 Vdc.

    If the indication is correct, the −40 Volt regulator is defective. Go to Service Sheet 35 to isolate the problem.

    If the indication is not correct, the Rectifier Assembly is defective. Go to Service Sheet 33

-10 Volt Switched Check (√8)

14. Remove Negative Regulator A3A4 and replace it on an extender board. *Set the RF output switch to ON.*

15. Connect the voltmeter to XA3A4-14 or -32 (TPD), and verify that the voltmeter reads −10 volts.

    If the voltage is correct, proceed with Step 16.

    If the voltage is not correct, proceed with Step 21 to check the relay control input.

DCU Frequency Control SERVICE SHEET BD9

SERVICE SHEET BD10 (cont'd)
Negative Regulator Assembly (cont'd)

16. While observing the voltmeter, set the RF output switch to OFF. With the RF output switch in the OFF position, the −10 volt switched supply should be turned off.

    The voltmeter indication should drop from −10 volts to more than zero volts when the RF output switch is set to OFF.

    If the voltage does change to more than zero, proceed with Step 17.

    If the voltage is not correct, proceed with Step 19.

17. Set the front panel RF output switch to ON and verify that the voltmeter indication returns to −10 volts.

18. While observing the voltmeter, short A3A3TP2 to ground. Shorting the +5.2 volt supply to ground should deactivate the relay and turn off the −10 volt switched supply.

    The voltmeter indication should change to more than zero volts.

    If the voltage does change to more than zero, the power supplies are functioning normally.

    If the voltage does not change to more than zero, proceed with Step 21.

19. Set the front panel RF output switch to ON.

20. Connect the voltmeter to XA3A4-18 (TPC), and, while observing the voltmeter, set the front panel RF output switch to OFF.

    The voltmeter indication should drop from +5 volts to zero volts when the key is switched.

    If the voltage does drop, relay A3A4K1 or associated components are defective. Go to Service Sheet 35 to isolate the problem.

    If the voltage does not drop, there is a problem with the logic latch, the switch or associated circuitry on DAC and ENABLE board A1A5. Go to Service Sheet 22 to isolate the problem.

21. Remove the ground from A3A3TP2, connect the voltmeter to XA3A4-18 (TPC), and, while observing the voltmeter, ground A3A3TP2.

    The voltage should drop from +5 volts to zero volts when A3A3TP2 is grounded.

    If the indication is incorrect, relay A3A4K1 is defective. Go to Service Sheet 35 to isolate the problem.

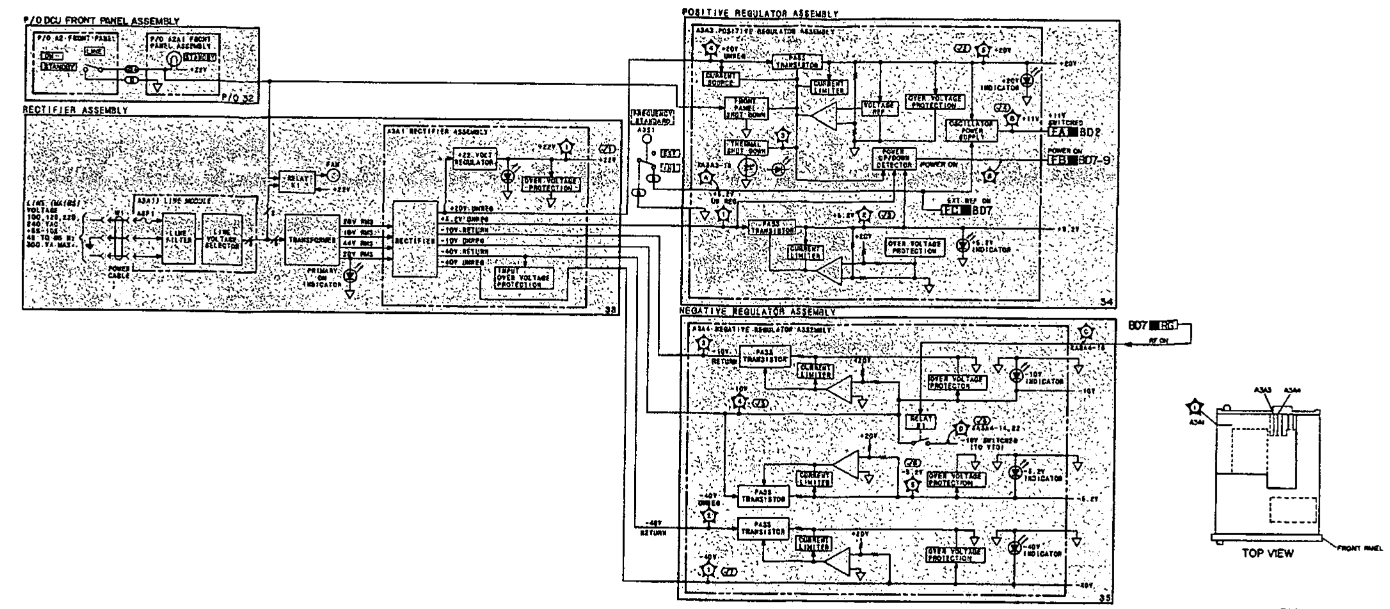
    If the indication is correct, proceed with Step 22.

22. Remove the ground from A3A3TP2, connect the voltmeter to XA3A3-35 (TPB), then, while observing the voltmeter, ground A3A3TP2.

    The voltage should drop from +5 volts to zero volts when A3A3TP2 is grounded.

    If the indication is correct, there is a problem with the switch or associated components on *A1A11 Digital Processor Assembly.* Go to Service Sheet 19 to isolate the problem.

    If the indication is not correct, there is a problem with the Power Up/Down Detector on Positive Regulator A3A3. Go to Service Sheet 34 to isolate the problem.



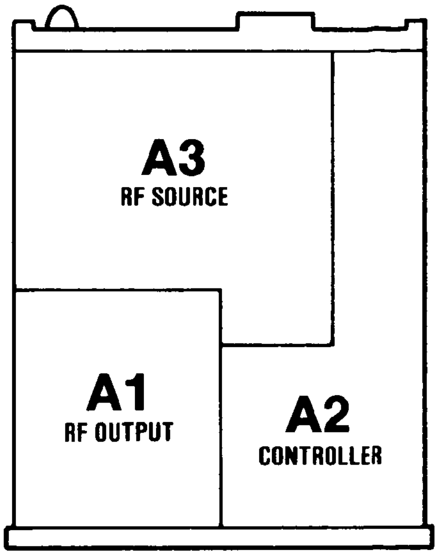
8010

Figure 8-49. Power Supply Block Diagram

8-67/8-68

Power Supplies
Block Diagram
SERVICE SHEET

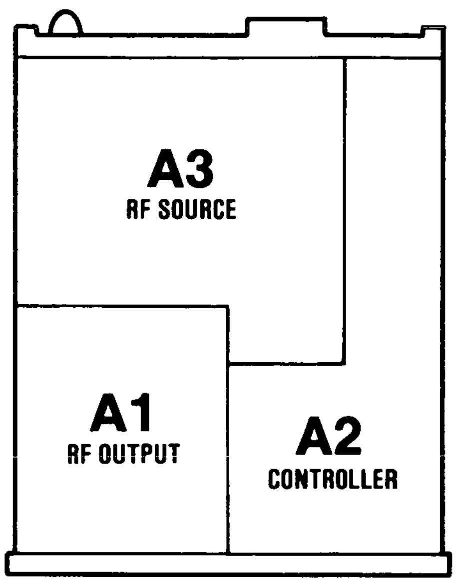
BD10



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35

SERVICE SHEET 1

REFERENCE PHASE DETECTOR ASSEMBLY

REFERENCES

Overall Block Diagram ..... Service Sheet BD1
Time Base Reference Block Diagram .... Service Sheet BD2
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB)... Section VI
Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

General

The Reference Phase Locked Loop Phase Detector is part of the Time Base Reference. It contains Reference Oscillator A3A8 and Reference Phase Detector A3A1A1. The Reference Oscillator is the master frequency reference for the CW Generator. The Reference Phase Detector is used to phase lock the output of a 100 MHz Voltage Controlled Crystal Oscillator (VCXO) to the output of the Reference Oscillator in order to generate the 10, 20, and 400 MHz reference frequencies required by the CW Generator.

The Reference Phase detector divides the input from the 100 MHz VCXO down to 10 MHz and compares this 10 MHz frequency to the output of the 10 MHz Reference Oscillator. Any difference between the two frequencies will change the TUNE VOLTAGE signal to keep the two 10 MHz frequencies equal by tuning the 100 MHz VCXO. The 10 and 20 MHz reference frequency outputs are derived from the 100 MHz VCXO using frequency division.

A3A8 10 MHz Reference Oscillator

The following discussion refers to the Schematic Diagram of Service Sheet 1. The Reference Oscillator is a highly stable, temperature controlled, crystal oscillator. Its operating temperature is controlled by an internal heater control unit. The heater control unit, and the heater it controls, are powered by the +22 volt regulator that is on any time the CW Generator is connected to the power mains. The crystal oscillator is powered by the +11 volt switched supply which is controlled by the rear panel INT/EXT switch.

A3A1A1 Reference Phase Detector Assembly

The Reference Phase Detector Assembly compares the output frequencies of the VCXO and the Reference Oscillator and generates a TUNE VOLTAGE output to fine tune the VCXO. The output of the 10 MHz Reference Oscillator is applied to a Limiting Amplifier consisting of a differential input stage followed by a voltage follower stage. The Limiting Amplifier is powered by an on board +5V Regulator. This isolates the Limiting Amplifier from any transients that may be on the +5.2 volt power supply.

The output of the Limiting Amplifier is a sine wave at TTL levels. This signal is applied to a Pulse Generator consisting of U2A, U2B, U2C and U2D. The Pulse Generator converts the sine wave to a series of narrow pulses that are buffered by the Buffer Amplifier to provide sufficient drive for the two sampling circuits, Phase Lock Sampler and Lock Indicator Sampler.

The second input to the Phase Lock Sampler is a 10 MHz frequency derived from the 100 MHz frequency output of the 100 MHz VCXO. The 100 MHz frequency is divided by 10 in U3A and U3B then phase shifted 45 degrees by Q1 and associated components. The phase shifting of the divided frequency ensures that the two inputs to the Phase Lock Sampler have the proper phase relationship.

The output of the Phase Lock Sampler is applied to the Integrating Amplifier consisting of Q4, Q5, and Q6. This circuit changes the TUNE VOLTAGE based on the error voltage produced by the Phase Lock Sampler circuit. The Tune Voltage is applied to the 100 MHz VCXO to tune the 100 MHz output so that the two 10 MHz frequencies present at the input to the Phase Lock Sampler are equal in frequency.

The second sampler, the Lock Indicator Sampler, outputs zero volts when the Reference loop is phase locked and a positive voltage when phase lock is lost. Phase Lock Detector U5 compares the output of the Lock Indicator Sampler to a −0.4 volt reference and outputs a negative voltage when the loop is phase locked and a positive voltage when it is unlocked. Zener diode VR1 clamps the output voltage swing of U5 to −0.7 volts and +4.6 volts.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD2 was used to isolate a malfunction to the Reference Phase

SERVICE SHEET 1 (cont'd)

Detector Assembly. The following information allows further isolation to the defective component on Service Sheet 1.

Test Equipment

Oscilloscope .... HP 1980B
Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Procedures

The following procedures are divided into the following sections:

- Phase Lock Detector
- VCXO Divider and Buffers
- Phase Lock Chain

The procedures in the Phase Lock Detector section should be used if the Reference Loop seems to be phase locked but the REF phase lock indicator on A2A7 is off. The procedures in the VCXO Divider and Buffers section should be used if the Reference Loop is phase locked but the 10 MHz and/or 20 MHz frequency reference(s) are incorrect. If the Reference Phase Locked Loop is not phase locked, use the procedures in the Phase Lock Chain section.

Phase Lock Detector.

1. Connect the DVM to the negative terminal of C13 (same as U5 pin 3) and observe the DVM reading.

   The DVM should read approximately −1.3 volts.

   If the DVM indication is correct, check U5 and associated components.

   If the DVM indication is not correct, proceed with Step 2.

2. Connect the oscilloscope probe to the collector (case) of Q2. Verify that the signal observed is 10 MHz (100 ns period) with a peak-to-peak amplitude of 2.9 volts.

   If the signal is correct, check CR5, CR6 and associated components.

   If the signal is not correct, check Q2 and associated components.

VCXO Driver and Buffers. For problems with the 20 MHz reference, proceed with Step 3. For problems with the 10 MHz reference proceed with Step 4.

3. Connect the oscilloscope probe to U3 pin 2. Verify that the signal is 20 MHz (50 ns period) with a peak-to-peak amplitude of 1.9 volts.

   If the signal is correct, check U4B and associated components.

   If the signal is not correct, U3 is defective.

4. Connect the oscilloscope probe to U3 pin 15 and verify that the signal is 10 MHz (100 ns period) with a peak-to-peak amplitude of 1.0 volt.

   If the signal is correct, check the appropriate section of U4 and associated components.

   If the signal is not correct, U3 is defective.

Phase Lock Chain.

5. Connect the oscilloscope to A3A1A1TP1 and observe the display

   The display should be as shown on Service Sheet 1 for A3A1A1TP1.

   If the display is correct, proceed with Step 7.

   If the display is not correct, proceed with Step 6.

6. Connect the oscilloscope probe to U1 pin 7 and verify that the signal is 10 MHz (100 ns period) with a peak-to-peak amplitude of 2.5 volts.

   If the signal is correct, check U2 and associated components.

   If the signal is not correct, check U1 and associated components.

7. Connect the oscilloscope probe to the collector (case) of Q1 and verify that the signal is 10 MHz (100 ns period) with a peak-to-peak amplitude of 2.8 volts.

   If the signal is correct, proceed with Step 9.

   If the signal is not correct, proceed with step 8.

8. Connect the oscilloscope probe to U3 pin 14 and verify that the signal is 10 MHz (100 ns period) with a peak-to-peak amplitude of 1.0 volts.

   If the signal is correct, check Q1 and associated components.

   If the signal is not correct, U3 is defective.

9. Connect the DVM to Q4 pin 3 and verify that the dc voltage is 0 volt.

   If the voltage is correct, check Q4, Q5, Q6, and associated components.

   If the voltage is not correct, check CR3, CR4 and associated components.

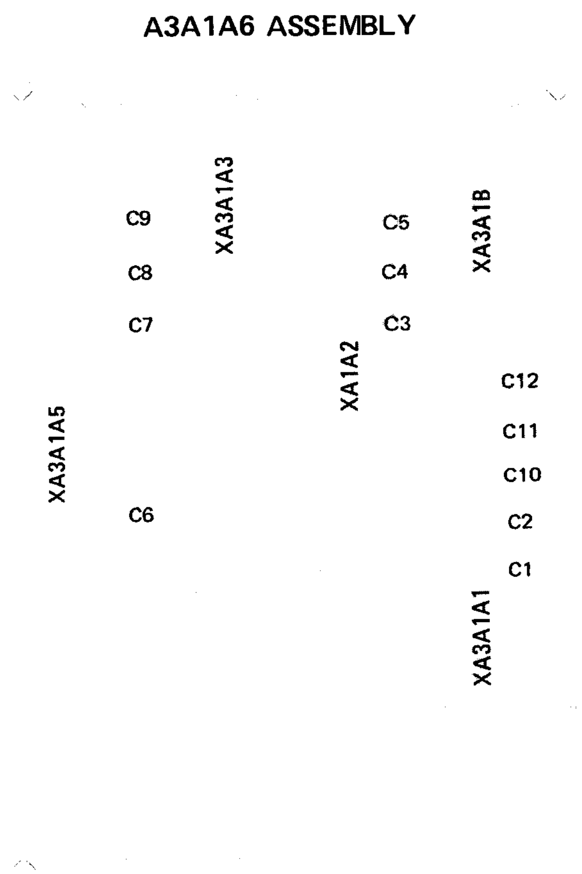


Figure 8-50. A3A1A6 Reference and M/N Motherboard Assembly Component Locations

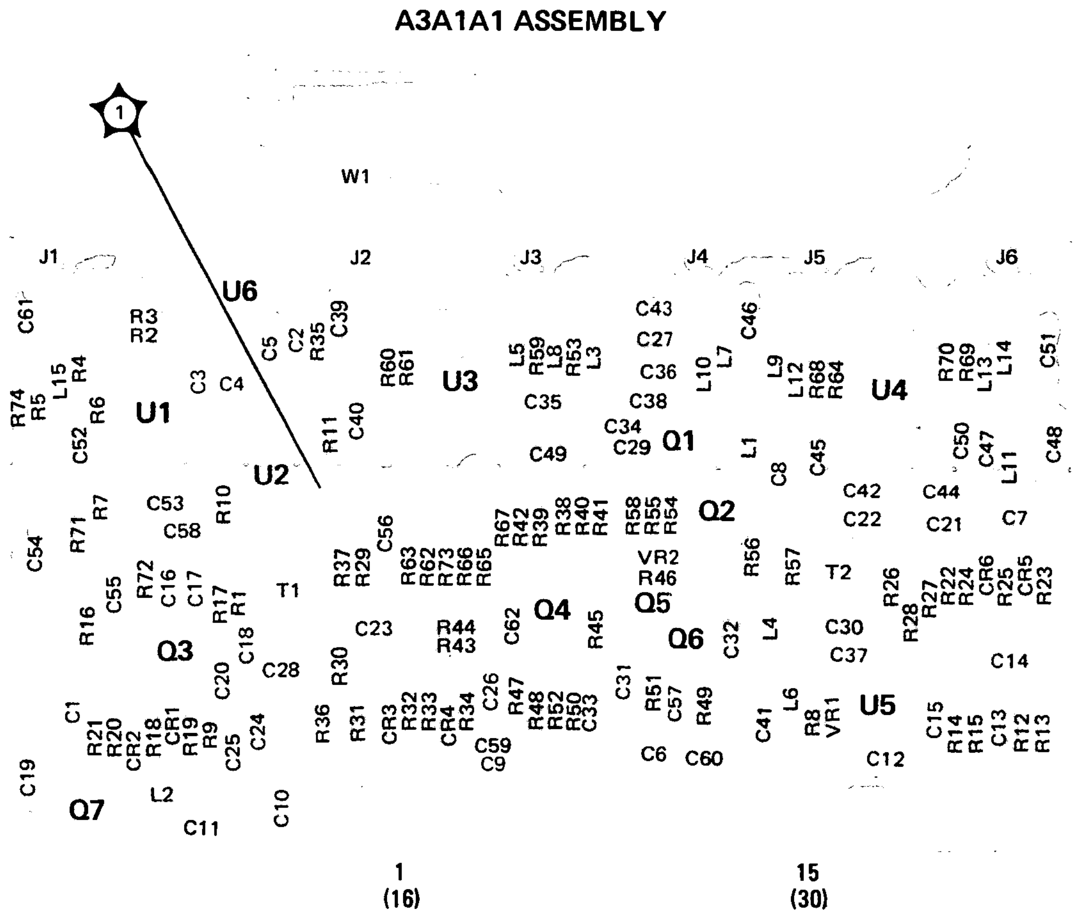


Figure 8-51. A3A1A1 Reference Phase Detector Assembly Component and Test Point Locations

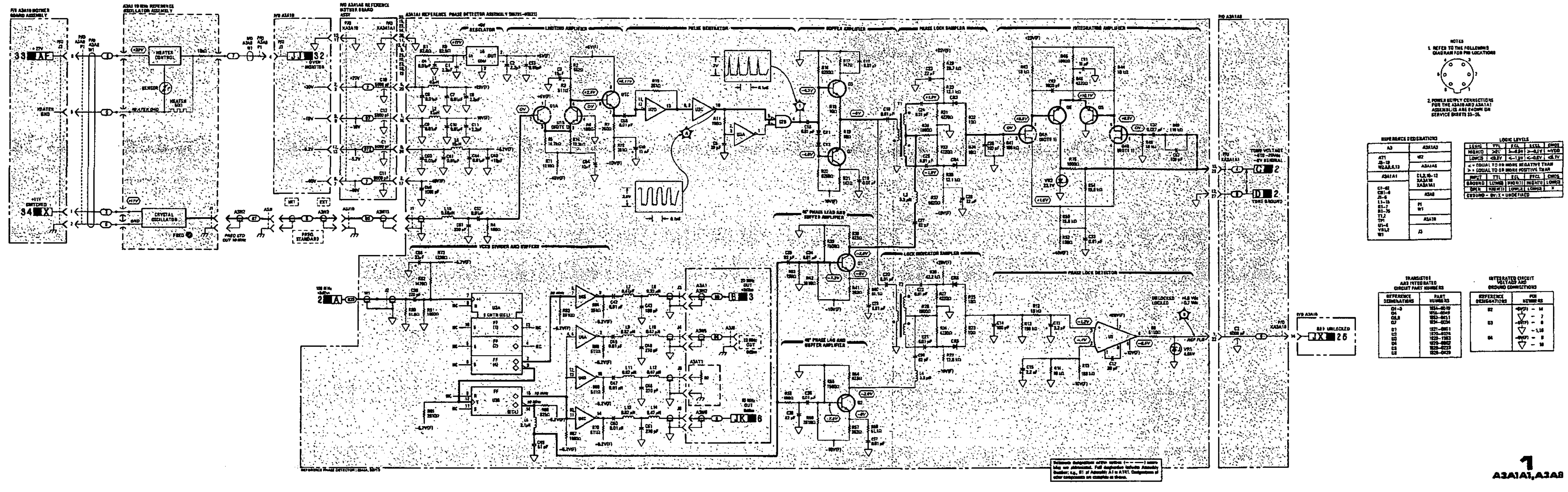


Figure 8-52. Reference Phase Detector Assembly Schematic Diagram

SERVICE SHEET 2

100 MHz VCXO ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
Time Base Reference Block Diagram	Service Sheet BD2
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The 100 MHz VCXO Assembly, A3A1A2, is part of the Time Base Reference. It generates a 100 MHz signal that is phase locked to the 10 MHz internal (or 5 or 10 MHz external) reference signal by circuitry on Reference Phase Detector Assembly A3A1A1. The stable 100 MHz signal thus produced is multiplied by four and routed to M/N Output Assembly A3A1A5. The 100 MHz signal is also available at rear panel connector A3J7.

Detailed Discussion

100 MHz Oscillator. The heart of the Time Base Reference Phase Locked Loop is the 100 MHz voltage controlled crystal oscillator (VCXO). Crystal Y1, that controls the frequency, and varactor diode CR1, that allows a small deviation, are both found in the VCXO's feedback path. Some degree of manual frequency control is provided by C4. Diodes CR3 and CR4 limit the VCXO's output to ±0.4 volts peak.

The output of the oscillator is buffered by 100 MHz Buffer Q9, Q8 and Q11. One output of the buffer is routed back to the A3A1A1 Assembly where it is sampled by the phase detector circuits. The other output of the buffer is applied to power splitter T1. One output of the splitter is routed through 100 MHz Amplifier Q6 to rear panel output connector A3J7. The other output goes to the Quadrupler.

Quadrupler. The Quadrupler is a Class C push-push amplifier. The output approximates a pulse and is rich in even harmonics. The 400 MHz Amplifier that follows the Quadrupler is tuned to, and therefore amplifies the 400 MHz output of the Quadrupler. The output level to the M/N Loop is critical and is set by selecting the values of R67, R68, and R69.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated

Reference Phase Detector (A3A1A1) SERVICE SHEET 1

SERVICE SHEET 2 (cont'd)

with Service Sheets BD1 and BD2 have been used to isolate a problem to the 100 MHz VCXO Assembly. The following procedures can be used to further isolate the problem to the defective component.

Test Equipment

Frequency Counter	HP 5343A
Variable Power Supply	HP 6200B
Digital Voltmeter	HP 3456A
Oscilloscope	HP 1980B

Troubleshooting Procedures

There are two troubleshooting procedures. The first isolates between the 100 MHz Oscillator and the 100 MHz Buffer. The second isolates between the elements of the Quadrupler.

100 MHz Amplifier. There is only one active component in the 100 MHz Amplifier. Therefore, if the procedures in BD2 indicate a problem with this amplifier, check Q6 and associated components.

100 MHz Oscillator/100 MHz Buffer.

1. If it has not already been done, remove A3A1A1 and set the power supply to 8 volts.

2. Remove A3A1A2 and replace it on a 30-pin extender board, connect the negative lead of the power supply to TP1 TUNE test point and the positive lead to chassis ground.

3. Connect the Oscilloscope to the cathode of CR4. The display should show a 100 ±1 MHz sine wave at a peak-to-peak amplitude of 1.6 volt.

   If the display is as indicated, check Q8, Q9, and associated components.

   If the display is not as indicated, check Q5 and associated components.

Quadrupler.

1. If it has not already been done, repeat steps 1 and 2 above.

2. Connect the oscilloscope to the collector of Q7.

   The display should show a 100 ±1 MHz sine wave at a peak-to-peak amplitude of 2.5 volts.

   If the display is as indicated, proceed with Step 3.

   If the display is not as indicated, check Q7 and associated components.

3. Connect the oscillscope to the collector of Q3.

   The display should show a 100 ±1 MHz signal at a peak-to-peak amplitude of 150 mV.

   If the signal is as indicated, check Q1, Q2, and associated components.

   If the signal is not as indicated, check Q3, Q4, and associated components.

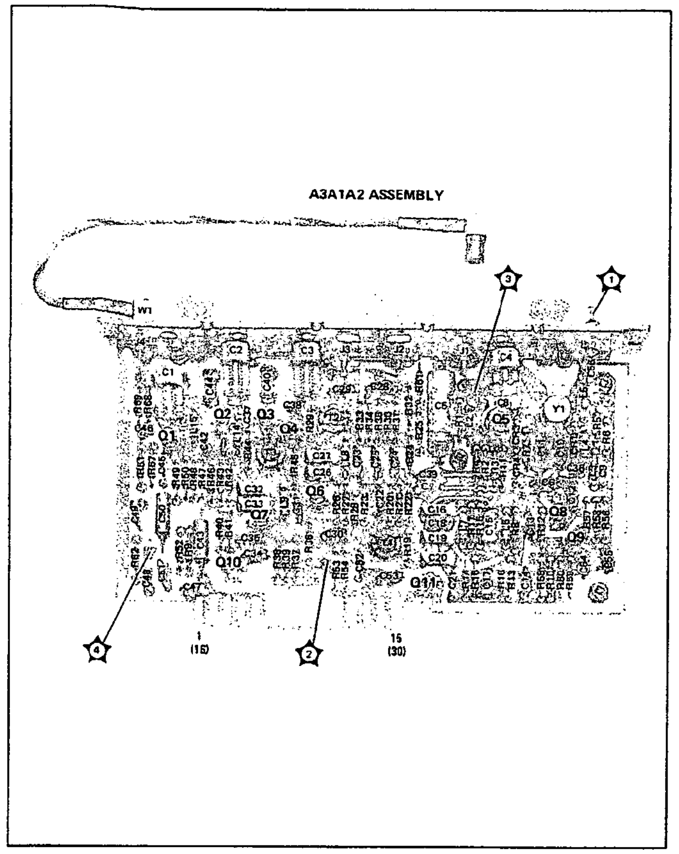
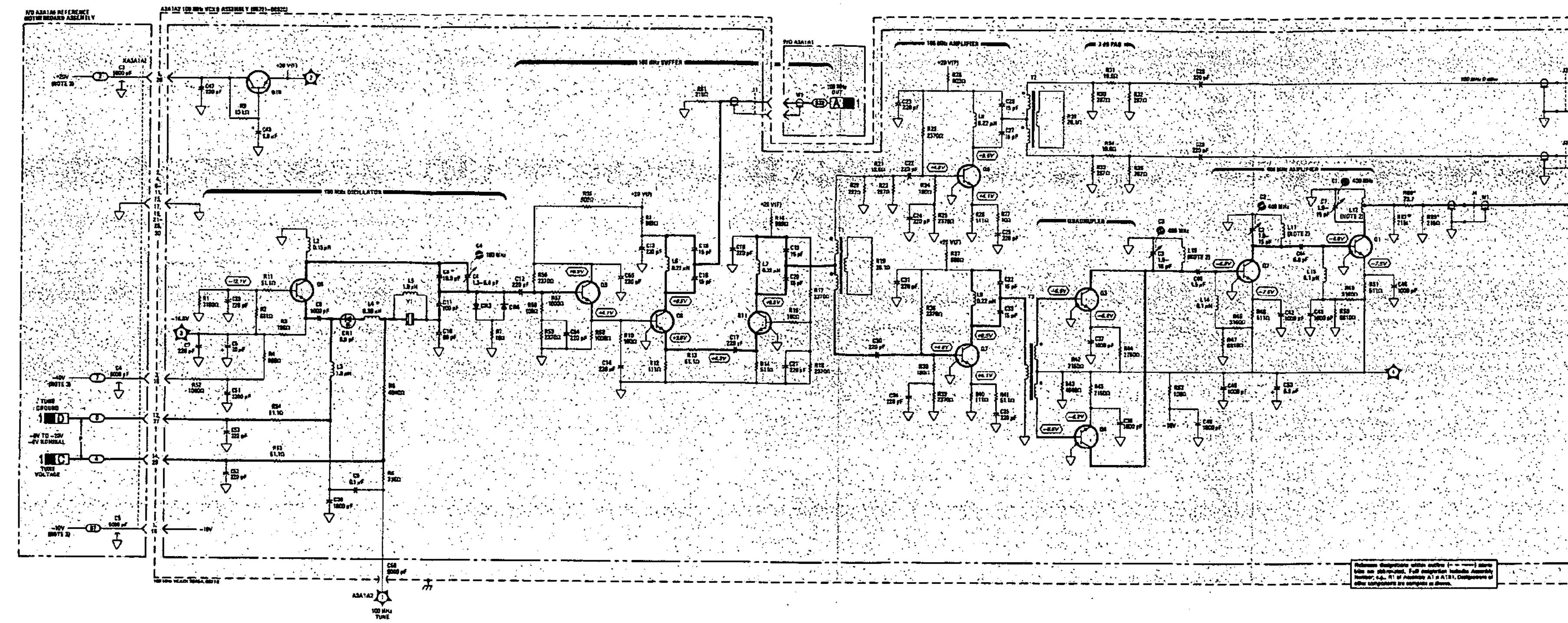


Figure 8-53. A3A1A2 100 MHz VCXO Assembly Component and Test Point Locations



NOTES
1. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
2. A3A1A2L10–12 ARE PART OF CIRCUIT BOARD AND ARE NOT REPLACEABLE.
3. POWER SUPPLY CONNECTIONS TO THE A3A1A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 35.

REFERENCE DESIGNATIONS

A3	A3A1A2
AT2 J7 W7	C1–68 CR1,3,4 J1–4 L1–12,14,15 Q1–11 R1–62,67–69 T1–3 TP1–4 W1 Y1
A3A1A1	A3A1A1
W1	C3–6 1A3A1A2

TRANSISTOR PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1–4,6–9,11	1854-0345
Q5	1854-0247
Q10	1854-0404

2
A3A1A2

Figure 8-54. 100 MHz VCXO Assembly Schematic Diagram

SERVICE SHEET 3

M/N PHASE DETECTOR ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
RF Phase Locked Loops Block Diagram .... Service Sheet BD3
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The frequency output of the M/N Phase Locked Loop is dependent on the front panel frequency. A digital equivalent of the M/N frequency (dependent upon the front panel frequency's most significant digits, 10 MHz to 10 GHz) is input to the M/N Phase Locked Loop as M and N numbers. The ratio of the M and N numbers actually determine the M/N OUT frequency. The M/N OUT frequency's Nth harmonic (based on the N number and selected by the YTO pretuning) tunes the YTO frequency in 10 MHz steps. There is a 10 MHz step (or band) for each valid M/N OUT frequency (M/N ratio) and Nth harmonic (N number). This 10 MHz band complements the LFS Phase Locked Loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N Phase Locked Loop, YTO pretuning and LFS Phase Locked Loop are able to tune the YTO from 2000.000 to 6199.999 MHz in 1 kHz steps. The YTO frequency is the front panel frequency divided by the band number. See Service Sheet BD1 for a list of band numbers and corresponding frequencies.

The M/N Phase Locked Loop provides a tunable phase locked reference signal for the YIG Tuned Oscillator (the microwave signal source). The M/N OUT frequency (177.5 to 197.5 MHz) is obtained by dividing the M/N VCO signal (355—395 MHz) by two. *The M/N IF signal (5—45 MHz) is the lower mixing* sideband of the VCO signal and the 400 MHz reference. The M/N Phase Locked Loop is phase locked by comparing a fraction of 20 MHz (20 MHz divided by the N number) to a fraction of the IF signal (5—45 MHz divided by the M number) in the phase detector. The phase detector generates an error signal that is integrated and coupled to the VCO as a tuning signal. The M and N numbers are determined by the Digital Control Unit and vary with the 10 MHz steps of the YTO frequency. The M/N OUT frequency is dependent on the ratio of the M and N numbers as expressed in the following formula:

$$
\begin{aligned}
f_{M/N} &= [200-10(M/N)]\text{MHz} \\
\text{where } f_{M/N} &= \text{M/N OUT frequency} \\
M &= \text{M number} \\
N &= \text{N number}
\end{aligned}
$$

To determine M (M varies from 8 to 27):
If the 100 MHz digit of the YTO Frequency is even then M = 17−10 MHz digit

If the 100 MHz digit is odd then M = 27−10 MHz digit.

To determine N (N varies from 11 to 32):
Divide the left two (most significant) digits of the YTO Frequency by 2.

SERVICE SHEET 3 (cont'd)

Add 1 to the result and round up if necessary to the nearest integer.

For example, if the ratio is 1-to-1 (M=N) then $f_{M/N}$ = 190.000 MHz. If the ratio is 1-to-2 (M=2N) the $f_{M/N}$ = 195.000 MHz. Refer to Table 8-3 in Service Sheet BD3 Principles of Operation for a complete list of M and N Numbers and Resulting Frequencies.

Detailed Discussion

M and N Dividers. The Phase Detector Assembly's M and N Dividers are essentially identical in operation. In each case the input frequency is divided by the divide number (a binary coded number input from the A2 Digital Control Unit). The resulting output pulses are phase compared to produce an error voltage which tunes the M/N VCO. The following formulas show the frequency relationship of the inputs and outputs of the dividers:

$$
\begin{aligned}
f_N &= (4/N)20\text{ MHz} \\
f_M &= (4/M)f_{IF} \\
\text{where } f_N &= \text{N Divider Output pulse repetition frequency (PRF) MHz} \\
f_M &= \text{M Divider Output PRF (MHz)} \\
N &= \text{N Divide number} \\
M &= \text{M Divide number} \\
f_{IF} &= \text{M Divider Clock frequency (MHz)} \\
20\text{ MHz} &= \text{N Divider Clock frequency} \\
f_N &= f_M \text{ when the loop is phase locked therefore} \\
(4/N)20\text{ MHz} &= (4/M)f_{IF} \\
\text{and } f_{IF} &= [(M/N)20]\text{ MHz for the phase locked condition.}
\end{aligned}
$$

Because of the similarities of the M and N Dividers, only the N Divider will be described in detail.

The N divider circuit is clocked by a pulse train derived from the input frequency (in this case the 20 MHz reference signal). The divider outputs 4 pulses for each sequence of clock pulses which add up to the N number. In other words, a pulse is output for each N/4 or N/4+1 clock pulses. If dividing the N number by 4 leaves no remainder, the number of clock pulses between output pulses is determined solely by N/4. If there is a remainder the number of clock pulses between outputs is determined by N/4 and N/4+1, where N/4+1 replaces N/4 once for each unit in the remainder. For example, if N=16, then N/4=16/4=4 with a remainder of R=0. An output pulse occurs for each 4 clock pulses. If N=19, then N/4=19/4=4 with R=3. An output pulse occurs once with a spacing of 4 clock pulses and three with a spacing of 5 clock pulses.

a. **Counting Operation and Control.** Refer to the schematic diagram and Figure 8-55, and to Table 8-19, and consider the example N=16. At the beginning of a divide sequence (clock 1) the 4 most significant bits (MSB) of the N number (0100) are loaded into the programmable counter. Clock 2 subtracts 4 (0001) from the previous total leaving (0011), Clock 3 subtracts 4 more and the 0010 output enables the End of Count Decoder. At Clock 4, Count Control U2B and Output Flip-Flop U2B are set. The Count Control outputs inhibit the End of Count Decoder, cause the Programmable Counter to enter its load mode, and clocks the Divider Flip-Flops U4A & B. The Output Flip-Flop U2A outputs a high to the Phase/Frequency Detector. Clock 5 resets the flip-flops and loads the counter. This series of events repeats itself 3 more times for the N=16 sequence.

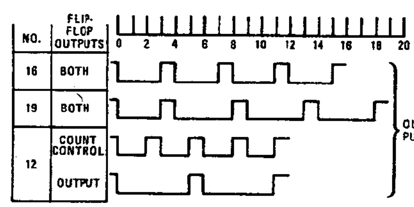


Figure 8-55. Divider Operation Timing Diagram

b. **Increment Decoder Operation.** The Increment Decoder and Divider (divide by four) circuits come into play if the N number cannot be divided by four evenly. The 2 least significant bits (LSB) of the N number (N2 and N1) control the output of the Increment Decoder. The divide-by-four circuit provides a sequence of four sequential states, that are the input to the Increment Decoder. Each *state coincides with one of the four count down sequences whose* length is characterized by N/4 or N/4+1. Refer to Table 8-20. Note that for the N=16 sequence (N2=N1=0), the Increment Decoder Output Sequence (TP6) never leaves the low state and the count down sequences are N/4. For N=19 (N2=N1=1) the first output is low with the remaining three high. This means that the first pulse occurs after N/4 clock pulses and the other three occur after N/4+1 pulses. During the final count down sequences, the high at the Increment Decoder Output inhibits U11B allowing the counter to count down to 0001 (rather than 0010) before the End of Count Decoder is enabled through U11A. This allows the extra count to occur. The rest of the sequence occurs as described in the previous section. See also Table 8-19 and Figure 8-55.

c. **Divide-by-1 or 2 Operation.** When the N input is equal to or greater than 16, the N5 or N6 inputs are high and the Divide-by-1 or 2 Decoder is enabled. Thus the Output Flip-Flop follows the Count Control Flip-Flop and each End of Count pulse is passed directly to the output. If N<16, then the Divide-by-1 or 2 Decoder is enabled and therefore passes only every other End of Count pulse to set the Output Flip-Flop. (Refer to Table 8-19 and Figure 8-56).

SERVICE SHEET 3 (cont'd)

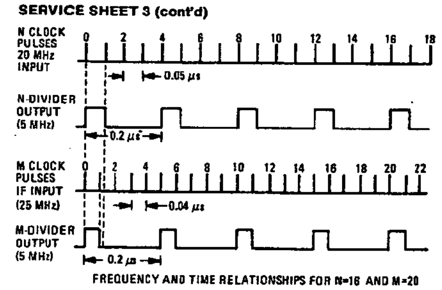


Figure 8-56. Divider Clock Pulses versus Output Pulses Timing Diagram

This circuit reduces the apparent gain of the of the Phase/Frequency detector. This keeps the DeltaF$_{VCO}$/DeltaV sensitivity of the VCO in a specific portion of its tuning curve thereby keeping the M/N bandwidth constant. Note that the N5 and N6 inputs are also connected to the M Divider in same manner as in the N Divider. Note also that the frequency of the M and N Divider Outputs is halved for N<16.

Phase/Frequency Detector

The output of the M and N dividers are fed to the phase/frequency detector U1. If the output of the N Divider leads the output of the M Divider, a negative going pulse appears at U1-3 and U1-12 will remain at dc level (about −1.7 Vdc). If the output of the M Divider leads the output of the N Divider, then the output of U1-3 will remain at dc level and a positive going pulse will appear at U1-12. The pulse width of the output pulse is a measure of the phase or frequency difference between inputs at U1-6 and U1-9. When the loop is locked, TP2 will be between 20 and 90 mV (nominal 60 mV) more positive than TP1. U7 forms a dual comparator which gives an unlocked indication if TP1 and TP2 are outside the normal range.

Q1, Q2 and Q15 form an integrating differential amplifier whose inputs are the bases of Q1 and Q2. C14 and R25 form the feedback path from the amplifier output at U15-6 to the inverting input at the base of Q1. The output of the amplifier varies from −2 Vdc to −35 Vdc depending on the required VCO frequency and is varied to achieve phase lock as determined by the dc levels from the outputs of U1.

TROUBLESHOOTING

It is assumed that the troubleshooting information associated with Service Sheets BD1 and BD3 was used to isolate a malfunction to the M/N Phase Locked Loop. The following procedures can be used to further isolate a malfunction to the defective component.

SERVICE SHEET 3 (cont'd)

Test Equipment

Frequency Counter .... HP 5343A
Digital Voltmeter .... HP 3456A
Logic Pulser .... HP 546A
Oscilloscope .... HP 1980B

Troubleshooting Procedure

1. Press PRESET (3 GHz).

2. Observe the M/N phase lock indicator on A2A7. The lamp should be on. If the lamp is not on, continue with this procedure. If the lamp is on, perform the next two steps to confirm correct operation.

3. Connect 10 MHz output from the frequency counter to the external reference input on the CW Generator, then connect the frequency counter input to the M/N output on A3A1A5. The frequency should be 189.375000 MHz.

4. Check the following frequencies (the extremes of the M/N Phase Locked Loop).

RF Output Frequency	M/N Loop Output
2100 MHz	177.500000 MHz
6090 MHz	197.419355 MHz

If the frequencies are correct, the M/N VCO has adequate tuning range and is probably operating correctly.

5. Using the oscilloscope, measure the signal at A3A1A3TP1 with the CW Generator set to 6100 MHz. The signal should be 20 MHz divided by N/4 (N=32 at 6100 MHz) or exactly 2.50 MHz (period = 400 ns) at ECL levels. Refer to schematic notes for definition of ECL levels

6. Tune the CW Generator to 2900 MHz. The signal at TP1 should be 5.0 MHz (period = 200 ns) (N=16).

7. Tune the CW Generator to 2900 MHz. The signal at TP1 should be 2.666666 MHz (2/N x 20 MHz; N=15). If steps 5, 6 and 7 were correct, the N Divider is working properly and N decoder in the controller is operating correctly. If steps 5, 6 and 7 are not correct, proceed to step 11.

8. Connect the IF IN white-red coaxial cable to the 20 MHz reference signal in place of the gray-white coax. This connects a known (20 MHz signal to the M Divider. Tune to 3010 MHz and measure the frequency at TP4. It should be 5.0 MHz. (period = 200 ns).

100 MHz VCXO Assembly (A3A1A1) SERVICE SHEET 2

SERVICE SHEET 3 (cont'd)

9. Tune to 2820 MHz (M=15). The frequency at TP4 should be 2.666666 MHz. (period = 375 ns) If steps 8 and 9 are correct the M Divider is working properly and the M Decoder in the Digital Control Unit is operating properly. If not, proceed to step 11.

10. Reconnect the IF and 20 MHz inputs. Tune to 2800 MHz. Connect the voltmeter to A3A1A5 TUNE test point. The voltage should be about −4 Vdc. Tune to 3010 MHz. The voltage should change to about −26.2 Vdc. If these voltages are correct, the Phase Detector Assembly is operating correctly. If the voltages are not correct, proceed to step 16.

11. Because of the similarities of the N-Divider and the M Divider, only the troubleshooting procedure for the N Divider will be described here. To troubleshoot the N Divider perform the following steps.

12. Place the M/N Phase Detector Assembly on an extender board.

13. Disconnect the gray-white coaxial cable from the 20 MHz Reference. Connect the Logic Pulser in its place.

14. Tune the CW Generator to 3500 MHz (N=19) if troubleshooting the N-Divider or 4980 MHz (M=19) if troubleshooting the M-Divider.

15. Use the Logic Pulser to inject one pulse at a time and use the Divider Operation and the Increment Decoder Operation tables to verify the proper signal at succeeding nodes until the faulty part is located.

16. To troubleshoot the Phase/Frequency Detector U1 and the succeeding stages perform the following steps.

17. If both the M Divider and the N Divider are working, place the M/N Phase Detector Assembly on an extender board.

18. Connect the oscilloscope to A3A1A3TP3 and TP2. Press PRESET (3 GHz). Observe the waveform which should be as shown in Figure 8-57. Repeat this step for A3A1A3TP4. If the waveforms are not as shown, the Phase/Frequency Detector U1 is faulty and should be replaced.

19. If the waveforms of step 18 were correct, disconnect the 20 MHz Reference input. Ground the junction of C14 and C17. Measure the voltages at the collectors of Q1 and Q2. The voltages should be −17.9 volts and −15.9 volts respectively.

20. Replace the 20 MHz Reference coaxial cable and disconnect the IF IN cable. Measure the voltages at the collectors of Q1 and Q2. The voltages should be −15.7 volts and −18 volts respectively. If the voltages in step 19 and 20 are not correct replace the faulty part.

NOTE

After repairing the A3A1A3 Assembly, perform the M/N Phase Detector Adjustments in Section V.

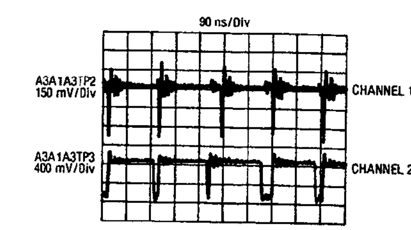


Figure 8-57. A3A1A3TP2 and TP3 Waveforms

Table 8-19. Divider Operation

N	Input-Clock Pulses	Operation	Counter Output	End of Count Decoder	Flip-Flops	
					Count Control	Output
16	0,4,8,12 1,5,9,13 2,6,10,14 3,7,11,15	Load Counter Minus 4 Minus 4 Minus 4	0100 0011 0010 0001	Inactive Inactive Active Inactive	Reset Reset Reset Set	Reset Reset Reset Set
19	0,4,9,14 1,5,10,15 2,6,11,16 3,7,12,17 8,13,18	Load Counter Minus 4 Minus 4 Minus 4 Minus 4	0100 0011 0010 0001 0000	Inactive Inactive Inactive[1] Active[2] Inactive	Reset Reset Reset Reset[3] Set	Reset Reset Reset Reset[3] Set
12	0,3,6,9 1,4,7,10 2,5,8,11	Load Counter Minus 4 Minus 4	0011 0010 0001	Inactive Active Inactive	Reset Reset Set	Reset Reset Set[4]

[1] Active for step 3 only.
[2] Inactive for step 4 only.
[3] Set for step 4 only.
[4] The Output Flip-Flop is set only every other time the Counter Control Flip-Flop is set for N<16.

Table 8-20. Increment Decoder Operation

Increment Decoder Control Inputs		Increment Decoder Output Sequence*			
N2	N1	1	2	3	4
L(0)	L(0)	L	L	L	L
L(0)	H(1)	L	L	H	L
H(1)	L(0)	L	H	L	H
H(1)	H(1)	L	H	H	H

*The sequence of four states is controlled by a modified ring counter made up of the two flip-flops contained in U4. The count sequence of U4 may be checked by verifying that the active high outputs of the flip-flops follow the sequence LL, HH, LH, and HL (U4A-2 and U4B-15 respectively).

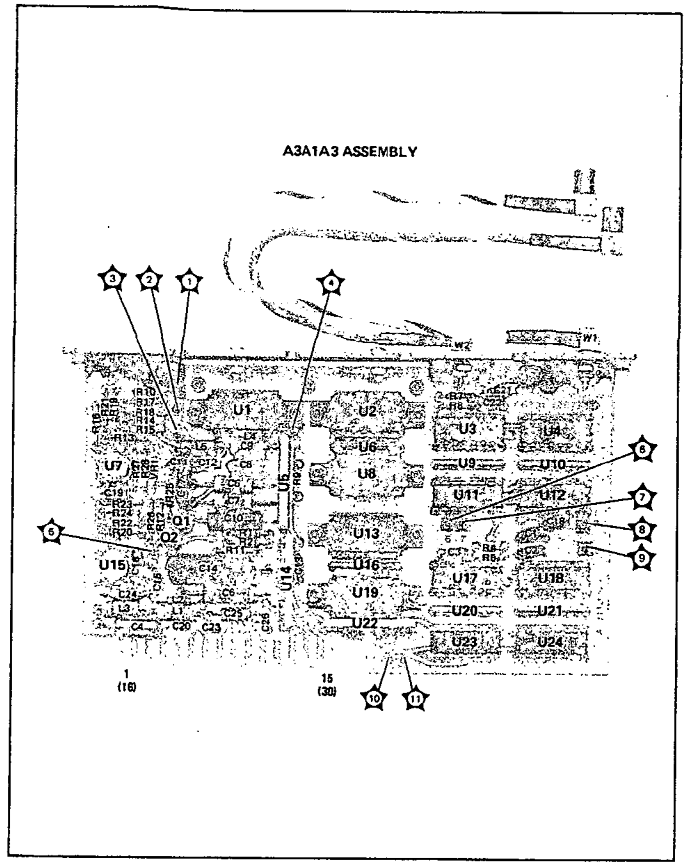
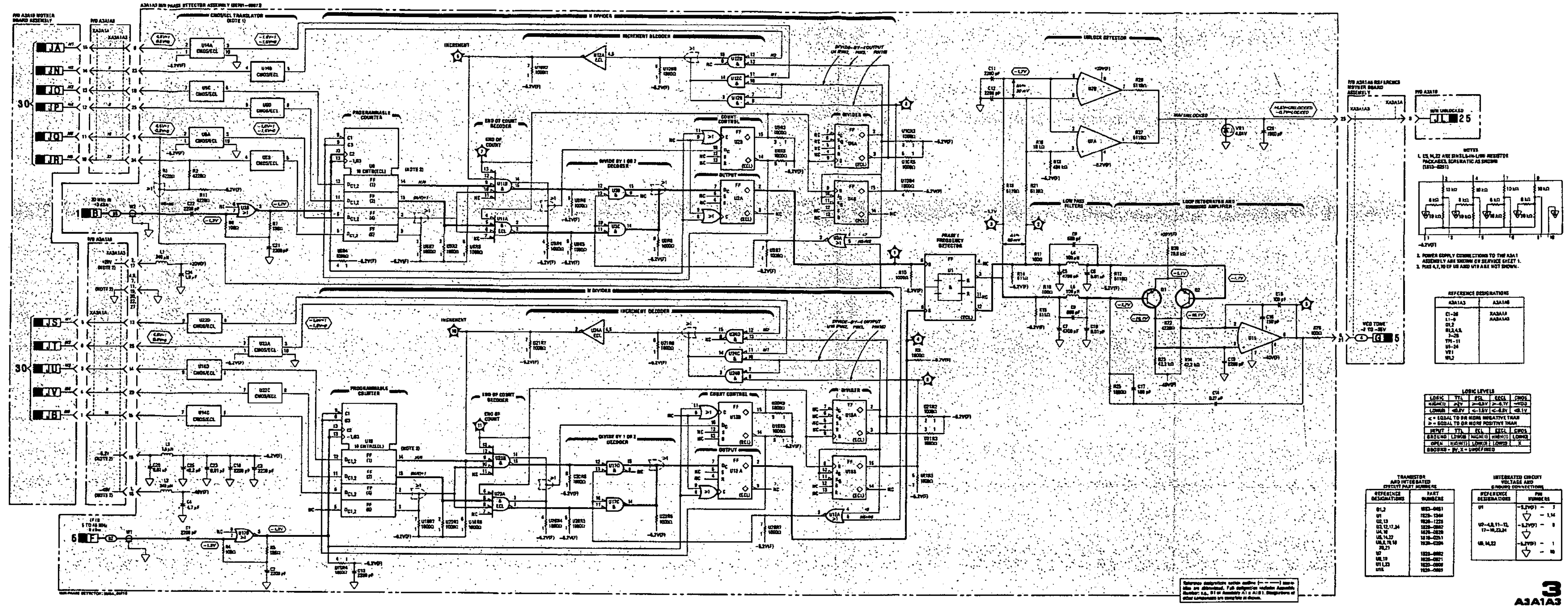


Figure 8-58. A3A1A3 M/N Phase Detector Assembly Component and Test Point Locations



3
A3A1A3

Figure 8-59. M/N Phase Detector Assembly Schematic Diagram

SERVICE SHEET 4

M/N VCO ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
RF Phase Locked Loops Block Diagram	Service Sheet BD3
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

The frequency output of the M/N Phase Locked Loop is dependent on the front panel frequency. A digital equivalent of the M/N frequency (dependent upon the front panel frequency's most significant digits, 10 MHz to 10 GHz) is input to the M/N Phase Locked Loop as M and N numbers. The ratio of the M and N numbers actually determine the M/N OUT frequency The M/N OUT frequency's Nth harmonic (based on the N number and selected by the YTO pretuning) tunes the YTO frequency in 10 MHz steps. There is a 10 MHz step (or band) for each valid M/N OUT frequency (M/N ratio) and Nth harmonic (N number). This 10 MHz band complements the LFS Phase Locked Loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N Phase Locked Loop, YTO pretuning and LFS Phase Locked Loop are able to tune the YTO from 2000.000 to 6199.999 MHz in 1 kHz steps. The YTO frequency is the front panel frequency divided by the Band Number. See Service Sheet BD1 for a list of band numbers and corresponding frequencies.

The M/N Phase Locked Loop provides a tunable phase locked reference signal for the YIG Tuned Oscillator (the Synthesizer's microwave signal source). The M/N OUT frequency (177.5 to 197.5 MHz) is obtained by dividing the M/N VCO signal (355—395 MHz) by two. The M/N IF signal (5—45 MHz) is the lower mixing sideband of the VCO signal and the 400 MHz reference. The M/N Phase Locked Loop is phase locked by comparing a fraction of 20 MHz (20 MHz divided by the N number) to a fraction of the IF signal (5—45 MHz divided by the M number) in the phase detector. The phase detector generates an error signal that is integrated and coupled to the VCO as a tuning signal. The M and N numbers are determined by the Digital Control Unit (DCU) and vary with the 10 MHz steps of the YTO frequency. The M/N VCO frequency is dependent on the ratio of the M and N numbers as expressed in the following formula:

$$f_{M/N\ VCO} = [400-20(M/N)]\text{MHz}$$

where $f_{M/N\ VCO}$ = M/N VCO frequency
M = M number
N = N number

M/N Phase Detector (A3A1A3) SERVICE SHEET 3

SERVICE SHEET 4 (cont'd)

To determine M (M varies from 8 to 27):

If the 100 MHz digit of the YTO Frequency is even then M=17−10 MHz digit

If the 100 MHz digit is odd then M=27−10 MHz digit.

To determine N (N varies from 11 to 34):

Divide the left two (most significant) digits of the YTO Frequency by 2.

Add 1 to the result and round up if necessary to the nearest integer.

For example, if the ratio is 1-to-1 (M=N) then $f_{M/N\ VCO}$ = 380.000 MHYz. If the ratio is 1-to-2 (M=2N) then $f_{M/N\ VCO}$ = 390.000 MHz. Refer to Table 8-5 in Service Sheet BD3, RF Phase-Locked Loops, for a complete list of M and N Numbers and Resulting Frequencies.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the M/N VCO Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information allows further isolation to the defective component.

Test Equipment

Digital Voltmeter (DVM)	HP 3456A
Power Supply	HP 6200B
Spectrum Analyzer	HP 8556A/ 8552B/141T
High Impedance Probe	HP 1121A

Troubleshooting Procedures

1. Remove A3A1A3 to open the M/N Phase Locked Loop.
2. Remove A3A1A4 and replace it on an extender board.
3. Connect the positive lead of the power supply to chassis ground and the negative lead to A3A1A4TP1 TUNE test point.

CAUTION

Do not apply a positive voltage to A3A1A4TP1. This would forward bias the VCO tuning diodes and could destroy them.

4. Set the power supply to −35 volts and connect the spectrum analyzer, using the high impedance probe, to the emitter of Q2.

   The spectrum analyzer display should show a 395 MHz signal at 0 dBm.

   If the signal is as indicated, proceed with step 5.

   If the signal is not as indicated, check Q2 and associated components.

5. Connect the high impedance probe to the base of Q1.

   The spectrum analyzer display should show a 395 MHz signal at −34 dBm.

   If the signal is as indicated, check Q1 and associated components.

   If the signal is not as indicated, replace VCO Resonator Assembly A3A1A4A1.

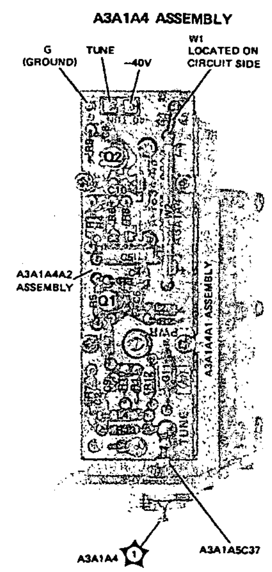
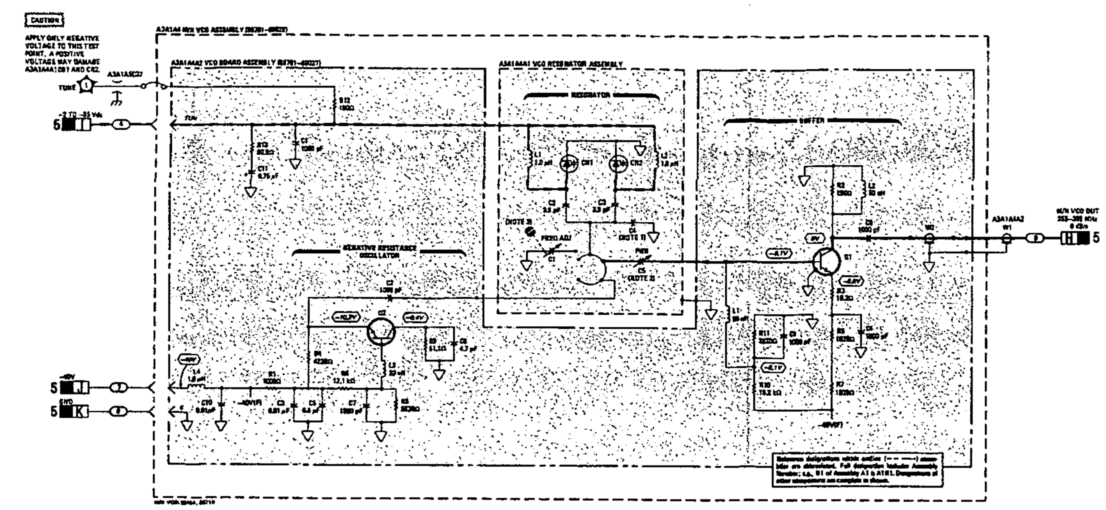


Figure 8-60. A3A1A3 M/N Phase Detector Assembly Component and Test Point Locations



NOTES

1. A3A1A4A1C4 IS AN AIR DIELECTRIC CAPACITOR FORMED BY RESONATOR HOUSING AND RESONATOR CENTER CONDUCTOR.
2. PWR ADJUSTMENT IS AN ADJUSTABLE PROBE MOUNTED ON A3A1A4A2 AND EXTENDING INTO THE VCO RESONATOR ASSEMBLY.
3. ADJUSTMENT SCREW LOCATED ON COVER OF M/N OUTPUT ASSEMBLY A3A1A5.

REFERENCE DESIGNATIONS

A3A1A4A1	A3A1A4A2
C1–5 CR1,2 L1,2	C1–11 L1–4 Q1,2 R1–13 TP1 W1,2
A3A1A5	
C37	

TRANSISTOR PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0610
Q2	1854-[illegible]

4
A3A1A4

Figure 8-61. M/N VCO Assembly Schematic Diagram

SERVICE SHEET 5

M/N OUTPUT ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
RF Phase Locked Loops Block Diagram	Service Sheet BD3
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

The frequency output of the M/N Phase Locked Loop is dependent on the front panel frequency. A digital equivalent of the M/N frequency (dependent upon the front panel frequency's most significant digits, 10 MHz to 10 GHz) is input to the M/N Phase Locked Loop as M and N numbers. The ratio of the M and N numbers actually determines the M/N OUT frequency The M/N OUT frequency's Nth harmonic (based on the N number and selected by the YTO pretuning) tunes the YTO frequency in 10 MHz steps. There is a 10 MHz step (or band) for each valid M/N OUT frequency (M/N ratio) and Nth harmonic (N number). This 10 MHz band complements the LFS Phase Locked Loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N Phase Locked Loop, YTO pretuning and LFS Phase Locked Loop are able to tune the YTO from 2000.000 to 6199.999 MHz in 1 kHz steps. The YTO frequency is the front panel frequency divided by the Band Number. See Service Sheet BD1 for a list of band numbers and corresponding frequencies.

The M/N Phase Locked Loop provides a tunable phase locked reference signal for the YIG Tuned Oscillator (the Synthesizer's microwave signal source). The M/N OUT frequency (177.5 to 197.5 MHz) is obtained by dividing the M/N VCO signal (355—395 MHz) by two. The M/N IF signal (5—45 MHz) is the lower mixing sideband of the VCO signal and the 400 MHz reference. The M/N Phase Locked Loop is phase locked by comparing a fraction of 20 MHz (20 MHz divided by the N number) to a fraction of the IF signal (5—45 MHz divided by the M number) in the phase detector. The phase detector generates an error signal that is integrated and coupled to the VCO as a tuning signal. The M and N numbers are determined by the Digital Control Unit (DCU) and vary with the 10 MHz steps of the YTO frequency. The M/N Out frequency is dependent on the ratio of the M and N numbers as expressed in the following formula:

$$f_{M/N} = [\,200 - 10(M/N)\,]\ \text{MHz}$$

where $f_{M/N}$ = M/N OUT frequency
M = M number
N = N number

M/N VCO Assembly (A3A1A4) SERVICE SHEET 4

SERVICE SHEET 5 (cont'd)

To determine M (M varies from 8 to 27):

If the 100 MHz digit of the YTO Frequency is even then M=17−10 MHz digit

If the 100 MHz digit is odd then M=27−10 MHz digit.

To determine N (N varies from 11 to 34):

Divide the left two (most significant) digits of the YTO Frequency by 2.

Add 1 to the result and round up if necessary to the nearest integer.

For example, if the ratio is 1-to-1 (M=N) then $f_{M/N}$ = 190.000 MHz. If the ratio is 1-to-2 (M=2N) then $f_{M/N}$ = 195.000 MHz. Refer to Table 8-3 in Service Sheet BD3, RF Phase Locked Loops, for a complete list of M and N Numbers and Resulting Frequencies.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the M/N VCO Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Spectrum Analyzer	HP 8556A/ 8552B/141T
High Impedance Probe	HP 1121A

Troubleshooting Procedures

There are two procedures provided below, one for IF OUT problems and the other for M/N OUT problems.

IF OUT. Use this procedure if the procedures in Service Sheet BD3 indicate a problem with the IF OUT signal.

1. Remove A3A1A5 and replace it on a 30-pin extender board.
2. Connect A3A5TP5 (−5.2 volts) to A3A1A5TP1 TUNE test point. This sets the M/N VCO output to about 365 MHz.

3. Using the high impedance probe, connect the spectrum analyzer to the collector of Q5.

   The spectrum analyzer should show a signal of about 365 MHz at a level of +5 dBm.

   If the signal is as indicated, proceed with Step 4.

   If the signal is not as indicated, check Q9, Q7, Q5 and associated components.
4. Using the high impedance probe, connect the spectrum analyzer to pin 6 of the mixer U1.

   The spectrum analyzer should show a signal of about 35 MHz at a level of −18 dBm.

   If the signal is as indicated, check Q1, Q2 and associated components.

   If the signal is not as indicated, check U1 and associated components.

M/N OUT. Use this procedure if the procedures in Service Sheet BD3 indicate a problem with the M/N OUT signal.

1. Remove A3A1A5 and replace it on a 30-pin extender board.
2. Connect A3A5TP5 (−5.2 volts) to A3A1A5TP1 TUNE test point. This sets the M/N VCO output to about 365 MHz.
3. Using the high impedance probe, connect the spectrum analyzer to U2 pin 13.

   The spectrum analyzer should show a signal of about 365 MHz at a level of −15 dBm.

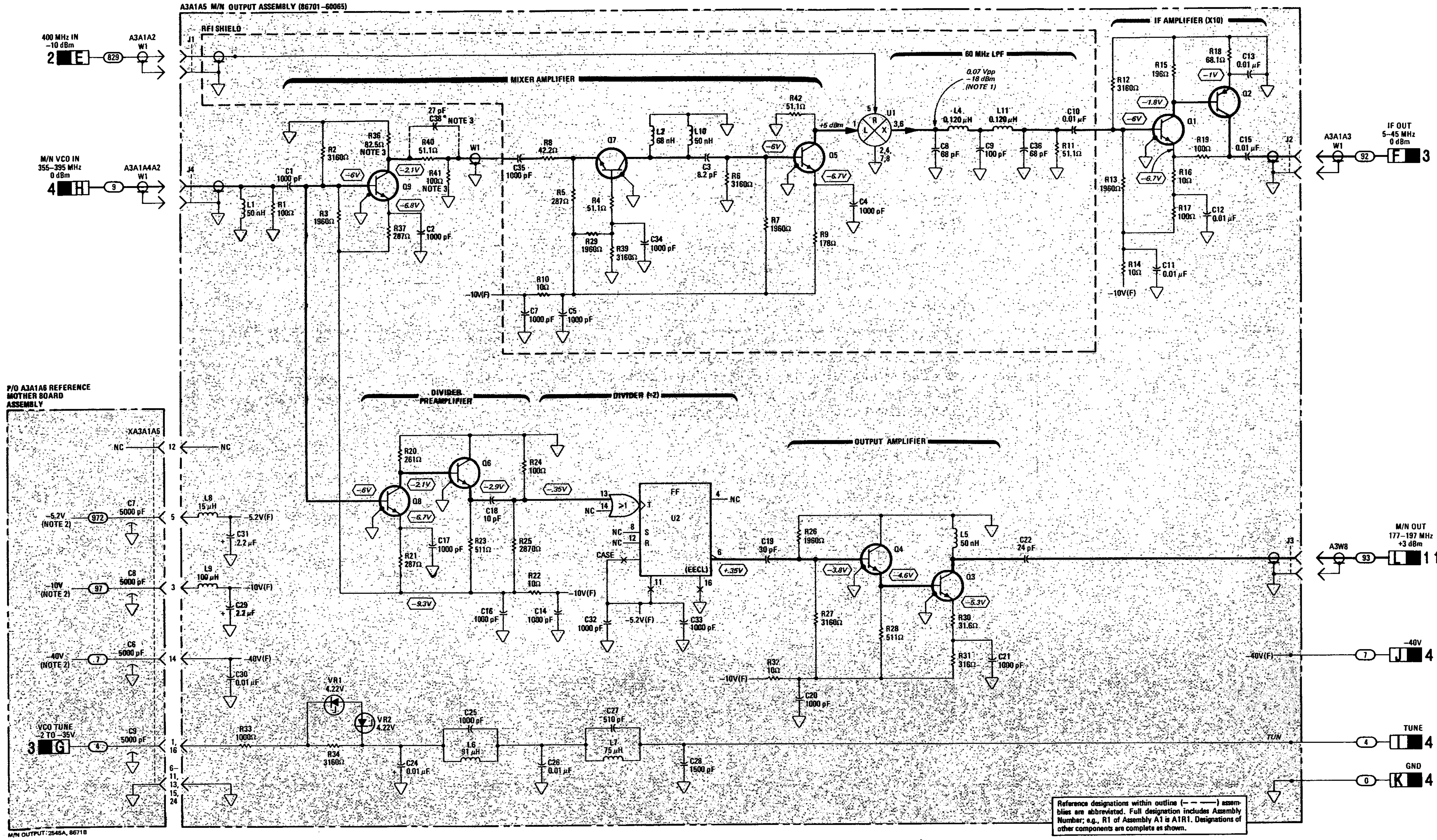
   If the signal is as indicated, proceed with Step 4.

   If the signal is not as indicated, check Q8, Q6, and associated components.
4. Using the high impedance probe, connect the spectrum analyzer to U2 pin 6.

   The spectrum analyzer should show a signal of about 182 MHz at a level of −6 dBm.

   If the signal is as indicated, check Q4, Q3, and associated components.

   If the signal is not as indicated, check U2 and associated components.



NOTES
1. MEASURED WITH SPECTRUM ANALYZER HIGH IMPEDANCE PROBE.
2. POWER SUPPLY CONNECTIONS TO THE A3A1 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1.
3. ASTERISK (*) INDICATES SELECTED COMPONENTS' NOMINAL VALUE SHOWN. EITHER R40 OR C38 WILL BE USED IN ANY INSTRUMENT' SELECTION IS COVERED IN SECTION V.

REFERENCE DESIGNATIONS

A3	A3A1A5
W8	C1–5,7–22, 24–36,38
A3A1A2	J1–4
W1	L1,2,4–11
A3A1A3	Q1–9
W1	R1–34,36, 37,39–42
A3A1A4A2	U1,2 VR1,2 W1
W1	A3A1A6
	C6–9 XA3A1A5

DELETED: A3A1A5C6,C39,L3,L12, R35,R38

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH(1)	≥2V	≥-0.5V	≥-0.1V	≈VDD
LOW(0)	≤0.8V	≤-1.5V	≤-0.6V	≤0.1V
≤ = EQUAL TO OR MORE NEGATIVE THAN ≥ = EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND – 0V; X = UNDEFINED				

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1, 3, 4	1854-0345
Q2	1853-0015
Q5–9	1854-0546
U1	0955-0063
U2	1820-2642

5
A3A1A5

Figure 8-63. M/N Output Assembly Schematic Diagram

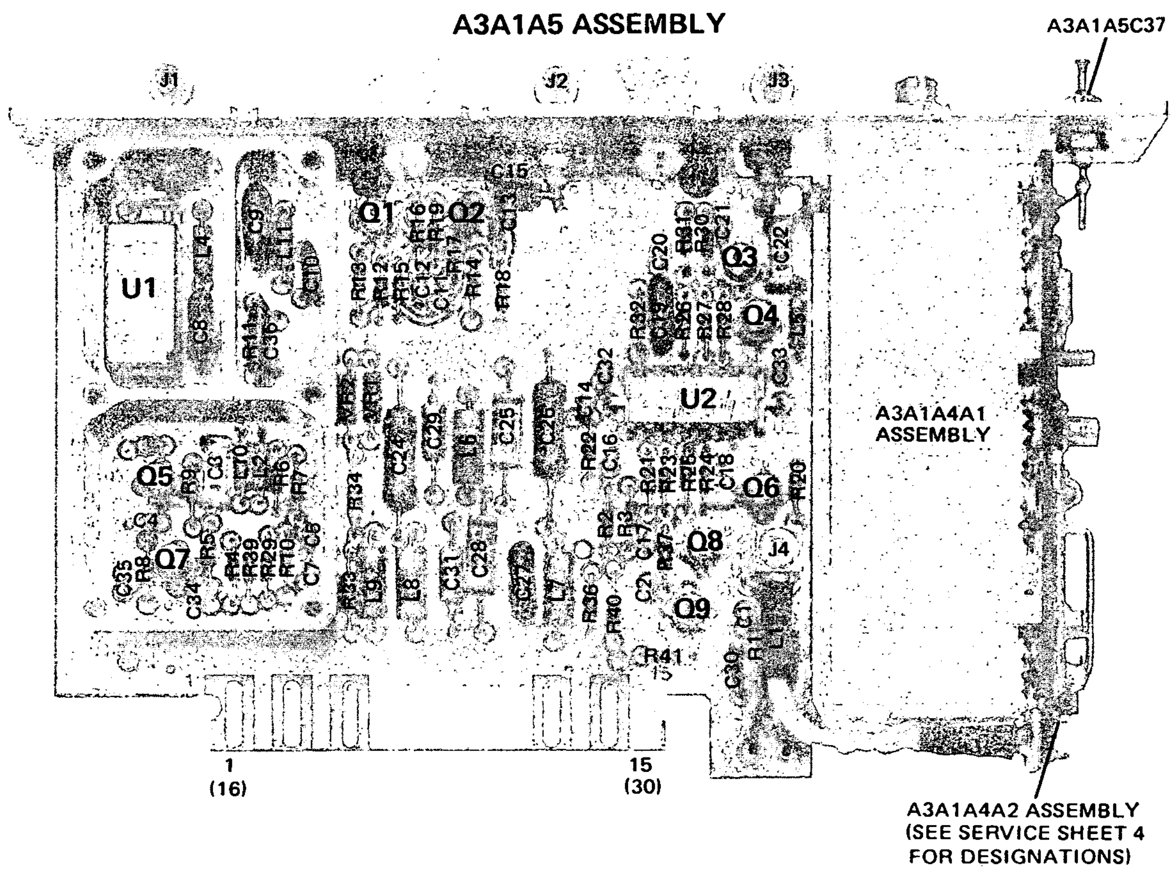


Figure 8-62. A3A1A5 M/N Output Assembly Component and Test Point Locations

SERVICE SHEET 6

20/30 DIVIDER ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
RF Phase Locked Loops Block Diagram	Service Sheet BD3
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The LFS Phase Locked Loop converts tuning information of the four least significant digits (1 MHz through 1 kHz) of the YTO frequency into a frequency between 20 MHz and 30 MHz. (The YTO frequency is the input frequency divided by the Band Number.) This frequency is obtained by dividing the 160—240 MHz VCO output by 8. The 160—240 MHz is fed back to a programmable divider where it is divided by a number N1, to produce 80 kHz. The 10 MHz reference is divided (by 125) to obtain 80 kHz and the two are compared in the phase detector. Phase difference is converted into a VCO TUNE voltage and applied to the VCO.

Detailed Description

The 20/30 divider (A2A5 board) contains of a programmable divider and a fixed divider. The programmable divider consists of a divide by 10 or 11 prescaler and a low frequency divider. It divides by N1 which varies between 2000.1 and 3000.0, depending on the four digits of the YTO frequency. The relationship is as follows:

N1 = 8(30 MHz−D4.D3 D2 D1 MHz)/80 kHz

where:

D4 = 1 MHz digit of the YTO Frequency
D3 = 100 kHz digit of the YTO Frequency
D2 = 10 kHz digit of the YTO Frequency
D1 = 1 kHz digit of the YTO frequency

If D1 and D2 are zero, the prescaler divides by 11 for 5 of its output cycles and by 10 for the rest, and the low frequency divider counts the programmed number of prescaler output pulses. When D2 is not zero, unit division takes place. This is done by the prescaler, which divides by 11 one less time for each increment of D2. For example, if D2 is 4, the prescaler will divide by 11 four times less. If D1 is not zero, fractional division is done by changing the unit division number over ten 80 kHz cycles. For example, if N1 is 2100.5, the 20/30 divider will divide by 2100 five times and by 2101 five times. This results in an average N1 of 2100.5 and an average frequency (over ten output cycles) of 80 kHz.

The prescaler U8 divides the 160—240 MHz VCO output by 10 if pin 2 is high and by 11 if it is low. The resulting pulses are counted by the low frequency divider. The count starts with the numbers preset by the 1 MHz and 100 kHz digits and ends at 299. This results in a pulse at the beginning of each 80 kHz cycle. It stays that way until the first time U15A goes low. This clocks a low through U7B which causes the prescaler to divide by 11. When U14 reaches a count of 9, the J input of U7A goes high and is clocked through U7A by the next low going prescaler output. This causes a high to be clocked through U7B which tells the prescaler to divide by 10 until the end of the 80 kHz cycle.

Fractional division depends on the 1 kHz digit. Rate multiplier U12 outputs a number of negative transitions per ten 80 kHz cycles. This number is the value of the 1 kHz digit. Each of these negative transitions causes the prescaler to divide by 11 one less time than programmed by the D2 information.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the 20/30 Divider Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Frequency Counter	HP 5343A
Oscilloscope	HP 1980B
Digital Voltmeter (DVM)	HP 3456A

Troubleshooting procedures

There are two procedures; the first is used for problems with the 80 kHz reference signal and the second for problems with the ÷N1 signal.

80 kHz Reference Prodedure. Use this procedure if the troubleshooting information in Service Sheet BD3 indicates that the 80 kHz reference signal is not correct.

1. Install A2A5 on an extender board.

2. Connect the DVM to U9 pin 2.

The DVM should indicate +5 volts.

If the indication is normal, troubleshoot the ÷125 Counter Q1, U10, U1, and U2.

If the indication is not correct, U9 is defective.

SERVICE SHEET 6 (cont'd)

÷N1 Procedure. Use this procedure if the troubleshooting information in Service Sheet BD3 indicates that the ÷N1 output is not correct.

1. Remove A2A5 and replace it on a 36-pin extender board.

2. Remove A2A3 and set the test switch to the TEST HIGH FREQ position. Reinstall A2A3. Confirm that the frequency at A2A5J1 is greater than 240 MHz. This signal will be used to test the divider assembly.

3. Set the CW Generator frequency to 3000.000 MHz. Connect the frequency counter or oscilloscope to A2A5TP5. The frequency should be about 25 MHz at TTL levels. This signal is rich in harmonics (i.e., the sine wave is distorted). If the signal is near 22.7 MHz, the 10/11 prescaler is dividing incorrectly (or its input control at pin 2 is wrong).

4. Ground A2A5TP4 (LSB). The frequency should drop to about 22.7 MHz as the prescaler is switched to divide by 11. If this does not happen, troubleshoot U8 and associated components.

5. Disconnect the ground on TP4 and observe the signal at TP4 on an oscilloscope. Set the frequency to 2999.900 MHz. There should be low true pulses about 0.65 μs wide with a 8 μs spacing, TTL levels.

6. Increase the frequency in 1 kHz steps to 2999.999 MHz. The pulses should become narrower and finally disappear. This pattern is repeated every 100 kHz. The pulse spacing varies with frequency from 12 μs for frequencies ending in 0.000 to 8 μs for frequencies ending 9.9xx. If the pulse does not behave properly, troubleshoot the ÷10/11 Controller, the Unit Divide Controller and the Fractional Divide Control.

7. Connect the oscilloscope or frequency counter to TP3. At 3000.000 MHz the frequency should be about 83.3 kHz (period = 1.2 μs; 250 MHz divided by 3000). Change frequency to 2999.999 MHz and TP3 should go to about 125 kHz (period = 8 μs; 250 MHz divided by 2000.1). If both of these frequencies are correct the A2A5 divider assembly is probably functioning properly. Otherwise, troubleshoot the Low Frequency Divider (U14, U13, U11, U3 and U6).

8. As a final check of the dividers, tune in 1 kHz and 10 kHz steps from 3000.000 MHz to 2009.999 MHz to assure that the divider output frequency increases as the frequency is turned higher. If this happens, the divider is functioning normally. Be sure to reset the TEST switch to the NORMAL position.

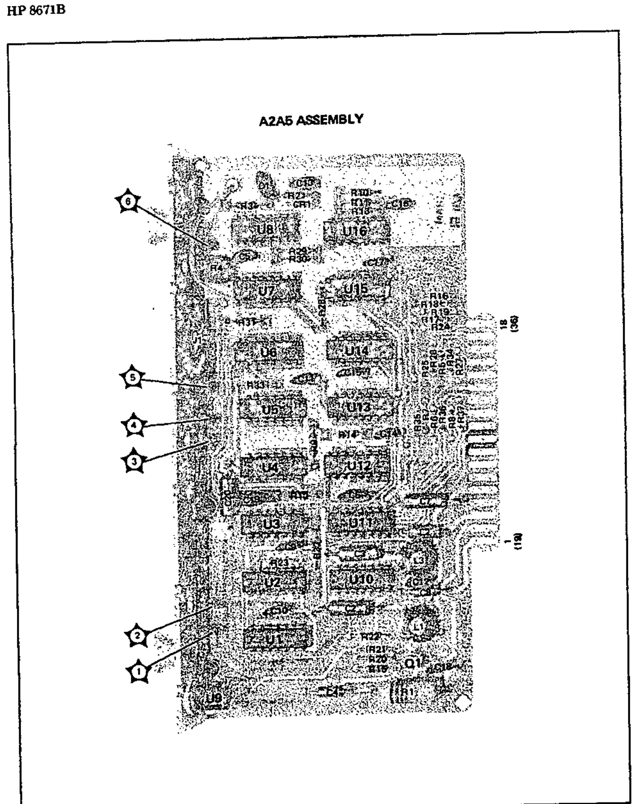
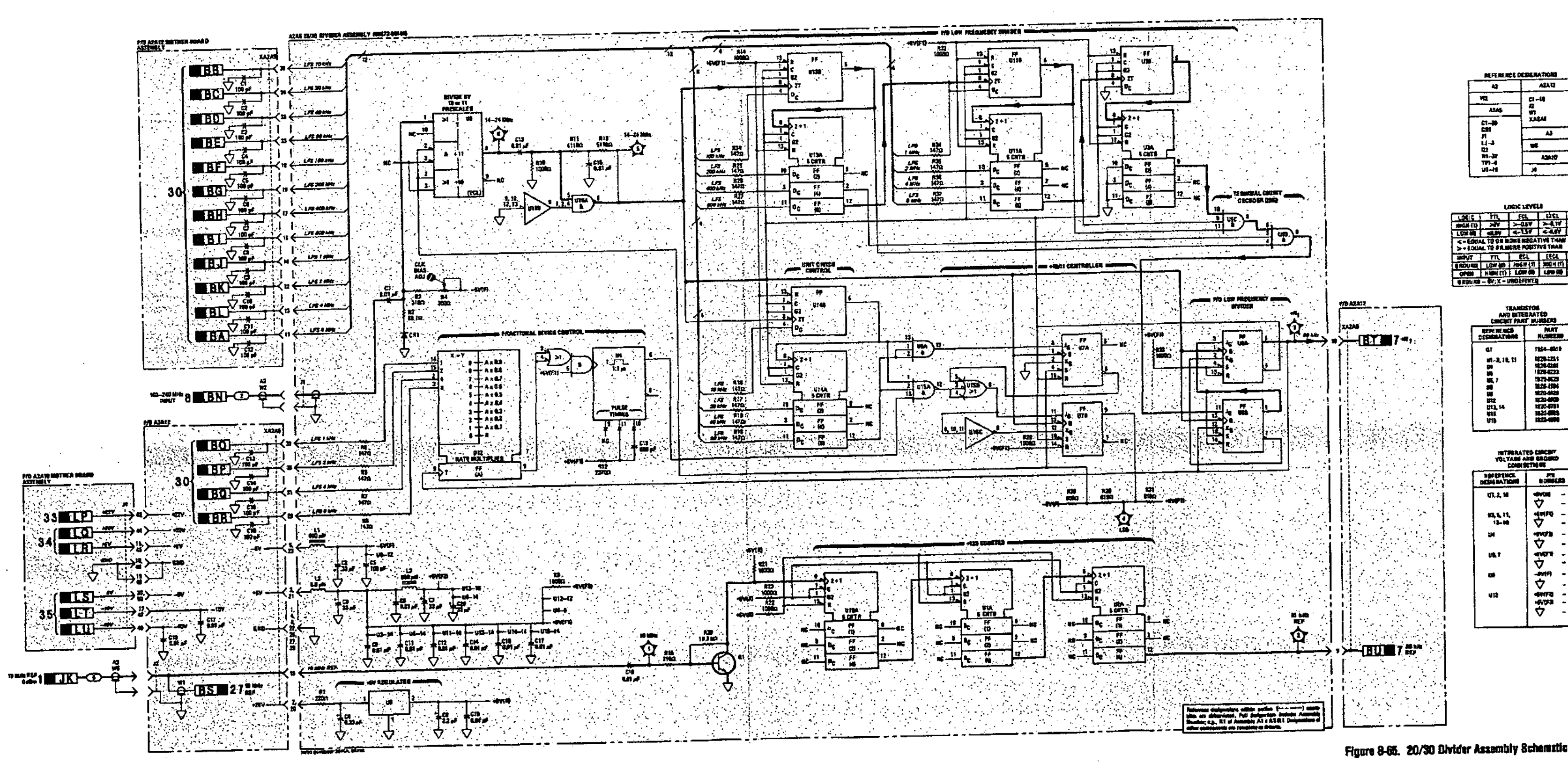


Figure 8-84. A2A5 20/30 Divider Assembly Component and Test Point Locations



6
A2A5

Figure 8-85. 20/30 Divider Assembly Schematic Diagram

SERVICE SHEET 7

20/30 MHz PHASE DETECTOR ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
RF Phase Locked Loop Block Diagram .... Service Sheet BD3
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB).................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The LFS Phase Locked Loop converts tuning information of the four least significant digits (1 MHz through 1 kHz of the YTO frequency) into a frequency between 20 MHz and 30 MHz. The YTO frequency is the input frequency divided by the Band Number. The frequency between 20 and 30 MHz is obtained by dividing the 160—240 MHz VCO output by 8. The 160—240 MHz is fed back to a programmable divider where it is divided by a number N1, to produce 80 kHz. The 10 MHz reference is divided (by 125) to obtain 80 kHz and the two 80 kHz frequencies are compared in the phase detector. Phase difference is converted into a VCO TUNE voltage and applied to the VCO.

Detailed Description

The Digital Phase Detector compares the REF 80 kHz and ÷N1 80 kHz and uses the phase difference to produce a dc voltage, VCO TUNE, which sets the VCO frequency. When the Phase Locked Loop is unlocked, the Gain Control Logic and Pulse Width Detector (pulse width varies directly with frequency or phase error) circuitry increases the integrating amplifier's gain (and thus increases bandwidth) during unlocked conditions, speeding up the re-lock process. When the Phase Locked Loop is unlocked, the Unlock Detector will pulse the LFS UNLOCKED line high. If the loop remains unlocked, the signal on the LFS UNLOCKED line will be a string of 140 μs pulses.

Flip-flops U3A, B and NAND gate U2C phase compare the two 80 kHz inputs by generating a pulse that represents, by its width, the phase error. Starting in the reset state, the flip-flop's non-inverting output will go high on the trailing edge of the first input pulse. When both U3A and U3B are high, the NAND gate, U2C goes low and resets the flip-flops, restarting the process. If the two 80 kHz inputs are in phase, the pulses at TP1 and TP2 will occur at the same time which, to the integrating amplifier's input, means no change in the VCO TUNE voltage. See Figure 8-66. But if a phase difference exists, one of the flip-flops will output a longer pulse which the Integrating Amplifier will translate to a positive or negative dc voltage. Normally, the 80 kHz REF pulse will begin to rise about 20 ns before the ÷N1 pulse.

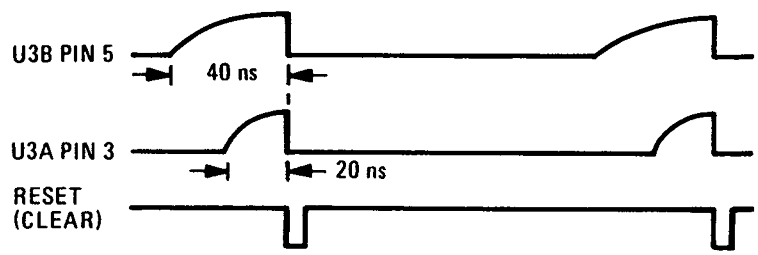


Figure 8-66. Phase Detector Timing

Q1 and U5 form an operational amplifier which amplifies and integrates differences between inputs to produce the VCO TUNE voltage. R8, R12, R16 and C9, R11, R13, R20 and C12 determine the gain and integrating time constant, while CR1 and CR2 speed up the integration during fast input changes. VR1 and the voltage divider R27 and R29 act as a clamp to keep VCO TUNE under 14 volts. A linearizing network, CR3, CR4 and associated resistors, modifies the VCO TUNE voltage so that loop bandwidth will be nearly constant for all frequencies, thus yielding a constant phase noise characteristic.

When the loop is out of lock, switches U4C and U4D close which shunts R8, R12, and R11 with R10 and R14. This increases the Integrating Amplifier's gain allowing the loop to relock faster.

The 8 kHz notch filter removes the 8 kHz and 16 kHz sidebands produced during fractional division. Higher sidebands are attenuated by the low pass filter in the next stage.

One shot U7, flip-flop U8 and NAND gate U2D activate the switches U4C and D, if the phase detector pulse width exceeds 1.5 μs. When the output of U2D goes high, the one shot will trigger, but normally the input will stay high for only about 20 ns so by the time U7-6 goes high the D input to U8 is low and a low is clocked through to the switches. If a phase error exists for more than about 150 μs, U8-12 will still be high when the one shot's output pulse goes positive and a high will be clocked through U8. One shot U16 and NAND Gate U2A signal the front panel indicator and the HP-IB status byte circuitry when the LFS loop is unlocked. During lock periods and brief unlock periods both inputs to U2A are high. When the loop is unlocked for short periods, U2A outputs very short negative pulses which increase to 140 μs for long unlock periods.

Short pulses are attenuated by R21 and C15 but longer ones will trigger U6, the output of which will cause the LFS UNLOCKED line to pulse high. As long as the loop remains unlocked, U6 will be triggered and output a string of 140 μs pulses to the LFS UNLOCKED line via U2A.

SERVICE SHEET 7 (cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the 20/30 MHz Phase Detector. It is also assumed that an attempt has been made to correct the malfunction using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Frequency Counter .... HP 5343A
Oscilloscope .... HP 1980B
Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Procedures

Two procedures are provided, one for problems with the VCO TUNE output and the other for problems with the LFS UNLOCKED output.

VCO TUNE Procedure. Use this procedure if the troubleshooting information on Service Sheet 3 indicates a problem with the VCO TUNE output.

1. Remove A2A4 and replace it on a 36-pin extender board. Be sure all cables remain connected.

2. Connect the DVM to U1 pin 2.

   The DVM should read +5.0 volts dc.

   If the reading is as indicated, proceed with Step 3.

   If the reading is not as indicated, check U1, Q2 and associated components.

3. Connect the oscilloscope to test points TP1 and TP2.

   The waveforms should be as shown on the schematic.

   If the waveforms are as indicated, proceed with Step 4.

   If the waveforms are not as indicated, check U3 and associated components.

4. Using the DVM, check the voltage at pins 2 and 3 of U5.

   In both cases the DVM should indicate 12.1 volts dc.

   If the voltages are as indicated, check U5 and associated components.

   If the voltages are not as indicated, check Q1 and asssociated components.

5. The Gain Control Logic speeds up the phase locking process by extending the loop bandwidth. If the Phase Locked Loop is not locked, there is no way to check this circuit except to see that U8 pin 9 is high and that the same signal appears at pins 11 and 12 and pins 8 and 9 of U4, that is, that U4C and U4D are turned on.

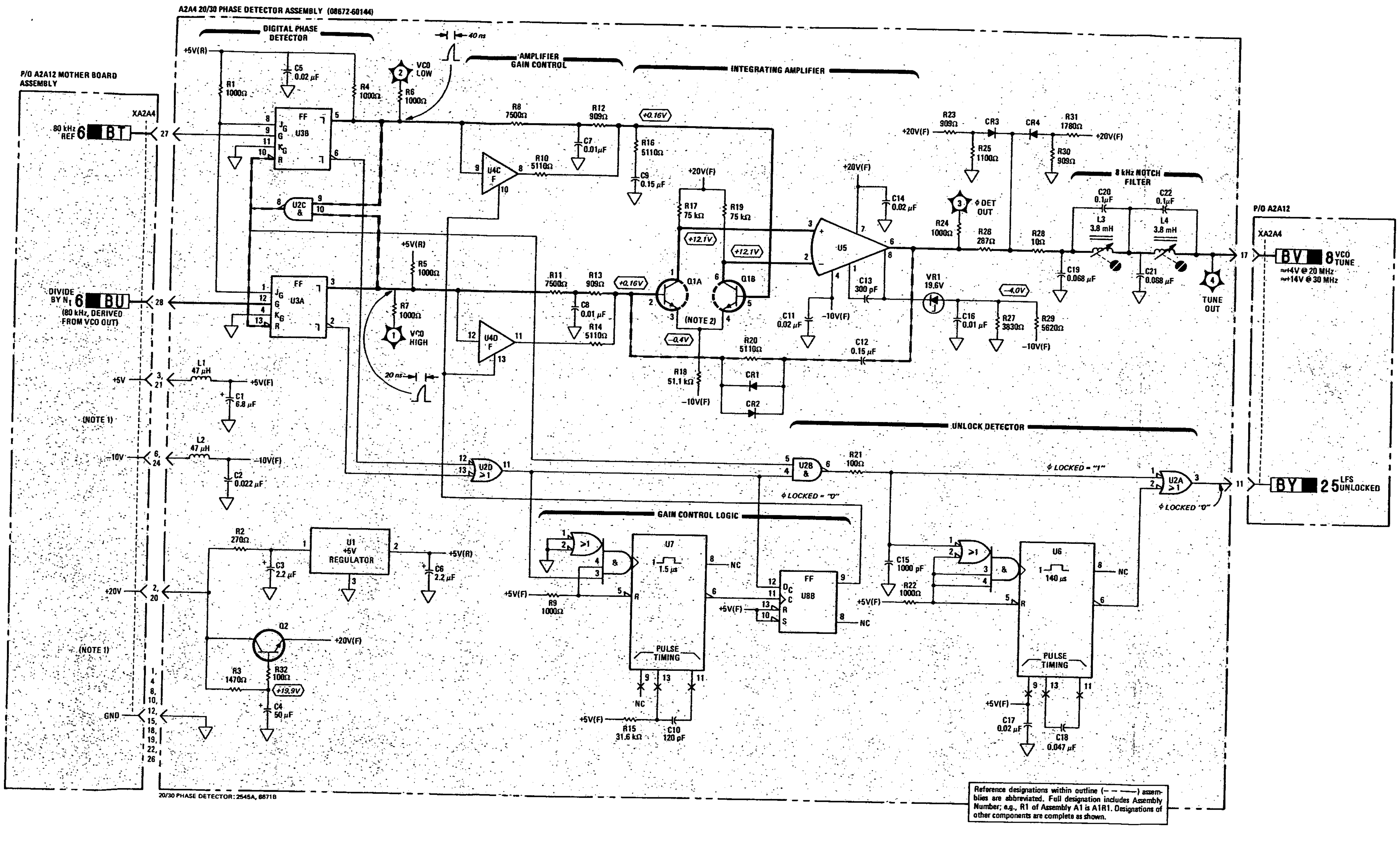
LFS UNLOCKED Procedure. Use this procedure if the CW Generator seems to be operating normally, but the LFS indicator on A2A7 is off.

1. Connect the DVM to U2 pin 3, then, while observing the DVM display, disconnect the red cable from A2A5J1.

   The DVM should initially indicate less than about 0.5 volt dc, then jump to about 4.5 volts dc when the cable is removed.

   If the DVM indication is correct, the Unlock Detector is functioning normally. Proceed to Service Sheet 25 to further isolate the problem.

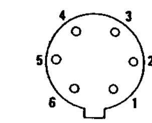
   If the DVM indication is not correct, check U2 and U6.



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

NOTES

1. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.
2. REFER TO THE FOLLOWING DIAGRAM FOR PIN LOCATIONS.



REFERENCE DESIGNATIONS

A2A4	A2A12
C1–22 CR1–4 L1–4 Q1–2 R1–31 TP1–4 U1–8 VR1	XA2A4

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH (1)	>2V	>–0.5V	>–0.1V	≈VDD
LOW (0)	<0.8V	<–1.5V	<–0.6V	<0.1V
< = EQUAL TO OR MORE NEGATIVE THAN > = EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW (0)	HIGH (1)	HIGH (1)	LOW (0)
OPEN	HIGH (1)	LOW (0)	LOW (0)	X
GROUND – 0V; X = UNDEFINED				

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0712
Q2	1854-0071
U1	1820-0429
U2	1820-1197
U3	1820-0281
U4	1820-0846
U5	1820-0223
U6–7	1820-1422
U8	1820-1112

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U2, 3	+5V(R) – 14 ⏚ – 7
U4, 8	+5V(F) – 14 ⏚ – 7
U6, 7	+5V(F) – 16 ⏚ – 7

7
A2A4

Figure 8-68. 20/30 Phase Detector Assembly Schematic Diagram

A2A4 ASSEMBLY

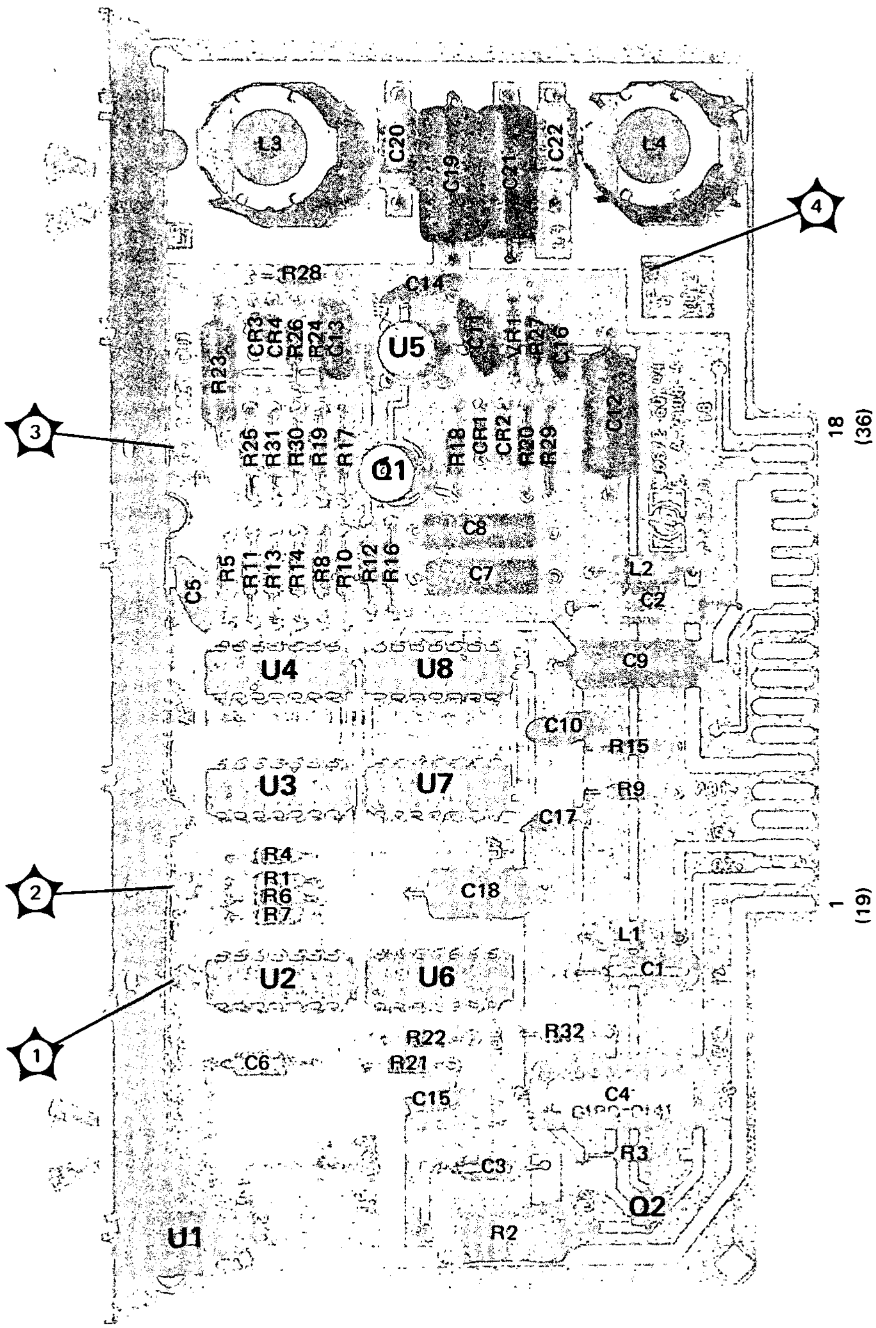


Figure 8-67. A2A4 20//30 Phase Detector Assembly Component and Test Point Locations

SERVICE SHEET 8

VCO 160—240 MHz ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
RF Phase Locked Loop Block Diagram .... Service Sheet BD3
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The LFS Phase Locked Loop converts tuning information of the four least significant digits (1 MHz through 1 kHz on the front panel display) into a frequency between 20 and 30 MHz. This frequency is obtained by dividing the 160—240 MHz voltage controlled oscillator (VCO) output by 8. The 160—240 MHz is fed back to a programmable divider where it is divided by a number, N1, to produce 80 kHz. The 10-MHz reference is divided by 125 to obtain 80 kHz and the two are compared in a phase detector. Phase difference is converted into a VCO TUNE voltage and applied to the VCO.

Detailed Description

The VCO 160—240 MHz Assembly uses a varactor tuned oscillator and dividers to produce a 20—30 MHz signal, which is used in the YTO Summing Phase Locked Loop, and a 160—240 MHz signal which is fed back to the N1 divider. The VCO TUNE voltage, after passing through a low-pass filter, tunes the VCO over its 160—240 MHz range. A power splitter and drivers buffer the VCO output and drive a divider for the 20—30 MHz output and a low pass filter for the 160—240 MHz output.

The oscillator consists of Q1 with the primary of T1 and CR1 through CR4 for the tuned circuit. Feedback is provided through C6. The VCO TUNE voltage is applied through the low-pass filter and switch S1. In the NORM position S1 connects the VCO TUNE voltage to the varactor diodes, but in TEST HIGH FREQ and TEST LOW FREQ, a dc voltage is substituted for the VCO Tune signal that sets the VCO frequency to greater than 240 MHz or less than 160 MHz. Transistor Q1 is biased by the −40 volt supply through ripple filter Q6. RF energy is coupled to the Power Splitter by the one-turn secondary of T1.

Amplifier Q4 buffers the VCO from the two common base drivers Q2 and Q3. Transistor Q5 acts as a ripple filter for the Q2, Q3, and Q4 bias supply. The output of Q2 is filtered and applied to J2 as the 160—240 MHz OUTPUT. The signal at the collector of Q3 is divided by U2, U1A, and U1B, filtered and applied to J1 as the 20/30 MHz output.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1

SERVICE SHEET 8 (cont'd)

and BD3 was used to isolate a malfunction to the VCO 160—240 MHz Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM)	HP 3456A
Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8556A/ 8552B/141T
High Impedance Probe	HP 1121A

Troubleshooting Procedures

There are two procedures provided below, one for problems with the 160—240 MHz output and the second for problems with the 20/30 MHz output.

160—240 MHz Output. Use this procedure if the troubleshooting information in Service Sheet BD3 indicates a problem with the 160—240 MHz output.

1. Remove A2A3, set the Test Switch to TEST HIGH FREQ and replace it on a 36-pin extender board.

2. Using the DVM, check the voltages at the emitters of Q5 and Q6 against the voltages given on the schematic.

   If either voltage is not as indicated on the schematic, check the affected transistor and associated components.

   If both voltages are as indicated, proceed with Step 3.

3. Using the high impedance probe, connect the spectrum analyzer to the collector of Q4.

   The spectrum analyzer should show a signal greater than 240 MHz, at about −10 dBm.

   If the signal is as indicated, check Q2 and associated components.

   If the signal is not as indicated, check Q4, Q1 and associated components.

20/30 MHz Output. Use this procedure if the troubleshooting information in Service Sheet BD3 has indicated a problem with the 20/30 MHz output.

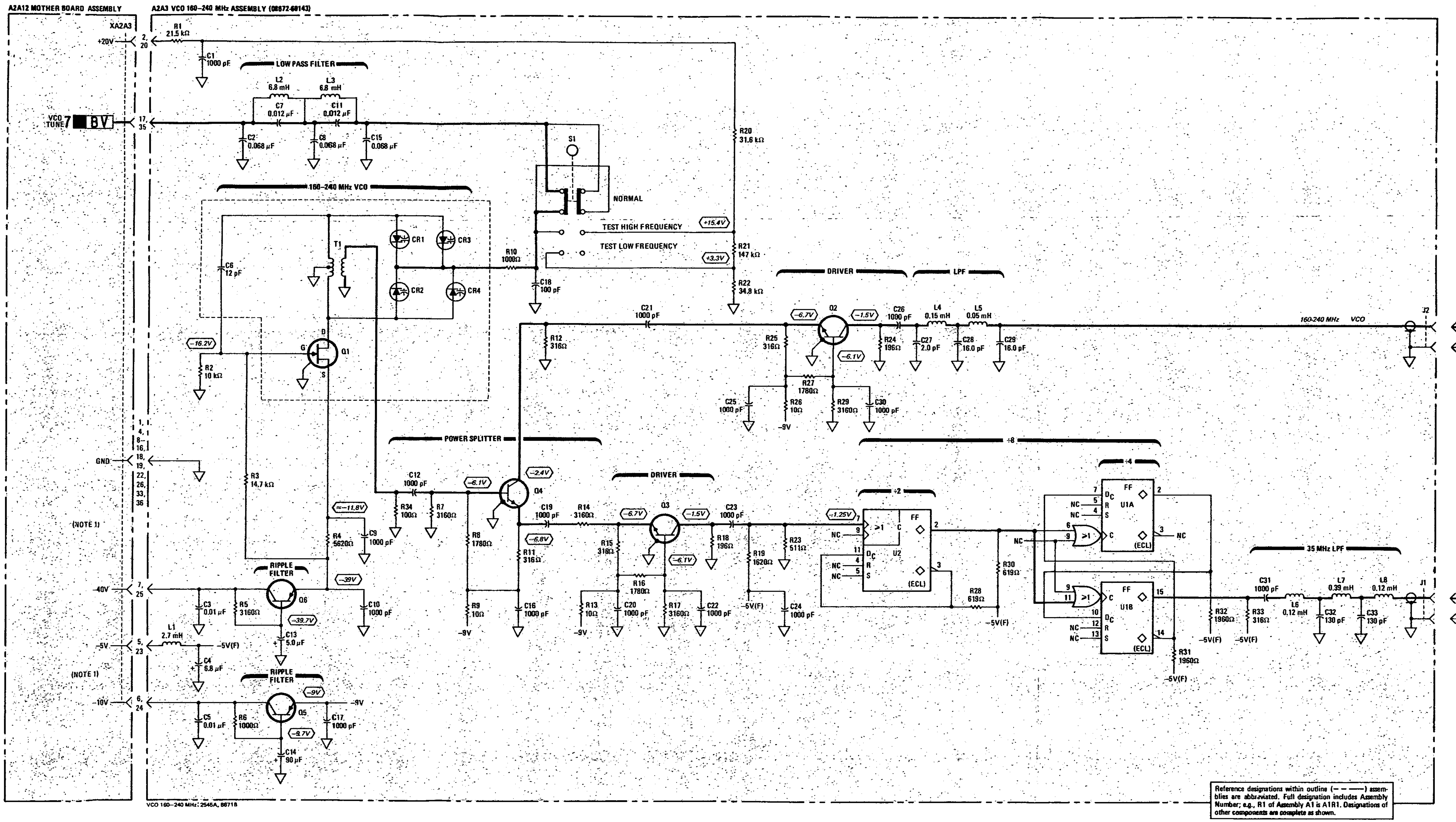
1. Remove A2A3, set the Test Switch to TEST HIGH FREQ and replace A2A3 on a 36-pin extender board.

2. Using the high impedance probe, connect the spectrum analyzer to U2 pin 7.

   The spectrum analyzer should show a signal greater than 240 MHz at a level of about −10 dBm.

   If the signal is as indicated, check U1 and associated components.

   If the signal is not as indicated, check Q3 and associated components.



A2 W2 — 6 160–240 MHz OUTPUT

A3 W14 — 12 20/30 MHz OUTPUT 0 dBm

NOTES

1. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.

REFERENCE DESIGNATIONS

A2	A2A3
W2	C1–33
A2A12	CR1–4
XA2A3	J1, 2
A3	L1–8
W14	Q1–6
	R1–34
	S1
	T1
	U1, 2

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH (1)	>2V	>–0.5V	>–0.1V	≈VDD
LOW (0)	<0.8V	<–1.5V	<–0.6V	<0.1V

< = EQUAL TO OR MORE NEGATIVE THAN
> = EQUAL TO OR MORE POSITIVE THAN

INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH (1)	LOW (0)
OPEN	HIGH (1)	LOW (0)	LOW (0)	X

GROUND = 0V; X = UNDEFINED

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1855-0392
Q2–4	1854-0345
Q5	1853-0020
Q6	1853-0451
U1	1820-1225
U2	1820-0794

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 2	–5V(F) – 8 ⏚ – 1,16

8 A2A3

Figure 8-70. VCO 160—240 MHz Assembly Schematic Diagram

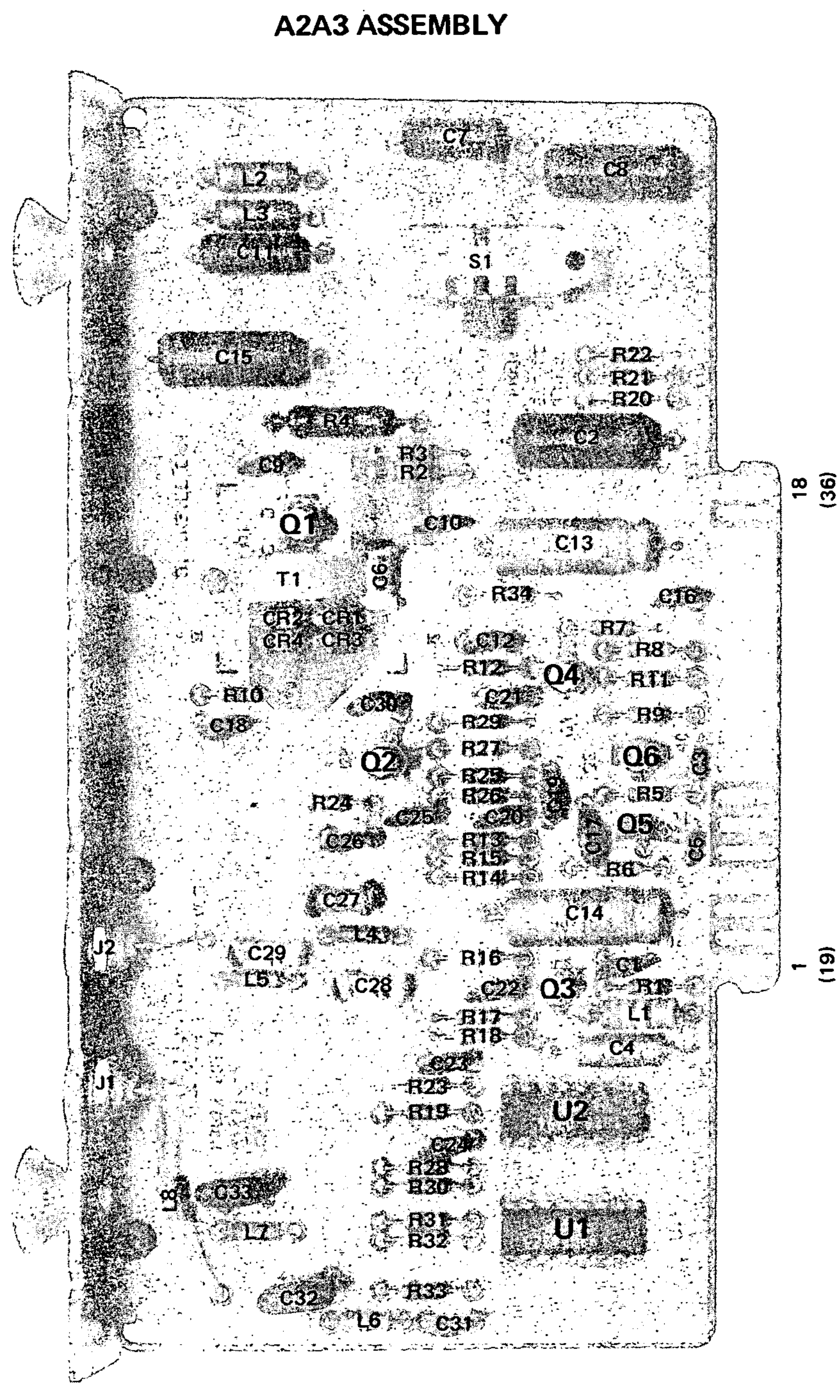


Figure 8-69. A2A3 VCO 160—240 MHz Assembly Component and Test Point Locations

SERVICE SHEET 9

DIGITAL TO ANALOG CONVERTER ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
YTO Summing Phase Locked Loop Block Diagram .... Service Sheet BD4
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB).................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

YTO Summing Phase Locked Loop. The YIG Tuned Oscillator's frequency output is phase-locked: 1, to the difference of the YTO frequency and a selected harmonic of the M/N Phase Locked Loop; and 2, to the LFS Phase Locked Loop. The YTO is pretuned near the correct harmonic of the M/N Output frequency by the YTO pretune ciruits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the LFS signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N Phase Locked Loop (also the M/N harmonic near to which the YTO loop is pretuned)
$f_{M/N}$ = M/N Phase Locked Loop output frequency (MHz), and
f_{LFS} = LFS Phase Locked Loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-3; M and N Numbers and Resulting Frequencies in Service Sheet BD3.

Also, $f_{LFS} = (30.000 - D4\ .\ D3\ D2\ D1)$ MHz

where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit for YTO frequencies less than 6200 MHz.

YTO Pretune. The digital control inputs to the DAC from the Digital Control Unit (DCU) select the pretune frequency. These inputs are first converted from a digital signal to an analog dc voltage (the YTO Pretune signal). This signal is amplified (in the Main Coil Driver) and output as a tuning current to the YTO.

Notice that the input tuning resolution to the DAC is 1 MHz. If the YTO frequency is within ±10 MHz of the desired frequency (for frequencies less than 6200 MHz) then the pretune circuits are operating properly. Pretuning, however, normally brings the YTO frequency to within 1 or 2 MHz of the desired YTO frequency.

Detailed Discussion

The digital inputs to the DAC are in BCD and binary format. These inputs, (operating through the open-collector buffers) switch the diodes on or off. When on, current flows through the resistor, the diode and into the current summing node. The resistor value is selected so the current flow is proportional to the BCD weighting of the control input. The total current flow to the major summing node (at the input to the Summing and Buffer Amplifier) is proportional to the frequency as dictated by the digital inputs (0.5 mA/GHz). The Summing and Output Buffer Amplifier, with a gain of −6.000 V/mA, converts the summed current to a voltage (−3.000 V/GHz). Transistors Q6 and Q7 increase the slew rate of the amplifier by quickly charging or discharging C11 when large changes occur. RC network C12 and R59 provide compensation to prevent high frequency oscillation.

Current Summing. The least significant bits of the DAC inputs are summed in a node with 75 mA/GHz sensitivity. Upon dividing this current by 10, it is summed with the mid-range bits at 7.5 mA/GHz. This current is also divided (by 15) and summed with the most significant bits at 0.5 mA/GHz. Note that a 0.8 mA offset current equivalent to 1.6 GHz and used in adjusting the DAC is also summed at the major summing node.

Reference Amplifiers. The Reference Current Source generates a temperature stabilized constant current for VR1 via R6. Reference Buffer U1B isolates VR1 and provides a stable but adjustable voltage reference for the rest of the circuits. This voltage is further buffered by Reference Buffers U3 and U4.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the Digital-to-Analog Converter Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Hints

Before attempting to troubleshoot the DAC Assembly, clean it thoroughly using the procedure outlined in the front of Section VIII,

SERVICE SHEET 9 (cont'd)

and try it again. Experience has shown this board to be sensitive to contamination by foreign matter. If the DAC functions normally at some frequencies but not others, the problem is most likely in U5, U6, U7, U8, U9, or U10. Check these by setting the CW Generator to various frequencies to exercise all inputs and check that the high logic levels are getting through the diodes.

Troubleshooting Procedure

1. Remove A3A5 and replace it on a 36-pin extender board.

2. Check the voltages at TP1 and TP2 against the voltages on the schematic.

   If both voltages are correct, proceed with Step 4.

   If either is incorrect, proceed with Step 3.

3. Check the voltage at TP4 against the voltage on the schematic.

   If the voltage is within the tolerance given, the affected reference buffer, U3 or U4, is defective.

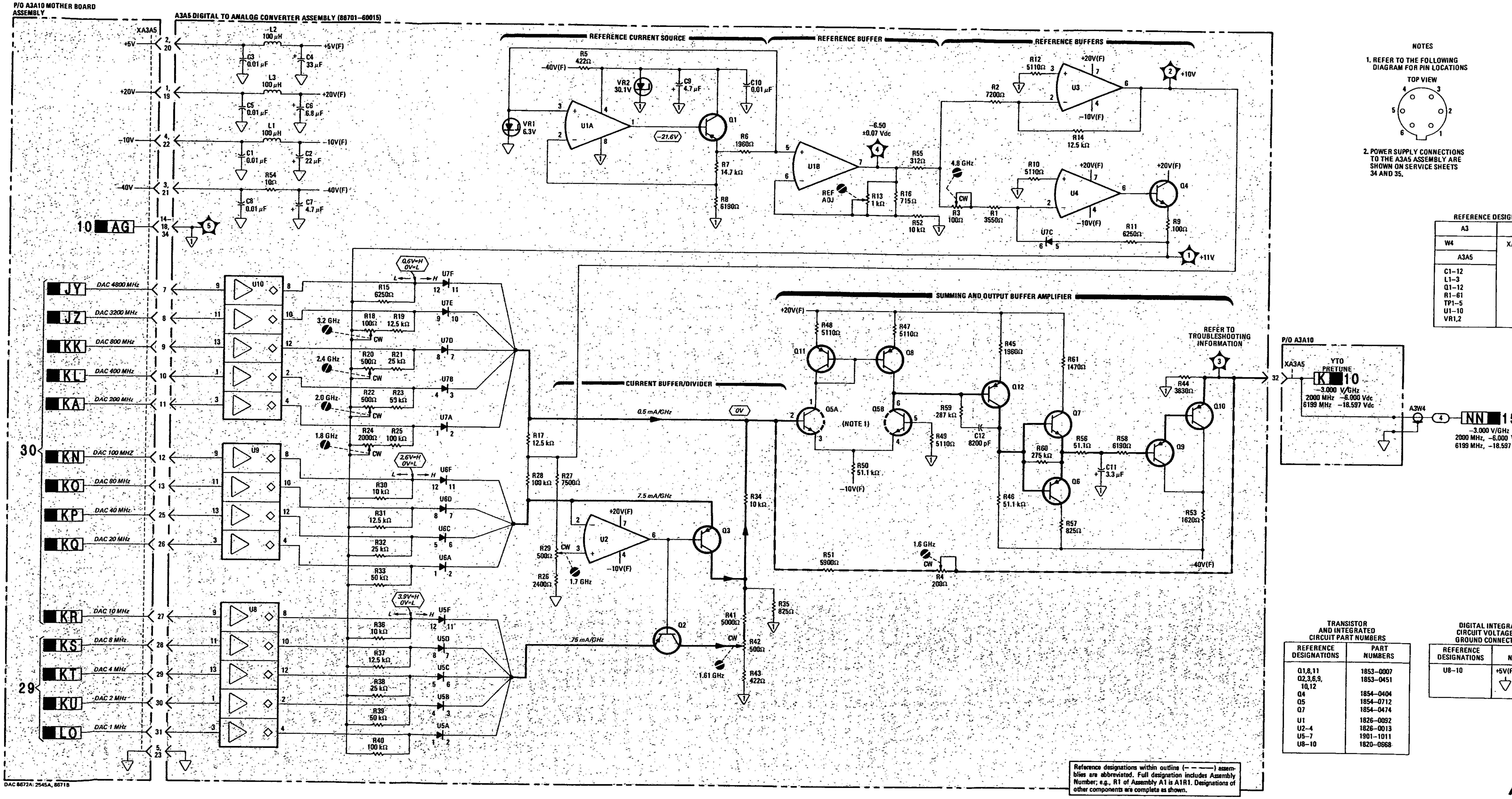
   If the voltage is not within tolerance, check U1 and Q1.

4. Connect the DVM to Q5 pin 6.

   The voltage at this point should be at or near ground.

   If the voltage is as indicated, the Summing and Output Buffer Amplifier is working normally so the problem must be with Current Buffer/Divider. Check U2, Q2, Q3, and associated components.

   If the voltage is not as indicated, the problem is with the Summing and Output Buffer Amplifier (although the Current Buffer/Divider could also be faulty). Because of the feedback around the Summing and Output Buffer Amplifier it is difficult to troubleshoot here. The best thing to do is to check the bias on each transistor and replace any that are faulty.



NOTES

1. REFER TO THE FOLLOWING DIAGRAM FOR PIN LOCATIONS
   TOP VIEW
2. POWER SUPPLY CONNECTIONS TO THE A3A5 ASSEMBLY ARE SHOWN ON SERVICE SHEETS 34 AND 35.

REFERENCE DESIGNATIONS

A3	A3A10
W4	XA3A5
A3A5	
C1–12 L1–3 Q1–12 R1–61 TP1–5 U1–10 VR1,2	

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1,8,11	1853–0007
Q2,3,6,9,10,12	1853–0451
Q4	1854–0404
Q5	1854–0712
Q7	1854–0474
U1	1826–0092
U2–4	1826–0013
U5–7	1901–1011
U8–10	1820–0668

DIGITAL INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U8–10	+5V(F) – 14 ▽ – 7

9
A3A5

Figure 8-72. Digital-to-Analog Converter Assembly Schematic Diagram

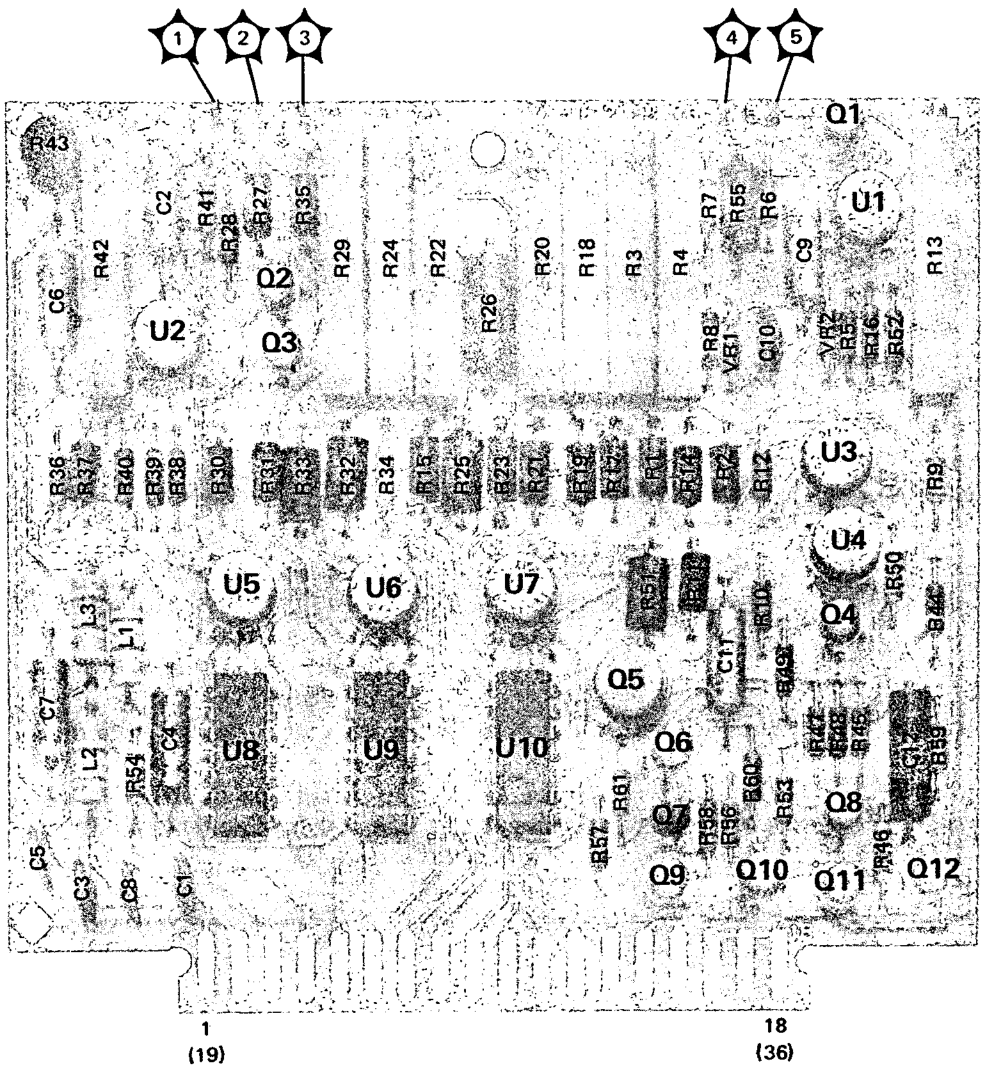


Figure 8-71. A3A5 DAC Assembly Component and Test Point Locations

SERVICE SHEET 10

YTO DRIVER ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
YTO Summing Phase Locked Loop Block Diagram .... Service Sheet BD4
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB).................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

YTO Summing Phase Locked Loop. The YIG Tuned Oscillator's frequency output is phase locked: 1, to the difference of the YTO frequency and a selected harmonic of the M/N Phase Locked Loop; and 2, to the LFS Phase Locked Loop. The YTO is pretuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the LFS signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N Phase Locked Loop (also the M/N harmonic near to which the YTO loop is pretuned)
$f_{M/N}$ = M/N Phase Locked Loop output frequency (MHz), and
f_{LFS} = LFS Phase Locked Loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-3; M and N Numbers and Resulting Frequencies in Service Sheet BD3.

Also, $f_{LFS} = (30.000 - D4 . D3\ D2\ D1)$ MHz

where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit for YTO frequencies less than 6200 MHz.

YTO Pretune. The digital control inputs to the DAC from the Digital Control Unit (DCU) select the pretune frequency. These inputs are first converted from a digital signal to an analog dc voltage (the YTO Pretune signal). This signal is amplified (in the Main Coil Driver) and output as a tuning current to the YTO.

Notice that the input tuning resolution to the DAC is 1 MHz. If the YTO frequency is within ±10 MHz of the desired frequency (for frequencies less than 6200 MHz) then the pretune circuits are operating properly. Pretuning, however, normally brings the YTO frequency to within 1 or 2 MHz of the desired YTO frequency.

Detailed Discussion

The YTO Driver Assembly produces a current in the YTO main coil that is proportional to the sum of the YTO Pretune (DAC output), the YTO TUNE 2 (the low frequency component of the YTO TUNE 1), and an offset voltage.

Coil Driver. The Coil Driver acts in two primary capacities. It provides a summing point for the input currents and it outputs a current to the YTO main coil. It is important to realize that the Coil Driver current flow is supplied through the Sense Resistor (this current is dependent upon the YTO Pretune voltage input) and from the Phase Lock Amplifier. The currents are summed at the Coil Driver's non-inverting output. The total current flows into the non-inverting input and out the inverting output as the YTO Main Coil Drive.

Input Amplifier. The YTO Pretune Voltage is amplified by the Input Amplifier (a discrete component operational amplifier). The output voltage appears at the Coil Driver's non-inverting output and therefore across the Sense Resistor. A portion of this voltage is returned to the Input Amplifier's inverting input. This return voltage is adjustable to allow for variation in the frequency-to-voltage sensitivity of different Oscillators. See Figure 8-73. RC network C4 and R10 provide compensation to prevent high frequency oscillation.

The Shaping Network (connected across the Sense Resistor) compensates for the non-linearity of the YTO frequency-to-voltage curve.

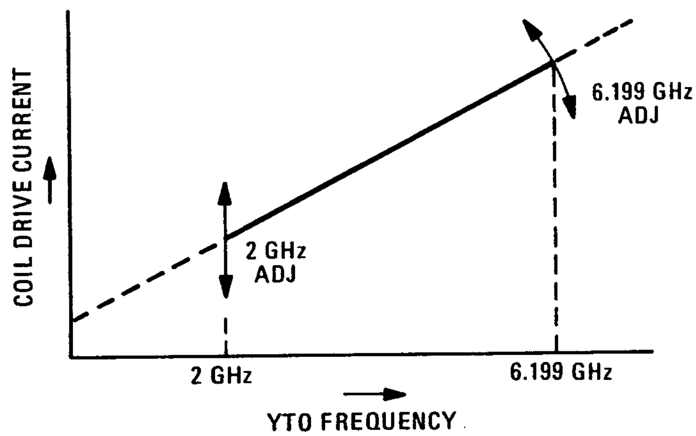


Figure 8-73. YTO Frequency versus Coil Drive Current

SERVICE SHEET 10 (cont'd)

NOTE

The YTO Main Coil Drive current contributed by the Input Amplifier is equal to the YTO Pretune voltage divided by the sum of R16 (125 ohms) and that portion of R24 (15 ohms) that supplies the feedback voltage to the Input Amplifier through R25. The remaining summed current flows through R30.

The dominant pole of this amplifier (at 0.8 Hz) is set by R11 and C7. They also provide noise filtering. Transistors Q8 and Q12 increase the slew rate of the amplifier by quickly charging or discharging C7 when large changes occur. Current limiter Q13 protects its associated components by removing the drive voltage from Q12 if the current is excessive.

Phase Lock Amplifier. The YTO Tune 2 and Offset voltages are summed in the Phase Lock Amplifier. The YTO Tune 2 signal is the low frequency component of the YTO tuning voltage (YTO Tune 1). The 100-Hz low-pass filter removes the high frequency components of the tuning voltage. The offset voltage is adjusted at 2 GHz (2 GHz Adj) so the YTO Frequency extrapolated to 0 GHz is 0 volt.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the YTO Driver Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Procedure

1. Remove A3A6 and replace it on a 30-pin extender board.

2. Using the DVM, measure the voltages at TP1 and TP4.

   The voltage at TP4 should be 2.9 + (0.64 x V_{TP1}).

   If the voltage at TP4 is as indicated, proceed with Step 4.

   If the voltage at TP4 is not as indicated, proceed with Step 3.

3. Connect the DVM to U1 pin 1.

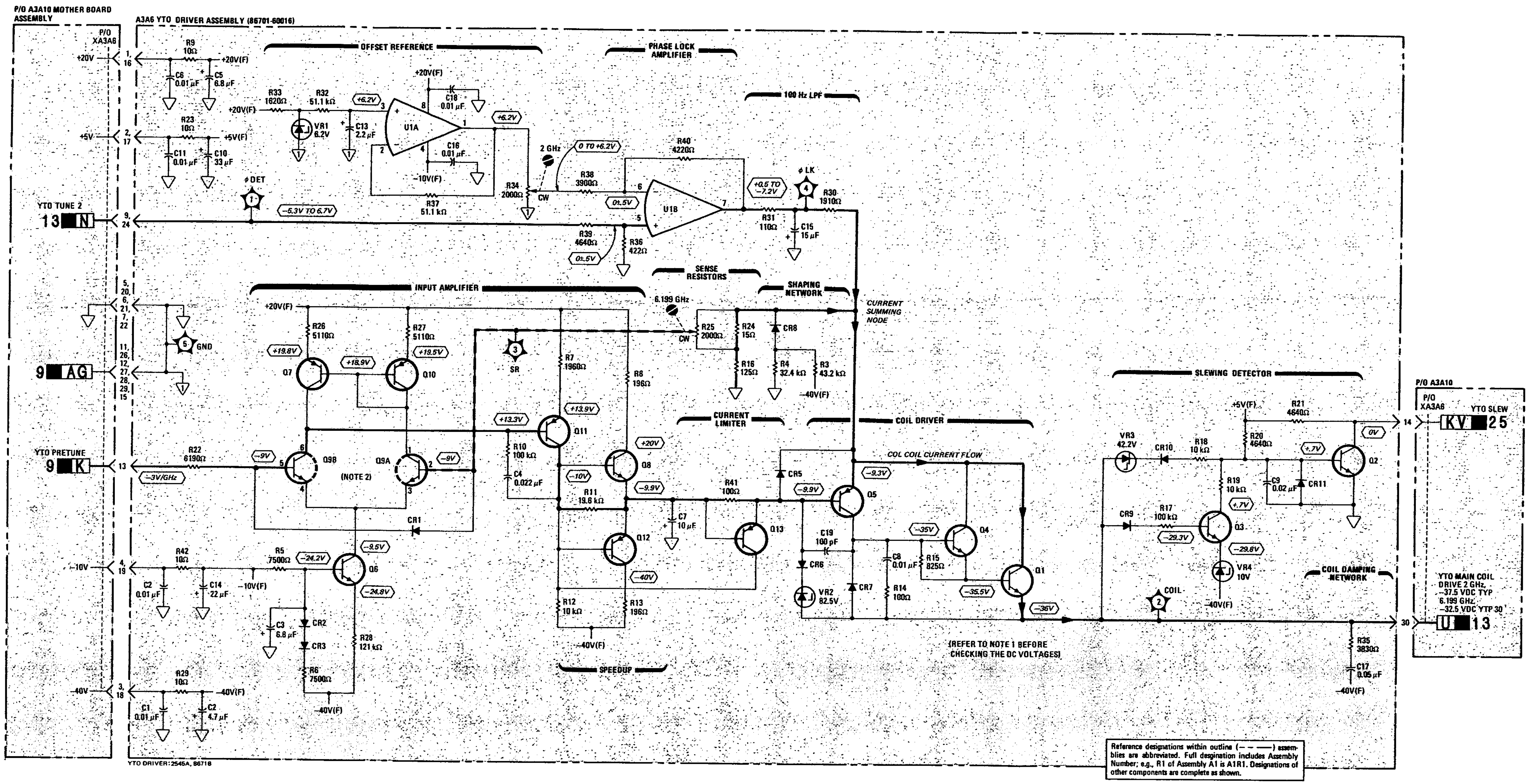
   The voltage should be +6.2 Vdc.

   If the voltage is as indicated, check U1B and associated components.

   If the voltage is not as indicated, check U1A and associated components.

4. Because of feedback it is difficult to isolate between the Input Amplifier, the Current Limiter, and the Coil Driver. The best way to proceed is to check the voltages on the transistors against the voltages on the schematic. Be sure to press PRESET (3 GHz) to set the CW Generator Frequency to 3 GHz before proceeding.

5. If a slewing detector problem is suspected, proceed as in Step 4 for Q2 and Q3.



NOTES

1. THE DC VOLTAGES SHOWN ARE FOR A CARRIER FREQUENCY OF 3 GHz.
2. REFER TO THE FOLLOWING DIAGRAM FOR PIN LOCATIONS.

TOP VIEW

3. POWER SUPPLY CONNECTIONS TO THE A3A6 ASSEMBLY ARE SHOWN ON SERVICE SHEETS 34 AND 35.

REFERENCE DESIGNATIONS

A3A6	A3A10
C1–19 CR1–3,5–11 Q1–13 R3–42 TP1–5 U1 VR1–4	XA3A6

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854–0237
Q2,6	1854–0404
Q3,8	1854–0022
Q4	1854–0232
Q5	1853–0038
Q7,10	1853–0007
Q9	1854–0712
Q11,13	1853–0451
Q12	1853–0012
U1	1826–0092

10
A3A6

Figure 8-75. YTO Driver Assembly Schematic Diagram

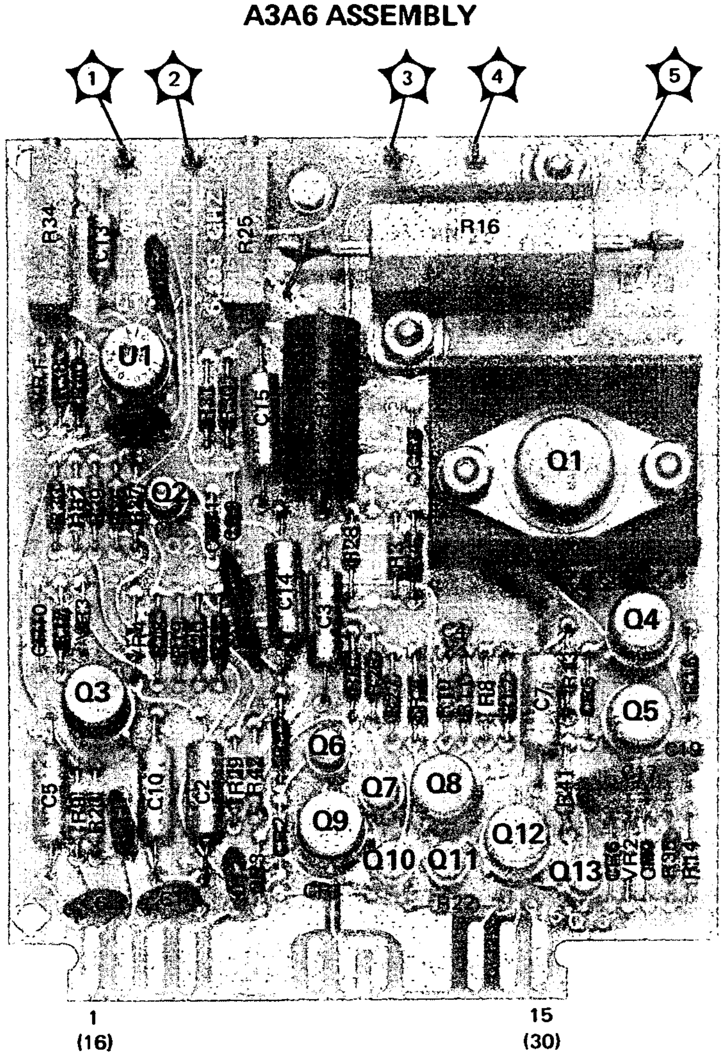
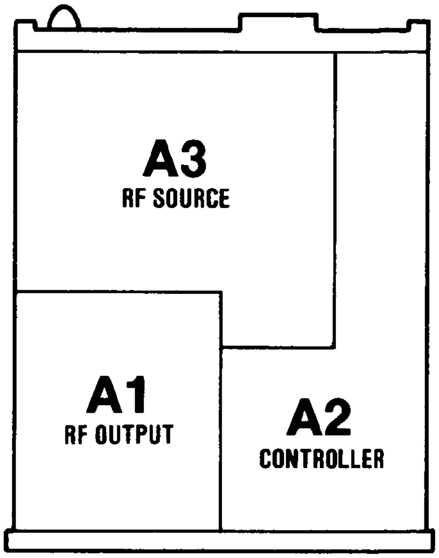


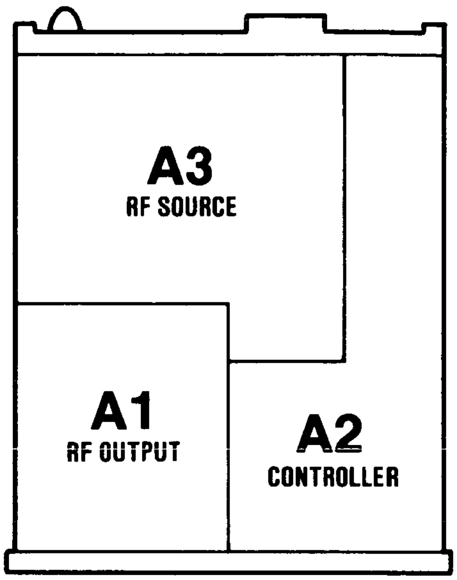
Figure 8-74. A3A6 YTO Driver Assembly Component and Test Point Locations



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35

SERVICE SHEET 11

YTO SAMPLER ASSEMBLY

REFERENCES

Overall Block Diagram ..... Service Sheet BD1
YTO Summing Phase Locked Loop Block Diagram .... Service Sheet BD4
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YIG Tuned Oscillator's frequency output is phase-locked: 1, to the difference of the YTO frequency and a selected harmonic of the M/N Phase Locked Loop; and 2, to the LFS Phase Locked Loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the LFS signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N Phase Locked Loop (also the M/N harmonic near to which the YTO loop is pretuned)
$f_{M/N}$ = M/N Phase Locked Loop output frequency (MHz), and
f_{LFS} = LFS Phase Locked Loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-3; M and N Numbers and Resulting Frequencies in Service Sheet BD3.

Also, f_{LFS} = (30.000 – D4 . D3 D2 D1) MHz
where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit for YTO frequencies less than 6200 MHz.

Detailed Discussion

The YTO Output signal is mixed with the Nth harmonic of the M/N OUT signal. The difference signal (20/30 MHz) is output to the YTO Phase Detector where it is phase compared to the LFS Phase Locked Loop Output.

The M/N Phase Locked Loop Signal is matched to the input of the Sampler Drive Amplifier by R40, L1 and C10. This signal is amplified and matched to the Sampler's Harmonic Generator input. The numerous harmonics are mixed with the RF Input signal in the Sampler's Mixer. The outputs are summed and matched to the IF Preamplifier by L10 and R13. The impedance matching throws the IF Amplifier's frequency response off. The de-emphasis network at the output provides compensation that brings the frequency response back to normal. After buffering, the signal passes through a 70-MHz low-pass filter to remove the multitude of unimportant harmonics of the mixing process. The signal is then amplified and output to the YTO Phase Detector. The important signal is the 20 to 30 MHz signal which is to be phase compared with the LFS Loop signal in order to phase lock the YTO Summing Loop.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the YTO Summing Phase Locked Loop Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Spectrum Analyzer .... HP 8556A/8552B/141T
High Impedance Probe .... HP 1121A

Troubleshooting Procedure.

1. Install the A3A9 assembly in the service position according to the procedure on Service Sheet A. Remove the cover on the right side of the YTO Phase Locked Loop Assembly to expose the A3A9A5 assembly.

2. Press PRESET (3 GHz), then, using the high impedance probe, connect the spectrum analyzer to the gate of Q4.

SERVICE SHEET 11 (cont'd)

The spectrum analyzer should show a 30-MHz signal at −30 dBm.

If the signal is as indicated, proceed with Step 4.

If the signal is not as indicated, proceed with Step 3.

3. Using the high impedance probe, connect the spectrum analyzer to the base of Q6.

   The spectrum analyzer should show a 30-MHz signal at −31 dBm.

   If the signal is as indicated, check Q6, Q5, Q1, and associated components.

   If the signal is not as indicated, check Q2, Q4, Q7, and associated components.

4. Using the high impedance probe, connect the spectrum analyzer to the right (non-grounded) side of R9.

   The spectrum analyzer should show a 189-MHz signal at +7 dBm.

   If the signal is as indicated, Sampler U12 is defective.

   If the signal is not as indicated, check Q3, Q8, and associated components.

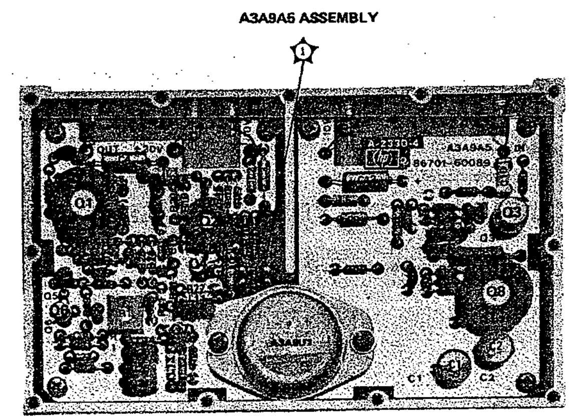


Figure 8-76. A3A9A5 Sampler Assembly Component and Test Point Locations

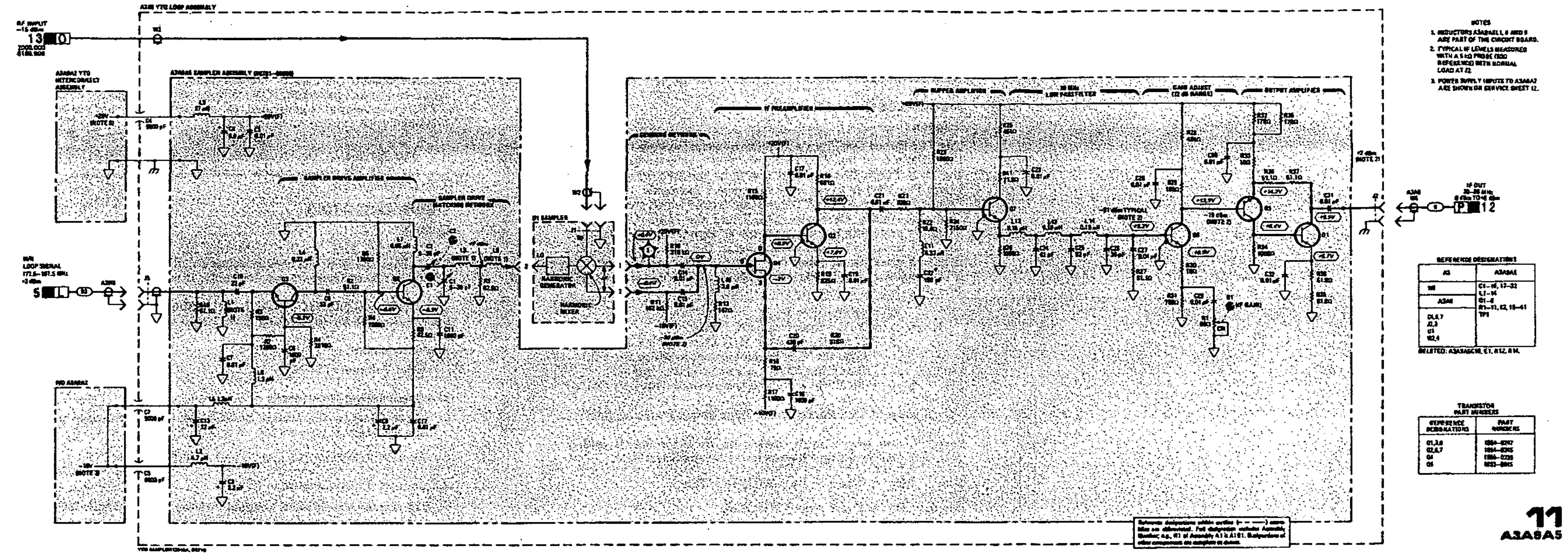


Figure 8-77. YTO Sampler Assembly Schematic Diagram

SERVICE SHEET 12

YTO PHASE DETECTOR

REFERENCES

Overall Block Diagram .... Service Sheet BD1
YTO Summing Phase Locked Loop
 Block Diagram .... Service Sheet BD4
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB)................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YIG Tuned Oscillator's frequency output is phase locked 1) to the difference of the YTO frequency and a selected harmonic of the M/N Phase Locked Loop and 2) to the LFS Phase Locked Loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Sampler is phase compared to the LFS signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS Phase Locked Loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N Phase Locked Loop (also the M/N harmonic near to which the YTO Summing Phase Locked Loop is pretuned.
$f_{M/N}$ = M/N Phase Locked Loop output frequency (MHz), and
f_{LFS} = LFS Phase Locked Loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-3; M and N Numbers and Resulting Frequencies in Service Sheet BD3.

Also, f_{LFS} = (30.000 – D4 . D3 D2 D1) MHz

where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit for YTO frequencies less than 6200 MHz.

Detailed Discussion

YTO Phase Detector Assembly. The Phase/Frequency detector compares the frequency and phase of the Sampler IF signal to the output of the LFS Phase Locked Loop. The resultant error signal is integrated and amplified in the Loop Integrators. The output signal YTO Tune 1 is applied to the YTO coils to achieve phase lock.

The IF IN (from the Sampler) and the LFS Phase Locked Loop signal are divided by two and routed to the Phase/Frequency Detector. If the phase of the IF signal leads that of the LFS Phase Locked Loop signal, a negative going pulse appears at U1 pin 12 (TP3). Pin 3 (TP4) remains at a steady dc level (about −0.6 Vdc). If the LFS loop signal leads, a negative pulse appears at pin 3. In each case the pulse width is proportional to the phase difference between the signals. The outputs are filtered and coupled to the differential amplifier whose output is then applied to the Loop Integrator. The output (YTO Tune 1) tunes the YTO frequency.

Unlock Detector. The Unlock Detector compares the YTO TUNE 1 signal to a preset reference. If the voltage swing exceeds ±5 Vdc, a YTO unlock signal is generated. RC network C12/R14 prevents transients from causing an unlock signal.

NOTE

The FM Switch, Overmodulation Detector, Divide Selector, and FM Status/Enable circuits are not used in the CW Generator.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the YTO Summing Phase Locked Loop Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Procedures

1. Place A3A9 in the service position using the procedure in Service Sheet A. Remove the cover from A3A9A4.

2. Press PRESET (3 GHz) and ground A3A6TP1.

3. Connect the oscilloscope to TP2.

   The display should show a signal between 10 and 15 MHz (100 to 66 ns period), and a peak-to-peak amplitude of between 1 and 1.5 volts.

   If the signal is as indicated, proceed with Step 5.

   If the signal is not as indicated, proceed with Step 4.

4. Connect the oscilloscope to U6 pin 14.

   The display should show a 30 MHz (33 ns period) signal at a peak-to-peak amplitude of between 1 and 1.5 volts.

SERVICE SHEET 12 (cont'd)

If the signal is as indicated, U7 is defective.

If the signal is not as indicated, U6 is defective.

5. Connect the oscilloscope to TP5.

   The display should show a signal between 10 and 15 MHz (100 to 66 ns period) at a peak-to-peak level of between 1 and 1.5 volts.

   If the display is as indicated, proceed with Step 7.

   If the display is not as indicated, proceed with Step 6.

6. Connect the oscilloscope to U6 pin 2.

   The display should show a signal greater than 30 MHz (less than 33 ns period) at a peak-to-peak level of 1 to 1.5 volts.

   If the signal is as indicated, U9 is defective.

   If the signal is not as indicated, check U6 and asssociated components.

7. Connect the DVM to U4 pin 6. While observing the DVM display, disconnect the black IF IN cable from A3A9J1.

   The DVM should initially indicate about +10.5 Vdc, dropping to about +9.5 Vdc when the cable is removed.

   If the indication is correct, replace the black cable and proceed with Step 8.

   If the indication is not correct, check U5, Q4, Q5, and associated components.

8. Repeat Step 7 but remove the green LFS cable from A3A9J3.

   The DVM should initially indicate about +10.5 Vdc, rising to about +11.5 Vdc when the cable is removed.

   If the DVM indication is correct, check U3 and associated components.

   If the indication is not correct, check U5, Q4, Q5, and associated components.

NOTE

The FM Switch, Overmodulation Detector, Divide Selector, and FM Status Enable circuits are disabled in this application, therefore no troubleshooting procedure is provided for them.

9. For Unlock Detector problems check U1.

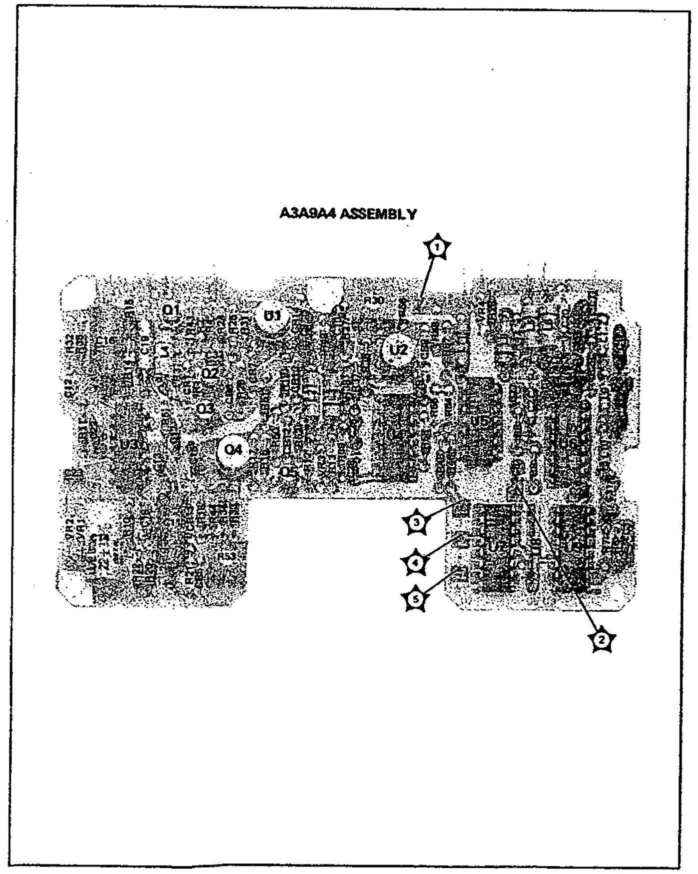
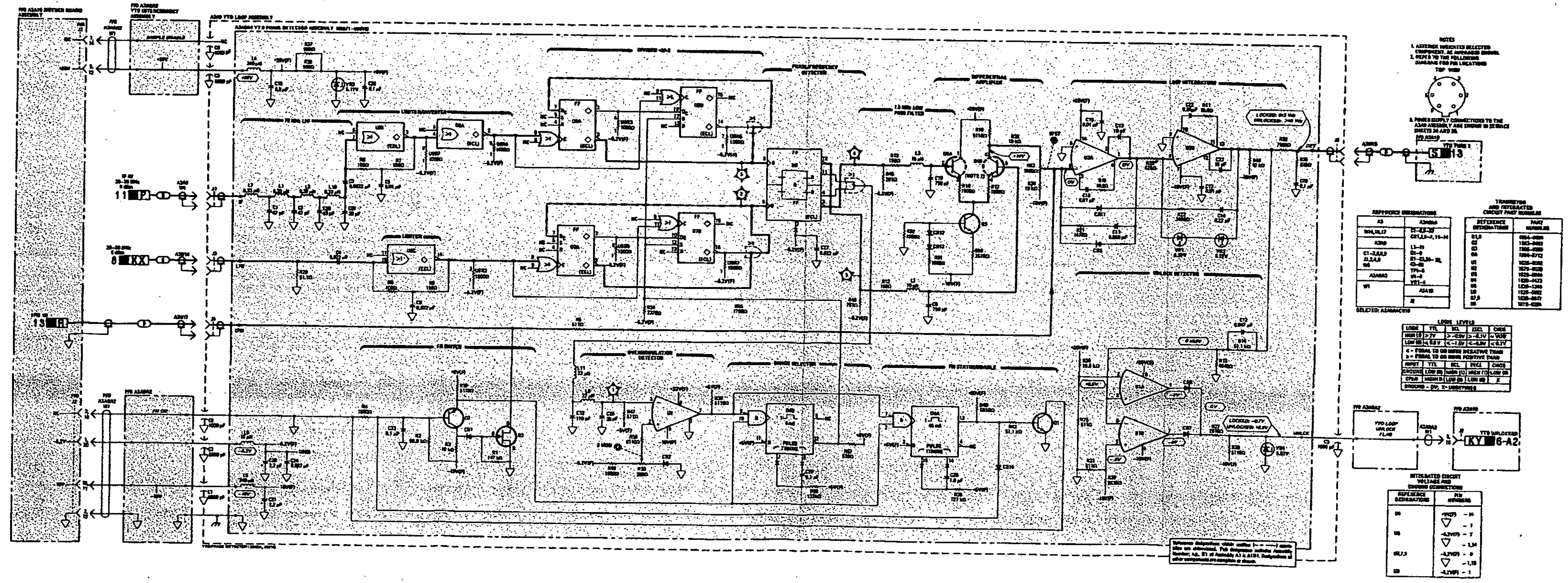


Figure 8-78. A3A9A4 YTO Phase Detector Assembly Component and Test Point Locations



12
A3A9A4

Figure 8-79. P/O YTO Phase Detector Assembly Schematic Diagram

SERVICE SHEET 13

YTO/HF COIL DRIVER ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
YTO Summing Loop Block Diagram	Service Sheet BD4
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YIG-Tuned Oscillator's frequency output is phase-locked: 1) to the difference of the YTO frequency and a selected harmonic of the M/N Phase Locked Loop; and 2) to the LFS Phase Locked Loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Sampler is phase compared to the LFS Phase Locked Loop signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS Phase Locked Loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N loop (also the M/N harmonic near to which the YTO is pretuned)
$f_{M/N}$ = M/N Phase Locked Loop output frequency (MHz), and
f_{LFS} = LFS Phase Locked Loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up on Table 8-3 M and N Numbers and Resulting Frequencies (on Service Sheet BD3).

Also, $f_{LFS} = (30.000 - D4\,.\,D3\,D2\,D1)$ MHz

where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit for YTO frequencies less than 6200 MHz.

Detailed Description

The HF Driver Assembly performs two major functions. They are: 1) shifting the YTO frequency to ensure it will pass through the loop capture range and achieve phase lock in the event the loop has become unlocked and 2) dividing the YTO tuning voltage (YTO Tune 1) into its high and low frequency components.

SERVICE SHEET 13 (cont'd)

Phase Lock Signals. The YTO TUNE 1 signal is amplified and the drive current is applied to the HF coil through an impedance matching network. The Frequency Shaping Network, located in the coil driver's feedback loop compensates for the gradual loss in sensitivity of the HF coil at higher frequencies.

YTO Loop Reset. The YTO Loop reset ensures that the YTO Summing Phase Locked Loop acquires phase lock after a frequency transition. When a frequency change occurs in less than 15 ms, the YTO achieves lock and the YTO NRST signal does not affect the YTO TUNE 1 input. If the loop does not achieve lock in less than 15 ms, the YTO UNLOCK signal causes YTO NRST to momentarily go low. The YTO TUNE 1 signal is pulsed to 0V. The result is that the YTO frequency is shifted to another frequency and then tries to return to the pre-pulse frequency. During this transition, the YTO 20/30 MHz IF signal passes through the capture range of the loop phase detector and the loop is locked. If a large frequency change occurs (on the order of 100 MHz), YTO SLEW causes the YTO NRST signal to immediately go low. The YTO output is effectively frequency modulated and the IF signal passes through the loop capture range.

Phase Lock Amplifiers. The YTO TUNE 1 signal is amplified by Q10. The YTO TUNE 2 signal is connected to the A3A6 Main Coil Driver Assembly where all frequencies above 100 Hz are filtered out. The high pass filter (C10, R14, and R15) passes only those components of the signal greater than 100 Hz to the Coil Driver.

HF Coil Driver. These circuits (Q4 through Q10) are used to improve frequency switching speed. Once the frequency is stabilized, the voltage at TP1 should be 0 ± 50 mVdc.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the YTO/HF Coil Driver Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Procedure

1. Connect the DVM to A3A6TP1 (on Service Sheet 10) and disconnect the green cable from LFS connector A3A9J3.

   The DVM should indicate about +6.5 Vdc.

SERVICE SHEET 13 (cont'd)

If the indication is correct, replace the green cable and proceed with Step 2.

If the indication is not correct, check Q1 through Q3 and associated components.

2. With the DVM still connected to A3A6TP1, disconnect the black cable from IF connector A3A9J1.

   The DVM should indicate about −5 Vdc.

   If the indication is correct, replace black cable and proceed with Step 3.

   If the indication is not correct, check Q1 through Q3.

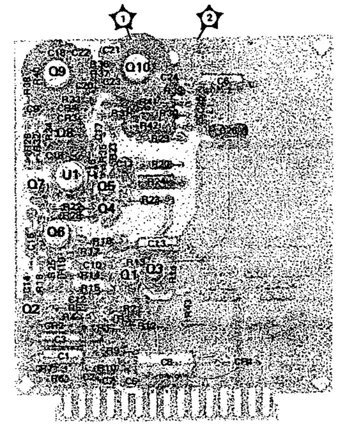


Figure 8-80. A3A7 YTO/HF Coil Driver Assembly Component and Test Point Locations

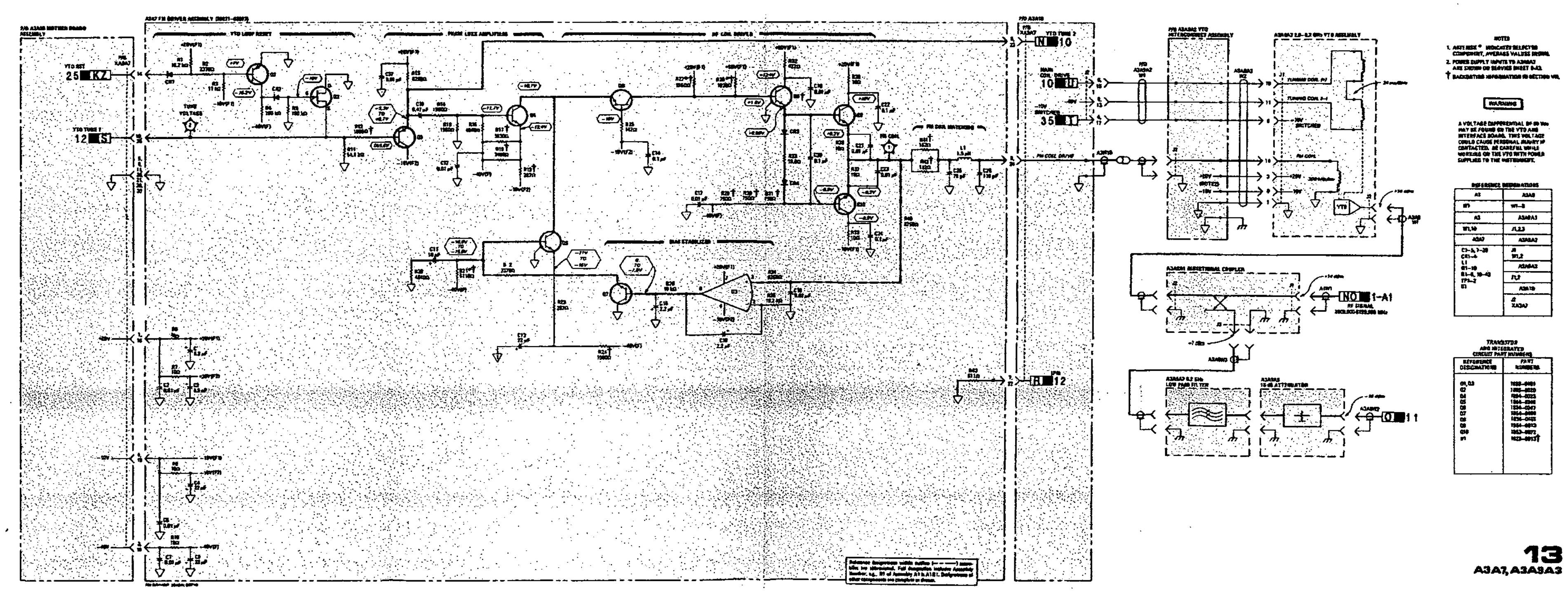


Figure 8-81. YTO HF Coil Driver Assembly Schematic Diagram

SERVICE SHEET 14

RF AMPLIFIER AND ALC ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Microwave Signal Path Block Diagram ...... Service Sheet BD5
Automatic Level Control (ALC) Block Diagram .... Service Sheet BD6
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB).................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

As shown on Service Sheet BD5 the YTM (YIG-Tuned Multiplier) multiplies the YTO (YIG-Tuned Oscillator) signal by 1, 2, or 3 to produce the desired frequency. The signal is amplified, leveled, and applied to a 10 dB step attenuator for final level selection.

The primary function of the ALC circuitry is to provide accurately calibrated output power over the CW Generator's 2 to 18 GHz frequency range. In addition, an external ALC input makes it possible to automatically control the level at a remote load.

Detailed Description

This service sheet describes the amplifier-modulator in the RF path and the ALC Assembly which is part of the ALC Loop.

RF Path. The A1A12 Amplifier-Modulator Assembly includes a preamplifier, PIN diode modulator to control the signal level, and a power amplifier to amplify the RF signal.

ALC Assembly A1A5. This assembly processes the ALC ERROR voltage to produce the ALC MOD voltage and signals for the Unleveled Detector and Level Meter. The ERROR voltage from the ALC detector is applied to an Integrator, U3, which has three possible gains depending on the band of the output frequency. This compensates for the YTM's different transfer characteristic on each band. The output of U3 drives Q2, which along with associated circuitry, is a current source for the PIN modulator.

CR12, Q4, Q9—13, U2 and U7 are amplitude modulation and control circuits that are not used in the instrument. Q4 collector should be less than 50 mVdc, and test point TP5 should be 0 mVdc.

The Meter Driver circuit converts the ERROR voltage into a meter current proportional to the RF output in dBm. The REF VOLTAGE

SERVICE SHEET 14 (cont'd)

is summed with the ERROR voltage to prevent the meter from indicating incorrectly when the ALC is unleveled.

The unleveled detector tells the front panel and the Digital Control Unit (DCU) when the ALC is not able to level the RF signal.

U9 and associated circuitry form a power clamp which prevents YTM sphere squegging by limiting power into the YTM. When the power sense voltage from the ALC detector circuitry exceeds a certain threshold, U9 and CR9 act as a current sink at the base of Q2 to override the integrated error signal from U3. The effect is that power is not allowed to exceed a preset level when operating over the 2—6.199999 GHz region.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and 5 or 6 was used to isolate an ALC problem to the circuits shown on this schematic.

Test Equipment

Power Sensor	HP 8481A
Power Meter	HP 436A
Digital Voltmeter (DVM)	HP 3455A

Troubleshooting Procedures

1. Connect the power meter to the RF OUTPUT connector. Disconnect the blue bias cable from A1A12 amplifier-modulator. The power output should rise to more than +8 dBm. At 3 GHz this will normally be > +10 dBm and will vary by several dB across the band. If the power is correct, the RF chain is working properly. Note that the available power must be at least +8 dBm at any frequency from 2 GHz to 18 GHz. If the power is incorrect or unmeasureable, continue with this procedure. Otherwise, skip to step 4.
2. Connect the power meter to the output of isolator A1AT2 (Service Sheet 15). The power should be > +15 dBm. If the power is correct, go to Service Sheet 15 to continue troubleshooting the RF chain. If not, continue with step 3.
3. Measure output power from A3A9A1J1. It should be > +11 dBm from 2 GHz to 6.199 GHz. If the power is incorrect, go to Service Sheet 13. Otherwise troubleshoot A1A13 and A2AT3.
4. Reconnect the blue bias cable using a Tee and connect one arm of the Tee to the DVM.
5. Set VERNIER fully clockwise and RANGE to 0 dB. The DVM should indicate about 0.75 Vdc. If the voltage is correct but the meter is not indicating full scale, troubleshoot the meter driver U8 and Q14 (or perform the ALC Adjustments in Section V).
6. Tune the frequency above 6.2 GHz. The voltage at the Tee will normally drop to about 0.65 Vdc.
7. Tune the frequency above 12.4 GHz. The voltage will normally remain about 0.65 Vdc. If the voltages in steps 8 and 9 do not behave properly, troubleshoot U1, U3, and Q3.
8. Set the RF switch to OFF. The LVL UNCAL annunciator should light and the voltage at the Tee should be near zero. If the LVL UNCAL annunciator does not light, troubleshoot U4, U5, and the lamp. If everything is correct to this point, the A1A5 ALC board is working properly.

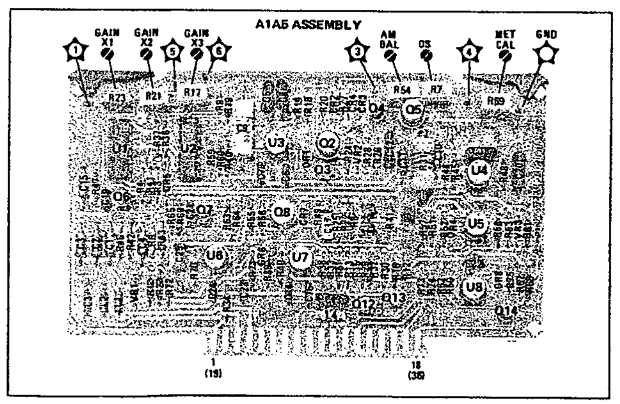


Figure 8-82. A1A5 ALC Assembly Component Locations

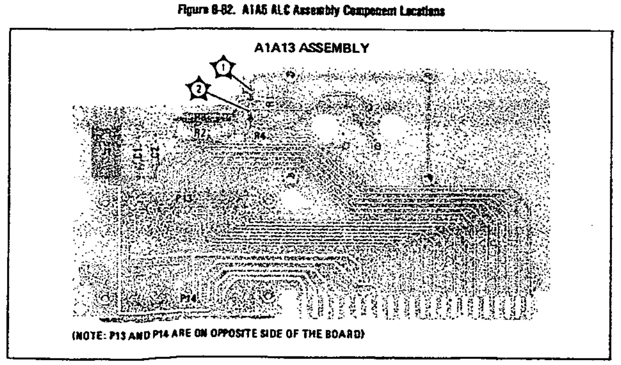


Figure 8-83. A1A13 Interconnect Assembly Component Locations

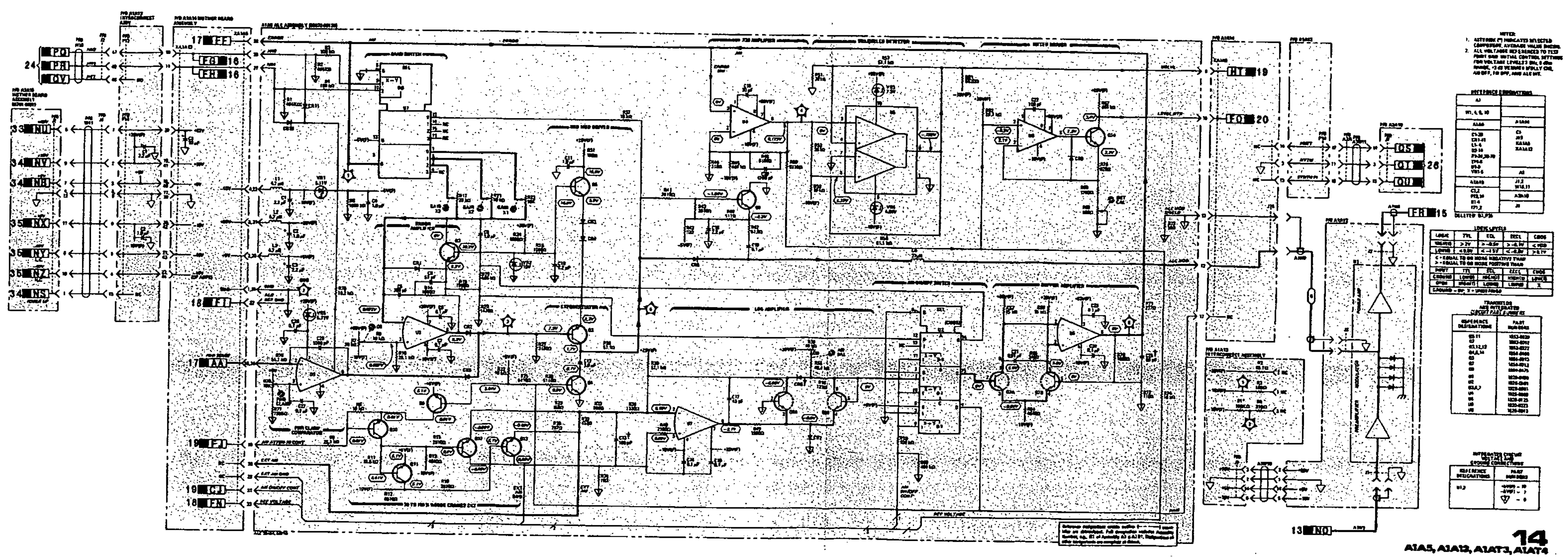


Figure 8-84. RF Amplifier and P/O ALC Schematic Diagram

SERVICE SHEET 15

YTM CONTROL

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Microwave Signal Path Block Diagram ...... Service Sheet BD5
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB).................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

As shown on Service Sheet BD5 the YTM (YIG-Tuned Multiplier) multiplies the YTO (YIG-Tuned Oscillator) signal by 1, 2, or 3 to produce the desired output frequency. Also, the signal is amplified, leveled, and applied to a 10 dB step attenuator for final level selection.

This service sheet describes the Isolator, High Pass Filter, and YIG Tuned Multiplier in the RF path and the YTM Driver Assembly.

RF Path. The Power Amplifier A1A12 (Service Sheet 14) operates close to saturation and provides a high drive level to the YTM. Isolator (A1AT2) protects the amplifier from reflections from the YTM. The isolator's output goes to a 1.5 GHz High Pass Filter (A1FL1) and then to a Step Recovery Diode (SRD) multiplier. The diode is biased to provide maximum output power at frequencies in the selected harmonic band. The YIG Filter selects the correct harmonic and is tuned over the frequency range by a current ramp generated by the YTM Driver Assembly.

YTM Driver Assembly. This assembly converts the 2—6.2 GHz voltage ramp, YTM TUNE, into a 2—18 GHz current ramp. The main coil shaping circuit multiplies the YTM TUNE voltage by factors determined by the decoded band information (I1 I2, I3, G2, and G3). This results in a linear ramp voltage which U5, and associated transistors, convert into a current ramp to tune the YIG Filter. The YIG Filter is not perfectly linear, so the positive and negative current sources and the Band 3 breakpoint circuit generate compensating currents that are summed with the main current at the emitter of Q1 so the YTM will accurately track the YTO frequency.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1 and 5 was used to isolate a YTM problem to the circuits shown on this schematic.

SERVICE SHEET 15 (cont'd)

Test Equipment

Power Sensor .... HP 8481A
Power Meter .... HP 436A
Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Procedures

1. Connect the power meter to the YTM output. Tune the CW Generator frequency from 2 to 18.0 GHz in 100 MHz steps; the power should remain above +9 dBm over the entire range. If the power is correct the YTM and all driving circuits are working properly. At band edges, 6.2 GHz and 12.4 GHz, it is normal to have an abrupt change in power level; if a power change does not occur, the YTM may not be changing bands.

2. If the power is not correct, measure the output of the A1AT2 isolator. It should deliver about +20 dBm from 2 to 6.2 GHz. If the output power is not correct, measure the input power to the Amplifier assembly, which should be > +11 dBm. If the input is incorrect, go to Service Sheet 14.

3. Connect the voltmeter to the A1A8 SENSE test point. Set the CW Generator frequency to 2 GHz. The voltage should be about −1 Vdc.

4. Set the CW Generator frequency to 18 GHz. The voltage should be about −9.9 Vdc. (The change with frequency is about −0.55 V/GHz.)

5. If the output is significantly wrong, measure the tuning voltage at edge connector pin 6. That voltage should be −3.000 V/GHz from 2 to 6.199 GHz. If the tuning voltage is incorrect, go to Service Sheet 9 to check DAC operation or perform DAC Adjustment procedure.

6. If the output voltage is correct, but the YTM output is wrong, troubleshoot to isolate the malfunction between the YTM, Isolator or High Pass Filter.

7. If the input tuning voltage is correct, but the output voltage is wrong, perform the YTM and ALC adjustments. A malfunction on the YTM Driver will generally be seen as a failure to adjust correctly. Use the voltages on the schematic to locate the malfunction. Also use table of voltages on Service Sheet 16 to be sure all band related inputs to the YTM Driver are functioning correctly.

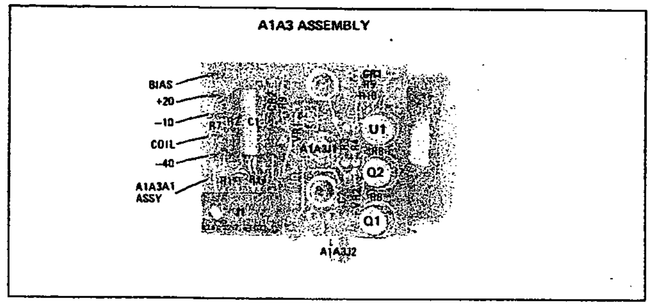


Figure 8-85. A1A3 YTM Assembly Component and Test Point Locations

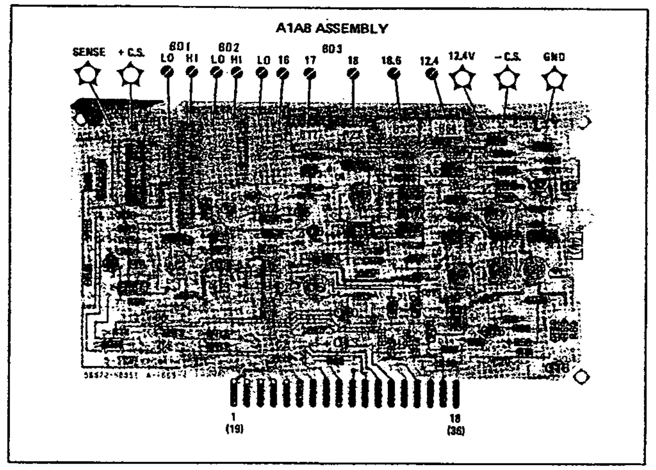
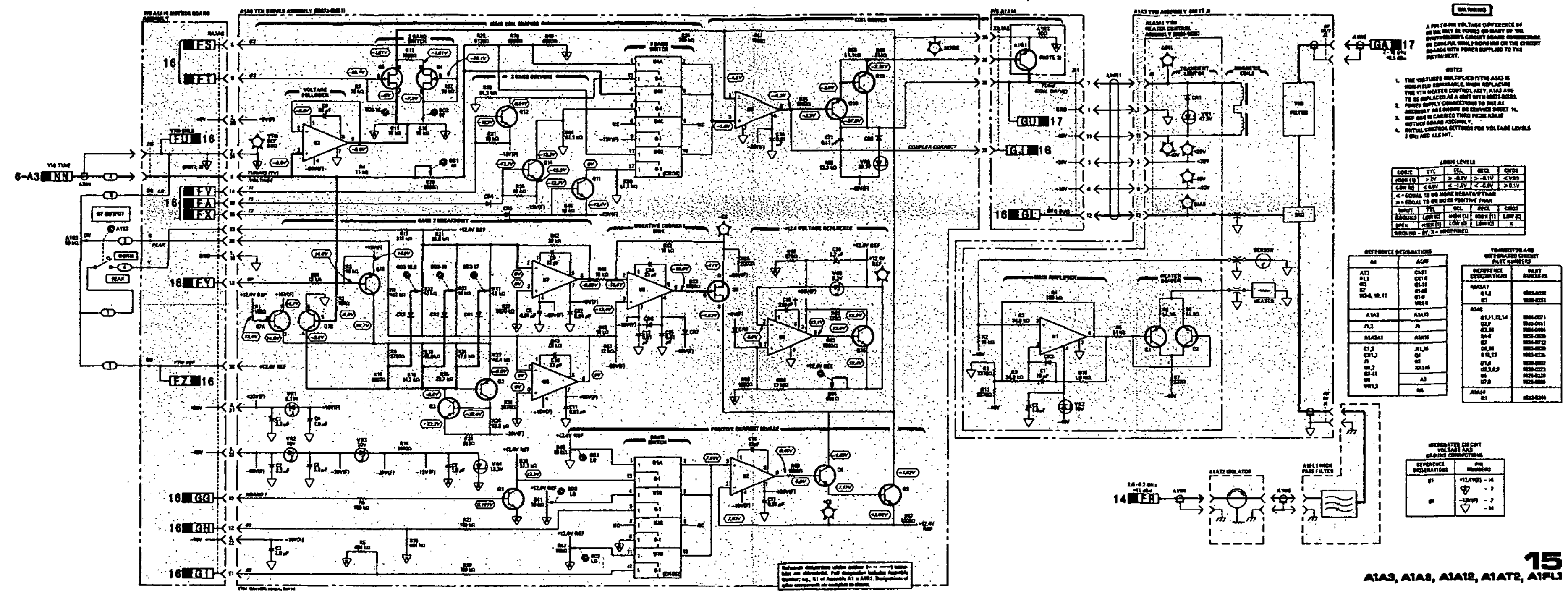


Figure 8-86. A1A8 YTM Driver Assembly Component, Adjustment, and Test Point Locations



15

A1A3, A1A8, A1A12, A1AT2, A1FL1

Figure 8-87. YTM Control Schematic Diagram

YTM Control
(A1A8, A1A3, A1AT2, A1FL1)
SERVICE SHEET 15

SERVICE SHEET 16

SRD CONTROL CIRCUITS

REFERENCES

Overall Block Diagram ..... Service Sheet BD1
Microwave Signal Path Block Diagram .... Service Sheet BD5
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YIG-Tuned Multiplier multiplies the YTO signal by 1, 2, or 3 to produce the desired output frequency.

This service sheet describes the SRD Bias Assembly which decodes band information and generates an F CORRECT voltage for the ALC circuitry.

SRD Bias Assembly

The coupler correct circuit converts the COUPLER CORRECT voltage, which is derived from the YTM tuning ramp, into a voltage ramp with the proper slope to correct for roll-off of the directional coupler. This ramp, F CORRECT, is then summed with the ERROR voltage in the ALC circuitry. The Band Decode and Logic Level Converters translate the band information, HN1 and HN2, to control signals for the YTM Driver Assembly.

The Bias Correct circuit generates a bias signal for the Step Recovery Diode (SRD) so that the SRD output power will be optimum in the band of the CW Generator's output frequency.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD5 was used to isolate an SRD bias problem to the circuits shown on this schematic.

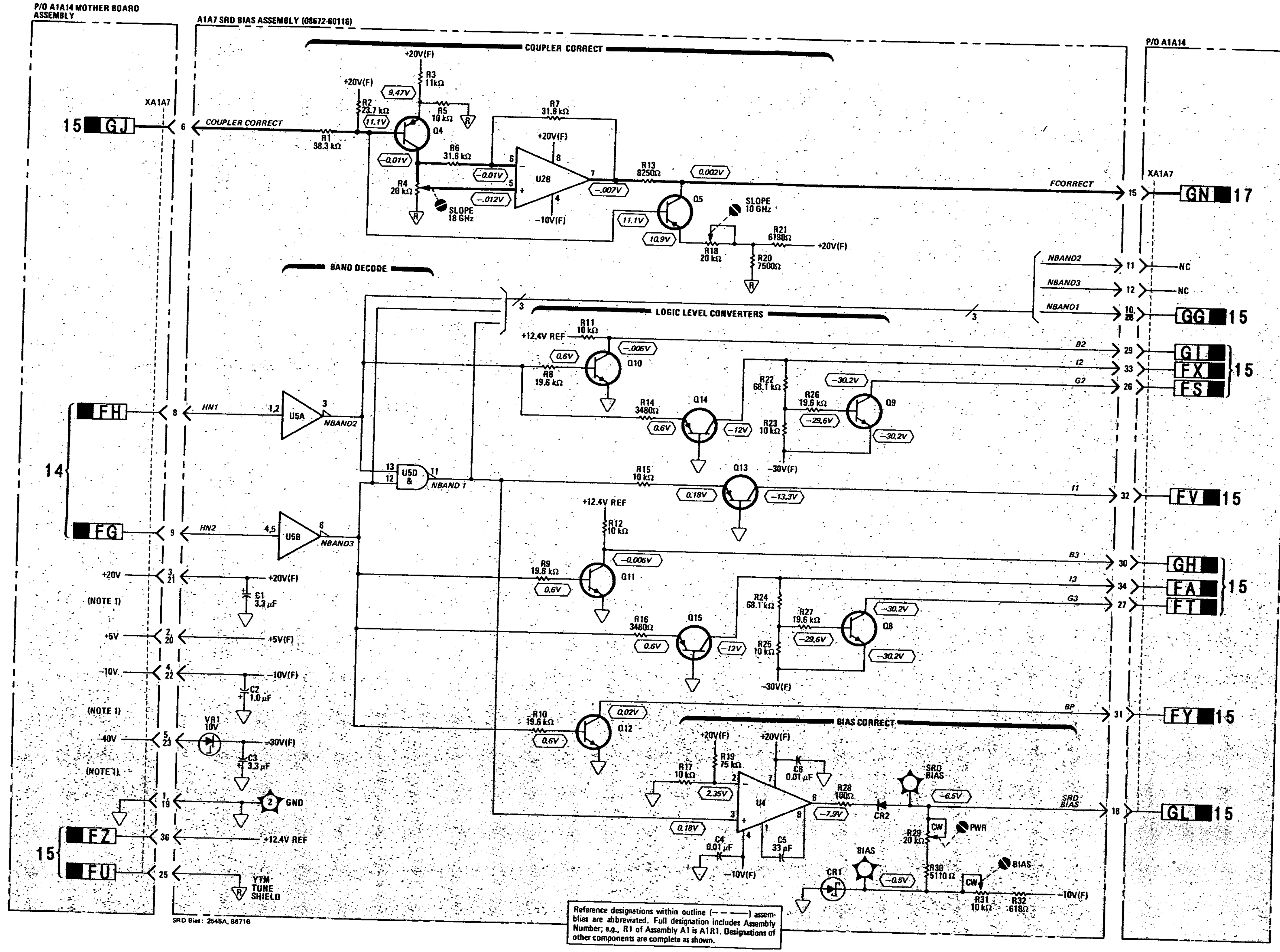
Test Equipment

Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Procedures

1. Use the following table to troubleshoot the various input and output signals of the SRD Bias assembly. The table shows the relationship between inputs HN1 and HN2 and the various outputs.

	BAND 1 (Vdc)	BAND 2 (Vdc)	BAND 3 (Vdc)
HN1	0.2	5	0.2
HN2	0.2	0.2	5
NBAND2	3.6	0.2	3.6
NBAND3	3.6	3.6	0.2
NBAND1	0.2	3.6	3.6
B2	0.01	12.1	0.01
I2	−12	−29.6	−12
G2	−29.7	−2.7 to −5.7	−29.7
I1	−13.2	−12.6	−12.6
B3	0.02	0.02	12
I3	−12	−12	−29.5
G3	−29.7	−29.7	−4.8 to −7.2
BP	0.04	0.04	14.7
SRD Bias	−6.4	+0.2 to −0.3	−0.2 to +1.0



NOTES:

1. POWER SUPPLY CONNECTIONS TO THE A1 ASSEMBLY ARE SHOWN ON SERVICE SHEET 14.
2. ALL VOLTAGES REFERENCED TO TEST POINT GND. INITIAL CONTROL SETTINGS FOR VOLTAGE LEVELS: 3 GHz, +3 dB VERNIER (FULLY CW).

REFERENCE DESIGNATIONS

A1A7	A1A14
C1-6 CR1,2 Q4,5,8-15 R1-32 U2,4,5 VR1	XA1A7

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH(1)	> 2V	> −0.5V	> −0.1V	< VDD
LOW(0)	< 0.8V	< −1.5V	< −0.6V	> 0.1V
< = EQUAL TO OR MORE NEGATIVE THAN > = EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND – 0V; X = UNDEFINED				

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q4,5,13-15	1853-0020
Q8-12	1854-0071
U2	1826-0092
U4	1820-0223
U5	1820-0681

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U5	+5V(F) – 14 ▽ – 7

16
A1A7

Figure 8-89. 16 SRD Bias Assembly Schematic Diagram

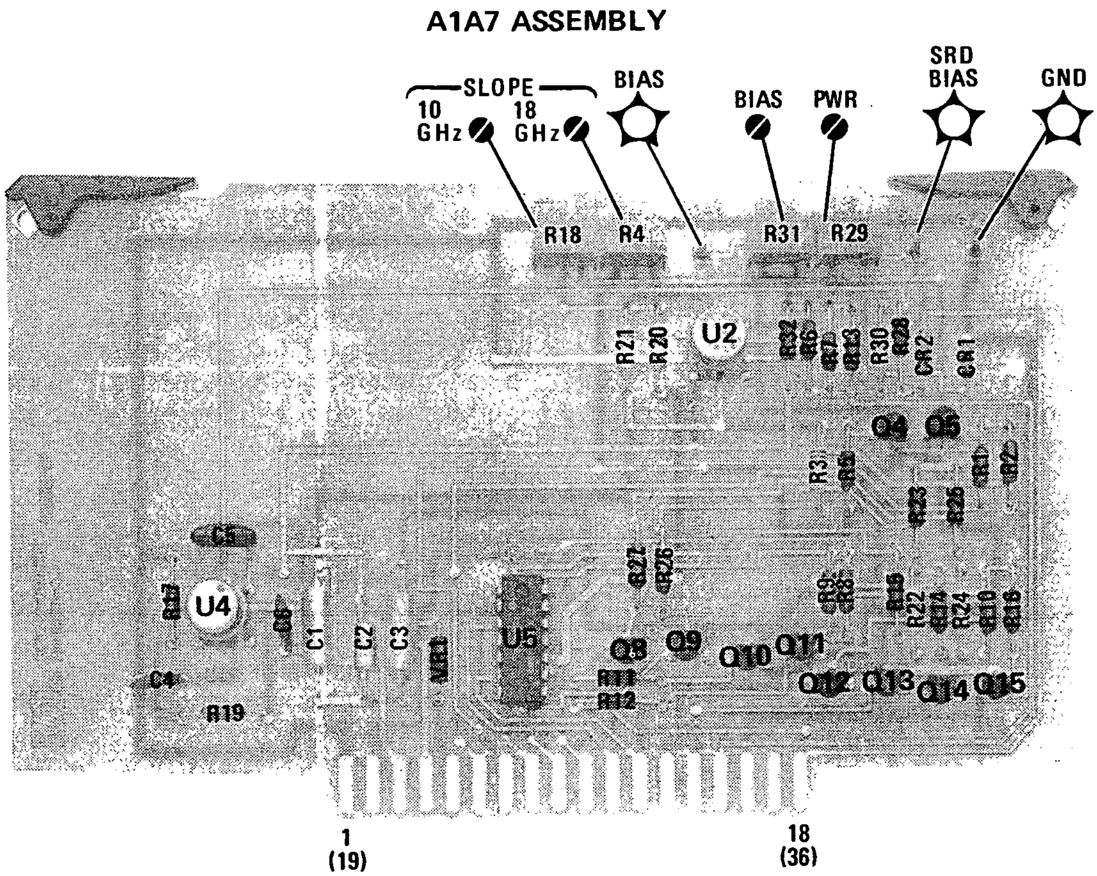


Figure 8-88. A1A7 SRD Bias Assembly Component Locations

SERVICE SHEET 17 (cont'd)
ALC Detector Assembly (cont'd)

The Ext ALC Amplifier allows the external ALC circuits to be calibrated for use with an external detector. U5 acts as an absolute value converter so that positive or negative detectors can be used.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD5 or 6 was used to isolate an ALC Detector problem to the circuits shown on this schematic.

Test Equipment

Power Sensor	HP 8481A
Power Meter	HP 436A
Digital Voltmeter	HP 3456A
Power Supply	HP 6200B

Procedure

1. Make sure the green output cable from A1CR1 is securely attached. If it is loose, there may be leveling problems at low vernier settings.

2. Set the ALC switch to INT and the RF switch to ON. Disconnect the Leveling Detector (A1CR1) from the Directional Coupler (A1DC1). Measure the power at the coupled arm of A1DC1. It should be >−3.5 dBm from 2 to 18 GHz. If sufficient power is not available, perform the YTM and ALC adjustments in Section V.

3. With the detector still disconnected, measure the voltage at A1A6TP3. With no leveling input, the voltage should be about −0.6 Vdc. Change the OUTPUT RANGE switch to +10 dB. The voltage at TP3 should not change significantly. If these voltages are not correct, troubleshoot the internal ALC Log Amplifier log network and buffer amplifier using voltages on the schematic.

4. Set ALC switch to XTAL. Make sure nothing is connected to the ALC input. The voltage should not change much. Switch to PWR MTR; the voltage should not change. If the voltages are incorrect in external leveling, troubleshoot the external ALC Amplifier and Log Amplifier.

5. Connect a low voltage power supply to the EXT ALC INPUT connector. Slowly increase the power supply output from zero to 1 Vdc. The signal at A1A6TP3 should increase smoothly from about −0.4 Vdc to +0.13 Vdc. If the voltage swing is correct, the external ALC amplifiers and the output buffer amplifier are working properly. To isolate buffer amplifier problems, the signal at TP4 should vary from about −0.08 Vdc to +0.04 Vdc.

6. Set the ALC switch to INT and reconnect the leveling detector. The voltage at TP3 should be about 0.17 Vdc and vary as the VERNIER is varied from about −0.21 Vdc to +0.17 Vdc. If the voltage is present but does not vary, go to Service Sheet 18 to continue troubleshooting.

SERVICE SHEET 17

ALC DETECTOR ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
Microwave Signal Path Block Diagram	Service Sheet BD5
Automatic Level Control (ALC) Block Diagram	Service Sheet BD6
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YTO signal is amplified, leveled and applied to a 10 dB step attenuator for final level selection. This service sheet describes the Directional Coupler in the RF path and the Leveling Detector and ALC Detector Assembly which are part of the ALC circuitry.

RF Path

Directional Coupler A1DC1 samples the RF output power and applies it to the Leveling Detector A1CR1. The sampled signal level is low enough that the detector operates in its square law region. As a result, the detected voltage linearly represents the RF power in watts. A logarithmic amplifier in the ALC Detector Assembly is used to obtain a voltage that is linearly proportional to the RF power in dB.

The output level of the directional coupler rolls off with increasing frequency. The detector does not indicate this change in output level with frequency. Therefore, an F CORRECT voltage is applied to the ALC circuitry (see Service Sheet 16) to provide a constant output level.

ALC Detector Assembly

The Int ALC Log Amplifier converts the output of the Leveling Detector into a dc voltage that is proportional to the RF output in dB. This allows linear voltage control of the output level and for the output level meter scale to read linearly in dB. U6 sums the REF VOLTAGE from the RF Output Level Control Assembly with the logged detector voltage. The resulting ERROR voltage is summed with the AM signal in the ALC Assembly and applied to the PIN modulator.

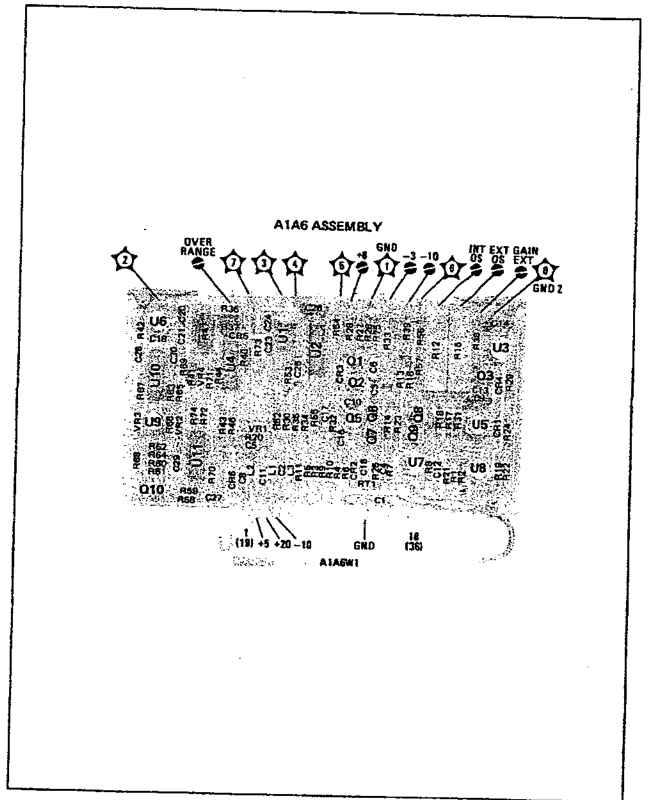


Figure 8-90. A1A6 ALC Detector Assembly Component, Adjustment and Test Point Locations

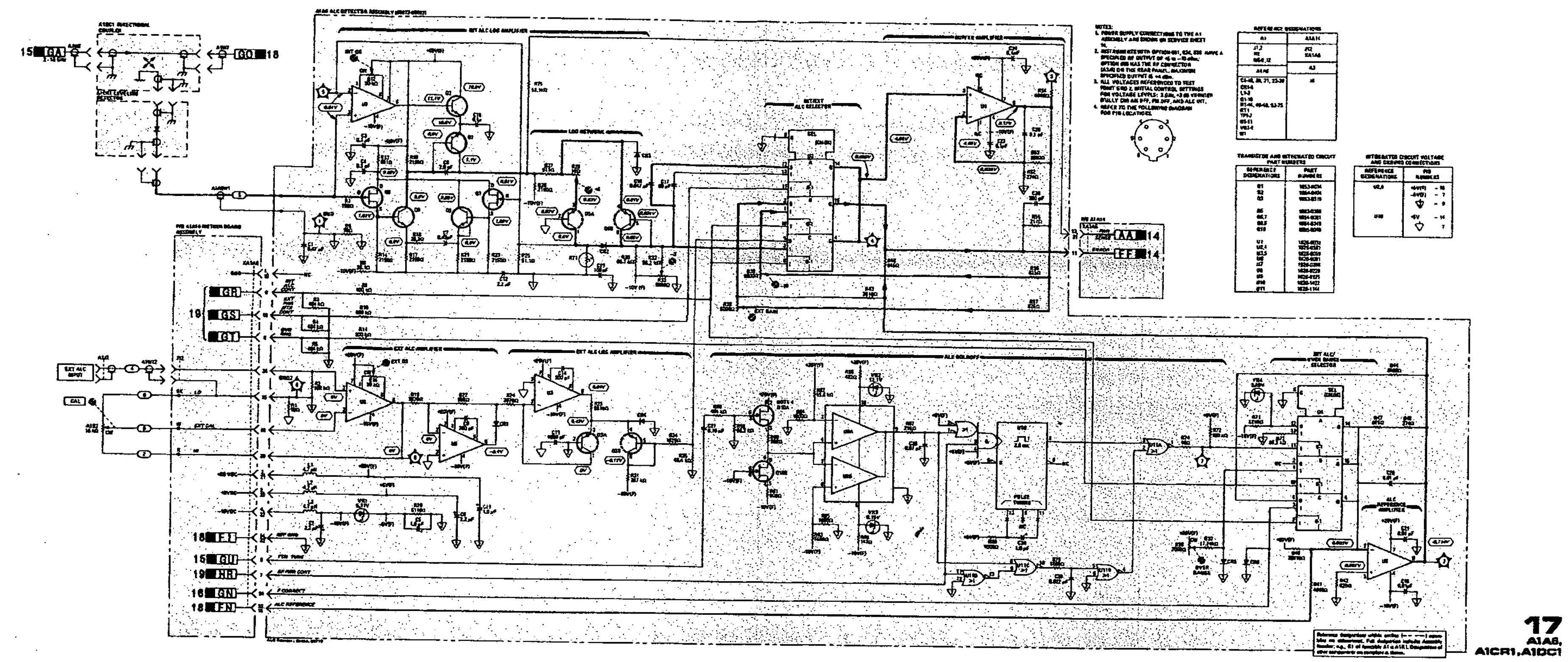


Figure 8-91. ALC Detector Assembly Schematic Diagram

SERVICE SHEET 18

RF OUTPUT LEVEL CONTROL ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
Microwave Signal Path Block Diagram	Service Sheet BD5
Automatic Level Control (ALC) Block Diagram	Service Sheet BD6
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

As shown on Service Sheet BD5 the RF Output Assembly multiplies the YTO signal by 1, 2 or 3 to produce the desired frequency. Also the signal is amplified, leveled and applied to a 10 dB step attenuator for final level selection.

This service sheet describes the Programmable Attenuator in the RF path and the Level Control Assembly, which controls the ALC Loop and the Programmable Attenuator (A1AT1).

RF Path

The programmable attenuator provides 0 to 110 dB of attenuation in 10 dB steps. From the attenuator the RF is applied to the front panel RF OUTPUT connector.

Level Control Assembly

This assembly controls the 10 dB step attenuator, and converts the 1 dB remote level data or the OUTPUT LEVEL VERNIER position into the REF VOLTAGE for the ALC.

The Encode Logic, Signal Buffers, and Solenoid Drivers condition the ATTEN 10 to 80 CONT signals so they can drive the programmable attenuator. In Remote, the D/A converter translates the 1 dB steps coded on the ALC 1 to 8 CONT lines into an analog reference voltage for the ALC Loop. In local, U7 acts as a follower for the voltage from the wiper of the OUTPUT LEVEL VERNIER control.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD5 or 6 was used to isolate a level control problem to the circuits shown on this schematic.

SERVICE SHEET 18 (cont'd)

Test Equipment

Power Sensor .... HP 8481A
Power Meter .... HP 436A
Digital Voltmeter .... HP 3456A
Controller .... HP 85B or HP 9826/36A

If the malfunction involves the VERNIER or 1 dB steps, start at step 1. If the problem involves 10 dB steps, start at step 4.

Procedure

1. Connect the voltmeter to DAC test point. Set the ALC switch to INT; make sure the instrument is not in REMOTE. Set the VERNIER fully counterclockwise. The voltmeter should indicate about −6.5 Vdc. Turn the VERNIER control clockwise while observing the voltage. The amplitude should drop at 0.5 V/dB and should be about 0.0 Vdc when the VERNIER is fully clockwise. If the voltages are correct, the local reference voltage circuitry is working properly. Skip to step 3 to check remote reference voltages. If the voltages are incorrect, continue with this procedure.

2. Measure voltages at −6.2 Vdc test point and +6.2 Vdc test point. If the negative voltage is incorrect, the local reference voltage will be incorrect. If the positive voltage is incorrect, the remote reference voltage will be incorrect. If both voltages are correct, troubleshoot U7 and Q10-Q15.

3. Execute the following program to check the remote reference voltage at the DAC test point. Observe voltmeter while running the program.

```
10 REMOTE 719
20 FOR V=61 TO 48 STEP−1
30 OUTPUT 719; "L" & CHR$(V)
40 DISP −(V−48)/2 "VDC"
50 WAIT 2! USE 2000 for HP 85B
60 NEXT V
70 END
```

If the voltages are not correct, troubleshoot the +V Reference and the D/A Converter.

4. Set OUTPUT LEVEL RANGE switch to 0 dB and connect a spectrum analyzer or the power meter to RF OUTPUT connector. Set VERNIER fully clockwise and RF switch ON. The power meter should indicate about +3 dBm.

5. Switch the RANGE switch to −10 dBm. The power meter should indicate −7 dBm.

6. Continue lowering the output range to the limit of the spectrum analyzer or power meter. If the power drops in 10 dB steps each time, the A1A10 board and the output attenuator are working properly. If the results are incorrect, continue with this procedure.

7. Locate the test points labeled 10, 20, 40, and 80 on A1A10. The signals here are TTL levels. Check them according to the truth table.

Range	Test Points			
	10	20	40	80
0 dB	L	L	L	L
−10	H	L	L	L
−20	L	H	L	L
−30	H	H	L	L
−40	L	L	H	L
−50	H	L	H	L
−60	L	H	H	L
−70	H	H	H	L
−80	L	L	H	H
−90	H	L	H	H
−100	L	H	H	H
−110	H	H	H	H

Note that the test point labeled "80" actually controls a second 40 dB attenuator section which is used only at power levels −80 dBm and below.

If the test points do not agree with the truth table, check U6 and if it is working properly, go to Service Sheet 19 to continue troubleshooting. Otherwise troubleshoot the appropriate solenoid driver.

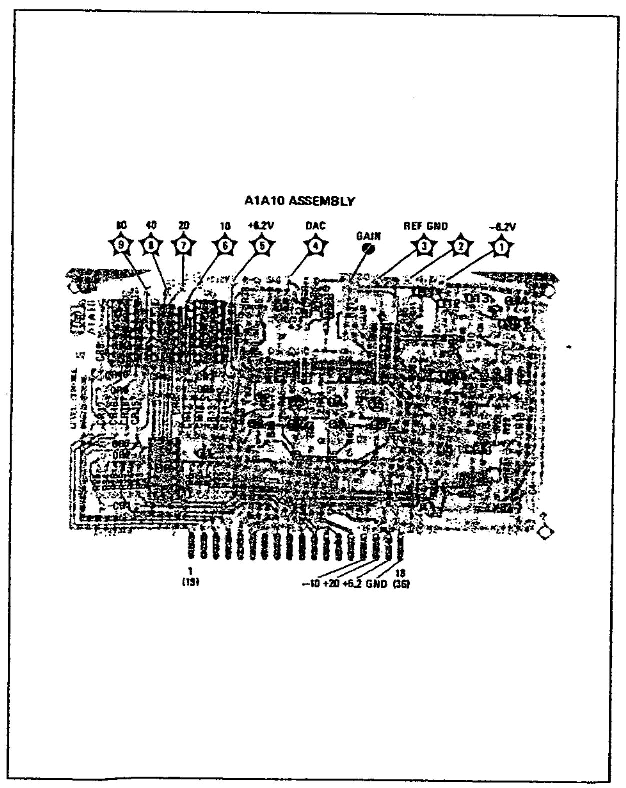


Figure 8-92. A1A10 RF Output Level Control Component Locations

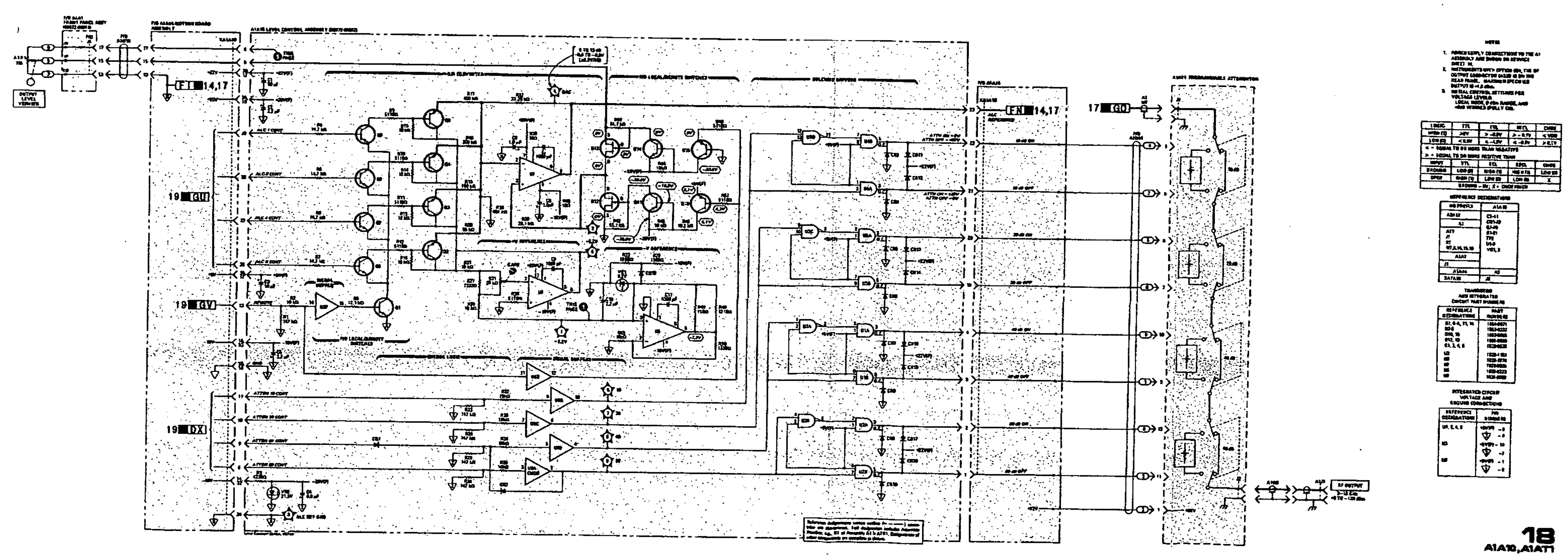


Figure 8-93. RF Output Level Control Schematic Diagram

SERVICE SHEET 19

DIGITAL PROCESSOR ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
Remote/Local Interface Block Diagram ...... Service Sheet BD7
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YTM (YIG-Tuned Multiplier) multiplies the YTO signal by 1, 2, or 3 to produce the desired frequency. Also the RF signal is amplified, leveled and applied to a 10 dB step attenuator for final level selection.

This service sheet describes the Digital Processor Assembly which selects between remote and local configuration information and converts the information into a form useable by the level control circuits and the front panel.

Digital Processor Assembly

The Local/Remote selectors have feedback resistors between the outputs and remote inputs so they will act as latches when first switched from local to remote. This ensures that the instrument's functions assume known configurations after the local to remote transition.

The Range Encoder converts the RANGE switch position into a binary coded decimal value. Priority encoder U7 acts as an octal to binary converter.

Display Decoder, U8, is a ROM with a table that converts the BCD range value into sign and value information for the front panel display.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD 1 and 7 was used to isolate a digital processor problem to the circuits shown on this schematic.

Test Equipment

Digital Voltmeter .... HP 3456A
Controller .... HP 85B, 9826A or 9836A

SERVICE SHEET 19 (cont'd)

Procedure

1. Make sure the CW Generator is in local mode at 3 GHz.

2. Rotate the RANGE switch from fully clockwise to fully counterclockwise. The RANGE dB display should indicate from +10 to −110 in 10 dB steps. If operation is incorrect, measure OVRRNG, LED 10, LED 20, LED 40, LED 80, LED 100, HB and VB plus ATN 10-80 lines to isolate the malfunction. The lines labeled HB and VB control the horizontal and vertical bars of the + and − signs.

3. Switch ALC control through its range and observe the annunciators. The annunciators should correspond to the switch positions and the LVL UNCAL annunciator should come on in the XTAL and PWR MTR positions.

4. Switch RF switch OFF. The RF annunciator should correspond, the LVL UNCAL and NOT PHASE LOCKED annunciators should come on. If everything is correct so far, the local portions of A1A11 are working properly.

5. The remaining steps in this procedure require an HP-IB controller. Program "KØ", "K1", "K2", "K3", "K4", "K5", "K6", "K7", "K8", "K9", "K:", "K;", "K>", and "K=". The RANGE dB display should go from 0 dB to −130 dB. In the −120 and −130 dB positions, the LVL UNCAL annunciator should light. If the results are incorrect, measure REM ATTN 10-80 inputs to A1A11 to isolate the malfunction.

6. Program the remote vernier through its range with "LØ" through "L=". The meter should move in 1 dB steps from +3 to −10 dBm. If the results are incorrect, measure REM ALC 1-8 lines to A1A11 to isolate the malfunction.

7. Program "KØO3". The output level range should be +10 dB and the OVERRANGE annunciator should be on. (The LVL UNCAL indicator may also be on.)

8. Program "OØ". The RF should be OFF and the range should be 0 dB. The LVL UNCAL and NOT PHASE LOCKED annunciators should be on.

9. Program "O5". The instrument should indicate external XTAL leveling and LVL UNCAL should be on.

10. Program "O=". The instrument should indicate external MTR leveling and LVL UNCAL should be on.

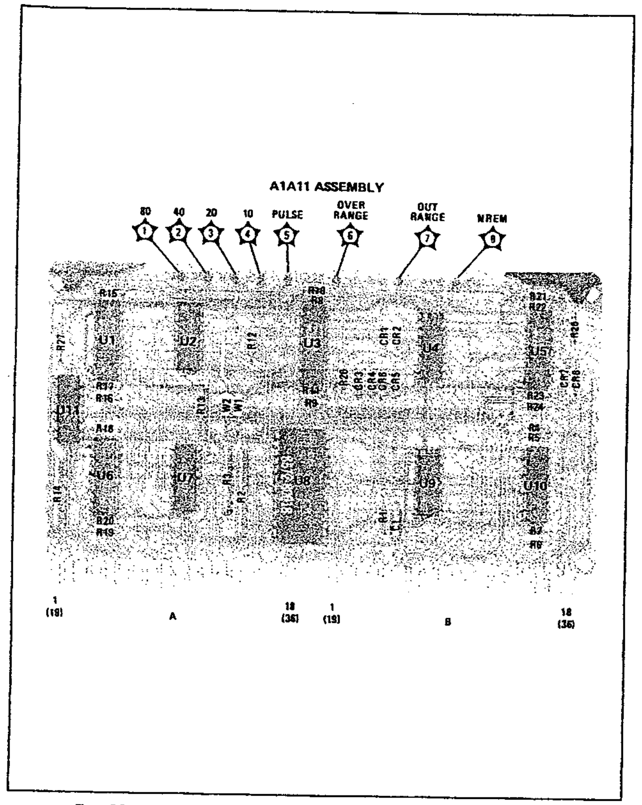


Figure 8-94. A1A11 Digital Processor Assembly Component, Adjustment and Test Point Locations

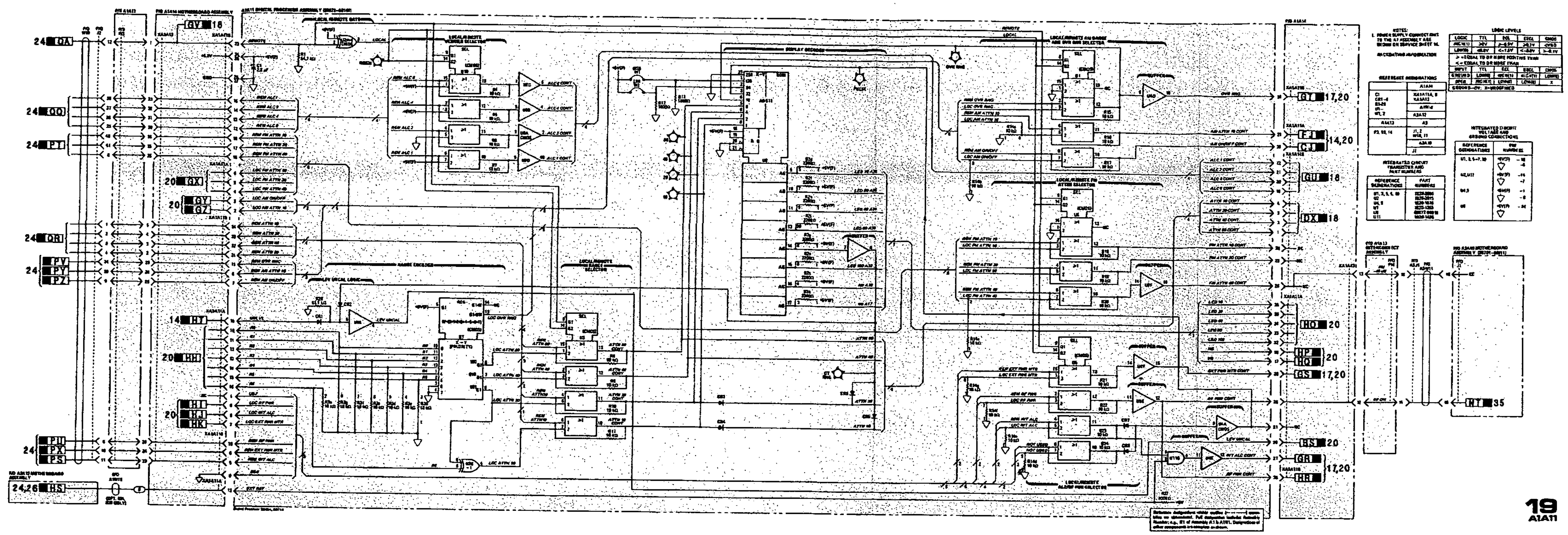


Figure 8-95. Digital Processor Schematic Diagram

SERVICE SHEET 20

RF FRONT PANEL CONTROLS AND DISPLAYS

REFERENCES

Overall Block Diagram ..... Service Sheet BD1
Remote/Local Interface Block Diagram .... Service Sheet BD7
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The RF Output Assembly multiplies the YTO signal by 1, 2 or 3 to produce the desired frequency. Also the signal is amplified, leveled, and applied to a 10 dB step attenuator for final level selection.

This service sheet describes the RF Front Panel assembly.

Front Panel Assembly

The front panel assembly has two major functions. It buffers status information and drives display lamps, and it applies switch position information to the Digital Processor.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and 7 was used to isolate a front panel problem to the circuits shown on this schematic.

Test Equipment

Digital Voltmeter .... HP 3456A

Procedure

1. Rotate the OUTPUT RANGE switch from fully clockwise to fully counterclockwise. The RANGE dB display should indicate from +10 dB to −110 dB in 10 dB steps. (The last digit should always be zero). If incorrect, go to service sheet 19 unless the problem is in the last digit (in which case the problem must be on A1A1).

2. Switch RF off. The RF OFF and LVL UNCAL annunciators should light.

3. Switch ALC switch through its range to check the annunciators.

4. Set RF switch on, VERNIER clockwise and RANGE to 0 dB. The meter should be at full scale.

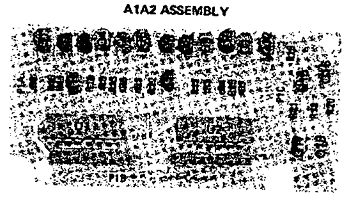


Figure 8-66. A1A2 Display Driver Assembly Component Locations

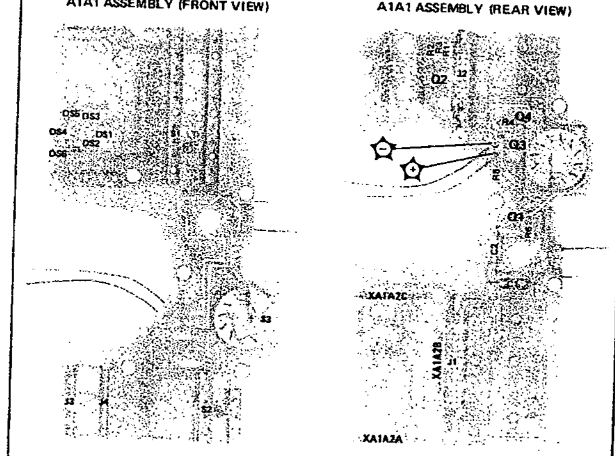


Figure 8-67. A1A1 RF Output Front Panel Assembly Component Locations

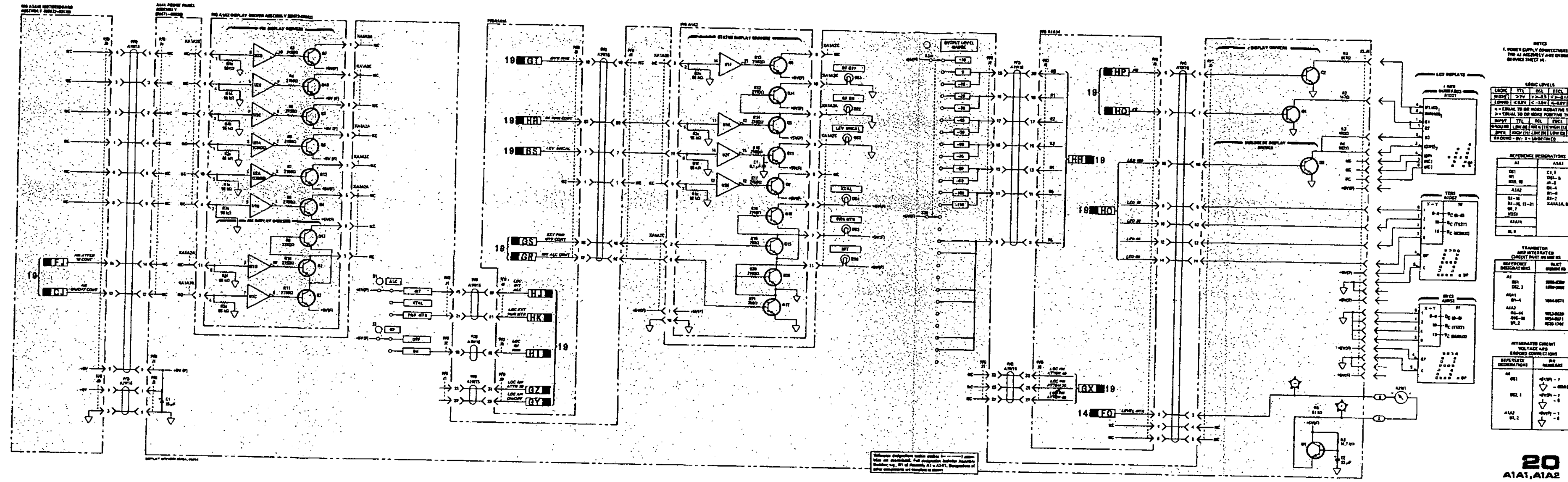
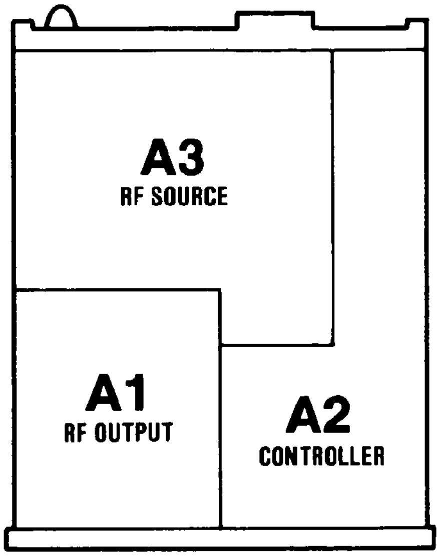


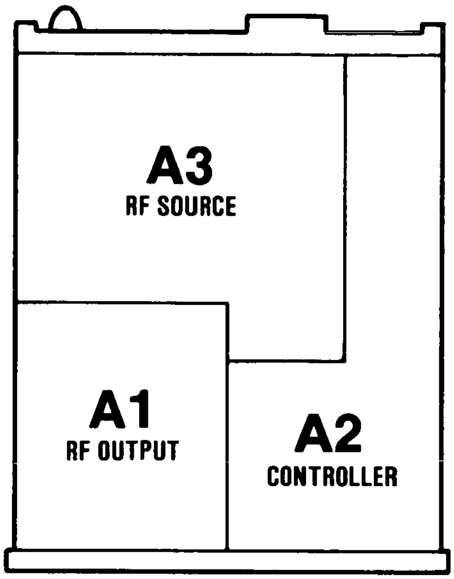
Figure 8-68. RF Front Panel Controls and Displays Schematic Diagram



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35

SERVICE SHEET 22

P/O HP-IB ADDRESS ASSEMBLY

REFERENCES

Overall Block Diagram ..... Service Sheet BD1
DCU HP-IB Interface
Block Diagram .... Service Sheet BD8
HP-IB Address Assembly
Schematic Diagram .... Service Sheet 22
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety
Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The HP-IB Interface converts ASCII characters on the HP-IB data lines into RF Output Assembly program information and output frequency data for the DCU Frequency Control circuitry. Status information concerning instrument operation is converted into the status byte which is sent on the eight HP-IB data lines. The DCU Remote Interface consists of the HP-IB Address (A2A9) and HP-IB Interface (A2A7) assemblies.

The HP-IB Address assembly (A2A9) receives a character from the HP-IB data lines under the control of the 3 handshake lines. The 5 HP-IB control lines are then decoded to determine whether the character is an address, a command or a data character. If the character is an address and the address matches the talk or listen switch setting (see address selection in Section II), the CW Generator will output the status byte (talk address) or will switch to listen mode in preparation for receiving data characters. If the character received is a command, the CW Generator will respond to the command if the capability exists (see Table 3-5 for a listing of commands that can be executed by the CW Generator). If the character is data and the CW Generator is in listen mode, the data is passed to the HP-IB Interface assembly for decoding.

The HP-IB Interface assembly (A2A7) determines whether a data character is a program code or an argument. If the character is a program code, the program code is used to select where the argument will be sent (its internal address). If the data character is an argument, it is sent to the current internal address for storage. If the last data character received was also an argument, the current data character will be sent to the next sequential internal address.

HP-IB Address Assembly

Remote Bus Transceivers. The Remote Bus Transceivers enable the CW Generator to send and receive data over the same data lines. In addition, the logic levels of the data bus are inverted for use by the CW Generator as high true logic and the data lines are buffered to avoid loading of the data bus by the CW Generator's internal circuitry.

Data received is routed to the address decoding circuits, command decoders, RF program selectors, and the interface storage register. The control signals are routed to the talk and listen handshake circuits, the command decoders, the address decoding circuits and the status and parallel poll circuit.

Acceptor Handshake. The acceptor handshake is enabled when the CW Generator is in the listen mode. The sequence is begun with the Not Ready For Data (NRFD) being allowed to go high by the CW Generator. This indicates to the controller that the CW Generator is now ready to receive the next character. The controller then indicates that the data character is available by setting the DAta Valid (DAV) line low.

Nand gate U13B provides a 2.5 μs delay before triggering one-shot U20B. U20B supplies a STOR pulse which clocks the serial poll flip-flop on the leading edge, enables the NRSTOR gate (U9B) while high, and clocks the TALK, LISTEN and REMOTE flip-flops.

The trailing edge of NSTOR clocks U5B, which was reset at the same time U20B was triggered. This sets NDONE to a low state after another 2.5 μs delay. The DONE flip-flop is set again after another delay introduced by R11 and C7. This chain of events acts to produce a low NDONE pulse at about 10 μs after the remote data is ready to signify to the controller that the CW Generator is done with the data.

Service Sheet 21
Not Used

SERVICE SHEET 22 (cont'd)

HP-IB Address Assembly (cont'd)

The NRDY signal is set to a high state whenever an acceptor handshake is in progress or the DCU is busy with a frequency change.

Source Handshake. The source handshake is initiated when the CW Generator is in talk mode and the ATN bus control line is set true. The listener sets the Not Ready For Data (NRFD) line false to indicate that it is ready for the CW Generator to place the data on the HP-IB data lines. U20A is triggered to produce a 2 μs wide System Delay State (SDYS) pulse to latch the current instrument status and sets the data valid line (DAV) on the falling edge of the system delay state. When the not data accepted (NDAC) is set true by the listener, U5A is reset and the source handshake is ready to send another character.

Talk, Listen and Remote Decoding. The talk and listen decoding is done using three BCD decoders. The three least significant digits of the HP-IB input data lines are routed to U2 to be decoded. The BCD8 digit is the attention (NATTN) line which is used as the enable for the decoder. When the attention line is set true, one of the 0 to 7 decoded lines is selected by the three HP-IB data lines. Switch S2 selects which of the seven outputs is to be used as part of the instrument address. Switch U3 is used to decode the remainder of the listen address (DI7=0) and U4 is used to decode the remainder of the talk address (DI7=1).

The address decoders are also used to decode the HP-IB bus commands and the additional decoded lines are sent to the bus command decoder. The decoded lines selected by switch S1 and S2 are sent to the Address Decode circuit to produce the talk address (MTA) and the listen address (MLA). Note that the CW Generator is switched out of the listen mode if the talk address is received and out of the talk mode if the listen address is received.

The store (STOR) pulse generated by the Acceptor Handshake is used to clock the remote, talk and listen flip-flops to set the CW Generator to the addressed mode.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet BD1 and BD8 was used to isolate the problem to the HP-IB Address assembly or there is a problem involving the processing of an HP-IB bus command. The following troubleshooting procedure will aid in isolating the defective component.

Test Equipment Required

Digital Voltmeter	HP 3456A
Oscilloscope	HP 1980B
Controller	HP 85B, 9826A or 9836A

1. Verify that the CW Generator address is set to 23 octal. See Section II for information on how to check the address setting.

2. Set the CW Generator to the following:

RF OUTPUT	Off
RANGE Control	Fully counter-clockwise
VERNIER	Fully counter clockwise
ALC	set to XTAL
Frequency	3000.000 MHz

3. With the controller, send "P12345678Z1K0072." This will program the CW Generator to 12345.678 MHz, ALC to INT, RF on and output level to 0 dBm. If the CW Generator accepts the data string and the front panel shows the correct settings, most of the remote circuits are working properly. If the CW Generator does not respond, proceed with step 4. Otherwise, proceed with the checks on Service Sheet 23.

4. Place the A2A9 assembly on an extender board. Set the CW Generator to remote with the command 'REMOTE 719' executed on the controller. Measure XA2A9C-24, REMOTE, and verify that it is a CMOS high. If the signal is not correct, troubleshoot the remote flip-flop (U17B) and the Address Select Circuit.

5. Connect the voltmeter to XA2A9-25, ATTN, and verify that the signal is high during the command mode and low during the data mode. If the signal is not correct, troubleshoot the remote flip-flop (U17B) or the acceptor handshake. If signal is correct, continue with step 6.

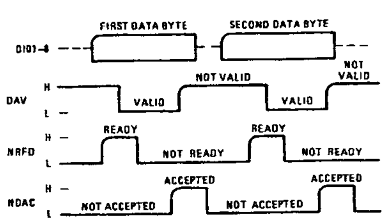
6. Monitor the handshake operation with an oscilloscope or Bus Analyzer. The handshake should proceed approximately as shown below. The pulse widths are not shown to

SERVICE SHEET 22 (cont'd)

Test Equipment Required (cont'd)

scale but the rise-fall relationships should be as shown. If the handshake is working correctly, proceed with step 7. Otherwise, troubleshoot the acceptor handshake circuit.

7. Check the DI1 through DI7 data lines to ensure that the data is the same as the data on the HP-IB bus. If the data is correct but the CW Generator does not respond, troubleshoot A2A7 HP-IB Interface Assembly. Otherwise check the Remote Bus Transceivers and the HP-IB bus itself.



HP-IB Handshake

Figure 8-99. HP-IB Handshake Waveforms

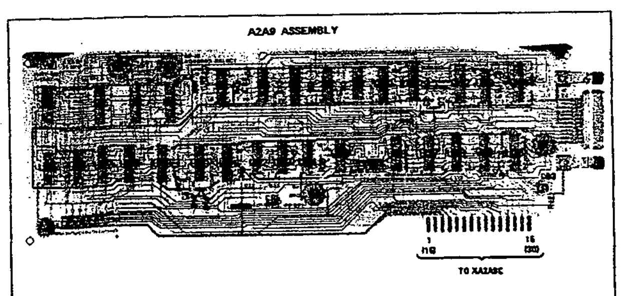


Figure 8-100. A2A9 HP-IB Address Assembly Component Location

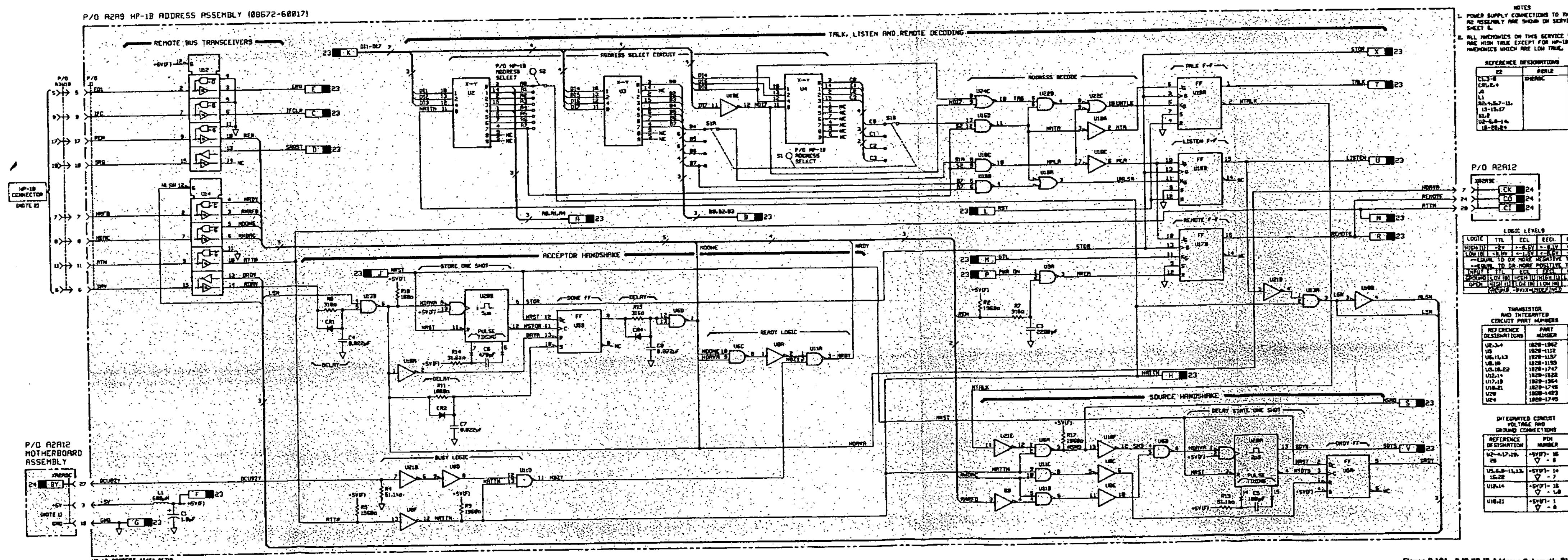


Figure 8-101. P/O HP-IB Address Schematic Diagram

SERVICE SHEET 23

P/O HP-IB ADDRESS ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
DCU HP-IB Block Diagram .... Service Sheet BD8
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB).................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The HP-IB Interface converts ASCII characters on the HP-IB data lines into RF Output Assembly program information and output frequency data for the DCU Frequency Control circuitry. Status information concerning instrument operation is converted into the status byte which is sent on the eight HP-IB data lines. The DCU Remote Interface consists of the HP-IB Address (A2A9) and HP-IB Interface (A2A7) assemblies.

The HP-IB Address assembly (A2A9) receives a character from the HP-IB data lines under the control of the 3 handshake lines. The 5 HP-IB control lines are then decoded to determine whether the character is an address, a command or a data character. If the character is an address and the address matches the talk or listen address switch setting (see address selection in Section II), the CW Generator will output the status byte (talk address) or will switch to listen mode in preparation for receiving data characters. If the character received is a command, the CW Generator will respond to the command if the capability exists (see Table 3-5 for a listing of commands that can be executed by the CW Generator). If the character is data and the CW Generator is in listen mode, the data is passed to the HP-IB Interface assembly for decoding.

The HP-IB Interface assembly (A2A7) determines whether a data character is a program code or an argument. If the character is a program code, the program code is used to select where the argument will be sent (its internal address). If the data character is an argument, it is sent to the current internal address for storage. If the last data character received was also an argument, the current data character will be sent to the next sequential internal address.

HP-IB Address Assembly.

Remote Bus Transceivers. The Remote Bus Transceivers enable the CW Generator to send and receive data over the same data

SERVICE SHEET 23 (cont'd)

lines. In addition, the logic levels of the data bus are inverted for use by the CW Generator as high true logic and the data lines are buffered to avoid loading of the data bus by the CW Generator's internal circuitry.

Data received is routed to the address decoding circuits, command decoders, RF program selectors, and the interface storage register. The control signals are routed to the talk and listen handshake circuits, the command decoders, the address decoding circuits and the status and parallel poll circuit. The status byte is sent when the CW Generator is addressed to talk and when the serial poll command is received.

Bus Command Decoder. The bus command decoder combines signals from the address select circuit and the HP-IB control lines to produce the signals required by the instrument to respond to various HP-IB bus commands. The go to local (GTL), direct clear (DC), serial and parallel poll (SPMS and PPOLL) commands are decoded and routed to the appropriate circuit. A reset signal is also decoded for a power up sequence or interface clear command.

The not remote store (NRSTOR) signal is used to tell the HP-IB Interface assembly that the data on the DI1-DI7 data lines is a program code or argument. This enables the HP-IB Interface to decode the program code or to route the data to the appropriate place in the instrument.

Status Encoder and Parallel Poll. The serial poll is used to send the status byte to the device requesting the serial poll. The SRQ encode circuit combines all of the status bits into a single signal which can be used to detect an error in instrument operation.

The parallel poll circuit places the SRQ bit onto one of the eight HP-IB data lines. The parallel poll is used by a controller to poll several instruments at the same time by setting each instrument's parallel poll response to a unique data line. An alternative to this approach when there are a large number of instruments involved is to set groups of instruments to each data line and then perform serial polls on each instrument once the group is determined from the parallel poll.

Output Data Latches. The individual bits of the status byte are latched when the serial poll is executed and when the source handshake is executed. The only data the CW Generator can send via the HP-IB data bus is the status byte and the parallel poll response bit.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet BD1 and BD8 was used to isolate the problem to the HP-IB Address assembly or there is a problem involving the processing of an HP-IB bus command. The following troubleshooting procedure will aid in isolating the defective component.

Test Equipment Required

Digital Voltmeter	HP 3456A
Oscilloscope	HP 1980B
Controller	HP 85B, 9826A or 9836A

1. Verify that the CW Generator address is set to 23 octal. See Section II for information on how to check the address setting.

2. Perform the HP-IB Operator's Checks in Section III. If any problems are noted, troubleshoot the associated circuitry. If the CW Generator does not respond at all to remote programming, perform the troubleshooting procedures on Service Sheet 22.

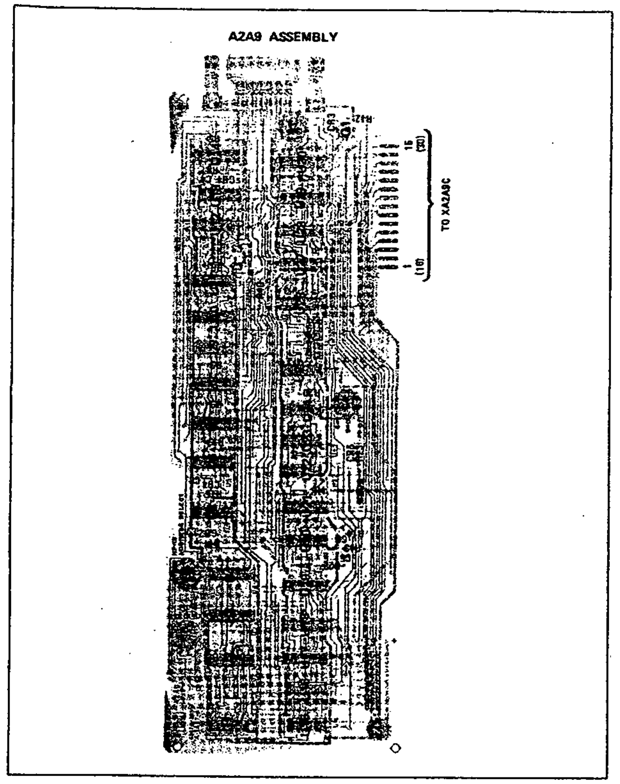
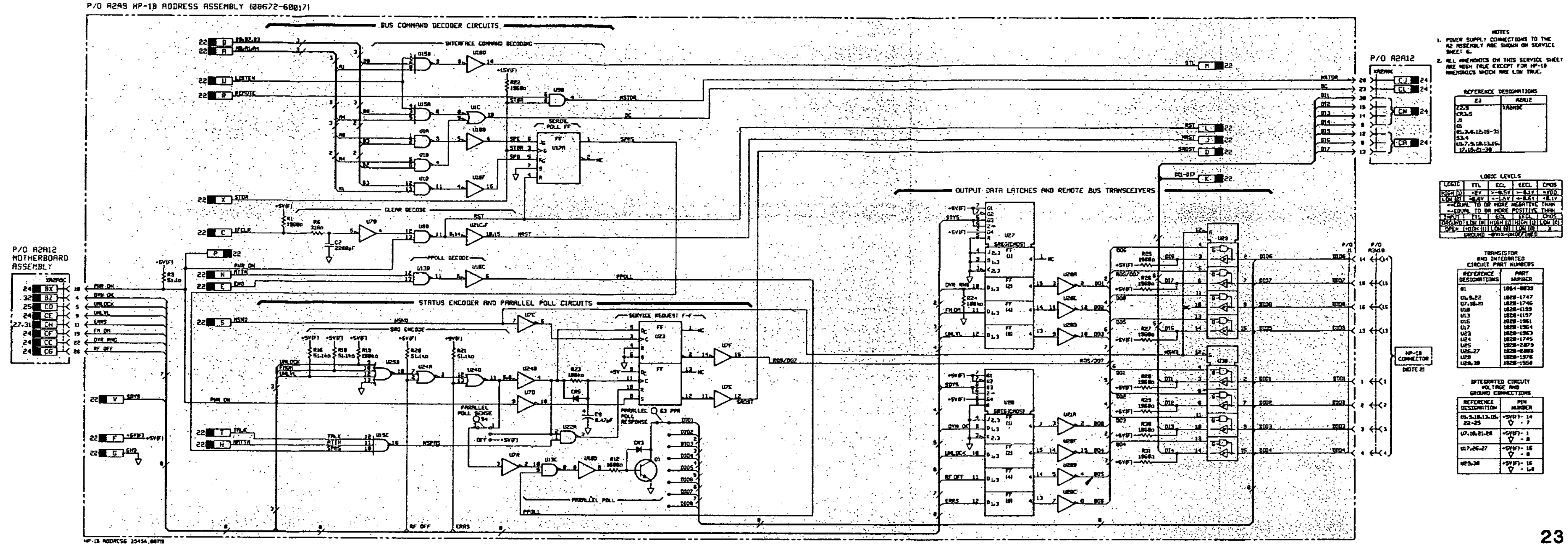


Figure 8-102. A2A9 P/O HP-IB Address Assembly Component Locations



23

Figure 8-103. P/O HP-IB Address Assembly Schematic Diagram

SERVICE SHEET 24

P/O HP-IB INTERFACE ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
DCU HP-IB Interface Block Diagram .... Service Sheet BD8
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB)..................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

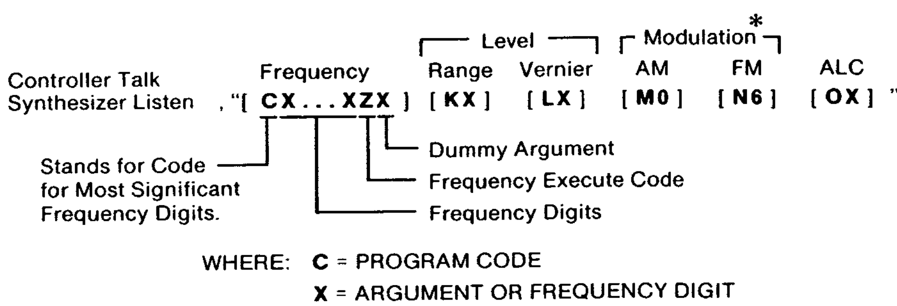
General

The HP-IB Interface converts ASCII data characters on the 7 HP-IB data lines into RF Output assembly program information and frequency data. Also, it converts status information from other parts of the CW Generator into a status byte which it sends to the HP-IB Address assembly.

P/O HP-IB Inteface Assembly

The HP-IB Interface assembly decodes program codes and routes the argument to the appropriate assembly. Any character on the bus will appear on the seven data lines (DI 1—7) but the HP-IB Interface assembly will only respond when the ATN line is false and an NRSTOR (low going) pulse is received. When these conditions are met, a program string is being sequenced into the CW Generator. During this sequence, ATN will always be low and a NRSTOR pulse will occur for each character. The characters will be coded as shown in the table on this sheet and the data string format is as follows (see Section III for complete programming information):

PROGRAM STRING SYNTAX



*Dummy codes for HP 8672A program compatibility.

SERVICE SHEET 24 (cont'd)

The data is entered into the CW Generator in a left to right sequence. When the first data character appears on the data lines, the program code/argument decoder will look at bits D15 to D17 to determine if it is a program code. Then, it will make pin 1 of the internal address counter (U4) high which will parallel load the DI1—4 bits. During this time the NRSTOR pulse is disabling the instruction decoders, but when NRSTOR goes high, U5 and U3 decode the program code. The next character could be another program code in which case the address counter would be reloaded, but normally it will be an argument. This character appears on the bus about 2 μs before the next NRSTOR pulse so it has time to be routed to the frequency register or RF program selector and latched. Then when NRSTOR goes low, the address counter is clocked to serial shift (count up), and the instruction decoders are disabled. This sets the address counter to the next program code in the sequence shown in the table. The new program code will be decoded when NRSTOR goes high. If the next character in the string is an argument rather than a program code, the data will be routed to the next internal address due to the serial shift that occurred in the address counter.

Switching delays are timed by U15 and U16 to allow the CW Generator to finish prooessing a character before receiving another one, and to signal the controller via a service request that ALC and output level have not settled.

TROUBLESHOOTING

It is assumed that the troubleshooting information Service Sheets BD1, BD8, and 23 was used to isolate an HP-IB Interface problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Oscilloscope .... HP 1980B

Procedure

1. If local operation is correct but remote operation is incorrect, continue with this procedure; otherwise go to the service sheet involved with the malfunctioning curcuit.
   - If the problem involves frequency, start with step 2.
   - If the problem involves RF output, start with step 5.

2. Connect the oscilloscope to A2A7TP1, INTFCLKGO. Program the CW Generator's center frequency with the program string "P12345678Z1". When the frequency execute command "Z1" is received by the CW Generator, TP1 should pulse high for a few microseconds. A program loop is useful to generate a string of pulses for this and most of the remaining tests.

3. Observe pulses at U5-14, (INTF CLK1 and U5-14 INTF CLK2) of U5. There should be one INTF CLK1 pulse for each of the

left four frequency digit positions (10 GHz to 10 MHz) which are programmed. There can be from zero to four pulses. There should also be one INTF CLK2 pulse for each of the right four frequency digits (1 MHz to 1 kHz) which are sent. For example if the data string "A2345Z1" is sent,there will be three INTF CLK1 pulses (due to the 2,3 and 4) and one INTF CLK2 pulse (due to the 5). Troubleshoot U5 and U4 after checking the input data DI 1—8 if the pulses are not correct.

4. Program the frequency with the programming string "P12345678Z1". Check the outputs of U3 REM 1000 CLK to REM 1 CLK. The REM 1000 CLK line should pulse once for the 10 GHz digit and once for the 1 MHz digit. The other three lines should perform similarly for their digits. If these pulses are correct go to Service Sheet 25 to troubleshoot the Interface Storage Register. If the pulses are incorrect,troubleshoot U3, U4 and associated gates.

5. The following troubleshooting should be performed if there is a remote RF level programming problem. Program "KØLØO1". The outputs of U10 and U11 should all be low and the RF output level should be +3 dBm. If the outputs of U10 and U11 are correct but the indicated power is incorrect, go to Service Sheet 19 to continue troubleshooting.

6. Measure U25A-3 REM ATTN CNTL and U3-3 REM VERNIER CNTL. The appropriate line should pulse high when remote level data is received. If the lines do not pulse properly, troubleshoot U3,U4 and the associated gates.

7. The following troubleshooting steps should be performed if the remote problem involves ALC. Program "MØØØ". The outputs of U2,U1 and U9 should all be low and RF should be off. If the outputs of U2,U1 and U9 are correct but the front panel indication is incorrect, go to Service Sheet 19 to continue troubleshooting.

8. Observe the pulses at U3-15 (REM ALC CNTL). A single pulse should occur when remote data for the ALC function is received. If the pulse occurs properly but the output data is incorrect,troubleshoot the appropriate RF Program Selector U9. If the pulse does not occur,troubleshoot the message decoder,address counter (U4) and the instruction decoder (U3).

SERVICE SHEET 24 (cont'd)

MNEMONICS

Mnemonics	Definition	Explanation
DI 1–7	Data In	Data lines from the bus.
ATN	Attention	Low means DI 1–7 carry a program code or argument. High means the Address counter and instruction decoder should ignore the character.
NRSTOR	Not Remote Store	Enables Program code/argument decoder.
DC	Device Clear	Line used to execute a clear message from the controller. See Table 3-5.
INTF CLK	Interface Clock	Tells Data Register 1 into which half to load the next four digits.
INTF REG RST	Interface Register Reset	Resets the remote frequency registers.
NDAV	Not Data Valid	Low means the bus NDAV line is true.
DCU BZY	Digital Control Unit Busy	High while the controller is busy processing a received character.

ASCII CHARACTER CODING

				ASCII Program Codes		Program Code Meaning	Instruction Decoder Outputs	
			DI-7 DI-6 DI-5	1 0 0	1 0 1		Instruction Decoder 2 Output	Instruction Decoder 1 Output
DI-4	DI-3	D1-2	DI-1					
0	0	0	0	@	P	10 GHz	REM 1000 CLK	INTF CLK1
0	0	0	1	A	Q	1 GHz	REM 100 CLK	INTF CLK1
0	0	1	0	B	R	100 MHz	REM 10 CLK	INTF CLK1
0	0	1	1	C	S	10 MHz	REM 1 CLK	INTF REG RST
0	1	0	0	D	T	1 MHz	REM 1000 CLK	INTF CLK2
0	1	0	1	E	U	100 kHz	REM 100 CLK	INTF CLK2
0	1	1	0	F	V	10 kHz	REM 10 CLK	INTF CLK2
0	1	1	1	G	W	1 kHz	REM 1 CLK	INTF CLK2
1	0	0	0	H	X	Not Used		
1	0	0	1	I	Y	Not Used		
1	0	1	0	J	Z	Freq. execute		INTF CLK GO
1	0	1	1	K	[	Output Level		REM ATTN CNTL
1	1	0	0	L	\	Vernier	REM VER CNTL	
1	1	0	1	M	]	AM	REM AM CNTL	
1	1	1	0	N	⌒	FM	REM FM CNTL	
1	1	1	1	O	—	ALC	REM ALC CNTL	

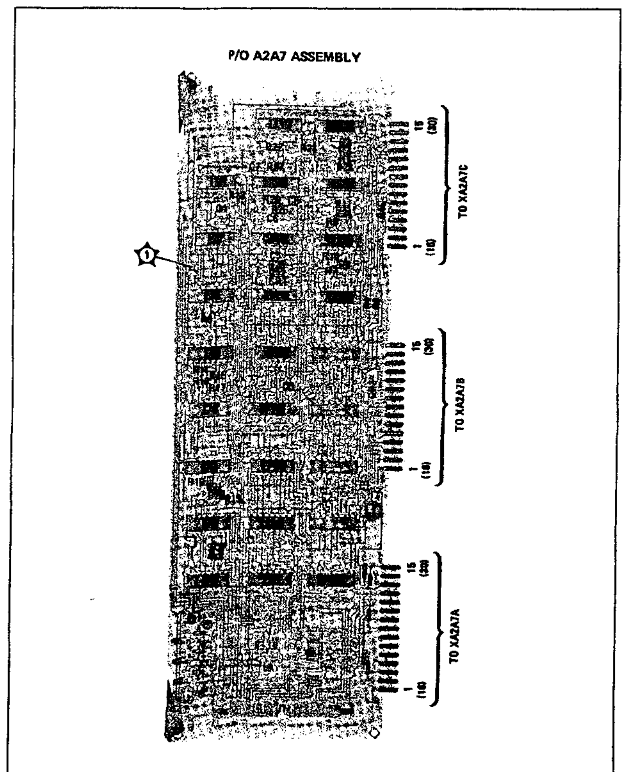
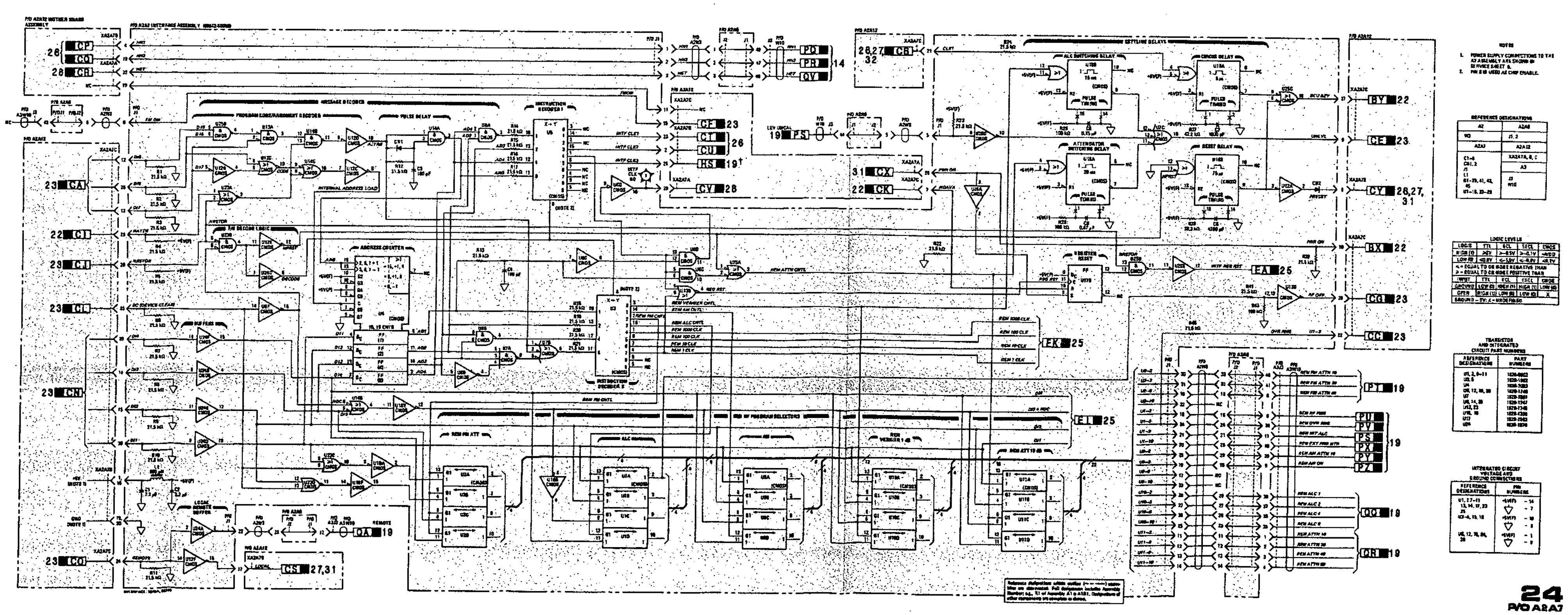


Figure 8-104. P/O A2A7 Interface Assembly Component and Test Point Locations



24
P/O A2A7

Figure 8-105. P/O HP-IB Interface Assembly Schematic Diagram

SERVICE SHEET 25

P/O HP-IB INTERFACE ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
Remote/Local Interface Block Diagram	Service Sheet BD7
DCU HP-IB Interface Block Diagram	Service Sheet BD8
P/O HP-IB Interface Assembly Block Diagram	Service Sheet 24
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The HP-IB Interface converts ASCII data characters on the 7 HP-IB data lines into RF Output assembly program information and frequency data. Also, it converts status information from other parts of the CW Generator into a status byte which it sends to the HP-IB Address assembly.

P/O HP-IB Interface Assembly

Frequency data on the DI 1—4 lines are clocked into the interface frequency register by the remote clocks (REM 1—1000 CLK). This register is loaded in blocks of four digits. Digits in the 10 GHz to 10 MHz block are clocked in first, then when enough time has elapsed for data register 1 to load the information, the interface register reset line (INTF REG RST) goes high and clears the register. Then the 1 MHz through 1 kHz digits are loaded.

The schematic illustrates how the unlock signals from the CW Generator's phase locked loops drive unlock indicators and are OR'd to make the UNLOCK bit of the status byte.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1, BD7 and 8, or Service Sheet 24 was used to isolate an HP-IB Interface problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter	HP 3556A

1. Set the CW Generator to 3 GHz with RF switch ON and rear panel FREQ. STANDARD switch set to INT with jumper cable in place. Observe the phase lock indicators on A2A7. All

SERVICE SHEET 25 (cont'd)

four indicators should be on and the front panel NOT PHASE LOCKED annunciator should be off. If any of the phase lock indicators are off, measure the unlocked signal from the appropriate phase locked loop. The UNLOCKED lines should all be low as they enter A2A7 for a locked loop. If the line is low, troubleshoot the lock indicator, otherwise troubleshoot the malfunctioning phase locked loop.

2. This step checks the switching of the phase lock indicators.

   Set rear panel FREQ STANDARD switch to EXT. The REF indicator should go out. Return the switch to INT and the indicator should light.

   Set the front panel RF switch to OFF. The YTO indicator should go out. Return the switch to ON.

   Unplug the blue cable from A3A1A1. The LFS indicator should go out. (This also disables the DCU.) Reconnect the cable. The YTO indicator may also extinguish at this step.

   Unplug the white/red cable at A3A1A5. The M/N indicator should go out. The YTO indicator may also extinguish at this step. Connect the cable. All the lock indicators should be on.

3. Quickly tune the frequency in 100 MHz steps. Measure the voltage at XA2A7A-9, YTO RST. This voltage should go low when the YTO is unlocked.

4. The following steps should only be followed if troubleshooting a frequency related programming problem. Program the following code: "PØØØ". Do not program a frequency execute command at this time. The outputs of U19-U22 should all be low. If all are OK, continue with this procedure. If the outputs of only one register is wrong, troubleshoot it. If the outputs of all registers are the same but incorrect, troubleshoot input lines DI 1—4.

5. Program "P1" through "P9" to assure that the outputs of U21 remain correct for all inputs. The data format is BCD.

6. Program "Q1" through "Q9" to assure that the outputs of U20 remain correct for all inputs.

7. Program "R1" through "R9" to assure that the outputs of U22 remain correct for all inputs.

8. Program "S1" through "S9" to assure that the outputs of U19 remain correct for all inputs.

9. Program "P12345678Z1". The front panel frequency display should indicate 12345.678 MHz. The outputs of U19 through U22 should be reset to zero.

   If all is OK through this step, the circuits on this service sheet are working properly.

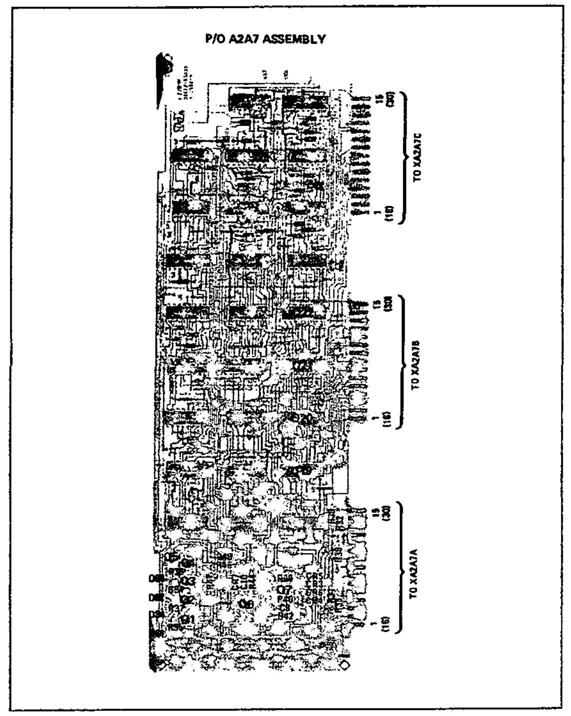


Figure 8-106. P/O A2A7 Interface Assembly Component Locations

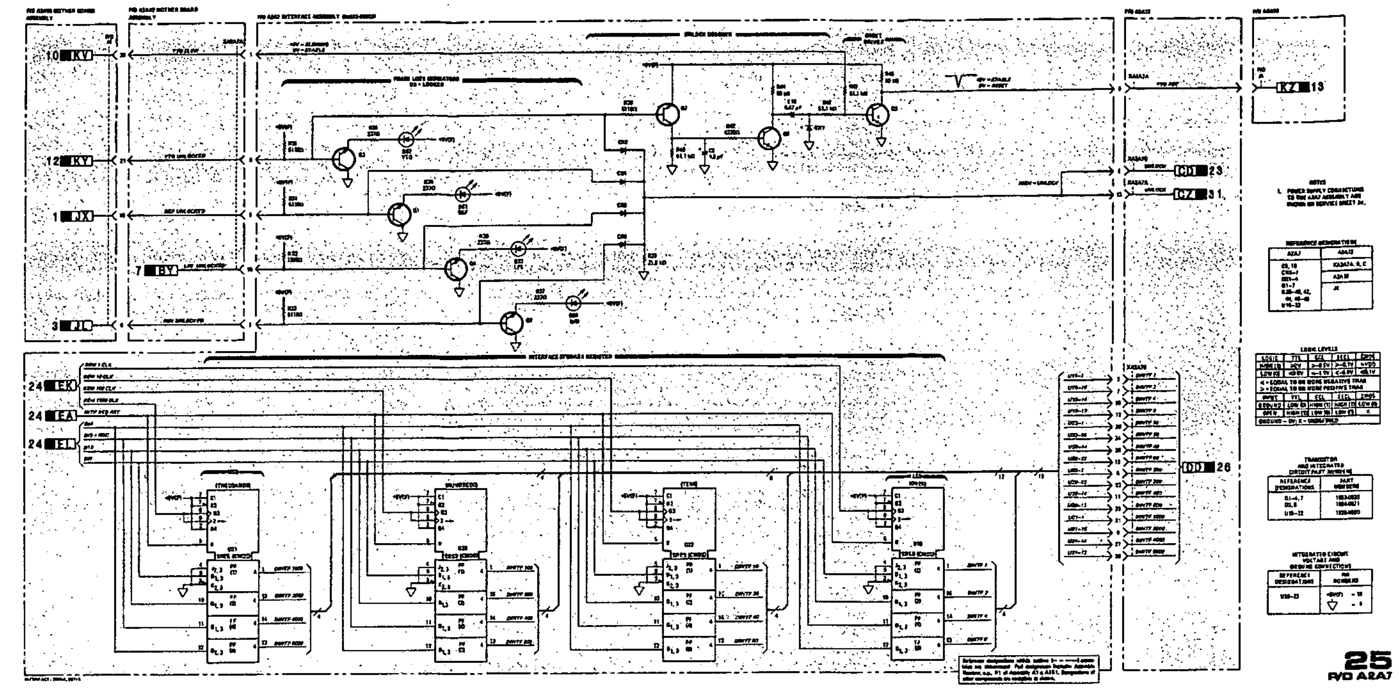


Figure 8-107. P/O HP-IB Interface Schematic Diagram

SERVICE SHEET 26

REGISTER 1 ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
DCU Frequency Control Block Diagram	Service Sheet BD9
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The Register 1 Assembly (A2A10) consists of a protected CMOS shift register (DATA REGISTER 1) and circuits for band and error decoding. Data Register 1 stores the CW Generator's frequency. A battery keeps the register active when Mains power is off. The band and error decoding circuit checks the frequency for out of range errors, tells the divider on the Output Register Assembly (A2A8) whether to divide by 1, 2, or 3, and tells the YIG Tuned Multiplier (YTM) whether to multiply by 1, 2, or 3.

Register 1 Assembly

Shift registers U7—U9 and U19—U23 store the CW Generator's frequency in a BCD format. The 10 GHz digit is on top and the 1 kHz digit is on the bottom. An extra digit which duplicates the 1 kHz digit is stored in the serial output latch. Nine clock 1 (CLK1) pulses serial shift the frequency out of the register, through the Timing and Control Assembly, into the front panel display and back to Data Register 1. This happens when NGO (Not Go) is true (low). Remote programmed frequencies are parallel shifted into Data Register 1 four digits at a time by INTF CLK1 and 2.

The adder, U15, converts the register's parallel BCD output into a binary address for the first ROM, U14. This ROM and U3 store tables of Harmonic numbers (HN2, HN1) and incorrect frequencies (NERR). Signals from the RF section affect the frequency limits of the instrument. Circuit operation is summarized as follows:

f = frequency	HN1	HN2	NERR	BAND
<2000.000 MHz	—	—	Low	Out of range
2000.000 MHz—6199.999 MHz	0	0	High	1
6200.000—12399.998	1	0	High	2
12400.002—18599.997	0	1	High	3
>18600.000 MHz	—	—	Low	Out of range

SERVICE SHEET 26 (cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and 9 was used to isolate a Register 1 problem to the circuits shown on this schematic. The following information will aid in isolating the defective component:

Test Equipment

Logic Analyzer	HP 1630A
Digital Voltmeter	HP 3456A
Oscilloscope	HP 1980B

1. Tune the frequency to 12345.678 MHz. If the frequency tunes properly, Register 1 is properly storing and clocking data. If the frequency does not tune properly, skip to step 3.

2. Unplug the CW Generator for at least one minute. Reapply Mains power. The frequency should be the same as displayed before power was removed. If not correct, troubleshoot battery A2BT1 and the charging circuit plus the clock protect circuitry on A2A11 (see Service Sheet 28). If everything is OK so far, skip to step 5.

3. Press the PRESET (3 GHz) pushbutton. Connect the logic analyzer to DR101—8. Use CLK1 to clock the logic analyzer. Set the analyzer to END DISPLAY and trigger on a BCD 3. Rotate the TUNING knob. BCD data for 3 GHz with the three at the bottom of the display should be displayed on the logic analyzer.

4. If the data does not appear to clock out properly, check CLK1 with an oscilloscope. It should be a string of 9 TTL pulses when the TUNING knob is turned or when test point pair A1A11TP1 is shorted together with an alligator clip. If CLK1 is not correct, go to Service Sheet 27.

5. Observe the HN1 and HN2 lines with a voltmeter. Below 6.2 GHz both lines should be TTL low. Between 6.2 GHz and 12.399998 GHz HN1 should be high. Above 12.4 GHz HN2 should be high.

6. Tune to the highest possible frequency. It should be 18599.997 MHz. Then tune to the lowest possible frequency. It should be 2000.000 MHz. If either one is incorrect, troubleshoot the frequency limit detection circuitry, U14, U3 and other associated gates. If everything has worked properly to this step, A2A10 is working correctly.

SERVICE SHEET 26 (cont'd)

MNEMONICS

Mnemonics	Definition	Explanation
GO (NGO)	Do a data cycle	Puts the shift registers in the serial shift mode.
CLK 1	Clock 1	Nine pulses occurring during the first half of a data cycle.
DINTF	Data Interface	Frequency information from the HP-IB interface.
INTF CLK1	Interface Clock 1	Shifts the 10 GHz to 10 MHz digits into the top half of Data Register 1.
DR1I 1—8	Data Register 1 In	Serial input to the register.
DR1O 1—8	Data Register 1 Out	Serial output of the register.
NERR	Not Error	Low means that an out of range frequency is stored.
LEFT	Data Register 2 shift left	High during the second half of a data cycle.
HN1, 2	Harmonic Number	Tells the divider and YTM the band of the frequency stored in Data Register 1.

DEFINITION

Data Cycle — The process of changing the CW Generator's frequency by adding or subtracting 1 from one of the digits.

SERVICE SHEET 26 (cont'd)

MNEMONICS

Mnemonics	Definition	Explanation
GO (NGO)	Do a data cycle	Puts the shift registers in the serial shift mode.
CLK 1	Clock 1	Nine pulses occurring during the first half of a data cycle.
DINTF	Data Interface	Frequency information from the HP-IB interface.
INTF CLK1	Interface Clock 1	Shifts the 10 GHz to 10 MHz digits into the top half of Data Register 1.
DR1I 1—8	Data Register 1 In	Serial input to the register.
DR1O 1—8	Data Register 1 Out	Serial output of the register.
NERR	Not Error	Low means that an out of range frequency is stored.
LEFT	Data Register 2 shift left	High during the second half of a data cycle.
HN1, 2	Harmonic Number	Tells the divider and YTM the band of the frequency stored in Data Register 1.

DEFINITION

Data Cycle — The process of changing the CW Generator's frequency by adding or subtracting 1 from one of the digits.

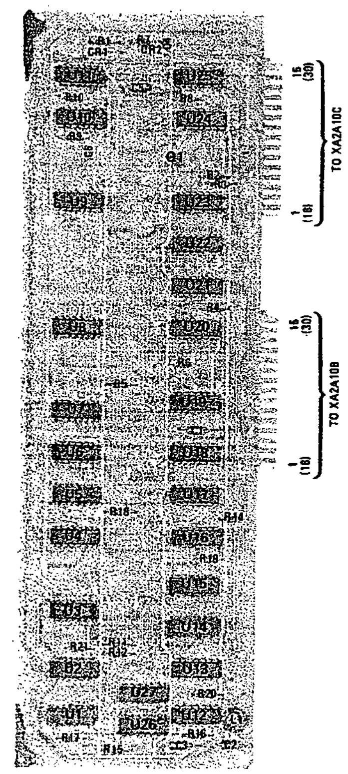


Figure 8-108. A2A10 Register 1 Assembly Component Locations

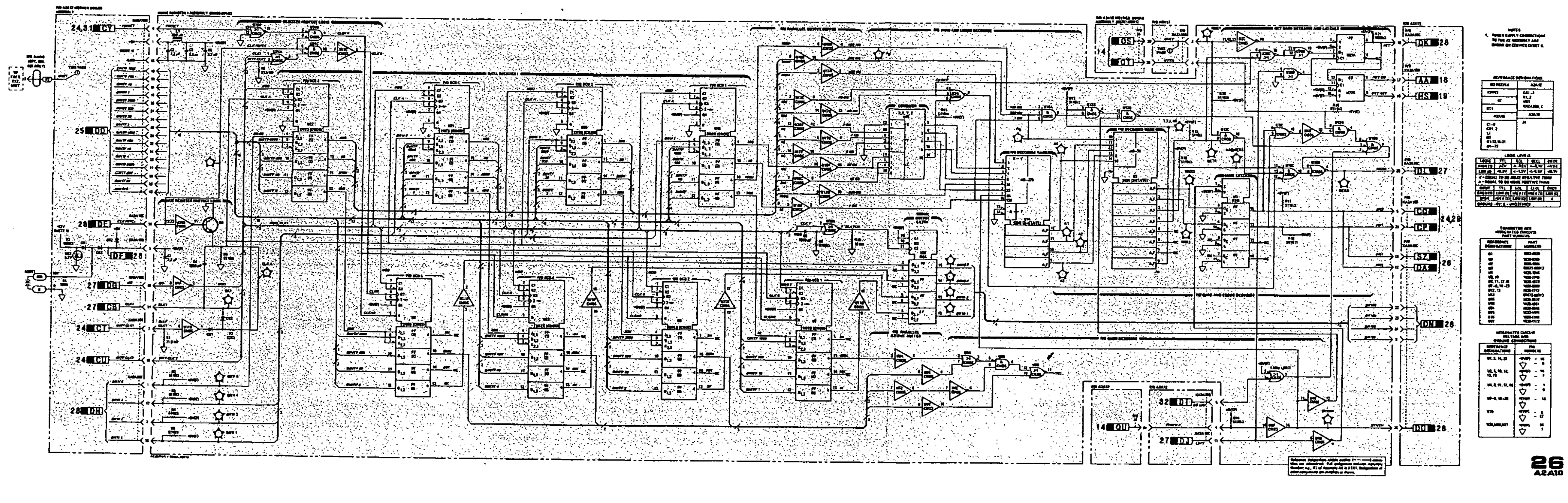


Figure 8-109. Register 1 Assembly Schematic Diagram

SERVICE SHEET 27

P/O TIMING AND CONTROL ASSEMBLY

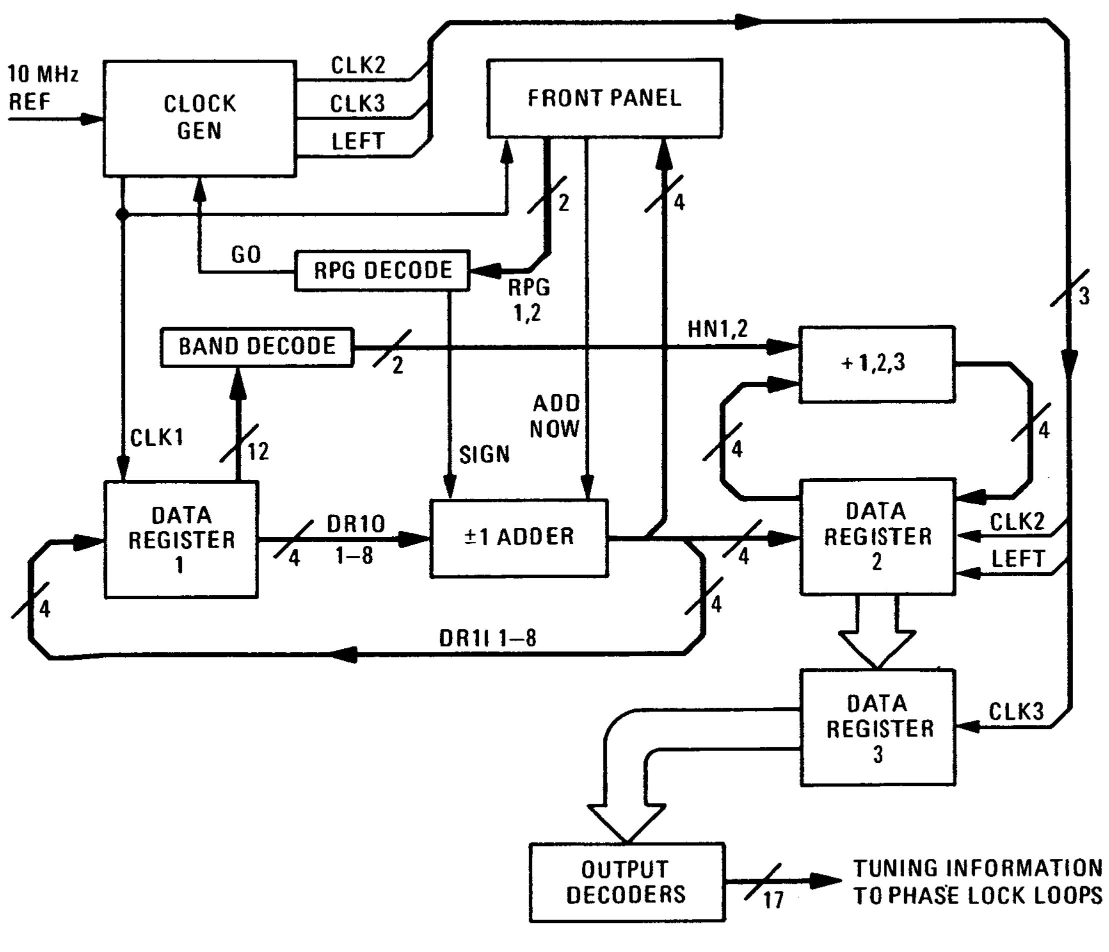
REFERENCES

Overall Block Diagram .... Service Sheet BD1
DCU Frequency Control Block Diagram .... Service Sheet BD9
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The timing and control assembly generates signals that initiate and control DATA CYCLES. A data cycle is the process of changing the CW Generator's frequency by adding or subtracting one from one of the digits stored in data register 1. The timing and control signals include clocks, tuning direction indicators, and error flags. If at the end of a data cycle an error flag is set, the timing and control assembly will do more data cycles until the error is corrected.



Digital Controller Block Diagram

SERVICE SHEET 27 (cont'd)

Relation to the Rest of the Instrument

The DCU Frequency Control circuitry (see block diagram on previous panel) is static between frequency changes. Tuning information is stored in Register 3 and applied, through output decoders, to the phase locked loops. Since the frequency data is the basis for all future frequency changes, it is stored in the Protected Register (Register 1) and displayed by the front panel.

The frequency (2—18 GHz) is displayed and stored as 8 BCD digits (10 GHz to 1 kHz). The phase locked loops tune from 2—6.2 GHz, which means the frequency must be divided by 1, 2, or 3 before being used to tune the phase locked loops. Frequency changes occur during a Data Cycle which is initiated by turning the TUNING control, pressing the PRESET button, or remotely programming a new frequency. During each data cycle the DCU operates on the frequency stored in Register 1 as follows:

In Local when the TUNING control is turned:

- Add ±1 to the digit selected by the resolution key.
- Update the display.
- Divide the new frequency by 1, 2, or 3 (so the phase locked loops will tune from 2—6.2 GHz).
- If a remainder exists, do more data cycles, adding or subtracting one from the least significant digit until the remainder is zero.
- Shift the new frequency data into Register 3.
- Stop!

In Local when PRESET is pushed:

- Clear Register 1.
- Add 3 to the 1 GHz digit.
- Update the display.
- Divide by 1 in Register 2.
- Shift the new frequency data (3 GHz) into Register 3.
- Stop!

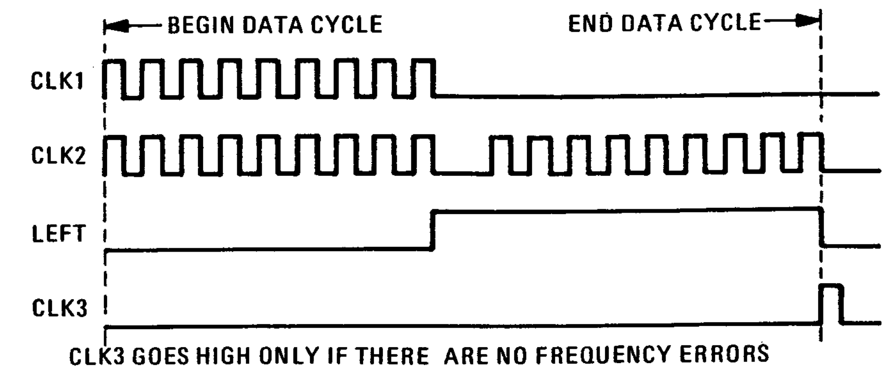
In remote when a new frequency is programmed:

- Store the new frequency into Register 1.
- Update the display.
- Divide by 1, 2 or 3.
- If a remainder exists, do more DATA CYCLES, adding ±1 to the 1 kHz digit until an evenly divisible frequency is obtained.
- Stop!

A data cycle begins when the GO line goes true. The clock generator produces timing signals as shown on next panel.

Starting with the 1 kHz digit, CLK1 shifts the frequency data serially out of Register 1 and into the ±1 adder. The adder adds or subtracts 1 from the digit selected by the RESOLUTION keys. The new frequency goes to three places: the front panel display, back into Register 1, and into Register 2. Then LEFT goes high,

SERVICE SHEET 27 (cont'd)



Clock Generator Outputs

changing Register 2 to the left shift mode, and the second half of CLK2 serial shifts the data (starting with the 10 GHz digit), through the divider. The divided frequency is shifted back into Register 2. If a remainder exists another data cycle will commence and the 1 kHz digit of the frequency Register 1 will be changed and the division will again occur. This process continues until an evenly divisible frequency is obtained. When the remainder is zero, CLK3 parallel shifts the data into Register 3 where it is decoded and applied to the phase-locked loops.

P/O Timing and Control Assembly

Clock divider, U14, divides the 10 MHz reference by 16 which results in a stream of 625 kHz pulses. The clock counter counts nine of these pulses during which time they are gated through U5C (clock 1) and U5D (first half of clock 2). At the end of the count U5C is disabled and the clock divider is reset. It stays reset until the end of the time delay measured by C6, R12 and R9 is finished. This accounts for the interval between the two halves of clock 2. U14 starts dividing again and 9 more pulses go through U5D. Clock 3 (CLK3) signals the end of an error free data cycle by going high for a short period when triggered by the negative going edge of LEFT.

The RPG (Rotary Pulse Generator) converts the smooth rotation of the TUNING control into digital information. The DCU interprets this information to determine if the frequency should be increased or decreased. RPG1 and RPG2 are pulses, the frequency of which depend on rotation speed, and the phase relationship depends on rotation direction. If the TUNING control is turned clockwise RPG1 will lead RPG2 and the frequency will increase. The presence of the squarewaves tells the DCU to do data cycles. RPG1's negative edge triggers a one shot composed of C3, and Q6 and associated resistors. This results in a short duration low pulse at U29B pin 6, the trailing edge of which sets GO. The gate, U29B, must be enabled by the Pulse Swallower. This circuit controls the rate of frequency change by varying the number of pulses gated through U29B. If the RPG is turning slowly only every third pulse gets through to set GO, but if turned fast enough every pulse clocks U20B. C8 and C9 store the positive voltage which enables

U29B. Q5 opens a discharge path every time GO becomes true. C8 requires three pulses to charge to the on threshold of U29B and is completely discharged every time Q5 conducts. This accounts for the every third pulse setting GO when the RPG is turned slowly. C9, however, charges relatively fast and discharges slowly so it works out that when the RPG is turning fast, a positive voltage will always be applied through CR7 to U29B thus allowing every pulse to gate U20B.

The Error flip-flop gets set when the band and error decoding circuit on the Register 1 assembly detects an incorrect frequency. This will cause the controller to repeat data cycles, modifying the RESOLUTION selected digit (1 kHz by default), until the frequency is in range. This occurs when an attempt has been made to tune below 2.0 GHz or above 18.6 GHz. If, for example, the frequency is 2.0 GHz, the RESOLUTION is 1 MHz, and the RPG is turned counterclockwise; the ±1 adder will subtract 1 MHz resulting in 1.999 GHz. The error circuitry will then cause the adder to add 1 MHz and thereby return to 2.0 GHz. Register 3 cannot be clocked when there is an error, so the frequency of the loops is unaffected. The process is so rapid that the operator will not be able to see 1.999 GHz on the front panel.

The First Cycle flip-flop tells the DCU whether or not the current data cycle is the first one or succeeding ones used to produce an evenly divisible frequency or correct an error. The XSCC (Excess Cycle Counter) and UPDATE SIGN flip-flop work together to determine whether a frequency to be modified should be increased or decreased.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD9 was used to isolate a Timing and Control problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Oscilloscope .... HP 1980B
Digital Voltmeter .... HP 3456A

This assembly contains several test point pairs which are designed to set certain signals to known conditions. By shorting the pair together with an alligator clip, the line will be set high or low as appropriate.

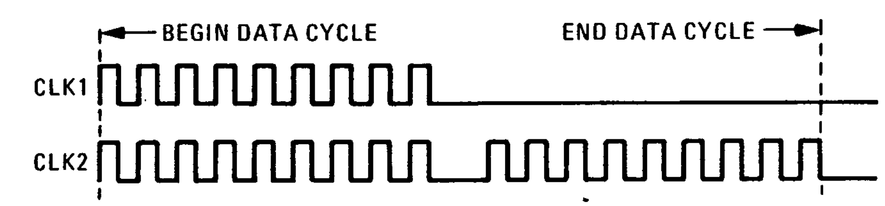
A2A11TP1 — causes DCU to continually cycle data
A2A11TP2 — suppresses frequency error limits
A2A11TP3 — suppresses operation of the ±1 adder
A2A11TP4 — suppresses round off
A2A11TP5 — aborts DCU operation

This assembly also contains a manual clock switch. Use this switch by unplugging the blue cable on A3A1A1 to disconnect the

SERVICE SHEET 27 (cont'd)

DCU clock. (Disconnecting this cable also causes the LFS phase locked loop to unlock but that is not important when troubleshooting the controller.)

1. Connect an alligator clip to test point pair A1A11TP1. Observe CLK1 and CLK2 test points on the oscilloscope. The strings of pulses should be as shown in the figure below (5 μs/div., 2V/div.). CLK1 consists of a string of 9 pulses. CLK2 consists of two strings of 9 pulses. If the front panel display is working properly, CLK1 must be OK.



Clock Pulse Waveforms

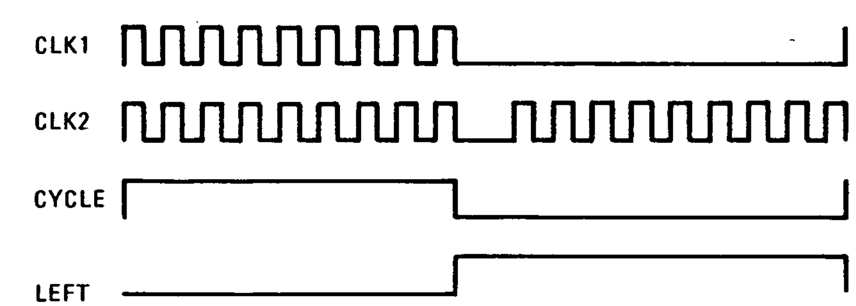
If these clock signals are OK, the clock divider, clock counter and clock drivers are OK. Also the RECYCLE flip-flop (U27B) is OK.

2. Attach one oscilloscope probe to XA2A11A-30, NCLK3. Leave the other probe attached to CLK1. The timing relationship of NCLK3 should be as shown in the text.

3. Observe LEFT and CYCLE lines in relationship to CLK1 and CLK2. They should be as shown in the following table.

4. Locate RPG SIGN test point. This point should go high when the TUNING control is tuned clockwise and low when turned counterclockwise.

5. Connect the oscilloscope or voltmeter to XA2A11B-1, ERRS. This line should be a CMOS low for all in-range frequencies. If everything is correct so far, turn to Service Sheet 28.



Clock, Cycle, and Left Timing Relationship

SERVICE SHEET 27 (cont'd)

MNEMONICS

Mnemonics	Definition	Explanation
NRMDR	Not Remainder	Low means a remainder exists after dividing by 2 or 3.*
NLSDR	Not Least Significant Digit Resolution	Low means the 1 kHz digit RESOLUTION button has been pushed.
UPDATE	Correct band change error	Initiates more data cycles to correct the 1 kHz digit after a band change.
NERR	Not Error	Low means an out-of-range frequency is stored in Data Register 1.
CYCLE SET	Set first cycle flip-flop	High when either INTF CLK GO is true or there is a frequency error and the 1 kHz RESOLUTION button has been pushed.
UPDATE SIGN	Change state of SUBTRACT line	Indicates whether previous round off was an addition or subtraction.
LEFT	Shift left	High during the second half of a data cycle. Causes Data Register 2 to shift left.
CLK1	Clock 1	9 pulses during the first half of a data cycle. Each pulse corresponds to a frequency digit.
CLK 2	Clock 2	18 pulses: 9 during the first half of a data cycle and 9 during the second half.
CLK 3	Clock 3	1 pulse at the end of an error free data cycle.
GO	Do a data cycle	Leading (positive going) edge triggers a data cycle. Stays high until the data cycle is finished.
XSCC NXSCC	Excess Cycle Generator	XSCC and NXSCC are two bits used to tally the extra data cycles done to obtain an evenly divisible frequency.
RPG SIGN	Rotary Pulse Generator Sign	Indicates tuning direction. High is clockwise, low is counterclockwise.
SUBTRACT	Subtract 1 from the RESOLUTION selected digit	Tells the ± Adder whether to add or subtract. High = subtract Low = add

*Should always be false (high) after the data cycle is completed.

DEFINITION

Data Cycle — The process of cycling frequency data through the various registers and the ± Adder, usually for the purpose of changing frequency.

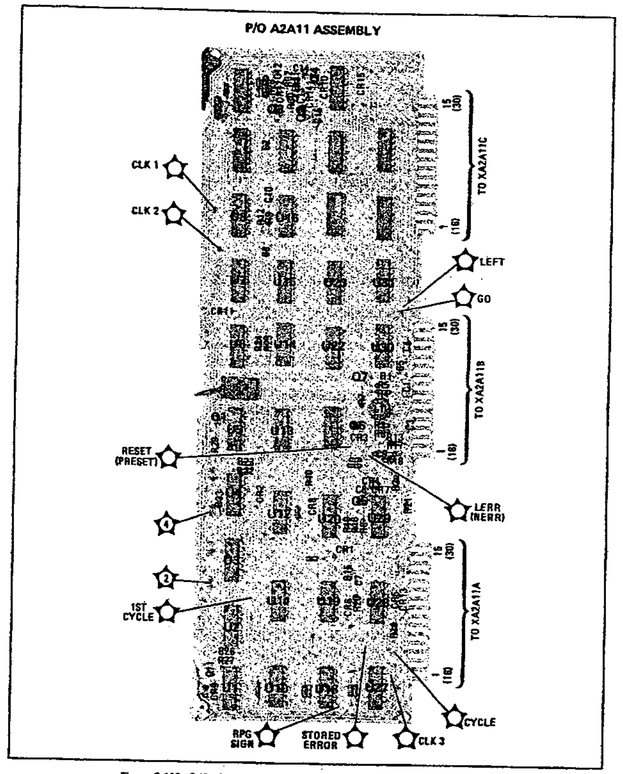
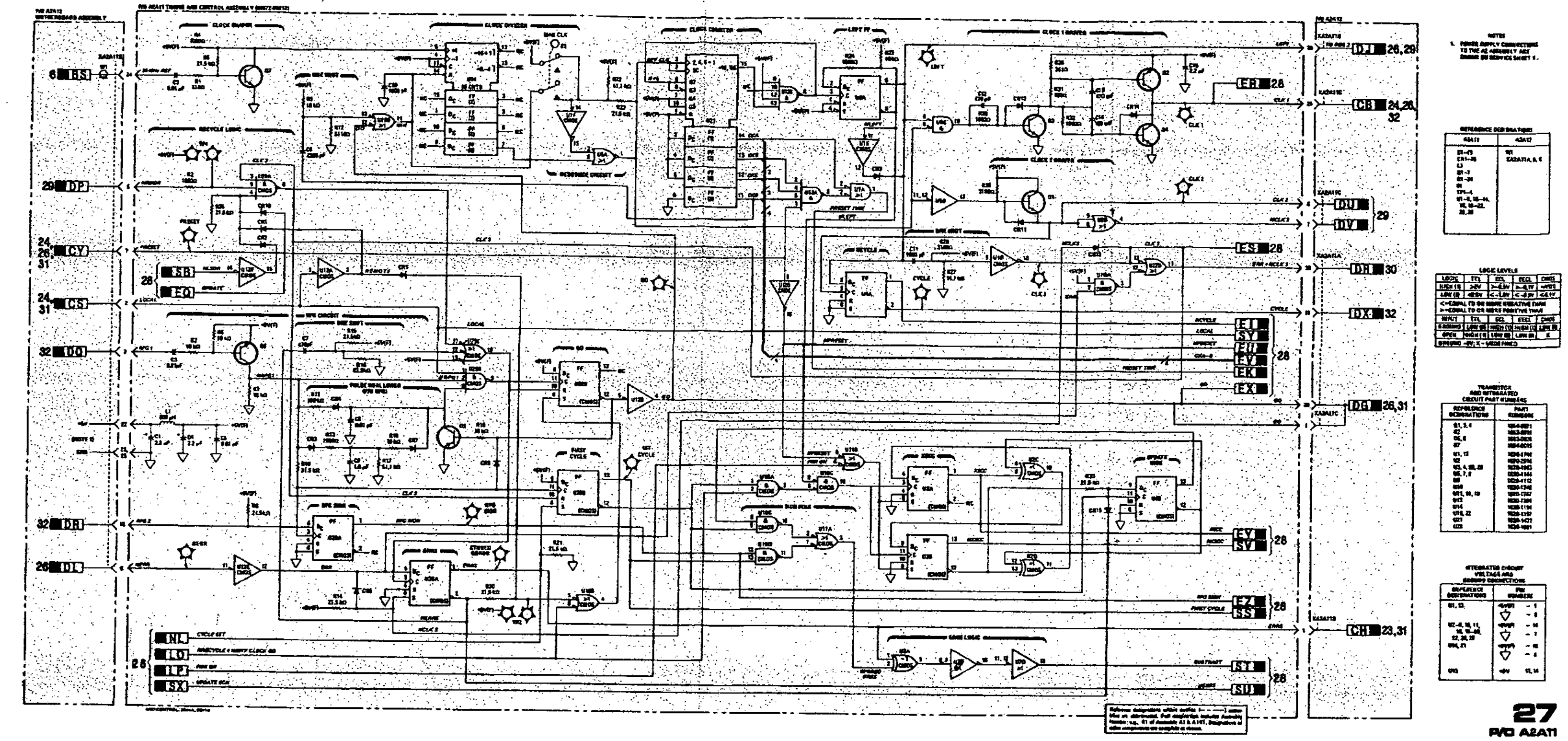


Figure 8-110. P/O A2A11 Timing and Control Assembly Component Locations



27
P/O A2A11

Figure 8-111. P/O Timing and Control Assembly Schematic Diagram

SERVICE SHEET 28

P/O TIMING AND CONTROL ASSEMBLY

REFERENCES

Overall Block Diagram .... Service Sheet BD1
DCU Frequency Control Block Diagram ...... Service Sheet BD9
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB).................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The Timing and Control Assembly generates signals that initiate and control data cycles. A data cycle is the process of changing the output frequency by adding or subtracting one from one of the digits stored in Data Register 1. The timing and control signals include clocks, tuning direction indicators, and error flags. If at the end of a data cycle an error flag is set, the Timing and Control Assembly will do more data cycles until the error is corrected.

This part of the Timing and Control Assembly consists of the Band Change Detector, ±1 Adder and the Offset Adder. The Band Change Detector translates harmonic number and excess cycle information into control signals for the Error and RPG Sign Logic. The ±1 Adder modifies the appropriate frequency digit to set a new frequency or correct an error. The Offset Adder is used to add an IF offset in special instruments. The frequency data for standard instruments is not changed by the Offset Adder.

P/O Timing and Control Assembly

The ±1 Adder, U33, performs the operation indicated by the SUBTRACT line when the ±1 Bit line goes high. For example:

If SUBTRACT line is low:

Add 1	DR10	8	4	2	1	
Y input		0	1	0	1	=5
Z input		0	0	0	1	=1
Y + Z		0	1	1	0	= 5 + 1 = 6

If SUBTRACT is high:

Subtract 1					
Y input	0	1	0	1	=5
Z input	1	1	1	1	=15
Y + Z	0	1	0	0	=5 −1 = 4

If the sum is 10 an illegal BCD 1010 will result so it must be converted to binary 0000 with a carry of one. U17D pin 11 goes Low when this is necessary. This Low does two things. First, it is clocked

SERVICE SHEET 28 (cont'd)

through U9B by a delayed CLK1 from the Double Clock circuit — it keeps the Adder Enable flip-flop set. Second, it changes the number at the Adder's B input to 7. A new sum, 16 or binary 0000 with a carry, results. Note that this happens within the period of one CLK1 pulse. The carry is added to the next digit. A similar process performs subtraction with borrow.

The OR gates at the ±1 Adder's output add 3 to the 1 GHz digit when the PRESET key is pushed. Pin 13 of U32D and pin 1 of 32A go high when the 1 GHz digit leaves the ±1 Adder.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1, BD9, and Service Sheet 27 was used to isolate a Timing and Control problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Logic Analyzer .... HP 1630A

1. Observe the front panel frequency display and press the PRESET (3 GHz) key. If the frequency is displayed correctly (3000.000 MHz) the DR1I 1—8 lines from the ±1 Adder (U33) are probably OK. If the frequency is not displayed properly, check the CLK1 line on Service Sheet 27 or check the data entering the display.

   NOTE

   An open pin on the front panel display data input will cause that pin to float high. A continuously lighted segment is an indication of this problem.

2. Connect the logic analyzer to DR1I 1—8 and DR2I 1—8 lines. Use CLK1 to clock the analyzer. Rotate the RPG to cause the data to circulate. The DR1 and DR2 data should be identical for standard instruments. If they are different, troubleshoot the Offset Adder.

3. Press the least significant digit (1 kHz) RESOLUTION key. Rotate the TUNING knob clockwise. Observe DR1I 1—8 on the logic analyzer. The data is displayed least significant digit first and should increase as the frequency is increased. Tune each digit from 0 to 9 to ensure that none of the DR1 lines are stuck high or low. If the frequency does not change, troubleshoot the ±1 Adder circuitry.

4. Note the center frequency and unplug the CW Generator from power Mains. Wait at least one minute and reconnect Mains. The center frequency should not have changed. If the frequency has changed, troubleshoot the clock protect circuitry (U27A) and the battery or charger circuit on Service Sheet 26.

5. Tune the frequency above 6.2 GHz and then tune the least significant digit. Between 6.2 and 12.4 GHz, the minimum step size should be 2 kHz; above 12.4 GHz, the minimum step should be 3 kHz. If the instrument turned on correctly in step 4 and rounds off properly above 6.2 GHz, the recycle circuitry and the excess cycle counter circuitry on Service Sheet 27 are working properly.

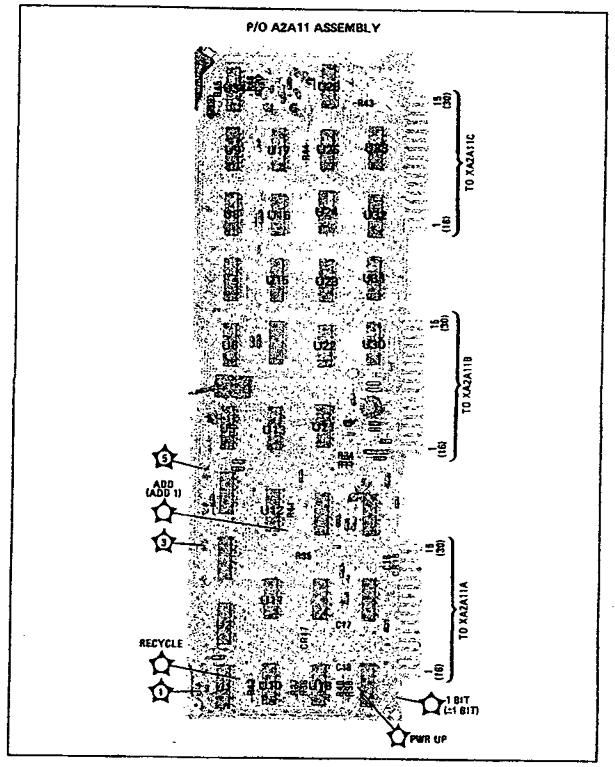


Figure 8-112. P/O A2A11 Timing and Control Assembly Component and Test Point Locations

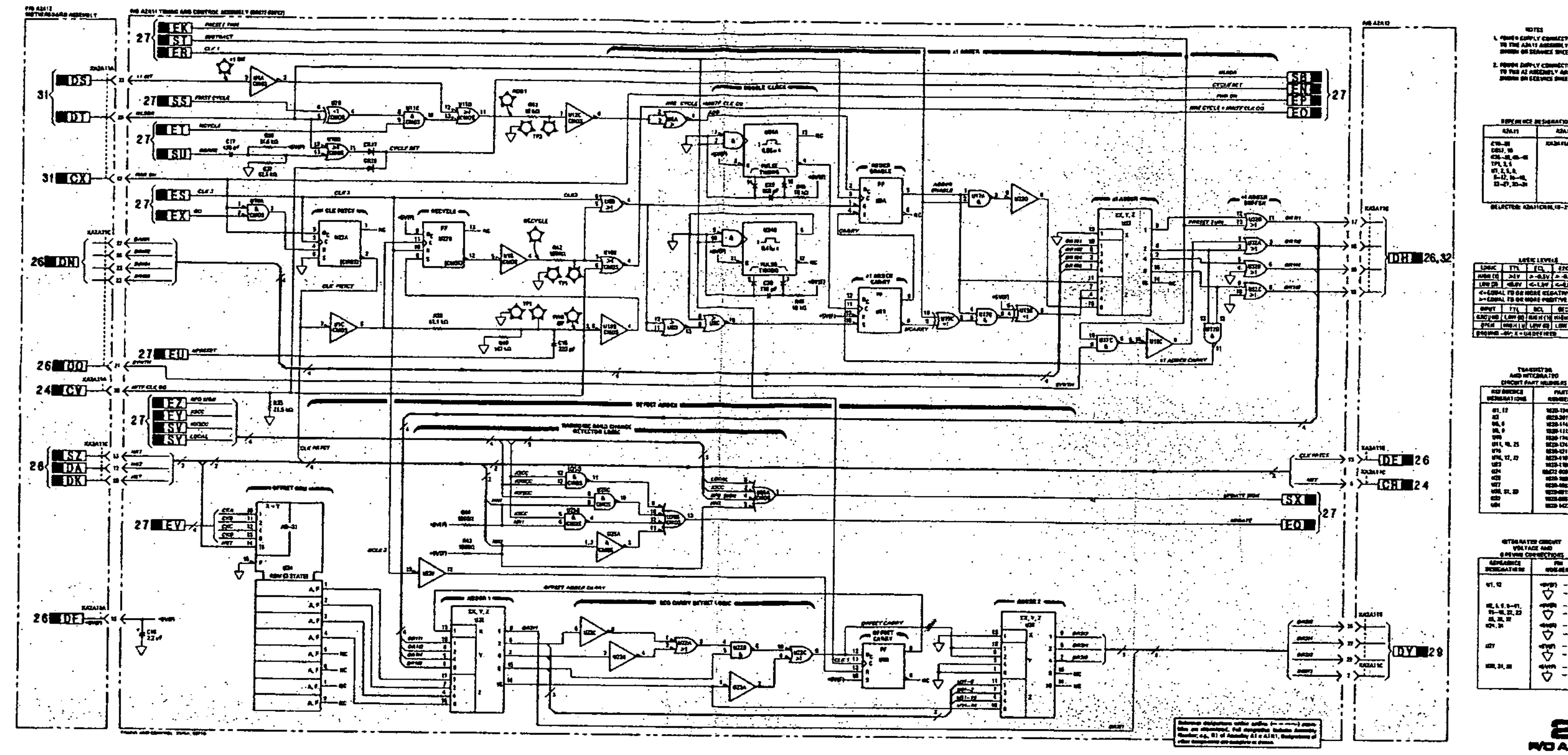


Figure 8-113. P/O Timing and Control Assembly Schematic Diagram

SERVICE SHEET 29

P/O OUTPUT REGISTER ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
DCU Frequency Control Block Diagram	Service Sheet BD9
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The Output Register Assembly consists of Data Register 2, Data Register 3, a Digital Divider, and the DAC and M/N Decoder. Service Sheet 29 covers the Digital Divider and Data Register 2 and Service Sheet 30 covers the rest. Additionally, Service Sheet 29 shows the Logic Test Circuit which is used as a logic probe.

Data Register 2 accepts frequency data from the ±1 Adder in a right shift mode during the first half of CLK2. Then LEFT goes true and the second half of CLK2 left shifts the data through the digital divider and back into Register 2.

The digital divider, controlled by HN1 and HN2, divides the frequency by 1, 2, or 3 so that the DAC, and M and N information will always tune the YTO from 2 to 6.2 GHz.

P/O Output Register Assembly

Register 2 consists of shift registers U1, 2, 3, 6, 7, 11, 15, 16 and 23. U23 serves a dual purpose: it stores the GHz digit and steers the data. During right shift the LEFT Line is low to enable data to flow from the ±1 Adder. When LEFT goes high during the second half of CLK1, data flows from the 100 MHz flip-flops, through the 2 inputs of U23 and to the digital divider.

The ROM's U24 and U25, contain division tables. Each digit, starting with the most significant, enters both ROM's as a dividend (address). U24 feeds the quotient back to Register 2. U25 puts the remainder into U8 where it is clocked back to the ROM's as part of the next dividend. If a remainder exists after the last digit, the NRMDR line will be low (true) and cause the timing and control circuitry to start another data cycle.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1, BD9 and Service Sheet 28 was used to isolate an Output Register problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

SERVICE SHEET 29 (cont'd)

Test Equipment

Digital Voltmeter .... HP 3456A
Logic Analyzer .... HP 1630A

1. Install A2A8 on an extender board or on the Output Register Test Board (HP Part Number 11712-60001).

2. Set the CW Generator frequency as shown in the following table. The edge connector pins with arrows should be measured with the voltmeter or the data can be observed on the output register test board. By checking all four frequencies, each output line will be cycled high and low.

Frequency	A Front	A Rear	B Front	B Rear	C Front	C Rear
6169.696	L	H	H	L	X	X
3696.969	H	L	L	H	X	X
5990.000	X	X	X	X	H	L
3640.000	X	X	X	X	L	H

MNEMONICS

Mnemonic	Definition	Explanation
HN1 HN2	Harmonic Number	Tells the digital divider whether to divide by 1, 2, or 3. ½ HN1 HN2 1 0 0 2 1 0 3 0 1
CLK2	Clock 1	Two sets of nine pulses. Each pulse within a set corresponds to a frequency digit.
LEFT	Shift Left	When low, Register 2 shifts right. When high, Register 2 shifts left.
DR21 1—8	Data Register 2 In	Binary coded decimal digits to Data Register 2.
NRMDR	Not Remainder	Low means that a remainder exists after division.

DEFINITION

Data Cycle — The process of cycling frequency data through the various registers and the ±1 Adder, usually for the purpose of changing frequency.

SERVICE SHEET 29 (cont'd)

3. Check the input data by connecting the logic analyzer to DR2I 1—8 lines and to CLK1. Set the analyzer to END DISPLAY. Set the frequency to 12345.678 MHz and set the logic analyzer to trigger on the "1". Connect an alligator clip to test point pair A1A11TP1. If the input data is correct, continue with this procedure. Otherwise go to Service Sheet 28 to continue troubleshooting. The data is clocked in least significant digit first; the last nine characters on the logic analyzer display should be:

1000	0110	0011
1000	0101	0101
0111	0010	0001

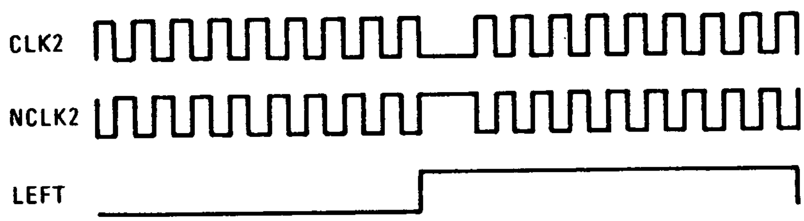
4. Check input lines CLK2, NCLK2 and LEFT with an oscilloscope. These lines should be as shown below. Trigger the oscilloscope on CLK1 for these measurements.

5. Check input lines HN1 and HN2. These lines set the divide number for the harmonic bands. If either line is malfunctioning, go to Service Sheet 26 to continue troubleshooting.

Frequency (MHz)	HN1	HN2
2000—6199.999	L	L
6200—12399	H	L
12400—18599	L	H

6. If all the input lines are correct, trace back from the incorrect output(s) discovered in step 2 to isolate the malfunction to a particular part. Note that the output of Register 2 should not be over 6199.999 MHz after CLK2 has finished clocking the data through the divider.

7. To check the divider, connect the logic analyzer to the outputs of U24. Depending on the harmonic band selected (see step 5) the output of U24 should be the selected frequency divided by 1, 2, or 3.



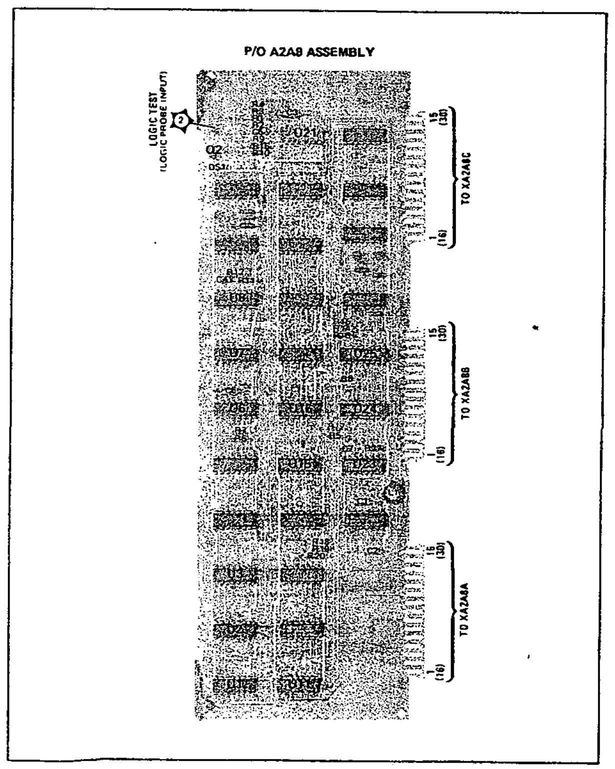


Figure 8-114. P/O A2A8 Output Register Assembly Component and Test Point Locations

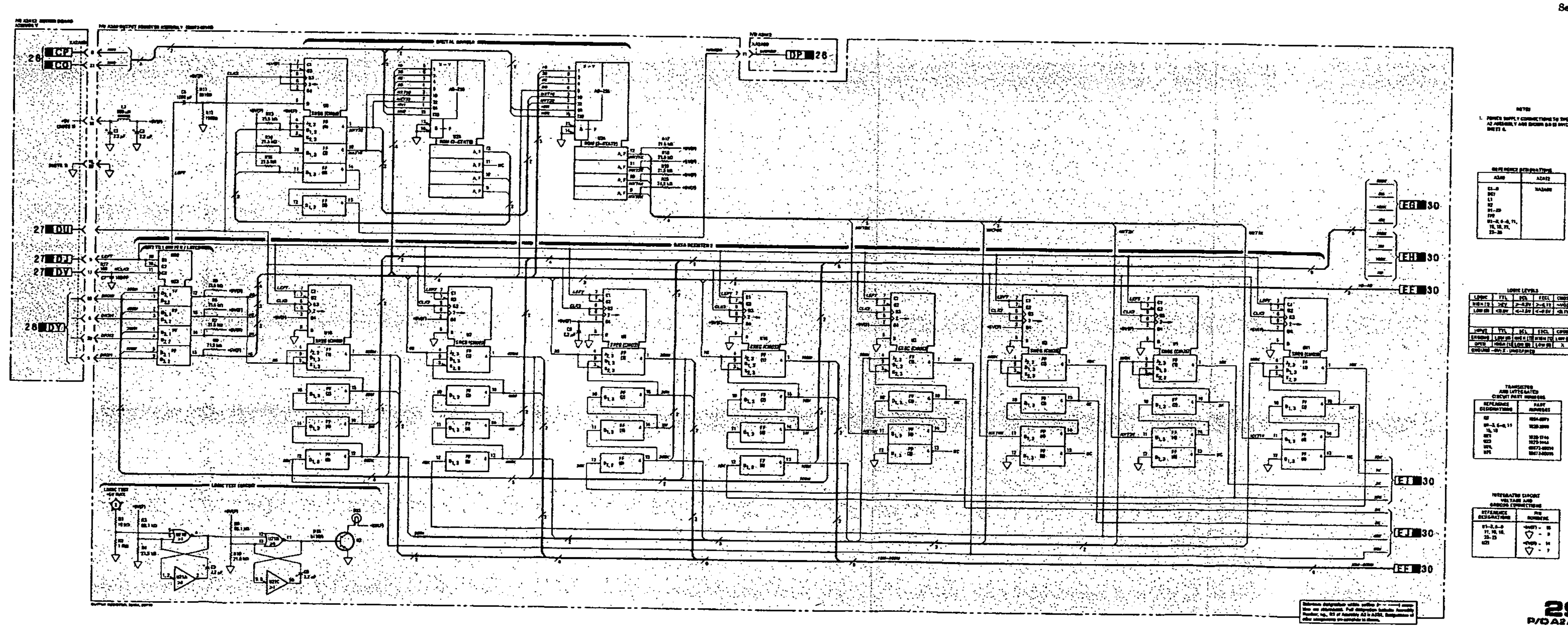


Figure 8-115. Output Register Assembly Schematic Diagram

SERVICE SHEET 30

P/O OUTPUT REGISTER ASSEMBLY

REFERENCES

Overall Block Diagram ..... Service Sheet BD1
DCU Frequency Control
Block Diagram .... Service Sheet BD9
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety
Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

P/O Output Register

This part of the output register assembly consists of Data Register 3 and the DAC and M/N Decoder circuits. CLK3, a single pulse at the end of the data cycle, parallel loads Register 3 with the frequency data from Register 2. From here the 1 kHz through 8 MHz digit information goes directly to the LFS phase locked loop. The DAC and M/N Decoder translates the remaining digits into tuning information for the YTO summing phase locked loop. The outputs relate to the YIG Tuned Oscillator (YTO) frequency as follows:

DAC 1—3200 MHz; round down to nearest 10 MHz. Note that the DAC 100 MHz through DAC 3200 MHz bits are effectively in binary.

M and N: look up the frequency in Table 8-3 and convert M and N to binary.

TROUBLESHOOTING

Troubleshooting is covered on Service Sheet 29.

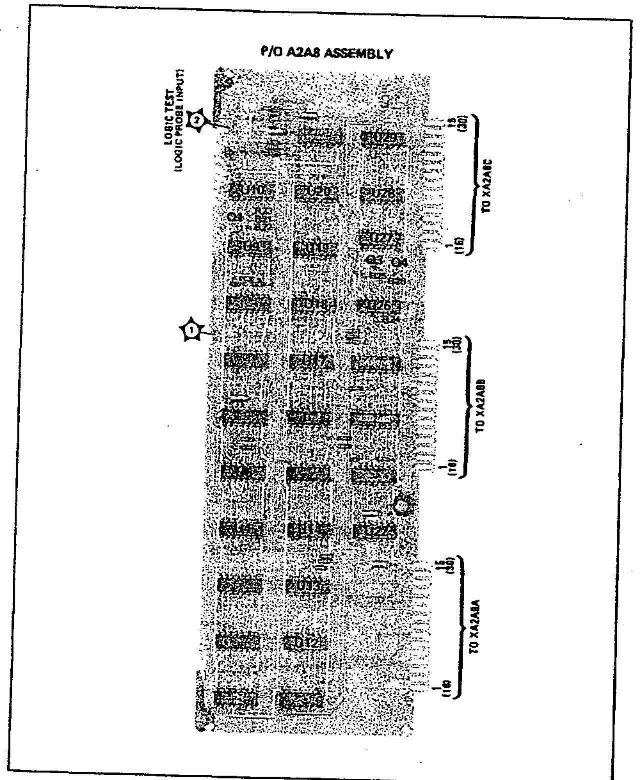


Figure 8-116. P/O A2A8 Output Register Assembly Component and Test Point Locations

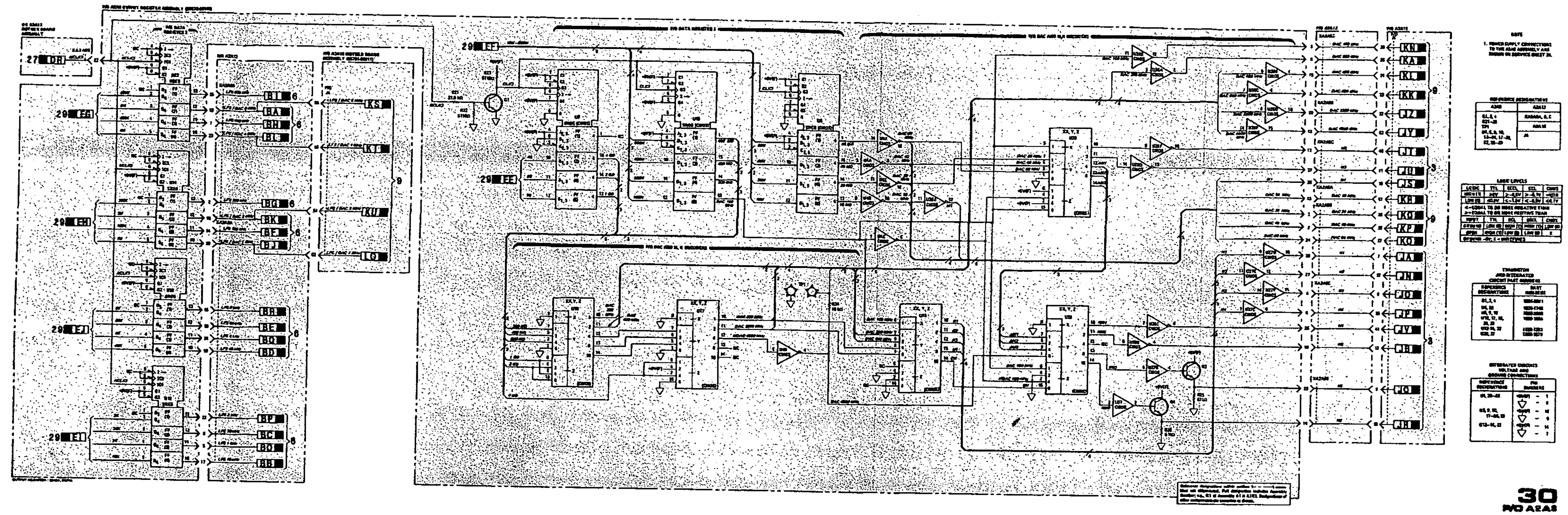
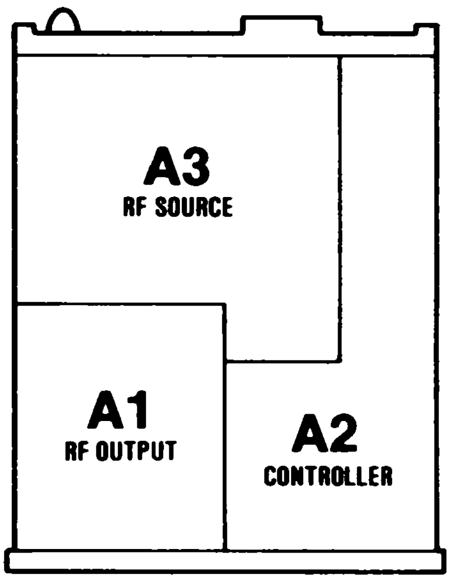


Figure 8-117. P/O Output Register Assembly Schematic Diagram

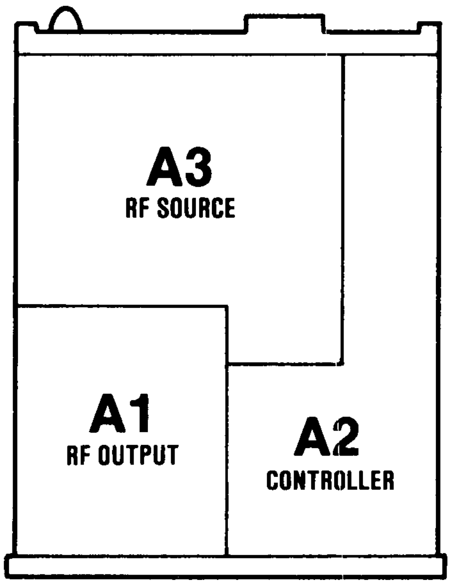
P/O Output Register Assembly
(P/O A2A8)
SERVICE SHEET 30



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35

SERVICE SHEET 31

P/O DCU FRONT PANEL ASSEMBLY

REFERENCES

Overall Block Diagram ..... Service Sheet BD1
Remote/Local Interface
Block Diagram .... Service Sheet BD7
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety
Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The DCU front panel (A2A1) consists of the power switch, frequency controls and indicators, and status annunciators.

This portion of the A2A1 Assembly contains status annunciators, tuning resolution indicators and the ±1 Bit control circuitry. The lamp drivers and status indicators show, by front panel lights, the following conditions: INTERNAL REF OFF, REMOTE, NOT PHASE LOCKED and frequency OUT OF RANGE. When the instrument is first turned on or the HOLD button is pressed, the tuning resolution circuits will disable CW Generator tuning. If one of the RESOLUTION keys is pressed, the frequency resolution indicators and lamp drivers will indicate the selected resolution which button was pressed and load that information into the resolution register. The ±1 Bit output of this register tells the ±1 Adder (located on A2A11) on which digit to operate.

P/O DCU Front Panel Board Assembly

Pin 2 of the resolution register U9 goes high when the appropriate digit is clocked through the ±1 Adder by CLK1. The desired resolution, selected by switches S3 through S6 and latched by U5, is clocked into U9 by the inverted GO line. When GO changes level, U9 becomes a serial register and the selected resolution is shifted through by CLK1. Three supporting circuits are significant. Diode CR1 clocks U5 when the LOCAL line goes low (when the instrument switches to remote). This causes the lows at U5's D inputs to appear at U9, thus disabling the ±1 Adder. U6A and associated capacitor and resistors debounce the RESOLUTION keys. OR gate Buffer, U1, drives the frequency resolution indicator circuitry, ensuring that the selected resolution light and any higher significant digit lights are on.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD7 was used to isolate a front panel problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Oscilloscope .... HP 1980B
Controller .... HP 85B or HP 9836A

1. Set the LINE switch to ON. Press the PRESET (3 GHz) key. Push the right hand (least significant digit) tuning resolution key. All four tuning resolution indicators should light. Rotate the TUNING knob clockwise and counterclockwise. The frequency should change in 1 kHz steps. If not correct, skip to step 9.

2. Press the next tuning resolution key. The least significant frequency resolution indicator should extinguish. The frequency should tune in 10 kHz steps when the TUNING knob is turned.

3. Press the next tuning resolution key. The 10 kHz resolution indicator should extinguish. The frequency should tune in 1 MHz steps.

4. Press the most significant tuning resolution key. Only the most significant resolution indicator should remain lighted. The frequency should tune in 100 MHz steps.

5. Press the HOLD key. The remaining tuning resolution indicator should extinguish and the frequency should not change when the TUNING knob is turned. If everything is correct so far, the tuning circuits on this service sheet are working. Otherwise, skip to step 9.

6. Set the rear panel FREQ STANDARD switch to EXT. The INTERNAL REF OFF and NOT PHASE LOCKED annunciators should light. Return the switch to INT.

SERVICE SHEET 31 (cont'd)

Troubleshooting (cont'd)

7. Program the CW Generator to 40 GHz (out of range). The REMOTE and OUT OF RANGE lamps should light.

   OUTPUT 719;"P4Z1"

   If everything is correct through this step, the circuits on Service Sheet 31 are working.

8. Return the CW Generator to local operation and press PRESET (3 GHz).

   NOTE

   When the CW Generator is returned to local with an out-of-range frequency displayed, it will begin to search in 1 kHz steps until an in-range frequency is reached. If one of the tuning resolution push-buttons is pressed, the instrument will search in the resolution selected.

9. If the frequency tunes but one or more of the resolution indicators does not light, troubleshoot U1, the lamps and their drivers.

10. If the frequency display does not tune, the problem may be in any of several places including:

    - A2A11 Timing and Control Assembly (Service Sheet 11)
    - Reference Phase Locked Loop (Service Sheet 1)
    - Rotary Pulse Generator (Service Sheet 31)
    - Register 1 (Service Sheet 26)
    - Resolution Register (this service sheet).

To check the resolution register, connect test point pair A2A11TP1 together with an alligator clip to continuously generate clock signals. Compare the signal at A2A1U9 pin 2 with CLK1 (clock 1) as each resolution button is pushed. U9 Pin 2 should go high along with the clock 1 cycle corresponding to the digit selected by a resolution button.

If these pulses are correct, the circuits on Service Sheet 31 are working.

If the pulses are not correct or not present, check A2A1U9 pin 10 for the presence of CLK1 before troubleshooting U5, U9 and U6.

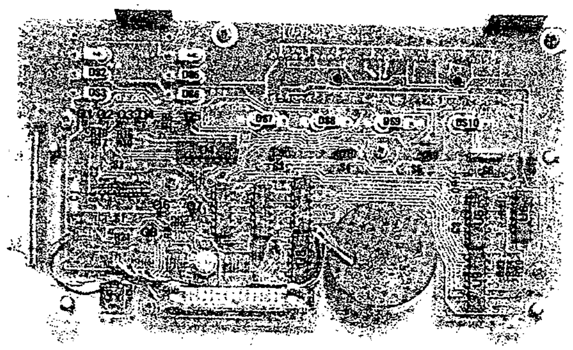
MNEMONICS

Mnemonic	Definition	Explanation
GO	Start Data Cycle	True when the RPG is turned, PRESET is pushed, or a new frequency is remote programmed.
ERRS	Error Store	An out of range frequency is stored in Data Register 1.
NLSDR	Not Lease Significant Digit Range	True (low) indicates the 1 kHz RESOLUTION button was pressed.
±1 BIT	Add now	Tells the ±1 Adder that the digit now at its input is the one selected by a RESOLUTION button.
CLK1	Clock 1	Nine pulses occurring during the first half of a data cycle. Each pulse corresponds to a frequency digit.

DEFINITION

Data Cycle — The process of cycling frequency data through the various registers and the ±1 Adder, usually for the purpose of changing frequency.

P/O A2A1 ASSEMBLY



NOTE: S1-6 ARE ON THE OPPOSITE SIDE OF THE BOARD.
DS2,3,5-10 ARE ON THE OPPOSITE SIDE OF THE BOARD.

Figure 8-118 P/O A2A1 Front Panel Assembly Component Locations

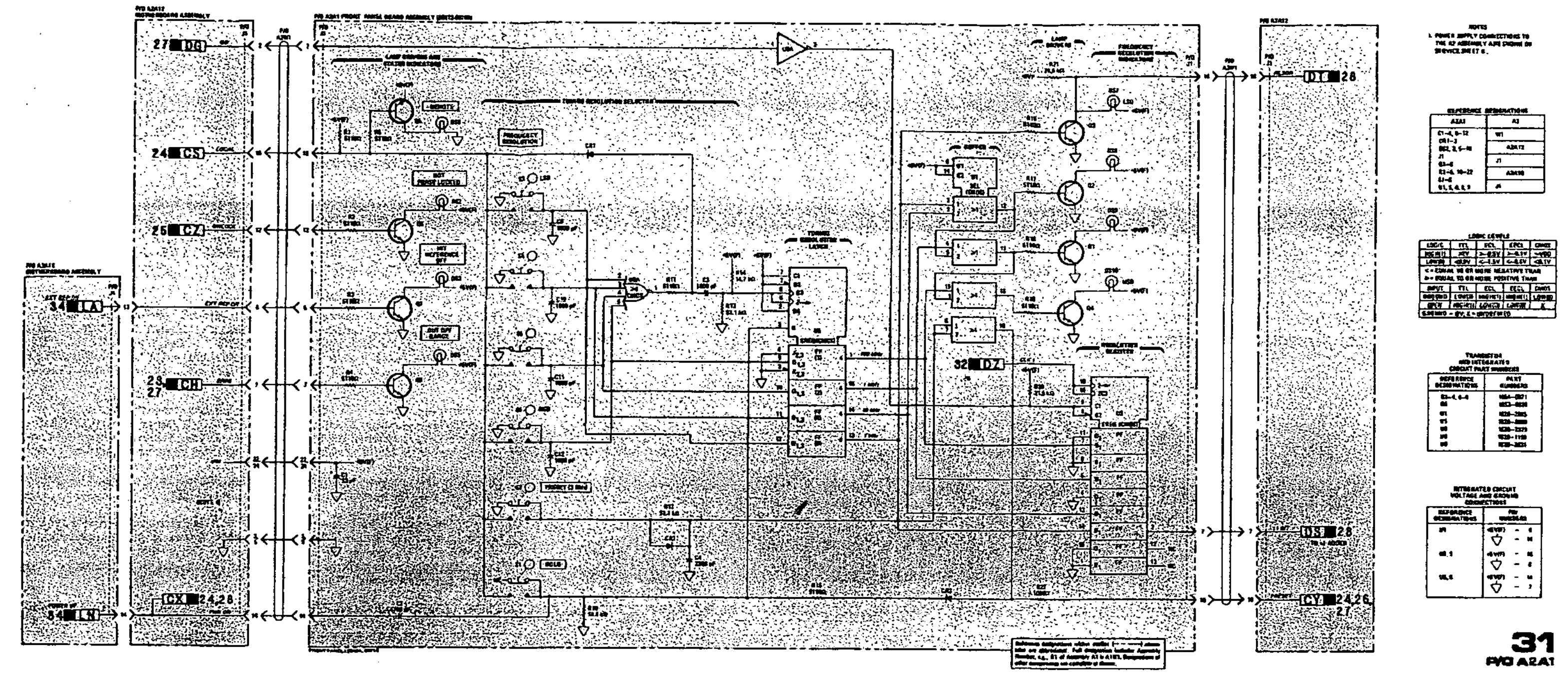


Figure 8-119. P/O GCU Front Panel Assembly Schematic Diagram

SERVICE SHEET 32

P/O DCU FRONT PANEL ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
Remote/Local Interface Block Diagram	Service Sheet BD7
Power Supplies Block Diagram	Service Sheet BD10
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The DCU front panel (A2A1) consists of the line (power) switch, frequency controls and indicators, and status annunciators.

This part of the A2A1 assembly contains the FREQUENCY MHz display circuits, the oven temperature comparator, the LINE (on-standby) switch, and the TUNING Rotary Pulse Generator (RPG).

P/O DCU Front Panel Board Assembly

Decoder/displays DS1 through DS8 display the CW Generator's output frequency. The display is updated during the first half of each data cycle. As each digit, starting with 1 kHz, appears on the DR1I 1—8 lines, the strobe latch, U4, sequentially latches the data in the associated display. U4 is clocked by CLK1 which is delayed by R23, C5, U8C and U8E. The delay allows the data lines to settle.

The four-digits on the left (DS1—DS4) have leading zeros blanked by U3 and associated components. Blanking is done sequentially starting with DS1 but a display blanks only when the blanking input stays high thus ensuring that only leading zeros are blanked. NOR gate U6B indicates zeros by outputting a high level. This signal is clocked through U3 by CLK1 (undelayed) and applied to DS1. When a non-zero digit appears at U6B, the low at the output is clocked through U3. At the next CLK1 pulse, U3 is reset by U2C.

The OVEN annunciator comes on when the 10 MHz Reference Oscillator oven is below normal temperature. An analog voltage inversely proportional to the temperature is applied to the inverting input of U7 by the OVEN MON line. When the voltage goes above 17V, the output swings negative turning on DS4 and putting a low on the OVN OK line.

The RPG outputs pulses on lines RPG1 and RPG2 when the TUNING knob is turned. Tuning direction is indicated by the phase relationship of the pulses. When the TUNING knob is turned clockwise RPG1 leads RPG2.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1, BD7, BD10 and Service Sheet 31 was used to isolate a Front Panel problem to the

SERVICE SHEET 32 (cont'd)

TROUBLESHOOTING (cont'd)

circuits shown on this schematic. The following information will aid in isolating the defective component:

Test Equipment

Digital Voltmeter .... HP 3456A
Oscilloscope .... HP 1980B

1. Press the PRESET (3 GHz) pushbutton. The display should indicate exactly 3000.000 MHz. If the display is correct, CLK1 is correct and all the displays are properly receiving data.

NOTE

A floating data input on display will be interpreted and displayed as a logic high.

2. Set the frequency to 2345.678 MHz. If the frequency cannot be changed, go to step 7. Disconnect the 10 MHz clock signal (blue cable) from A3A1A1. Select 1 kHz tuning resolution.

3. Turn the TUNING knob clockwise.

4. Use the manual clock switch on A2A11 to generate clock pulses. The display should progress in this manner:

Clock Pulse	Display
1	99999.999
2	77777.779
3	66666.679
4	55555.679
5	44445.679
6	33345.679
7	22345.679
8	02345.679
9	2345.679

Generate nine (9) more clock pulses to complete the controller cycle. The display should not change during the latter nine pulse. If the data does not clock in properly, check the input data (DR1I 1—8) with the voltmeter to ensure it is correct. If the data is correct, troubleshoot U4, U3 and A2DS 1—8. If the data is incorrect, go to Service Sheet 28 to continue troubleshooting.

5. Set the instrument to STANDBY. The STANDBY annunciator should light.

6. Unplug the instrument for 1—2 minutes. Reconnect the power Mains. The OVEN and STANDBY annunciators should both come on. If neither comes on, suspect a burned out lamp (with the OVEN light A2A1U7 or the A3A8 Reference Oscillator could be defective). If everything is correct to this step, the A2A1 and A2A3 assemblies are working.

7. Swing open the controller front panel (requires removal of four screws) to gain access to the outputs of the A2A2 Rotary Pulse Generator (RPG). Observe the outputs (RPG2 and RPG1) on the oscilloscope. When tuning clockwise the TTL pulses of RPG1 should occur before RPG2 pulses and when tuning counterclockwise RPG2 should occur before RPG1. If the pulses occur properly, the RPG is working and troubleshooting should proceed to Service Sheet 27.

MNEMONICS

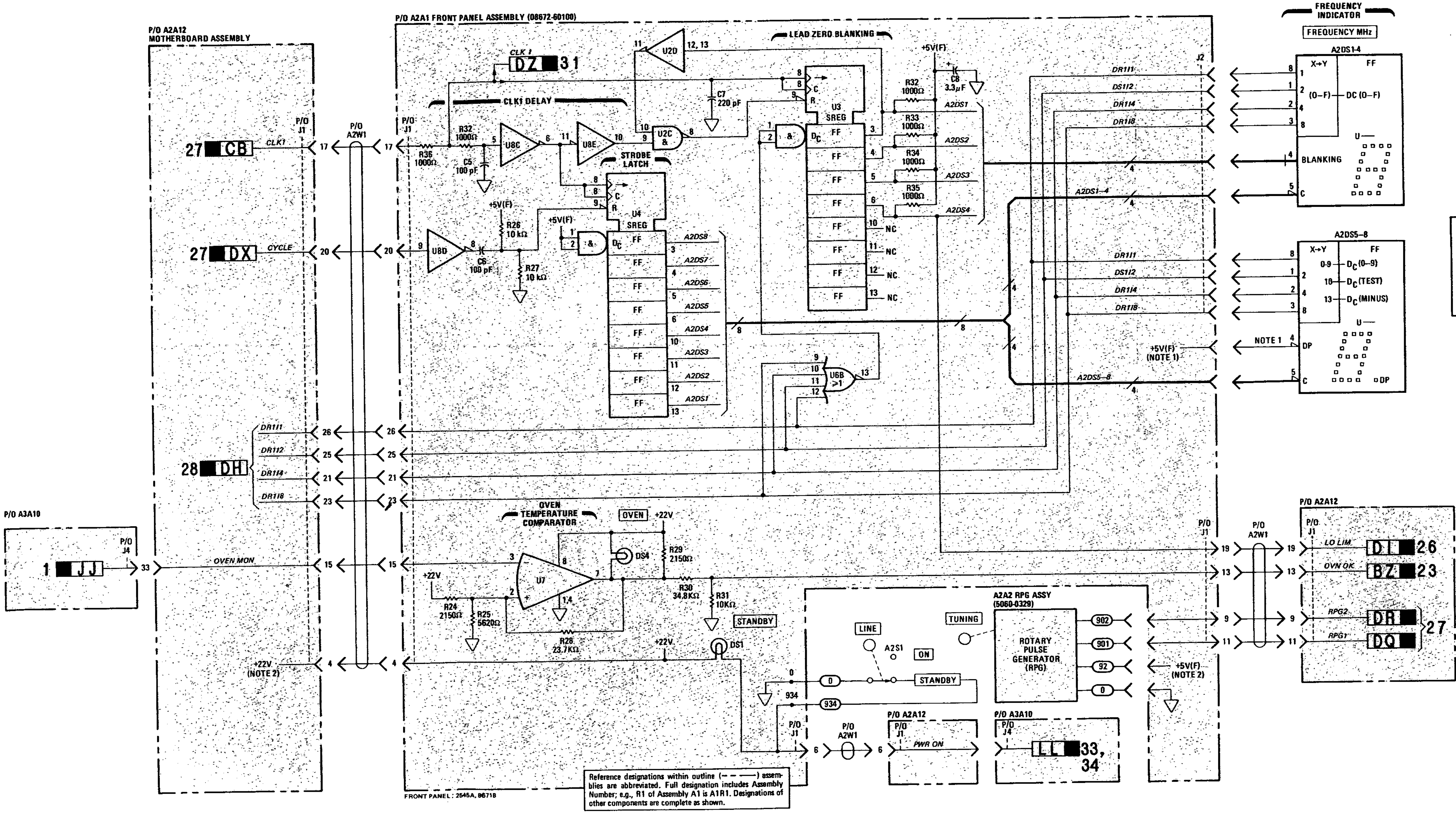
Mnemonic	Definition	Explanation
CLK1	Clock 1	Nine pulses during the first half of the data cycle. Each pulse coincides with a frequency digit.
CYCLE	One data cycle	Low during the first half of the data cycle, high during the second half.
DR1I 1—8	Data Register 1 In	Four lines that carry frequency information sequentially by digit in BCD format.

DEFINITION

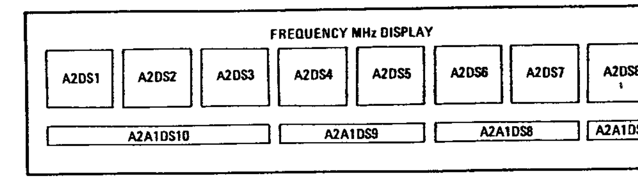
Data Cycle — The process of cycling frequency data through the various registers and the ±1Adder, usually for the purpose of changing frequency.

NOTES

1. PIN 4 OF A2DS5 IS CONNECTED TO GROUND. PIN 4 of A2DS6 – 8 IS CONNECTED TO +5V(F).
2. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.



FREQUENCY MHz DISPLAY



REFERENCE DESIGNATIONS

A2A1	A2
C5–8 DS1,4 J1 R23–35 U2–4, 6–8	DS1–8 S1 W1
	A2A12
	J1
	A3A10
	J4

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH (1)	>2V	>−0.5V	>−0.1V	<VDD
LOW (0)	<0.8V	<−1.5V	<−0.6V	>0.1V

< = EQUAL TO OR MORE NEGATIVE THAN
> = EQUAL TO OR MORE POSITIVE THAN

INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW (0)	HIGH (1)	HIGH (1)	LOW (0)
OPEN	HIGH (1)	LOW (0)	LOW (0)	X

GROUND –0V; X = UNDEFINED

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
A2	
DS1–4	1990-0651
DS5–8	1990-0686
A2A1	
U2	1820-1197
U3,4	1820-1433
U6	1820-0948
U7	1826-0026
U8	1820-1199

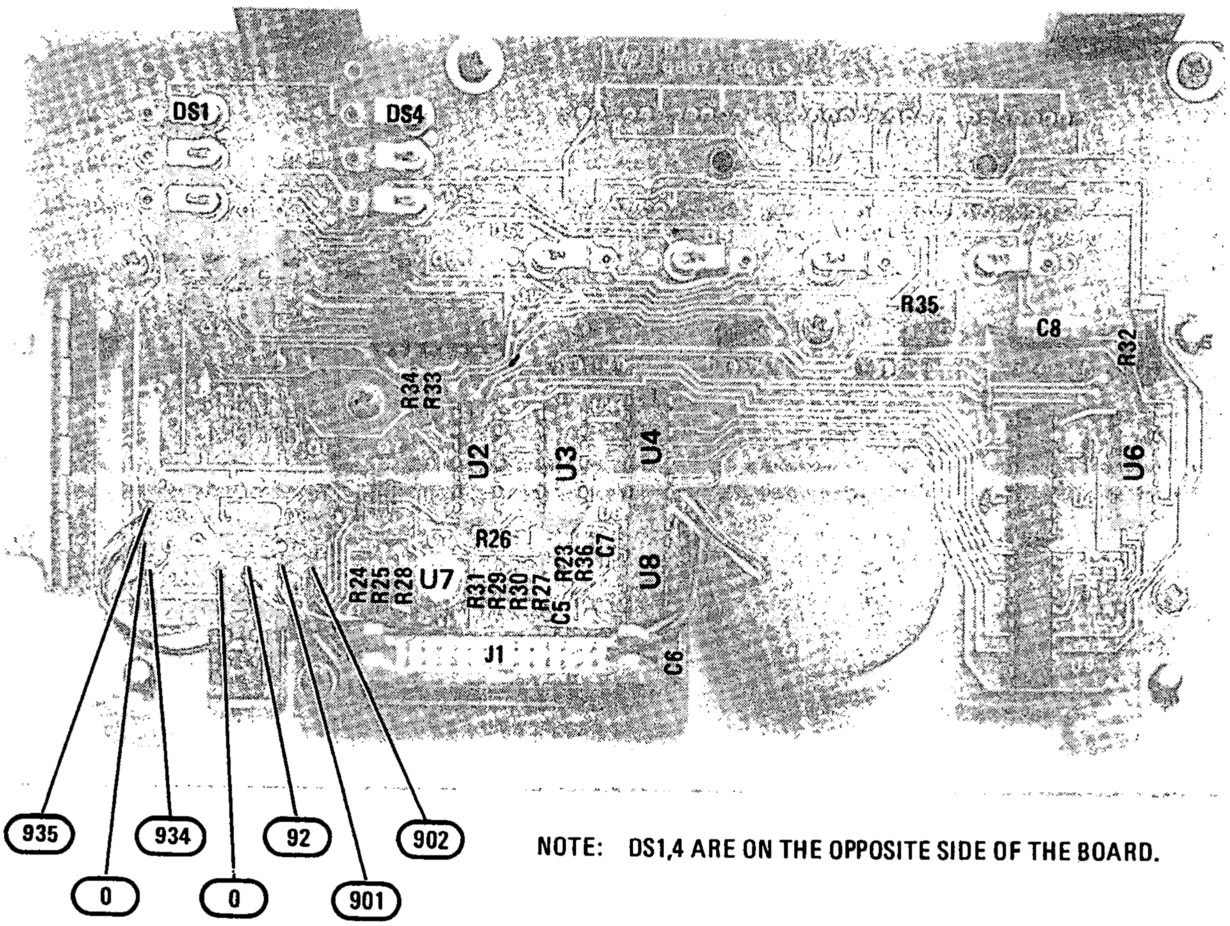
INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
A2 DS1–8	+5V(F) – 7 ▽ – 6
A2A1 U2–4, 6, 8	+5V(F) – 14 ▽ – 7

32
P/O A2A1,A2A2

Figure 8-121. P/O DCU Front Panel Assembly Schematic Diagram

P/O A2A1 ASSEMBLY



NOTE: DS1,4 ARE ON THE OPPOSITE SIDE OF THE BOARD.

Figure 8-120. P/O A2A1 DCU Front Panel Assembly Component Locations

SERVICE SHEET 33

RECTIFIER ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
Power Supplies Block Diagram	Service Sheet BD10
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

If the power cable W6 is connected between the line (mains) power outlet and the A3A11 Line Module, primary ac power is connected to transformer A3T1 and fan relay A3A10K1. A line voltage selector matches the line voltage to the transformer primary. When the front panel LINE switch is set to ON, 120 Vac is connected to the cooling fan A3B1.

The secondary ac voltages from the transformer are always present on the rectifier circuit board if the line voltage is connected to the Signal Generator. The four inputs are rectified and filtered before being output to the regulator circuits.

+22 Volt Regulator

The +22V Regulator supplies power to the Reference Oscillator's heater circuit any time the instrument is connected to the line voltage, to maintain operating temperature. This keeps the instrument ready to operate immediately after the LINE switch is set to ON.

The unregulated +20V is also used to supply power to the +22V Regulator. A3A1U1 is a monolithic 18 volt regulator that has the common terminal raised +4 Vdc above ground. If the regulated output exceeds +25 Vdc, the overvoltage protection circuit shorts the output to ground which causes the regulator to limit its output current. This action effectively turns the CW Generator off. If the primary power fuse A3F1 does not burn out, the instrument must be disconnected from the line voltage to reset the overvoltage protection circuit.

Input Overvoltage Protection

If the input voltage on the unregulated −40V line exceeds 82.5 Vdc (measured from −40V Unreg to −40V Return), the overvoltage protection circuit will short circuit the −40V input causing primary power fuse A3F1 to burn out. The intent of this circuit is to protect the instrument if 220 or 240 Vac is input with the Line Voltage

SERVICE SHEET 33 (cont'd)

Selector set for 100 or 120 Vac. If this occurs, change the fuse to correct value and orient the Line Voltage Selector so the line voltage is correctly matched to the transformer.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet BD1 and BD10 was used to isolate a malfunction to the A3A1 Rectifier Assembly. It is also assumed that an attempt was made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter .... HP 3456A

To troubleshoot the Rectifier Assembly proceed as follows:

1. Connect the instrument to the line (Mains) power.
2. LED A3A1DS1 should be on.
3. Verify that the voltage at A3A1TP1 is +22.0±0.1 Vdc.
4. Disconnect the power cable from the line power.
5. Install the assembly on an extender board and reconnect the instrument to the line power.

CAUTION

To prevent damage to the power supplies, measure the following voltages with a voltmeter that has a floating common terminal.

6. Measure voltages between edge connector pins as shown below:

Negative Pin	Positive Pin	Voltage Range
5	6	27-35 Vdc
15	17	15-21 Vdc
1	3	48-60 Vdc
7	10	10-14 Vdc

7. If any of the voltages are incorrect, check the ac input voltages from the power transformer. The voltages should be as shown on the schematic.
8. The transformer output may be checked with no load by removing the A3A1 assembly.

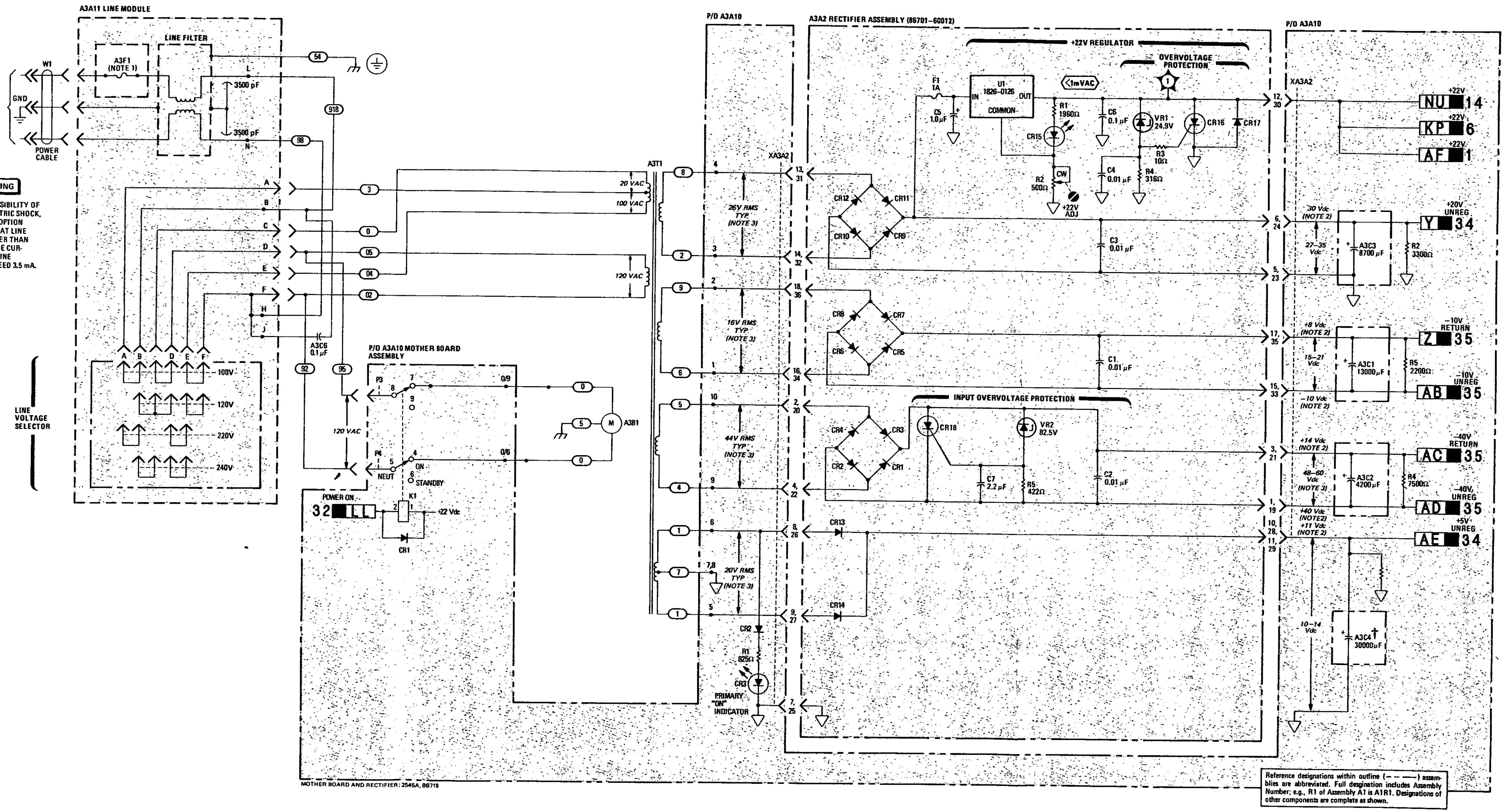
NOTE

With A3A1 removed the fan will run continuously in both STBY and ON. After repairing the A3A1 assembly, perform the Power Supply Adjustments in Section V. Also, perform the performance tests (if any) that led to the power supply repair.

LINE VOLTAGE
100,120,220,
240 VAC + 5%,
−10% 48 TO 66 Hz
300 VA MAX

WARNING

TO AVOID THE POSSIBILITY OF HAZARDOUS ELECTRIC SHOCK, DO NOT OPERATE OPTION 003 INSTRUMENTS AT LINE VOLTAGES GREATER THAN 126.5 Vac. LEAKAGE CURRENTS AT THESE LINE PARAMETERS EXCEED 3.5 mA.



WARNING

SECONDARY ac VOLTAGES OF GREATER THAN 30 Vac AND RECTIFIED dc VOLTAGES OF GREATER THAN 60 Vdc ARE ALWAYS PRESENT ON THIS ASSEMBLY WHEN THE INSTRUMENT IS CONNECTED TO THE LINE VOLTAGE. THESE VOLTAGES COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING ON THE CIRCUIT BOARDS WITH POWER SUPPLIED TO THE INSTRUMENT.
IF THIS CIRCUIT BOARD IS PLACED ON AN EXTENDER BOARD, THE POSSIBILITY OF COMING IN CONTACT WITH THE SECONDARY ac VOLTAGES (>30 Vac) OR RECTIFIED dc VOLTAGES (>60 Vdc) IS GREATLY INCREASED. THESE VOLTAGES COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING WITH THIS CIRCUIT BOARD WITH POWER SUPPLIED. WORK WITH ONE HAND. DO NOT TOUCH THE EXTENDER BOARD.

CAUTION

DO NOT REMOVE OR INSERT POWER SUPPLY BOARDS WITH THE POWER CABLE CONNECTED. DAMAGE TO THE INSTRUMENT MAY OCCUR.

NOTES

1. 3A 100/120 VAC
   1.5A 220/240 VAC.
2. MEASURED WITH RESPECT TO CHASSIS GROUND.
3. USE VOLTMETER WITH FLOATING COMMON.

REFERENCE DESIGNATIONS

NO PREFIX	A3A10
W1	CR1–3, K1, P3,4, R1–5, XA3A2
A3	
B1, C1–6, F1, T1	
	A3A11
A3A2	TB1
C1–7, CR1–18, F1, R1–5, TP1, U1, VR1,2	

33
A3A2, A3A10, A3A11

Figure 8-123. Rectifier Assembly Schematic Diagram

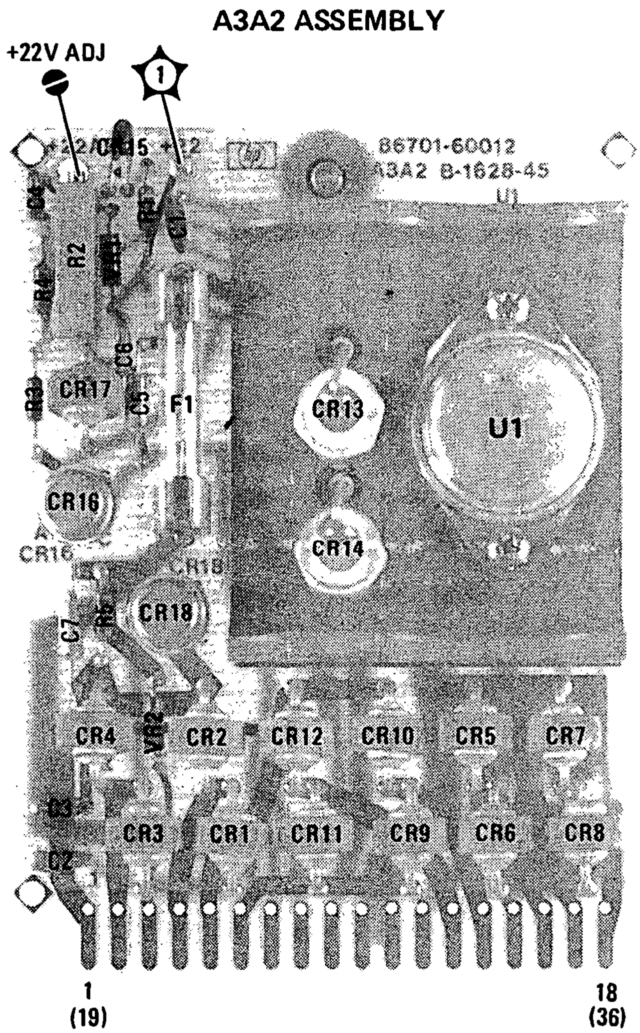


Figure 8-122. A3A2 Rectifier Assembly Component and Test Point Locations

SERVICE SHEET 34

POSITIVE REGULATOR ASSEMBLY

REFERENCES

Overall Block Diagram	Service Sheet BD1
Power Supplies Block Diagram	Service Sheet BD10
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The +20V Regulator provides a reference voltage for all regulated supplies other than the +22V supply. If, for any reason, the +20V supply is turned off, all the power supplies on the A3A3 and A3A4 Assemblies will also be off. This effectively turns off the instrument. Under normal circumstances the +20V Regulator is turned on or off with the front panel LINE switch.

+20V Regulator

A3A3Q2 and Q3 form a current source to bias A3Q3. The output voltage is divided by A3A3R9, R50 and R10 and coupled to the inverting input of A3A3U3. The other input to A3A3U3 is the reference voltage from A3A3VR2. The divided voltage is adjustable and sets the output voltage level.

When current flow through the +20V Regulator gets too high the voltage drop across A3A3R3 will equal that across A3A3R4, and A3A3Q4 will begin to conduct. The output of A3A3U3 will go more positive, which will turn A3A3Q4 on harder. This will shunt the bias current source away from A3A3Q3 and reduce the current drive of A3A3Q3, and limit the current available from the supply.

If the output voltage of the +20V Regulator reaches +23 Vdc, the overvoltage protection circuit shorts the output to ground. This causes the current limiter to turn the regulator off.

Front Panel Shutdown

The front panel LINE switch in the STBY position causes the Power On input to A3A3U1A to be 0V. This turns on A3A3Q3, which turns the +20V Regulator off. In the LINE switch ON position, the input voltage is approximately +22 Vdc which turns A3A3Q8 off.

Thermal Shutdown

This circuit operates much like the Front Panel Shutdown. At normal operating temperatures (less than 55°C) the value of thermistor A3A3RT1 is much greater than the 107 ohms of A3A3R53. Therefore, the voltage at the inverting input of A3A3U1B is more positive than the non-inverting input. This causes A3A3Q1 to be turned off. At temperatures exceeding 85°C, the resistance of RT1 drops below 107 ohms which causes A3A3Q1 to turn on. Even though the instrument is effectively turned off, the fan will continue to run to cool the instrument. The instrument will not return to normal operation until the internal temperature drops to +55°C or less.

+5.2V Regulator

The operation of this circuit is much like that of the +20V Regulator. The reference voltage is provided by the +20V supply and a separate fuse is provided for further protection.

Power Up/Down Detector

This circuit outputs a Power Up/Down voltage (+5V or 0V) when the instrument is turned on or off. This lets the last frequency displayed before turn-off to be restored at turn-on.

Reference Oscillator Power Supply

A rear panel switch controls power supplied to the A3A8 Reference Oscillator Assembly. When the FREQUENCY STANDARD INT/EXT switch is set to EXT, the Reference A3A3Q9 is turned on, which turns off A3A3Q10, shutting down the +11V supply. When the switch is set to INT, A3A3Q9 is turned off, and A3A3Q10 is turned on, so that +11V is turned on.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet BD1 and BD10 was used to isolate a malfunction to the A3A3 Positive Regulator Assembly. It is also assumed that an attempt was made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter .... HP 3456A

To troubleshoot the Positive Regulator Assembly proceed as follows:

1. Connect the line (Mains) power to the instrument and set the LINE switch to ON. Set rear panel FREQUENCY STANDARD INT/EXT switch to INT.

2. Observe the LED on the A3A3 Assembly. The two red LEDs (+20V and +5.2V indicators) should be on and the yellow LED (Thermal Shutdown indicator) should be off.

3. Set the LINE switch to STBY. The +20V and +5.2V indicators should turn off.

4. Set the LINE switch to ON and measure the following regulator output voltages.

Regulator	Test Point	Line Switch Position	
		ON	STANDBY
+20V*	A3A3TP5	+20.000±0.001 Vdc	0V
+11V	A3A3TP6	+11±1.1 Vdc	0V
+5.2V	A3A3TP2	+5.2±0.1 Vdc	0V

*The +20V supply is the reference for all other except the +22V supply. If the +20V supply is incorrect, all other supplies except the +22V supply will probably be incorrect.

5. While measuring the +11V supply, switch the FREQUENCY STANDARD INT/EXT switch to EXT. The supply should go to 0V. Set the FREQUENCY STANDARD INT/EXT switch to INT.
6. If the output voltages are incorrect, measure the following input voltages.

Input Voltage	Test Point	Line Switch Position	
		ON	STANDBY
+20VUNREG	A3A3TP4	≈32 Vdc	≈35 Vdc
+5.2 UNREG	A3A3TP1	≈12 Vdc	≈14 Vdc

Connect voltmeter common lead to chassis ground for these measurements.

CAUTION

DO NOT remove or install power supply boards with the power cable connected. Instrument damage may occur.

7. If the output voltages are incorrect and input voltages are correct, check the fuses before continuing. Use the voltages noted on the schematic to continue troubleshooting.
8. To test the Thermal Shutdown circuit, ground A3A3U1B-13. The yellow LED (Thermal Shutdown Indicator) should light and the 5 red LEDs on A3A3 and A3A4 assemblies should turn off. The front panel should turn off and the fan should continue to run. When the ground is removed the instrument should return to normal operation.
9. If the power supply problem is associated with the negative regulator circuits, refer to Service Sheet 35.

SERVICE SHEET 34 (cont'd)

Troubleshooting Line Related Spurious Signals

NOTE

This procedure is not part of the normal troubleshooting information. This procedure normally follows failure of the Power Line Related Spurious Performance Test.

High line related spurious signals can be caused by many different things; some ingenuity may be required to isolate the more subtle causes such as ground loops and externally inducted vibrations. The following procedure suggests items to check when trying to isolate a line spurious problem.

1. With a sensitive oscilloscope, observe the power supply ripple on each of the positive and negative supplies. The +20V, +11V, −10V, and −40V supplies should have ripple less than 300 μV while the +22V, 5.2V, and −5.2V should have ripple less than 1 mV. Power supply induced ripple will generally be twice the line frequency plus harmonics (e.g., 120, 240, 360 Hz, etc., for a 60 Hz line). If one or more supplies has excessive ripple, check the filter capacitors.
2. If any of the circuit boards were removed and reinstalled, line related spurious can increase if the board position in the socket was changed or if ground contact resistance increased. Remove the board, clean the edge connector contact and reinsert the board. When reinserting the board, push it as far as possible toward one end of the edge connector socket and thoroughly tighten any screws holding the board in place.
3. Fan induced spurious will generally be 3 to 5 Hz below line frequency. A loose circuit board (covers not properly tightened) can vibrate more than normal and may increase fan related spurious. The 10 MHz Reference Oscillator is also sensitive to vibration. Check the reference to make sure the rubber shock mounts are in good condition and the reference oscillator is properly mounted in them. An out of balance fan or one with defective bearings can generate much vibration. To isolate the origin, turn off the instrument and insert an insulated tool to prevent the fan from turning. Then turn on the instrument and see if the spurious signals have decreased. Do not operate the instrument longer than a few minutes with the fan disabled.
4. Apparent line related spurious can be caused by external instruments connected to the FM input when the FM deviation range is set to 10 MHz. A high level hum signal can cause significant FM sidebands even though the FM input is high pass filtered on the wide deviation ranges.
5. Bad ground connections and ground loops can occasionally cause spurious problems. Make sure the A1 and A2 modules are fully seated on their connectors and that all coax cables and circuit boards are properly seated in their connectors.

NOTE

After repairing the A3A3 assembly, perform the Power Supply Adjustments in Section V. Also, perform the performance tests (if any) that led to the power supply repair.

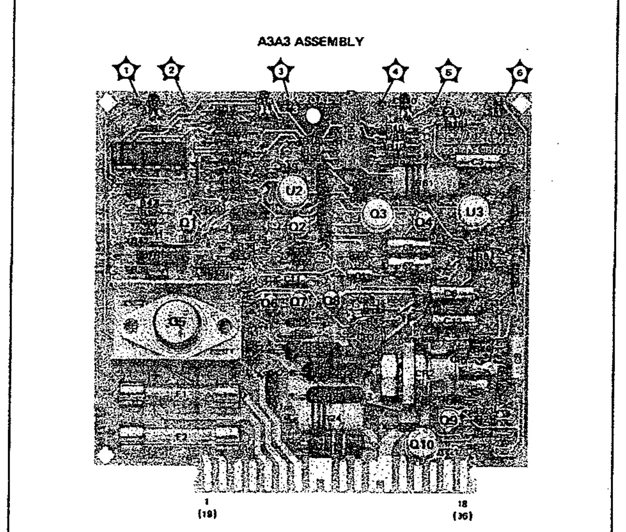


Figure 8-124. A3A3 Positive Regulator Assembly Component and Test Point Locations

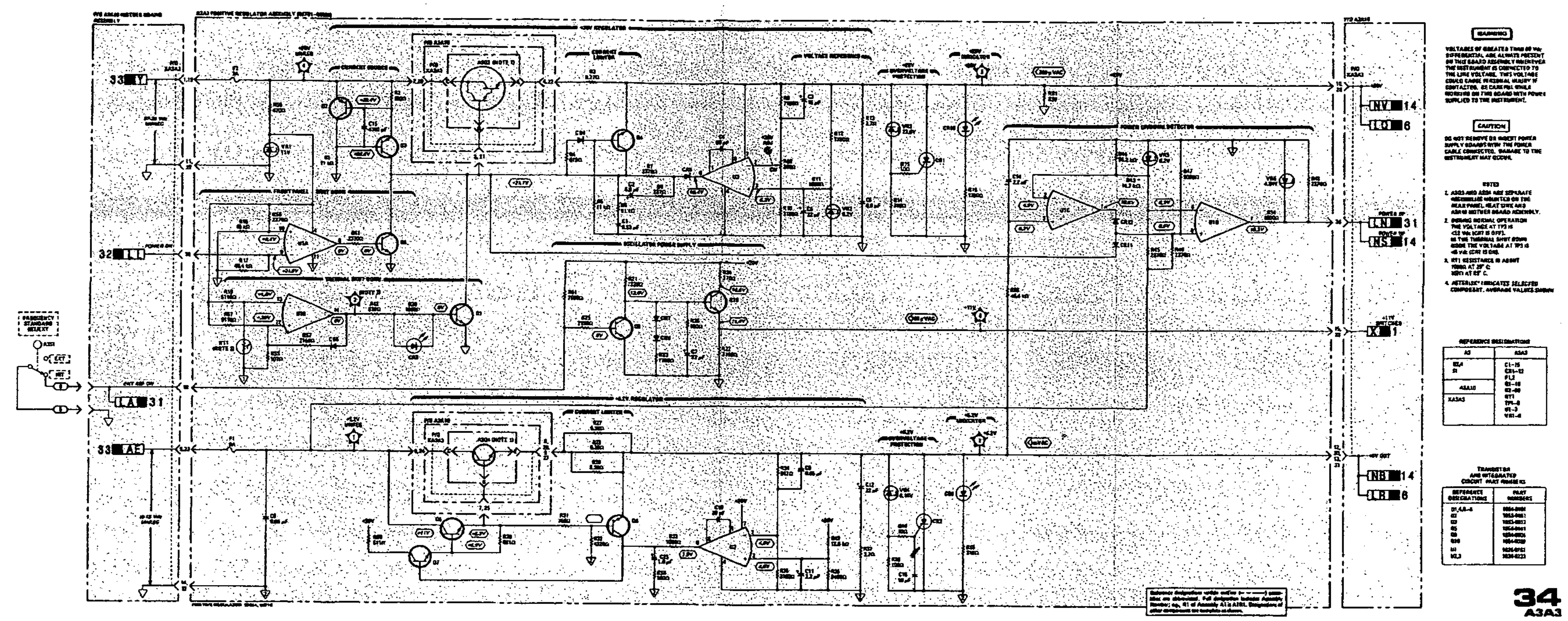


Figure 8-125. Positive Regulator Assembly Schematic Diagram

SERVICE SHEET 35
NEGATIVE REGULATOR ASSEMBLY
REFERENCES

Overall Block Diagram .... Service Sheet BD1
Power Supplies Block Diagram .... Service Sheet BD10
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB)................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The negative regulators are all controlled by the +20V Regulator output. The −10V Regulator and the −40V Regulator operate like the positive regulators. The only difference in the −5.2V Regulator is that the regulation occurs in the negative leg of the supply. Each supply has current limiting and overvoltage protection, and each is fused. The fuse in the −10V Unreg line, A3A4F3, is for the −10V and −5.2V Regulators. Note that there is a separate fuse for the −5.2V Regulator.

−10V Regulator

When the CW Generator is turned on, +20V is applied to A3A4U2. The −10V output goes more negative until the voltage at the non-inverting input of A3A4U2 is 0 Vdc. When current flow through A3Q1 exceeds normal operation, the voltage drop across A3A4R1 and A3A4R23 will equal that across A3A4R2 and A3A4CR1. Then A3A4Q1 will begin conducting. The output of A3A4U2 will go more positive. This turns A3A4Q1 on harder and reduces the bias on A3Q1 which limits the current available from the −10V supply.

+5.2V Regulator

The operation of this circuit is much like that of the −10V Regulator. The main difference is that the regulation is in the negative leg of the supply. Because it takes a feedback voltage of the opposite sense to control regulation, the +20V to −5.2V voltage divider is applied to the inverting input of U1.

+40V Regulator

The regulating action of this circuit is like that of the −10V Regulator. The differences in component values are due to the difference in voltage and current requirements.

−10V Switch

The RF OUTPUT switch (on the front panel of the CW Generator) controls the −10V SWITCH. This voltage is the supply voltage for the A3A9A3 YIG Tuned Oscillator Assembly.

SERVICE SHEET 35 (cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet BD1 and BD10 was used to isolate a malfunction to the A3A4 Negative Regulator Assembly. It is also assumed that an attempt was made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter .... HP 3456A

CAUTION

DO NOT remove or install power supply boards with the power cable connected. Damage to the instrument's internal circuitry may occur.

To troubleshoot the Negative Regulator Assembly, proceed as follows:

1. Connect the line (Mains) power to the CW Generator and set the LINE switch to ON.
2. Observe the three red indicators on the A3A4 Assembly. All should be on unless the instrument is in thermal shutdown.

CAUTION

To avoid damage to the power supply circuits, disconnect the power cable from the line voltage before removing or replacing any power supply circuit board.

3. Measure the following regulator output voltages. If any of the voltages are incorrect, go to step 4. If all the voltages are incorrect, place the A3A4 assembly on on extender board and measure the +20V input at pin 9 of the edge connector.

Regulator	Test Point	Output Voltage
−40V	A3A4TP1	−39.0 to −40.6 Vdc
−10V	A3A4TP4	−10.0±0.2Vdc
−5.2V	A3A4TP5	−5.2±0.1Vdc

CAUTION

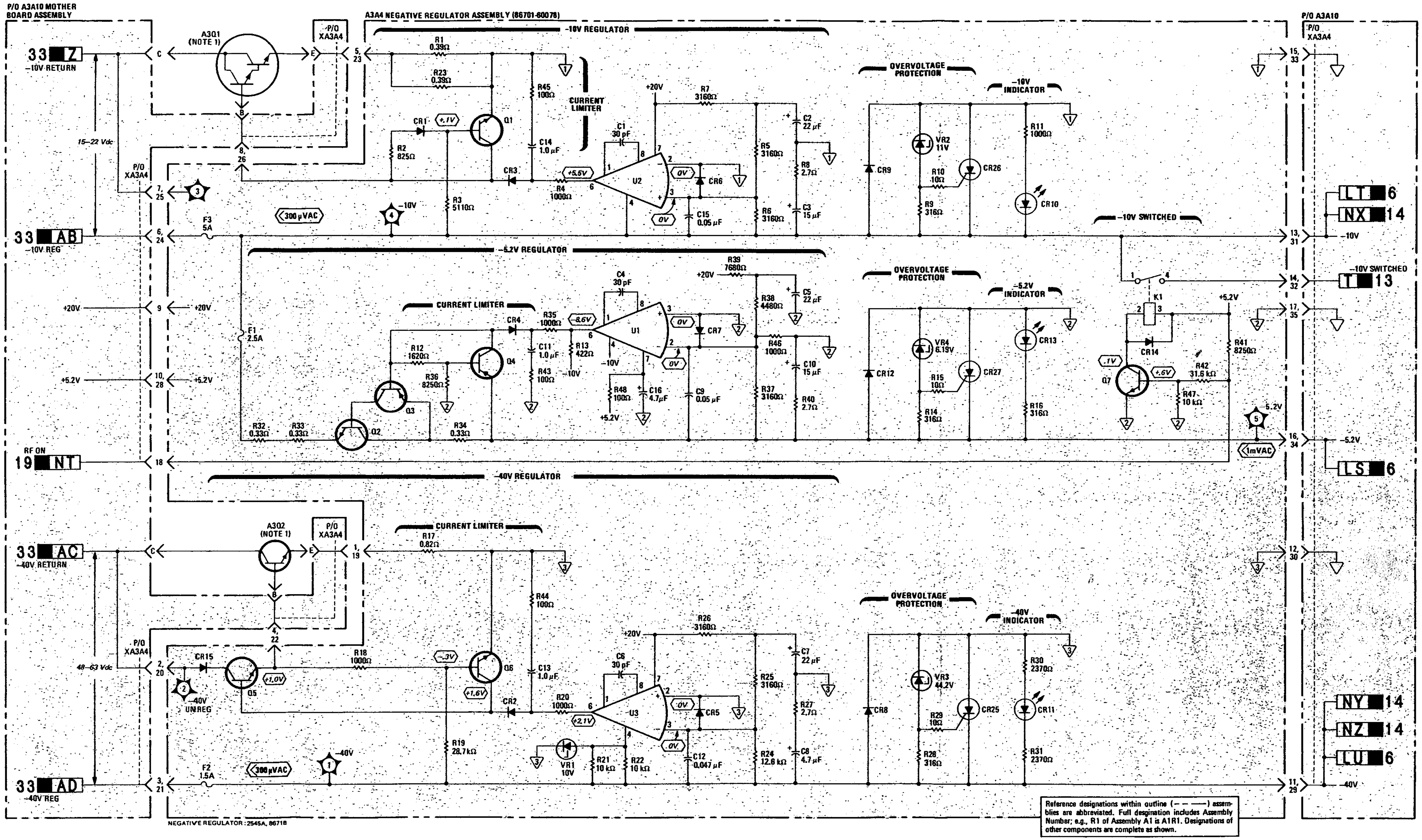
To avoid damage to the power supply circuits, measure the voltages of step 4 with a voltmeter that has a floating common.

4. Check the fuses for the two supplies shown and measure the input voltages to the regulators. They should be as indicated in the table below.
5. Measure the output voltage at edge connector pin 14. With the front panel RF switch ON, the voltage should measure about −10 Vdc; with the front panel RF switch OFF, the voltage should be approximately +0.5 Vdc.
6. If the input voltages are correct but the output voltages are incorrect, use the voltages on the schematic to isolate the bad component.

NOTE

After the A3A4 assembly is repaired, perform the Power Supply Adjustments in Section V. Also, perform the performance tests (if any) that led to the power supply repair.

Input Voltage	Test Point (Positive)	Test Point (Negative)	Line Switch Position	
			ON	OFF
−10V UNREG	A3A4TP3	A3A4TP4	≈19 Vdc	≈22 Vdc
−40V UNREG	A3A4TP2	A3A4TP1	≈57 Vdc	≈63 Vdc



WARNING

DC VOLTAGES OF >60 Vdc DIFFERENTIAL ALWAYS PRESENT ON THIS BOARD ASSEMBLY WHENEVER THE INSTRUMENT IS CONNECTED TO THE LINE VOLTAGE. THIS VOLTAGE COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING ON THIS CIRCUIT WITH THE LINE VOLTAGE CONNECTED. IF THIS CIRCUIT BOARD IS PLACED ON AN EXTENDER BOARD, THE POSSIBILITY OF COMING IN CONTACT WITH THE 60 Vdc DIFFERENTIAL IS GREATLY INCREASED. THIS COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING WITH THIS CIRCUIT BOARD WITH POWER SUPPLIED. WORK WITH ONE HAND. DO NOT TOUCH THE EXTENDER BOARD.

CAUTION

DO NOT REMOVE OR INSERT POWER SUPPLY BOARDS WITH THE POWER CABLE CONNECTED. DAMAGE TO THE INSTRUMENT MAY OCCUR.

NOTES

1. A3Q1 AND A3Q2 ARE MOUNTED ON THE REAR PANEL HEAT SINK AND A3A10 MOTHER BOARD ASSEMBLY.

REFERENCE DESIGNATIONS

A3	A3A4
Q1, 2	C1-16
A3A10	CR1-15, 25-27
XA3A4	F1-3 K1 Q1-7 R1-48 TP1-5 U1-3 VR1-4

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBER

REFERENCE DESIGNATIONS	PART NUMBERS
A3	
Q1	1854-0618
Q2	1854-0294
A3A4	
Q1,6,7	1854-0404
Q2	1854-0441
Q3	1853-0001
Q4	1853-0007
Q5	1854-0271
U1-3	1820-0223

35
A3A4

Figure 8-127. A3A4 Negative Regulator Assembly Schematic Diagram

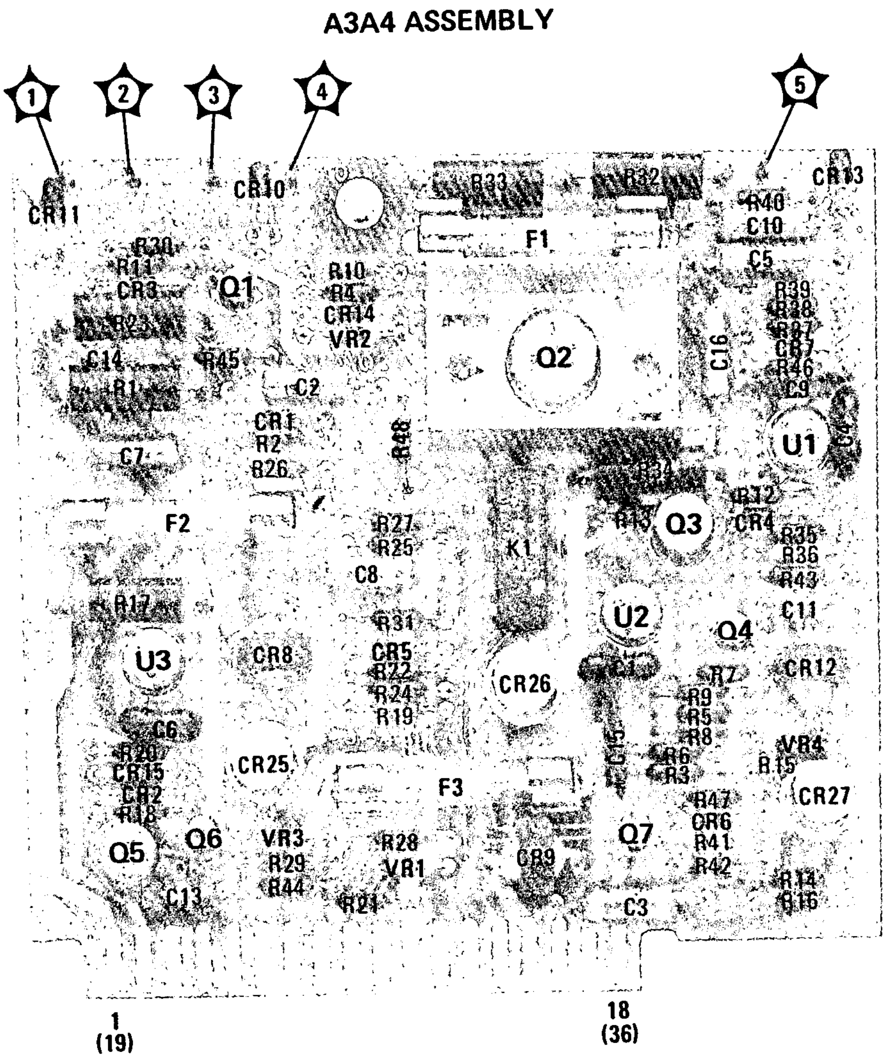
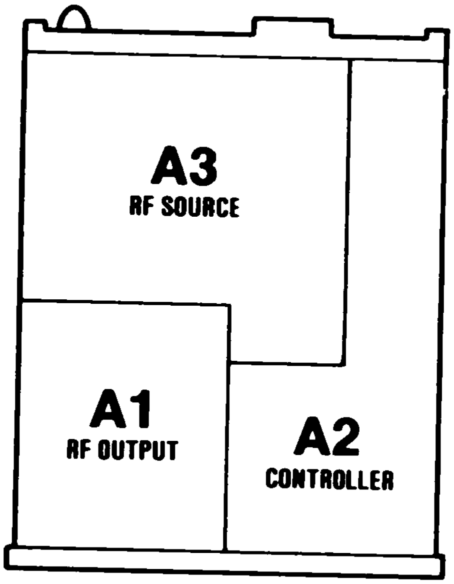


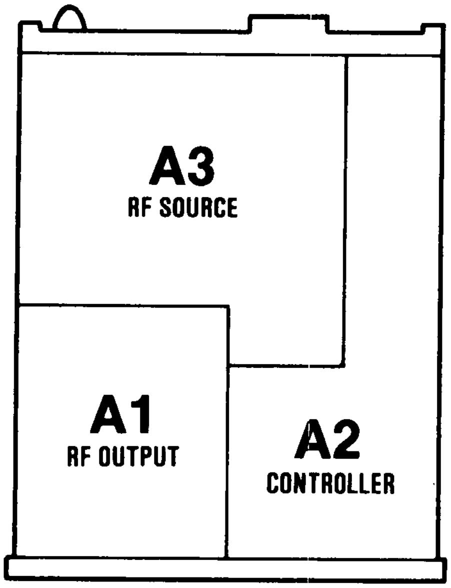
Figure 8-126. A3A4 Negative Regulator Assembly Component Locations



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35



MAJOR ASSEMBLIES, TOP VIEW

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Bd Assembly, RF Output Front Panel	20
A1A2	Display Driver Assembly	20
A1A3	YTM Assembly	15
A1A5	Assembly, ALC	14
A1A6	Board Assembly, Detector	17
A1A7	Assembly, SRD Bias	16
A1A8	Assembly, YTM Driver	15
A1A9	Not Assigned	
A1A10	Assembly, Level Control	18
A1A11	Digital Processor Assembly	19
A1A12	Power Amplifier Assembly	15
A1A13	Interconnect Assembly	14,15,22
A1A14	A1 Mother Board	14-20
A2A1	Assembly, DCU Front Panel	31,32
A2A2	Rotary Pulse Generator	20
A2A3	Assembly, VCO, 160-240 MHZ	8
A2A4	Assembly, 20/30 Phase Detector	7
A2A5	Assembly, 20/30 Divider	6
A2A6	Assembly, Interconnect Adapter	
A2A7	Assembly, Interface	24,25
A2A8	Assembly, Output Register	29,30
A2A9	Assembly, HP-IB Address	22,23
A2A10	Assembly, Register I	26
A2A11	Assembly, Timing Control	27,28
A2A12	A2 Mother Board	6-8,22-32
A3A1A1	Reference Phase Detector Assembly	1
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator Assembly	4
A3A1A4A2	Board Assembly, M/N VCO	4
A3A1A5	M/N Output Assembly	5
A3A1A6	Mother Board, Reference	1-3,5
A3A2	Rectifier Assembly	33
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	Digital-to-Analog Converter Assembly	9
A3A6	YTO Main Coil Driver Assembly	10
A3A7	YTO HF Coil Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Assembly, Sampler	11
A3A9A7	6.2 GHZ Low Pass Filter	13
A3A10	Mother Board	1,3,4,6,10, 13,25,30-35

SERVICE SHEET A

DISASSEMBLY AND REASSEMBLY PROCEDURES

WARNINGS

Disassembly procedures should be performed only by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

A pin-to-pin voltage difference of 60 Vdc may be found on many of the CW Generator's circuit board connectors.

If a circuit board is placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. This voltage could cause personal injury if contacted.

To avoid hazardous electrical shock, the line (mains) power cable should be disconnected before attempting to perform any disassembly procedures.

Battery Replacement. To replace the battery pack, follow the steps listed below:

1. Remove top cover.
2. Grasp the top of the battery holder's clip and pull forward until it slips off.
3. Grasp the battery pack on both sides with your fingers and pull straight out.
4. Position the new battery pack so the metal strips press against the flexible contacts of the battery holder.
5. Note that the bottom of the battery holder clip has a single bend; the top has a double bend. Hook the bottom end under the battery holder and snap the top end in place.

Top and Bottom Cover Removal and Replacement. To remove the covers proceed as follows:

1. Place the instrument with the appropriate cover up.
2. Remove the appropriate rear panel standoffs.
3. Unscrew the captive screw at the middle of the rear edge of the cover. This is a captive screw, and will cause the cover to pull away from the front frame.
4. Slide the cover to the rear and remove.
5. For replacement, follow the above steps in reverse order.

Power Transformer A3T1. To remove the power transformer, proceed as follows:

1. Place the instrument on its right side and remove covers, left handle and side cover.
2. Remove the bottom motherboard insulator by removing the five nylon screws, one near each corner and one near the center.
3. Free the Line Module A3A11 from the rear of the unit. Slide the line module out of the chassis sufficiently far to expose the solder terminals.
4. Unsolder the leads from the transformer to the line module.
5. Unsolder the transformer leads from the A3 motherboard terminals.
6. Refer to Figure 8-128 for the following steps.
7. Remove the two screws securing the transformer to the A3 motherboard.
8. Remove the eight screws securing the transformer to the side rails.
9. Remove the transformer.
10. For replacement, follow the above steps in reverse order.

Filter Capacitors A3C1—4. To remove a capacitor, proceed as follows:

1. Remove the bottom cover.
2. Refer to Figure 8-128 for the following steps.
3. For removal of A3C1 only, remove the five nylon screws securing the bottom motherboard insulator to the A3 motherboard. One screw is near each corner, and one near the center.
4. Remove the two screws securing the capacitor to the A3 motherboard. Remove the top capacitor support (for A3C1—4 only) or loosen the capacitor clamp for A3C4.
5. Remove the capacitor.
6. For replacement, follow the above steps in reverse order.

RF and DCU Front Panels. To remove the RF and/or DCU front panels, proceed as follows:

1. Remove the top and bottom covers.
2. Turn the instrument upside down.
3. Remove the Pozidriv screws from the bottom edge of the front frame. On the DCU front panel there are two screws; on the RF front panel there is only one, near the center of the instrument. Do not remove the center screws holding the center divider.
4. Turn the instrument right side up and remove the plastic trim strip from the top of the front frame.
5. Remove the two Pozidriv screws from the top edge of the front frame. There are two screws holding each panel.
6. Carefully pull the front panel outward to clear the frame.
7. If the front panel assembly is to be completely removed, disconnect cables and wiring as necessary, then remove the two Pozidriv screws from the hinge and remove the panel.
8. To install a front panel assembly, reverse the procedure.

A1A12 RF Amplifier-Modulator. To remove the A1A12 RF Amplifier, proceed as follows:

1. Remove the top and bottom covers.
2. Refer to Figure 8-129. Disconnect A1W1 semi-rigid cable from the input of the amplifier. Disconnect A1W9 modulator cable (blue) from the amplifier. Loosen A1W4 (SMA elbow) at the output of the amplifier.
3. Disconnect the ribbon cable from the amplifier assembly.
4. Turn the instrument on its side and while holding the amplifier, remove the two screws from the amplifier bracket. Slide the assembly to the right to disconnect the SMA elbow and lift it out.
5. To install the A1A12 Amplifier assembly, reverse the above procedure.

A1A2 Isolator. To remove the A1AT2 Isolator, proceed as follows:

1. Remove the top and bottom covers.
2. Disconnect A1CR1 Crystal Detector from A1DC1 Directional Coupler. Remove the detector and lay it aside.
3. Disconnect Filter A1FL1 from YTM A1A3. Disconnect semi-rigid cable A1W5 from the isolator and remove filter and cable.
4. To remove the filter, simply remove the cable. To remove the isolator, continue.
5. Turn the instrument on its side and remove the four nuts holding the isolator bracket, while holding the isolator. Slide the assembly forward to disconnect the SMA elbow and lift it out.
6. To install the filter or isolator, reverse the above procedure.

A1A3 YTM and A1FL1 High Pass Filter Removal. The following procedure explains how the YTM (YIG-Tuned Multipler) and filter are removed.

1. Remove the top and bottom covers.
2. Remove the RF cover from the A1 Assembly.
3. Open the RF front panel.
4. Set the instrument on its right side.
5. Remove the two Pozidriv screws that secure the YTM.
6. Set the instrument with its top up.
7. Remove the semi-rigid coaxial cable connector at the A1AT2 Isolator output.
8. Disconnect semi-rigid cable A1W6 at the YTM output.
9. Loosen the connector of the same cable at the Directional Coupler input. Rotate the cable up and away from the YTM. Tighten the connector slightly to hold the cable in place.
10. Tip the front of the YTM up. Reach through the front panel opening and remove the screw that holds the cable clamp.
11. To remove the flat ribbon cable connector, push the red tabs back and pull the connector straight up.
12. Pass the YTM and High Pass Filter out through the front panel opening.

A1AT1 Programmable Attenuator Removal. The following procedure explains how to remove the Attenuator.

1. Remove the instrument's top cover.
2. Remove the left side cover.
3. Disconnect the semi-rigid coaxial cable at the Attenuator's input and output.
4. Remove semi-rigid coaxial cable A1W7 that is connected to the A1DC1 Directional Coupler.
5. Remove the two panhead Pozidriv screws through the left side frame that secure the Attenuator.

NOTE

While removing the Attenuator, avoid moving or wrinkling the surrounding rubberized RF shield.

6. Remove the large gray cable from its clamp. The clamp is located above the Attenuator at the rear of the A1 RF Output Assembly.
7. Slide the rear of the Attenuator up. Be careful not to put excessive pressure on the gray cable's connector.
8. Continue to slide the Attenuator up and out of the A1 Assembly.

9. To remove the gray cable's connector from the Attenuator, press on the top and bottom of the connector (close to Attenuator) and pull it away.
10. To replace the attenuator, make sure the conductive rubber shield is in place and smooth, and that the holes for mounting the Attenuator are aligned with the holes in the bracket. Then reverse the above procedure to complete the installation.

A1 Assembly Removal. To remove the A1 RF Output Assembly from the instrument, follow the steps listed below:

1. Remove the top cover.
2. Disconnect the A1W1 from A1A12J1; loosen the cable at A3A9A1J1. Rotate the cable up and away from the A1 Assembly.
3. Remove the RF cover from the A1 Assembly.
4. Remove the A1A7 and A1A8 boards.
5. Set the instrument on its right side with the A1 Assembly up.
6. Remove the front frame top trim strip.
7. Remove the two Pozidriv screws from the top of the front frame.
8. Remove the Pozidriv screw from the bottom of the front frame.
9. Remove the two Pozidriv screws from the left side handle. Lift the handle's end pieces from the side cover. Push the side cover toward the rear of the instrument and remove it.
10. Remove the six Pozidriv screws that secure the A1 Assembly to the siderail. Remove the two Pozidriv screws that secure the A1 and A2 Assemblies to the center rail.
11. Pull forward on the brace in the A1 Assembly and it should start to slide out of the instrument. Place the two coaxial cables so they clear the A1 Assembly.

YTO Assembly. To place the YTO Assembly in the service position, proceed as follows:

1. Remove the top and bottom covers.
2. Turn the instrument on its right side.
3. Remove the two screws securing the bottom of the assembly. These screws are accessible through the holes marked "A" in the A3 Motherboard.
4. Turn the instrument upright.
5. Refer to Figure 8-130 for the following steps.
6. Remove the screw near directional coupler A3A9A1, which secures the YTO Assembly deck to the center divider.

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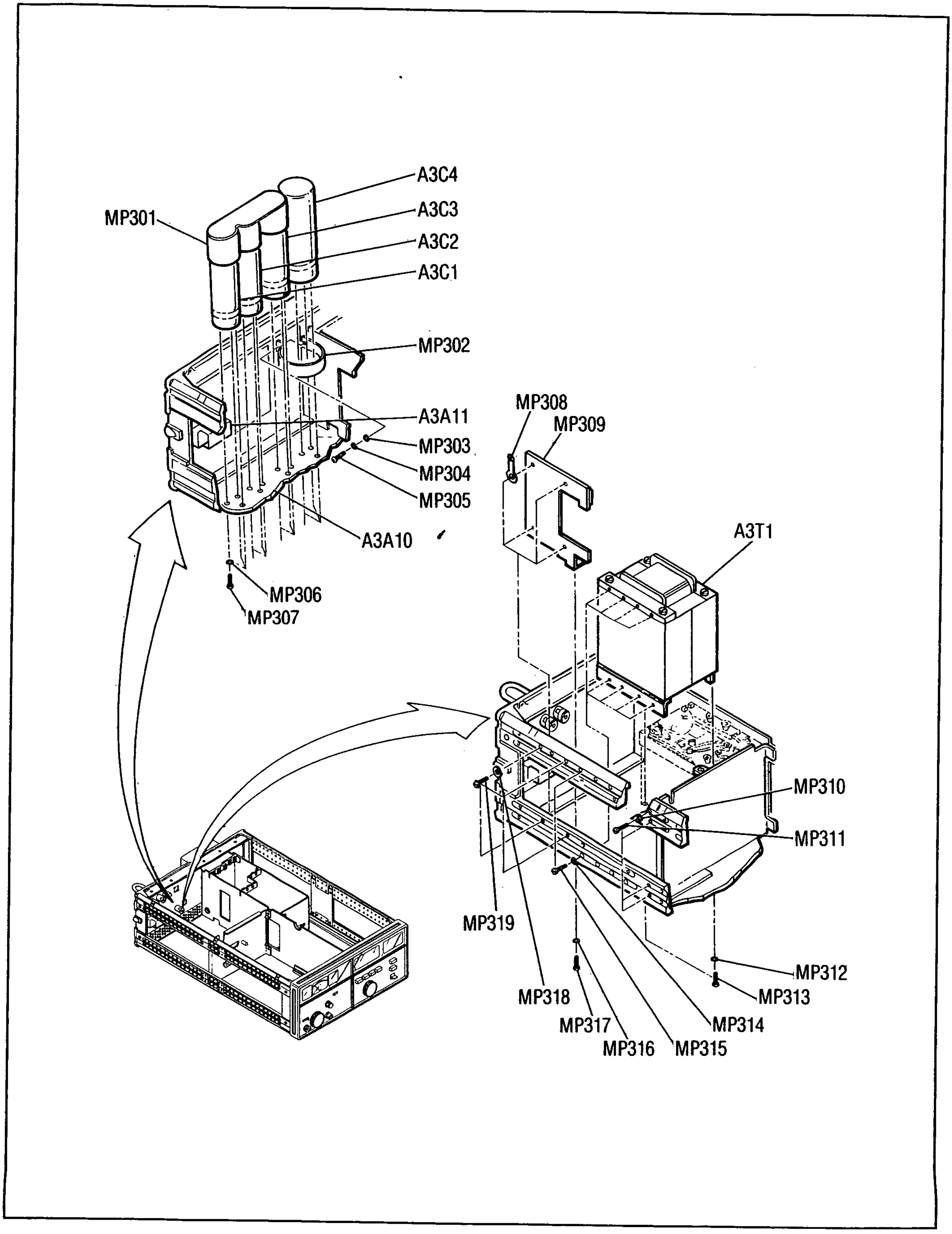

Figure 8-128. Transformer and Filter Capacitor Removal

SERVICE SHEET A (cont'd)

7. Disconnect the semi-rigid cable A1W1 from A3A9A1J1. Loosen the cable at amplifier A1A12 and rotate it up and away from the YTO Assembly.
8. Lift the assembly out until it is clear. Rotate the back of the assembly up and forward, then hook it over the DCU divider as shown in the figure. Secure the assembly with the captive Service Support Screw as shown.

10 MHz Reference Oscillator. To remove the A3A8 10 MHz Reference Oscillator, proceed as follows:

1. Remove the top and bottom covers.
2. Place the YTO Assembly in the service position.
3. Refer to Figure 8-130 for the following steps.
4. Remove the two screws which secure the Support Mount bracket to the center divider.
5. Remove the flexible cable A3W2 from the Reference Oscillator.
6. Remove cable A3A8W1 from A3A10J3.
7. Remove the Reference Oscillator.
8. For replacement, follow the above steps in reverse order.

Fan Removal and Replacement. To remove the fan from the CW Generator, follow the steps listed:

WARNING

The fan and fan relay always have 120 Vac across the terminals if the instrument is connected to the Mains (line) voltage. BE SURE the instrument is disconnected before removing the fan.

1. Remove the bottom cover.
2. Remove two Pozidriv screws from the fan cowl and remove the cowl.
3. Turn the instrument upside down. Remove the clear plastic protective cover from the bottom by removing the five white nylon screws.
4. Remove the plastic clamp holding the three wires going to the fan from the Motherboard.
5. Unsolder the two black wires from the Motherboard. Remove the screw from the ground wire.
6. Pull the three wires out of the rear frame going to the fan.
7. Remove the four nuts and lockwashers from the fan mounting bracket.
8. Carefully remove the fan from the mounting bracket.

9. Before replacing the fan, check to see that the magnetic shield is securely in place on the blade side of the fan motor.
10. Reassemble the fan in the reverse order. When tightening the four nuts and lockwashers, be careful that the four rubber shock mounts do not twist with the nuts as they are tightened. Be sure the wires go around the outside of the fan strut (away from the fan blade).

WARNING

BE SURE to replace the A3 Assembly's bottom protective plastic cover before replacing the bottom cover. This cover is intended to provide protection from electrical shock when the bottom cover is removed.

11. Replace the cable clamp and MAKE SURE that the plastic protective cover is replaced before replacing the bottom cover.

Rear Panel Removal. To remove the rear panel for access to the Line Module (A3A11), fan relay (A3K1), transistor (A3Q1—A3Q4), and the rear panel coax connectors, follow the steps listed below:

1. Remove the top cover.
2. Remove the two Pozidriv screws from the top of the rear frame and the three screws from over the heat sink (see Figure 8-2).
3. Push the top of the panel outward. The transistors (A3Q1—A3Q4) can be replaced by removing the two Pozidriv screws holding them in place.

A3A1 M/N Assembly Removal. To remove the A3A1 Assembly, follow the steps listed below:

1. Remove the top and bottom covers.
2. Set the instrument on its right side.
3. Remove the five coaxial cables from the A3A1 Assembly to free it from the other assemblies.
4. Remove the eight Pozidriv screws labeled B from the Motherboard, noting the sizes of each. These screws can be removed without removing the protective cover from the bottom of the instrument.
5. Hold the A3A1 Assembly while removing the last screw. Then lift the assembly away from the Motherboard.

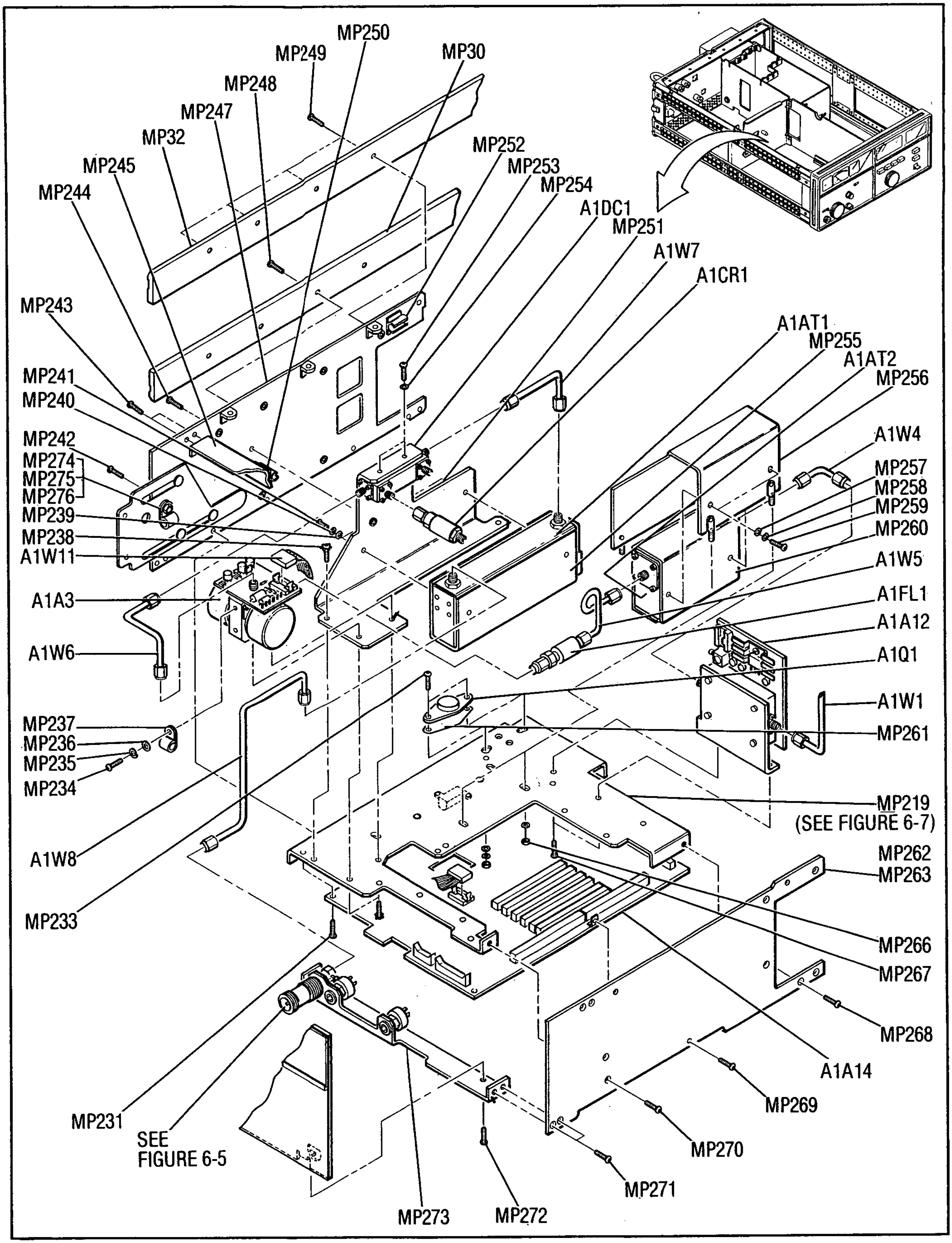

Figure 8-129. A1 RF Output Assembly, Amplifier, Attenuator and YTM

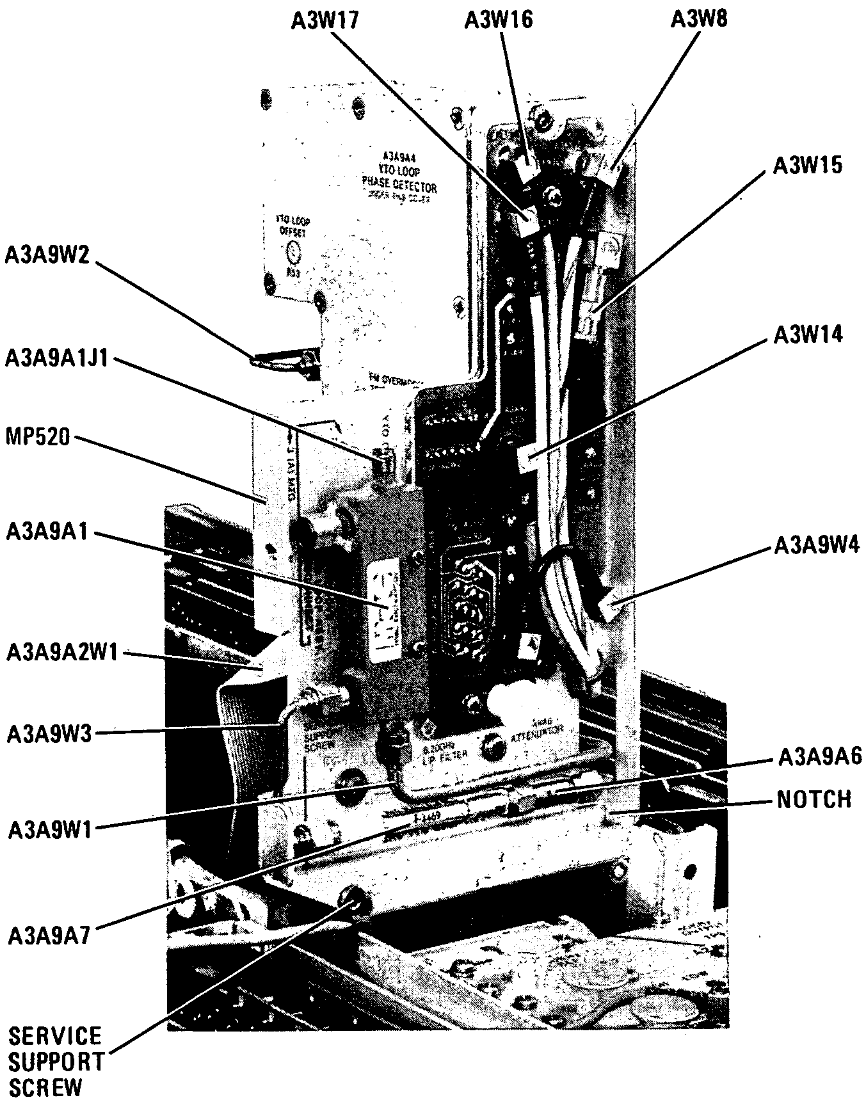

Figure 8-130. YTO Assembly in Service Position

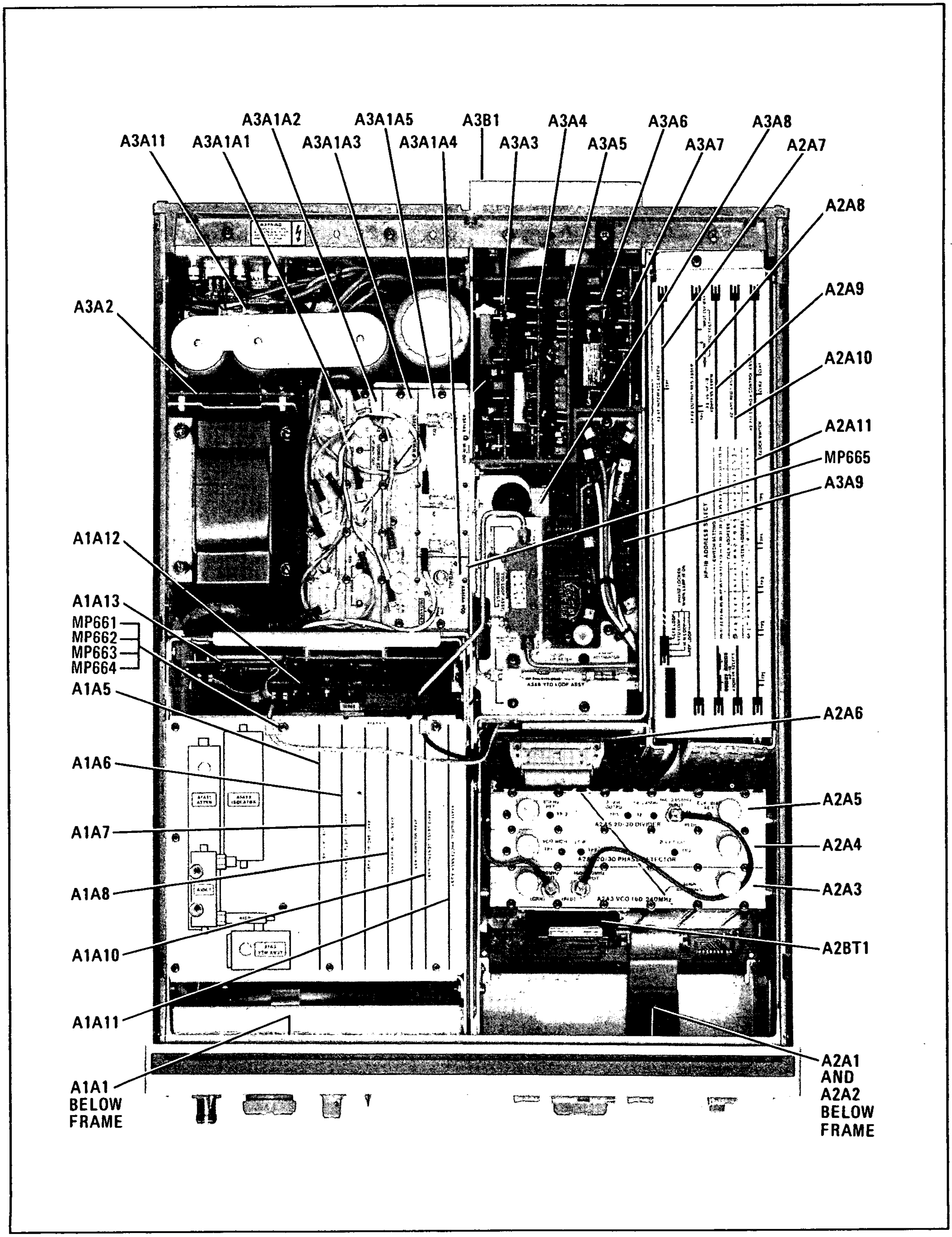

Figure 8-131. Top View, Assembly Location

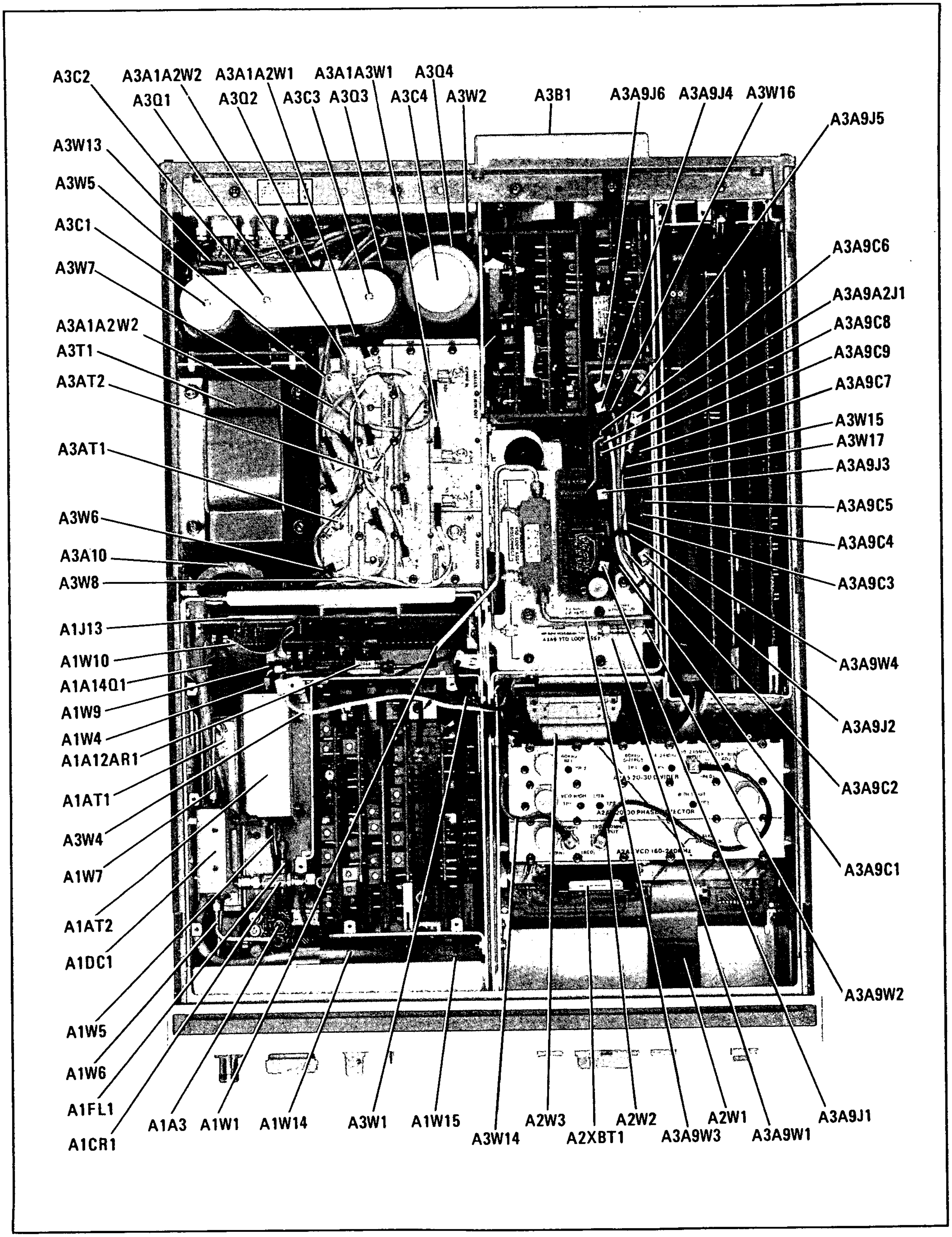

Figure 8-132. Top View, Component Location, Covers Removed

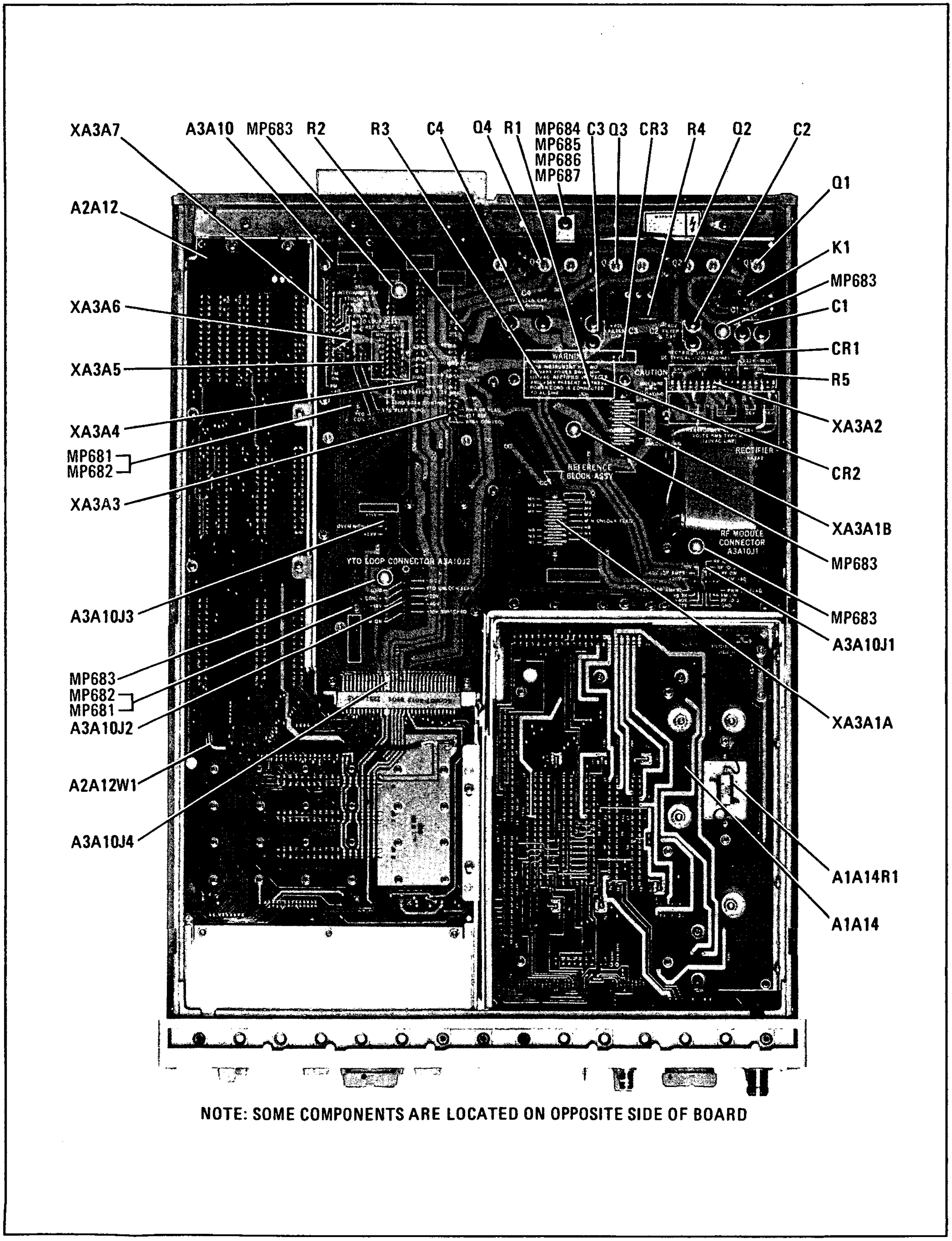

Figure 8-133. Bottom View, Component Location

Internal Views

B

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February, 1986

OPERATING AND SERVICE MANUAL

8673B
SYNTHESIZED SIGNAL GENERATOR
2.0 — 26.0 GHz
(Including Options 001 through 009)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2332A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

MANUAL PART NUMBER. 08673-90027
Microfiche Part No. 08673-90028

Printed: JULY 1984

CONTENTS

Page

Section I
GENERAL INFORMATION

Introduction 1-1
Specifications 1-1
Safety Considerations 1-1
Instruments Covered by this Manual 1-1
Manual Changes Supplement 1-1
Description 1-2
Options 1-2
Electrical Options 1-2
Mechanical Options 1-3
Accessories Supplied 1-3
Equipment Required but not Supplied 1-3
Electrical Equipment Available 1-3
Recommended Test Equipment 1-4

Section II
INSTALLATION

Introduction 2-1
Initial Inspection 2-1
Preparation for Use 2-1
Power Requirements 2-1
Line Voltage and Fuse Selection 2-1
Power Cables 2-1
HP-IB Address Selection 2-2
Interconnections 2-3
Mating Connectors 2-3
Operating Environment 2-4
Bench Operation 2-4
Rack Mounting 2-4
Storage and Shipment 2-4
Environment 2-4
Packaging 2-4

Section III
OPERATION

Introduction 3-1
Operating Characteristics 3-1
Local Operation 3-1
Remote Operation 3-1
Operator's Checks 3-1
Operator's Maintenance 3-1
Turn-On Instructions 3-4
Turn-On 3-4
Frequency Standard Selection 3-4
Additional Operating Information 3-6
Auto Peak 3-6
ALC (Automatic Level Control) 3-6
PULSE Modulation 3-6
SWEEP Mode in MASTER/SLAVE Configuration 3-6

Page

Operator's Checks 3-14
Basic Functional Checks 3-14
HP-IB Functional Checks 3-22
Remote and Local Messages and the LOCAL Key 3-22
Sending the Data Message 3-23
Receiving the Data Message 3-24
Local Lockout and Clear Lockout/Set Local Messages 3-24
Clear Message 3-25
Abort Message 3-25
Status Byte Message 3-26
Require Service Message 3-26
Status Bit Message 3-27
Trigger Message 3-28
Remote Operation, Auxiliary Control 3-29
AUX Input Lines 3-29
AUX Output Lines 3-29
Remote Operation, Hewlett-Packard Interface Bus 3-30
HP-IB Compatibility 3-30
Remote Mode 3-30
Local Mode 3-30
Addressing 3-32
Turn-on Default Conditions 3-33
Displays 3-33
Output Level 3-33
Data Messages 3-33
Receiving Data Messages 3-33
Sending the Data Message 3-34
Receiving the Clear Message 3-37
Receiving the Trigger Message 3-37
Receiving the Remote Message 3-37
Receiving the Local Message 3-37
Receiving the Local Lockout Message 3-37
Receiving the Clear Lockout/Set Local Message 3-37
Receiving the Pass Control Message 3-38
Sending the Require Service Message 3-38
Sending the Status Byte Message 3-38
Clearing the Status Byt 3-38
Sending the Status Bit Message 3-39
Sending the Abort Message 3-39

Section IV
PERFORMANCE TESTS

Introduction 4-1
Abbreviated Performance Test 4-1
Calibration Cycle 4-1
Performance Test Record 4-1
Equipment Required 4-1
Test Procedures 4-1

CONTENTS (cont'd)

Page
Frequency Range and Resolution Tests 4-3
Output Level, High Level Accuracy
and Flatness Tests 4-5
Low Level Accuracy Tests 4-9
Harmonics, Subharmonics & Multiples Test 4-12
Non-Harmonically Related Spurious Signals
(CW and AM Modes) Tests 4-14
Power Line Related Spurious Signals Tests 4-16
Single-Sideband Phase Noise Tests 4-19
Amplitude Modulation Tests 4-24
FM Frequency Response Tests 4-28
FM Input and Meter Accuracy Tests 4-30
Incidental AM Tests 4-33
Pulse Tests 4-35
Internal Time Base Aging Rate 4-45

Section V
ADJUSTMENTS

Introduction 5-1
Safety Considerations 5-1
Equipment Required 5-1
Automated Adjustment Procedures 5-1
Factory Selected Components 5-2
Related Adjustments 5-2
Power Supply Adjustments 5-8
10 MHz Reference Oscillator Adjustment 5-9
Reference Loop (VCXO) Adjustment 5-10
M/N Loop Adjustments 5-13
20/30 MHz (LFS) Loop Divider Bias
Adjustment 5-15
160—240 MHz (20/30 MHz or LFS Loop)
VCO Pretune Adjustments 5-17
LFS Loop Notch Filter Adjustments 5-19
YTO Pretune Digital-to-Analog Converter
Adjustments 5-21
YTO Driver Adjustments 5-23
YTO Loop Sampler Adjustments 5-24
YTO Loop Offset and FM Overmodulation
Adjustments 5-27
YTO Loop Phase Detector Adjustment 5-30
FM Driver Adjustments 5-33
FM Accuracy and Overmodulation
Adjustments 5-34
Sweep Out and Blanking/Marker
Adjustments 5-36
SRD Bias Adjustment 5-38
YTM Tune Adjustment 5-41

Page
Clamp Adjustment 5-43
Flatness and ALC Adjustments 5-45
AM Bandwidth Adjustment 5-48
AM Accuracy and Meter Adjustment 5-50
Pulse Modulation Adjustment 5-52
Pulse Amplitude Adjustment 5-58

Section VI
REPLACEABLE PARTS

Introduction 6-1
Exchange Assemblies 6-1
Abbreviations 6-1
Replaceable Parts List 6-1
Ordering Information 6-1
Spare Parts Kit 6-1

Section VII
MANUAL CHANGES

Introduction 7-1

Section VIII
SERVICE

Introduction 8-1
Service Sheets 8-1
Block Diagrams 8-1
Circuit Diagrams 8-1
Safety Considerations 8-1
Before Applying Power 8-1
Warnings and Cautions 8-1
Recommended Test Equipment and
Accessories 8-10
Service Tools, Aids, and Information 8-10
Support Kit 8-10
Parts and Cable Locations 8-10
Pozidriv Screwdrivers 8-10
Blade Tuning Tools 8-10
Servicing Aids on Printed Circuits 8-10
Factory Selected Components 8-10
Non-Field Repairable Assemblies 8-10
Module Exchange Program 8-10
After-Service Product Safety
Checks 8-11
Troubleshooting 8-11
General 8-11
Service Error Messages 8-12
Service Functions 8-12

LIST OF ILLUSTRATIONS

Figure		Page
1-1.	HP Model 8673B Accessories Supplied, and Options 907, 908, and 909	1-0
1-2.	Special Interconnect Cable	1-15
2-1.	Line Voltage and Fuse Selection	2-2
2-2.	Power Cable and Mains Plug Part Numbers	2-2
2-3.	HP-IB Address Switch Shown as Set by the Factory	2-3
2-4.	Hewlett-Packard Interface Bus Connection	2-5
2-5.	AUX Interface Connector	2-6
3-1.	Front Panel Features	3-2
3-2.	Displays and Status Annunciators	3-8
3-3.	Output Level Features	3-9
3-4.	Frequency Control features and LINE Switch	3-10
3-5.	Sweep Features and LOCAL Key	3-11
3-6.	Modulation Features	3-12
3-7.	Rear Panel Features	3-13
3-8.	AM Functional Check Setup	3-18
3-9.	FM Functional Check Setup	3-19
3-10.	Pulse Modulation Functional Check Setup	3-20
3-11.	Status Byte Information	3-39
4-1.	Frequency Range and Resolution Test Setup	4-3
4-2.	High Level Accuracy and Flatness Test Setup	4-6
4-3.	Low Level Accuracy Test setup	4-10
4-4.	Harmonics, Subharmonics, and Multiples Test Setup	4-12
4-5.	Non-Harmonically Related Spurious (CW and AM Modes) Test Setup	4-14
4-6.	Power Line Related Spurious Signals Test Setup	4-17
4-7.	Single-Sideband Phase Noise Test Setup	4-20
4-8.	AM Modulation Test Setup	4-25
4-9.	FM Frequency Response Test Setup	4-28
4-10.	FM Input and Meter Accuracy Test Setup	4-31
4-11.	Incidental AM Test Setup	4-33
4-12.	Pulse Test Setup	4-36
4-13.	Required Equipment Interconnect	4-37
4-14.	Rise Time, Fall Time, Overshoot and Ringing Measurement	4-38
4-15.	Pulse Accuracy Measurement	4-42
4-16.	On/Off Ratio Test Setup	4-44
4-17.	Internal Time Base Aging Rate Test Setup	4-45
5-1.	Title Screen	5-2
5-2.	Main Menu	5-2
5-3.	Adjustment Software	5-3
5-4.	10 MHz Reference Oscillator Adjustment Test Setup	5-9
5-5.	Reference Loop (VCXO) Adjustment Test Setup	5-10
5-6.	M/N Loop Adjustment Test Setup	5-13
5-7.	20/30 MHz (LFS) Loop Divider Bias Adjustment Test Setup	5-15
5-8.	LFS Loop Notch Filter Adjustment Test Setup	5-19
5-9.	YTO Loop Sampler Adjustment Test Setup	5-24
5-10.	Typical Swept Frequency Response at A3A9A5TP1 (frequency span per division 20 MHz)	5-25
5-11.	YTO Loop Offset and FM Overmodulation Adjustment Test Setup	5-27
5-12.	YTO Loop Offset Adjustment Test Setup	5-28
5-13.	YTO Loop Phase Detector Adjustment Test Setup	5-30
5-14.	Spectrum Analyzer Display of Phase Locked Loop Gain	5-31
5-15.	FM Driver Adjustment Test Setup	5-33
5-16.	FM Accuracy and Overmodulation Adjustment Test Setup	5-34
5-17.	Sweep Out and Blanking/Marker Adjustment Test Setup	5-36
5-18.	Oscilloscope Display for Sweep Out Adjustment	5-37
5-19.	Oscilloscope Display for Marker Adjustment	5-37
5-20.	Format for Entering SRD Bias Voltage	5-38
5-21.	Gate Voltage Adjustment	5-39
5-22.	SRD Bias Adjustment Test Setup	5-39
5-23.	Optimum YTM Response	5-41
5-24.	YTO Tune Adjustment Test Setup	5-42
5-25.	Clamp Adjustment Test Setup	5-43
5-26.	Typical Flatness Plot	5-45
5-27.	Flatness and ALC Adjustments Test Setup	5-46
5-28.	AM Bandwidth Adjustment Test Setup	5-48
5-29.	AM Accuracy and Meter Adjustment Test Setup	5-50
5-30.	Bias-2 DAC Test Setup	5-53
5-31.	Series Pulse Width Test Setup	5-53
5-32.	Series Pulse Width Waveform	5-54
5-33.	ALC Sample Pulse Test Setup	5-55
5-34.	ALC Sample Pulse Waveform	5-56
5-35.	Pulse Program Menu	5-58
5-36.	Pulse Amplitude Control Band Select Menu	5-59

LIST OF ILLUSTRATIONS (cont'd)

Figure		Page
6-1.	Synthesized Cabinet Parts	6-78
6-2.	Synthesizer Components	6-79
6-3.	Fan Assembly Components	6-80
6-4.	Controller Assembly Components	6-81
6-5.	RF Output Assembly Components	6-82
6-6.	YTO Loop Assembly Components	6-83
6-7.	Synthesizer A4 Front Panel Assembly Mechanical Parts Location	6-84
8-1.	Simplified Block Diagram	8-14
8-2.	Major Assembly Locations	8-16
8-3.	Overall Troubleshooting Block Diagram	8-19
8-4.	A3 RF Source Assembly Troubleshooting Block Diagram	8-31
8-4A.	HP 9825A and HP 85F Sample Diagram Listing	8-56
8-4B.	Sample Error Printout	8-55
8-5.	A2 Controller Assembly Troubleshooting Block Diagram	8-67
8-5A.	YTM Simplified Block Diagram	8-69
8-5B.	ALC Simplified Block Diagram	8-70
8-5C.	Pulse Modulation Simplified Block Diagram	8-72
8-5D.	Pulse Modulation Waveforms	8-73
8-5E.	Typical Output Power vs. Output Frequency	8-74
8-5F.	Pulse Modulation Troubleshooting Setup	8-78
8-6.	A1 RF Output Assembly Troubleshooting Block Diagram	8-81

Figure		Service Sheet No.
8-7.	A1A2A1 Detector/ALC Assembly Component and Test Point Location	1-A1
8-8.	Detector/ALC Assembly Schematic Diagram	1-A1
8-9.	A1A4 Pulse Driver Processing Assembly Component and Test Point Location	2-A1
8-10.	Pulse Driver Processing Assembly Schematic Diagram	2-A1
8-11.	A1A7 YTM Driver Board Assembly Component and Test Point Location	3-A1
8-12.	A1A10A1 YTM Assembly Component and Test Point Location	3-A1
8-13.	YTM Driver Assembly Schematic Diagram	3-A1
8-14.	A1A2A2 Detector Board Assembly Component and Test Point Location	4-A1
8-15.	Detector Assembly Schematic Diagram	4-A1
8-16.	A1A1 Attenuator Driver Board Assembly Component and Test Point Location	5-A1
8-17.	Attenuator Driver Assembly Schematic Diagram	5-A1
8-18.	A1A8 SRD Bias Board Assembly Component and Test Point Location	6-A1
8-19.	SRD Control Assembly Schematic Diagram	6-A1
8-20.	A1A3 Function Board Assembly Component and Test Point Location	7-A1
8-21.	Function Assembly Schematic Diagram	7-A1
8-22.	A1A6 Meter Board Assembly Component and Test Point Location	8-A1
8-23.	Metering Control Assembly Schematic Diagram	8-A1
8-24.	A1A5 DAC and Enable Board Assembly Component and Test Point Location	9-A1
8-25.	Digital to Analog Converter Assembly Schematic Diagram	9-A1
8-26.	A2A5 20/30 Divider Assembly Component and Test Point Location	1-A2
8-27.	20/30 Divider Assembly Schematic Diagram	1-A2
8-28.	A2A4 20/30 Phase Detector Assembly Component and Test Point Location	2-A2
8-29.	20/30 Phase Detector Assembly Schematic Diagram	2-A2
8-30.	A2A3 VCO 160—240 MHz Assembly Component Location	3-A2
8-31.	VCO 160—240 MHz Assembly Schematic Diagram	3-A2
8-32.	A2A2 Key Code Assembly Component Location	4-A2
8-33.	Key Code Assembly Schematic Diagram	4-A2
8-34.	A2A1 Panel Driver Assembly Component Location	5-A2
8-35.	Panel Driver Assembly Schematic Diagram	5-A2
8-36.	A2A8 Microprocessor Board Assembly Component and Test Point Location	6-A2
8-37.	Microprocessor Assembly Schematic Diagram	6-A2
8-38.	A2A11 ROM Assembly Component Location	7-A2
8-39.	ROM Assembly Schematic Diagram	7-A2
8-40.	A2A10 RAM Assembly Component Location	8-A2
8-41.	RAM Assembly Schematic Diagram	8-A2
8-42.	A2A9 Frequency Output — HP-IB Assembly Component and Test Point Location	9-A2
8-43.	Frequency Output — HP-IB Assembly Schematic Diagram	9-A2
8-44.	P/O A2A7 I/O Assembly Component and Test Point Location	10-A2
8-45.	P/O I/O Assembly Schematic Diagram	10-A2

LIST OF ILLUSTRATIONS (cont'd)

Figure	Service Sheet No.
8-46. P/O A2A7 I/O Assembly Component and Test Point Location	11-A2
8-47. P/O I/O Assembly Schematic Diagram	11-A2
8-48. A3A1A1 Reference Phase Detector Assembly Component and Test Point Location	1-A3
8-49. Reference Phase Lock Detector Assembly Schematic Diagram	1-A3
8-50. A3A1A2 100 MHz VCXO Assembly Component and Test Point Location	2-A3
8-51. 100 MHz VCXO Assembly Schematic Diagram	2-A3
8-52. A3A1A3 M/N Phase Detector Assembly Component and Test Point Location	3-A3
8-53. M/N Phase Detector Assembly Schematic Diagram	3-A3
8-54. A3A1A4A2 M/N VCO Board Assembly Component and Test Point Location	4-A3
8-55. M/N VCO Assembly Schematic Diagram	4-A3
8-56. A3A1A5 M/N Output Assembly Component Location	5-A3
8-57. M/N Output Assembly Schematic Diagram	5-A3
8-58. A3A5 DAC Assembly Component and Test Point Location	6-A3
8-59. Digital to Analog Converter Assembly Schematic Diagram	6-A3
8-60. A3A6 YTO Driver Assembly Component and Test Point Location	7-A3
8-61. YTO Driver Assembly Schematic Diagram	7-A3
8-62. A3A9A5 Sampler Assembly Component and Test Point Location	8-A3
8-63. P/O YTO Loop Assembly Schematic Diagram	8-A3
8-64. A3A9A4 YTO Phase Detector Assembly Component and Test Point Location	9-A3
8-65. P/O YTO Loop Assembly Schematic Diagram	9-A3
8-66. A3A7 YTO/FM Coil Driver Assembly Component and Test Point Location	10-A3
8-67. YTO/FM Coil Driver Assembly Schematic Diagram	10-A3
8-68. A3A1 Rectifier Assembly Component and Test Point Location	11-A3
8-69. Rectifier Assembly Schematic Diagram	11-A3
8-70. A3A3 Positive Regulator Assembly Component and Test Point Location	12-A3
8-71. Positive Regulator Assembly Schematic Diagram	12-A3
8-72. A3A4 Negative Regulator Assembly Component and Test Point Location	13-A3
8-73. Negative Regulator Assembly Schematic Diagram	13-A3
8-74. P/O A4A1 Front Panel Assembly Component Location	1-A4
8-75. P/O Front Panel Assembly Schematic Diagram	1-A4
8-76. P/O Front Panel Assembly Schematic Diagram	2-A4
8-77. Front Panel Assembly Connector Locations	
8-78. Rear Panel Connections	
8-79. A3A9 Assembly Locations and Cable Designations	
8-80. Top Internal View Assembly Locations	
8-81. Bottom Internal View Assembly and Mounted Parts Locations	

TABLES

Table	Page
1-1. Specifications	1-4
1-2. Supplemental Characteristics	1-10
1-3. Recommended Test Equipment	1-12
2-1. Allowable HP-IB Address Codes	2-3
3-1. Operating Characteristics	3-1
3-2. (Reserved for final manual)	3-5
3-3. AUX Connector Functions	3-29
3-4. Message Reference Table	3-31
3-5. Talk Functions	3-36
3-6. Response to a Clear Message	3-37
3-7. HP-IB Program Codes	3-40
3-8. Messages	3-41
4-1. Operation Verification	4-2
4-2. Performance Test Record	4-47
5-1. Factory Selected Components	5-4
5-2. Performance Test Failure and Required Action	5-5
5-3. Post-Repair Adjustments	5-6

TABLES (cont'd)

Table Page

6-1. Part Numbers for Exchange Assemblies 6-2
6-2. Reference Designations and Abbreviations 6-3
6-3. Replaceable Parts 6-5
6-4. Code List of Manufacturers 6-66

8-1. Schematic Diagram Notes 8-2
8-2. Etched Circuit Soldering Equipment 8-11
8-3. Service Error Messages 8-13
8-4. Service Functions 8-13
8-5. Front Panel Status Annunciators 8-17
8-6. Overall Troubleshooting 8-17
8-7. Short Checklist of M/N Numbers and Resulting Frequencies 8-24
8-8. Listing of All M and N Numbers and Resulting Frequencies 8-25
8-9. MPU, Address Line, and Address Decoder Signatures 8-39
8-10. Diagnostic ROM (U3) Signatures 8-39
8-11. MPU Signatures 8-39
8-12. Timing, Interrupt and Buffered Data Circuits Signatures 8-41

Table Page

8-13. MPU Timer and IRQ Encoder Signatures 8-41
8-14. MPU Signatures 8-43
8-15. Front Panel Driver Assembly Diagnostic 8-43
8-16. Divide-by-Three Circuit Signatures 8-45
8-17. Ram Assembly Diagnostic 8-46
8-18. ROM Error Codes 8-47
8-19. ROM and Converter Diagnostic 8-48
8-20. Frequency Diagnostic Output Lines Signatures 8-51
8-21. Frequency Diagnostic Input Lines Signatures 851
8-22. Frequency Output — HP-IB Assembly Diagnostic 8-51
8-23. HP-IB Diagnostic Output Signatures 8-53
8-24. HP-IB Diagnostic Input Lines Signatures 8-53
8-25. Frequency Output — HP-IB Diagnostic 8-54
8-26. Miscellaneous Signatures 8-57
8-27. Error Codes and Associated Lines 8-57
8-28. I/O Assembly 8-57
8-29. Processor Assisted Diagnostic Test 8-62
8-30. Band Numbers and Frequencies 8-69

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

SAFETY SYMBOLS

⚠ Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (see Table of Contents for page references).

ϟ Indicates hazardous voltages.

⏚ Indicates earth (ground) terminal.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

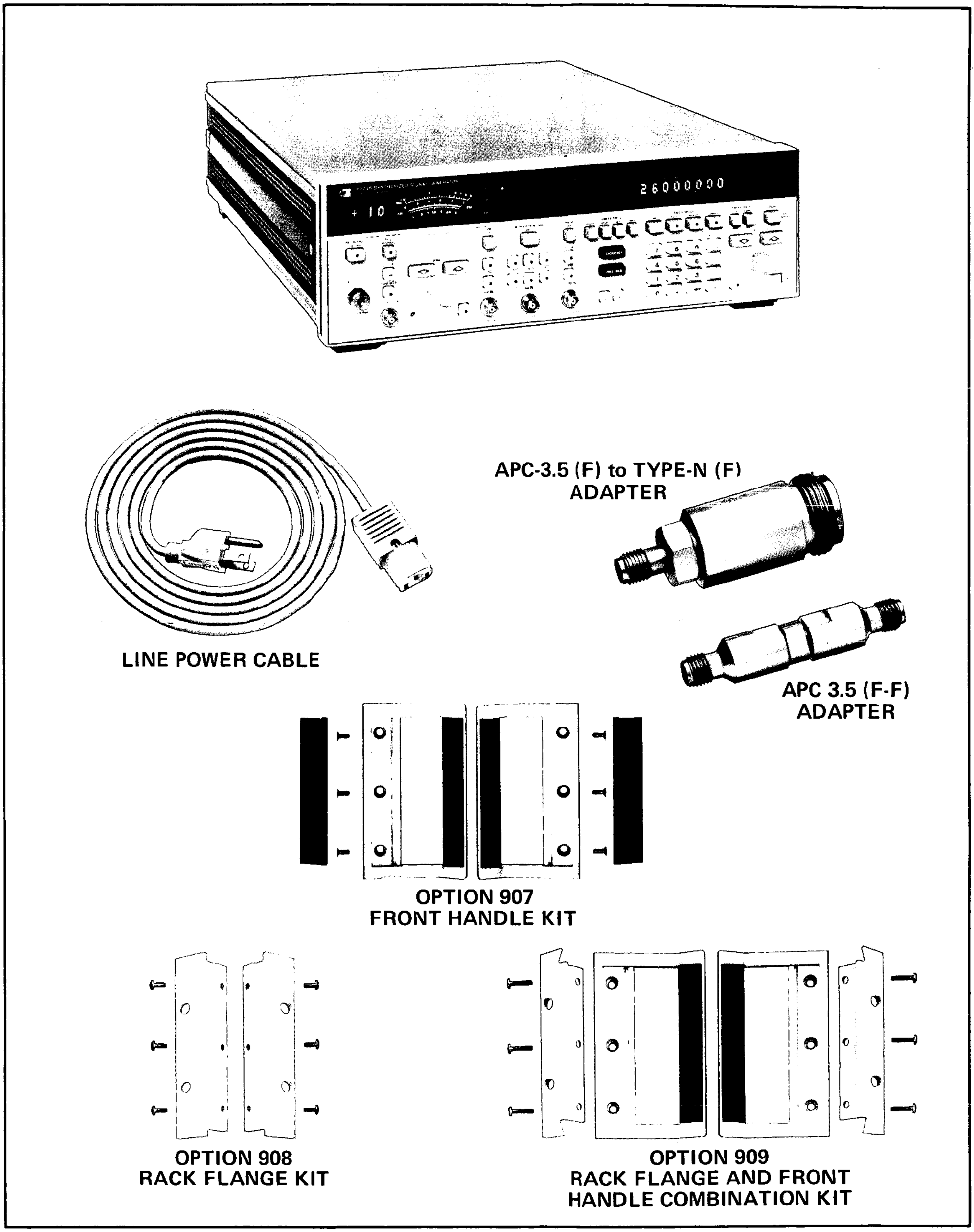

Figure 1-1. HP Model 8673B Accessories Supplied, and Options 907, 908, and 909.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust and service the Hewlett-Packard 8673B Synthesized Signal Generator. Figure 1-1 shows the Signal Generator with all of its externally supplied accessories.

The 8673B Operating and Service manual has eight sections. The subjects addressed are:

Section I, General Information
Section II, Installation
Section III, Operation
Section IV, Performance Tests
Section V, Adjustments
Section VI, Replaceable Parts
Section VII, Manual Changes
Section VIII, Service

The 8673B 10 MHz Reference Oscillator A3A8, is a field repairable component. A separate operating and service manual, HP Part No. 10811-90002, is provided for this assembly and should be retained with the 8673B manual.

Two copies of the operating information are supplied with the Signal Generator. One copy is in the form of an Operating Manual. The Operating Manual is a copy of the first three sections of the Operating and Service Manual. The Operating Manual should stay with the instrument for use by the operator. Additional copies of the Operating Manual can be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

Also listed on the title page of this manual, below the manual part number, is a microfiche part number. This number may be used to order 100 x 150 millimetre (4 x 6 inch) microfilm transparencies of this manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement, as well as all pertinent Service Notes.

1-2. SPECIFICATIONS

Instument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested. Supplemental characteristics are listed in Table 1-2. Supplemental characteristics are not warranted specifications, but are typical characteristics included as additional information for the user.

1-3. SAFETY CONSIDERATIONS

This product is a Safety Class I instrument, that is, one provided with a protective earth terminal. The Signal Generator and all related documentation should be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information for installation, operation, performance testing, adjustment, or service is found in appropriate places throughout this manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-5. MANUAL CHANGES SUPPLEMENT

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in this manual. The manual for this newer instrument is accompanied by a Manual Changes suppllement. The supplement contains "change information" that explains how to adapt this manual to the newer instrument.

MANUAL CHANGES SUPPLEMENT (cont'd)

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep the manual as current and as accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-6. DESCRIPTION

The HP Model 8673B Synthesized Signal Generator has a frequency range of 2.0 to 26.0 GHz (1.95 to 26.5 GHz overrange). The output is leveled and calibrated from +8 dBm to −100 dBm, depending on the frequency. (The output is leveled and calibrated from +10 to −10 dBm for Option 001, from +7 to −100 dBm for Option 004, and from +9 to −10 dBm for Option 005 and +8 to −100 dBm at 2 — 18 GHz; +7 to −100 dBc at 18.0 — 26.0 GHz for Option 008.) AM, FM, and pulse modulation modes can be selected. Frequency, output level, modulation modes, and most other functions can be remotely programmed via HP-IB.

Long-term frequency stability is dependent on the time base, either an internal or external reference oscillator. The internal crystal reference oscillator operates at 10 MHz while an external oscillator may operate at 5 or 10 MHz. The output of the Signal Generator is exceptionally flat due to the action of the internal automatic leveling control (ALC) loop.

External drive signals are required for all modulation modes. AM depth and FM deviation vary linearly with the applied external voltage. Full scale modulation is attained with a 1.0 volt peak signal. Pulse modulation is compatible with TTL levels.

Two ranges of AM depth can be selected: 30% and 100%. The front panel meter can be used to set AM depth. Specified AM rates are from 100 Hz to 100 kHz. However, useable amplitude modulation can be performed at any modulation frequency between 20 Hz and 100 kHz.

Six ranges of FM deviation are selectable: 0.03, 0.1, 0.3, 1, 3, and 10 MHz. FM peak deviation can be set using the front panel meter. At output frequencies below 6.6 GHz, peak deviation is limited to 10 MHz or five times the modulation frequency, whichever is lower. From 6.6 to 12.3 GHz, peak deviation is limited to the lesser of 10 MHz or ten times the modulation frequency; from 12.3 to 18.6 GHz the lesser of 10 MHz or fifteen times the modulation frequency; from 18.6 to 26.0 GHz the lesser of 10 MHz or twenty times the modulation frequency. Usable modulation rates fall between 100 Hz and 10 MHz.

Pulse modulation has two operating modes: NORM (normal mode) and COMPL (complement mode). In normal mode the RF output is On when the drive signal is the TTL high state. In the complement mode the RF output is On when the drive signal is in the TTL low state.

The Signal Generator is compatible with HP-IB to the extent indicated by the following code: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, and C0. The Signal Generator interfaces with the bus via three-state TTL circuitry. An explanation of the compatibility code can be found in IEEE Standard 488 (1978), "IEEE Standard Digital Interface for Programmable Instrumentation" or the identical ANSI Standard MC1.1. For more detailed information relating to programmable control of the Signal Generator, refer to Remote Operation, Hewlett-Packard Interface Bus in Section III of this manual.

1-7. OPTIONS

1-8. Electrical Options

Option 001. The internal 10 dB/step attenuator has been deleted. The specified output level is +10 dBm to −10 dBm from 2.0 to 18.0 GHz, +6 dBm to −10 dBm from 18.0 to 22.0 GHz, and +3 dBm to −10 dBm from 22.0 to 26.0 dBm.

Option 002. The internal 10 MHz crystal reference is removed. An external 5 or 10 MHz reference must be used.

Option 003. A special fan allows opertion from 400 Hz power mains.

Option 004. The Signal Generator's RF OUTPUT connector is located on the rear panel. Maximum output power is +7 dBm to −100 dBm from 2.0 to 18.0 GHz, +2 dBm to −100 dBm from 18.0 to 22.0 GHz, and −2 dBm to −100 dBm from 22.0 to 26.0 GHz.

Electrical Options (cont'd)

Option 005. The Signal Generator's RF OUTPUT connector is located on the rear panel and the attenuator is removed. This combines Options 001 and 004. The specified output level is +9 dBm to −10 dBm from 2.0 to 18.0 GHz, +4 dBm to −10 dBm from 18.0 to 22.0 GHz, and +1 dBm to −10 dBm from 22.0 to 26.0 GHz.

Option 008. The Signal Generator uses an internal GaAs FET Amplifier to deliver a +8 dBm leveled output to 18 GHz and +7 dBm leveled output from 18 to 26 GHz. Option 008 may also be combined with Option 001 to provide a leveled output of +10 dBm from 2 to 26 GHz. Additionally, Option 008 may be combined with Options 004 and 005. From 2 to 18 GHz, with both Options 004 and 005, the leveled output specification remains unchanged. From 18 to 26 GHz the leveled output, for Option 004 is +5 dBm, and for Option 005 is +8 dBm.

1-9. Mechanical Options

The following options may have been ordered and received with the Signal Generator. If they were not ordered with the original shipment and are now desired, they can be ordered from the nearest Hewlett-Packard office using the part numbers included in each of the following paragraphs.

Option 006 (Chassis Slide Mount Kit). This kit is extremely useful when the Signal Generator is rack mounted. Access to the internal circuits and components, or the rear panel is possible without removing the Signal Generator from the rack. The Chassis Slide Mount Kit part number is 1494-0017. An adapter (HP part number 1494-0023) is needed if the instrument rack mounting slides are to be mounted in a standard EIA rack. The slides without the adapter can be directly mounted in the HP system enclosures.

Option 907 (Front Handle Kit). Ease of handling is increased with the front panel handles. The Front Handle Kit part number is 5061-0089.

Option 908 (Rack Flange Kit). The Signal Generator can be solidly mounted to the instrument rack using the flange kit. The Rack Flange Kit part number is 5061-0077.

Option 909 (Rack Flange and Front Handle Combination Kit). This is a unique part which combines both functions. It is not simply a front handle kit and a rack flange kit packaged together. The Rack Flange and Front Panel Combination Kit part number is 5061-0083.

1-10. ACCESSORIES SUPPLIED

The accessories supplied with the Signal Generator are shown in Figure 1-1.

a. The line power cable is supplied in several configurations, depending on the destination of the original shipment. Refer to Power Cables in Section II of this manual.

b. An additional fuse is shipped only with instruments that are factory configured for 100/120 Vac operation. This fuse has a 2A rating and is for reconfiguring the instrument for 220/240 Vac operation.

c. Two adapters are provided: APC-3.5(F) to TYP-N(F); HP Part No. 1250-1745. APC-3.5(F-F); HP Part No. 1250-1749.

1-11. EQUIPMENT REQUIRED BUT NOT SUPPLIED

For Option 002 instruments, which lack an internal frequency standard, an external reference must be used. The performance of the external reference should at least match the specifications of the HP Model 10811B Crystal Oscillator. In particular, the frequency should be within ±50 Hz of 10 MHz. When using an external oscillator, microphonically generated or line related spurious signals may increase. SSB phase noise may also be degraded at some offsets from the carrier.

An external signal source is required if amplitude, frequency, or pulse modulation is desired. For AM, the source should have a variable output of 0 to 1 volt peak into 600 ohms, frequency rates up to 100 kHz, and distortion of less than 1%. For FM, the source should have a variable output of 0 to 1 volt peak into 50 ohms, frequency rates up to 10 MHz, and distortion of less than 1%. For pulse modulation, the source should have TTL output levels (>2.4V for a TTL high state and <0.4V for a TTL low state) and 50 ohms nominal impedance. Pulse repetition frequency rates should be 1 Hz to 1 MHz with transition times <10 ns.

1-12. ELECTRICAL EQUIPMENT AVAILABLE

The Signal Generator has an HP-IB interface and can be used with any HP-IB compatible computing controller or computer for automatic systems applications.

ELECTRICAL EQUIPMENT AVAILABLE (cont'd)

The HP-IB Controller and various ROMs are needed to do the automated SRD Bias, YTM Tune, Flatness and ALC, and Pulse adjustment procedures. Specific equipment needed for automated adjustments are:

Test Cassette HP Part No. 11726-10001
HP 85F Controller
82903A 16K Memory Module
00085-15005 Advanced Programming ROM
00085-15002 Plotter/Printer ROM
00085-15004 Matrix ROM
HP 3455A Digital Voltmeter
HP 436A/HP 8455A Power Meter and Sensor

Although the test cassette is part of the HP 11726A Support Kit, it can be ordered separately through the nearest Hewlett-Packard Office. The HP 11726A Support Kit is available for maintaining and servicing the Signal Generator. It consists of cables, adapters, termination, prerecorded programs, extender boards and test extender boards.

The HP 8116A Pulse/Function Generator is adequate for modulating the Signal Generator and meeting stated standards. This remotely programmable signal source is convenient for full remote control of modulation levels and rates.

For pulse modulation requiring pulse delay, the HP 8112A Pulse Generator is recommended.

1-13. RECOMMENDED TEST EQUIPMENT

Table 1-3 lists the test equipment recommended for testing, adjusting and servicing the Signal Generator. Essential requirements for each piece of test equipment are described in the Critical Specifications column. Other equipment can be substituted if it meets or exceeds these critical specifications.

Table 1-1. Specifications (1 of 6)

Note: Specifications apply after 1-hour warm-up, over temperature range 0 to 55°C (except specifications for harmonically related spurious signals, RF output, pulse peak level accuracy, and amplitude modulation, which apply +15 to +35°C).

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—26.0 GHz (1.95—26.5 GHz overrange)	
Resolution	1 kHz 2 kHz 3 kHz 4 kHz	2.0 to 6.6 GHz >6.6 to 12.3 GHz >12.3 to 18.6 GHz >18.6 to 26.0 GHz
Accuracy and Stability	Same as reference oscillator	
Reference Oscillator: Frequency	10 MHz	
Aging Rate	$<5 \times 10\mu^{10}$/day	After a 10 day warmup (typically 24 hours in a normal operating environment)
Switching Time (for frequency to be within specified resolution and output power to be within 3 dB of set level)	<20 ms	CW and AM modes; AUTO PEAK disabled
For Option 008: Switching time (for frequency table within specified resolution and output power to be within 3 dB of set level)	<25 ms for frequency changes across 16 GHz	CW and AM modes; AUTO, PEAK disabled

Table 1-1. Specifications (2 of 6)

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Single-sideband Phase Noise		1 Hz bandwidth; CW mode
2.0—6.6 GHz	–58 dBc	10 Hz offset from carrier
	–70 dBc	100 Hz offset from carrier
	–78 dBc	1 kHz offset from carrier
	–86 dBc	10 kHz offset from carrier
	–110 dBc	100 kHz offset from carrier
>6.6—12.3 GHz	–52 dBc	10 Hz offset from carrier
	–64 dBc	100 Hz offset from carrier
	–72 dBc	1 kHz offset from carrier
	–80 dBc	10 kHz offset from carrier
	–104 dBc	100 kHz offset from carrier
>12.3—18.6 GHz	–48 dBc	10 Hz offset from carrier
	–60 dBc	100 Hz offset from carrier
	–68 dBc	1 kHz offset from carrier
	–76 dBc	10 kHz offset from carrier
	–100 dBc	100 kHz offset from carrier
>18.6—26.0 GHz	–46 dBc	10 Hz offset from carrier
	–58 dBc	100 Hz offset from carrier
	–66 dBc	1 kHz offset from carrier
	–74dBc	10 kHz offset from carrier
	–98 dBc	100 kHz offset from carrier
Harmonics	<–40 dBc	Up to 26 GHz; output level meter readings ≤ = 0 dB on 0 dBm range and below
Subharmonics and Multiples thereof	<–25 dBc	2.0 to 18.6 GHz
	<–20 dBc	18.6 to 26.0 GHz
For Option 008 Subharmonics and Multiples thereof	<–25 dBc	2.0 to 26 GHz
	<–15 dBc	18.6 to 26 GHz (1/2 and 3/4 subharmonics only)
Spurious Signals		CW and AM modes
Nonharmonically Related	<–70 dBc	2.0 to 6.6 GHz
	<–64 dBc	>6.6 to 12.3 GHz
	<–60 dBc	>12.3 to 18.6 GHz
	<–58 dBc	>18.6 to 26.0 GHz
Power line related and fan rotation related within 5 Hz below line frequencies and multiplies thereof		
2.0—6.6 GHz	–50 dBc	<300 Hz offset from carrier
	–60 dBc	300 Hz to 1 kHz offset from carrier
	–65 dBc	>1 kHz offset from carrier

Table 1-1. Specifications (3 of 7)

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY (cont'd)		
>6.6—12.3 GHz	−44 dBc	<300 Hz offset from carrier
	−54 dBc	300 Hz to 1 kHz offset from carrier
	−59 dBc	>1 kHz offset from carrier
>12.3—18.6 GHz	−40 dBc	<300 Hz offset from carrier
	−50 dBc	300 Hz to 1 kHz offset from carrier
	−55 dBc	>1 kHz offset from carrier
>18.6—26.0 GHz	−38 dBc	<300 Hz offset from carrier
	−48 dBc	300 Hz to 1 kHz offset from carrier
	−53 dBc	>1 kHz offset from carrier
RF OUTPUT		
Output Level:		+15 to +35°C
Standard Leveled Output	+8 dBm to −100 dBm	2.0 to 18.0 GHz
	+4 dBm to −100 dBm	18.0 to 22.0 GHz
	0 dBm to −100 dBm	22.0 to 26.0 GHz
Option 001 Leveled Output	+10 dBm to −100 dBm	2.0 to 18.0 GHz
	+6 dBm to −100 dBm	18.0 to 22.0 GHz
	+3 dBm to −100 dBm	22.0 to 26.0 GHz
Option 004 Leveled Output	+7 dBm to −100 dBm	2.0 to 18.0 GHz
	+2 dBm to −100 dBm	18.0 to 22.0 GHz
	−2 dBm to −100 dBm	22.0 to 26.0 GHz
Option 005 Leveled Output	+9 dBm to −100 dBm	2.0 to 18.0 GHz
	+4 dBm to −100 dBm	18.0 to 22.0 GHz
	+1 dBm to −100 dBm	22.0 to 26.0 GHz
Option 008 Level Output	+8 dBm to −100 dBm	2.0 to 18.0 GHz
	+7 dBm to −100 dBm	18.0 to 26.0 GHz
Remote Programming Absolute Level Accuracy		
2.0 — 6.6 GHz	±1.25 dB	+10 dBm output level range
	±1.00 dB	0 dBm output level range
	±1.50 dB	−10 dBm output level range
	±1.70 dB	−20 dBm output level range
	±2.00 dB	−30 dBm output level range
	±2.00 dB plus ±0.1 dB per 10 dB step below −30 dBm	<−30 dBm output range
>6.6 — 12.3 GHz	±1.50 dB	+10 dBm output level range
	±1.25 dB	0 dBm output level range
	±1.75 dB	−10 dBm output level range
	±1.95 dB	−20 dBm output level range
	±2.25 dB	−30 dBm output level range
	±2.25 dB plus ±0.1 dB per 10 dB step below −30 dBm	<−30 dBm output range

Service Notes

SERVICE NOTE

SUPERSEDES:
8671B-1

HP MODEL 8671B SYNTHESIZED SIGNAL GENERATOR

All Serials

ELIMINATING POWER-UP DELAY

If during normal turn-on of the instrument it is found that there is a 4 second or greater time delay during power-up, it is recommended that the resistor R4 be changed from a value of 619 ohms to 750 ohms (part number 0757-0420). Changing the value of R4 on the 86701-60096 Positive Regulator will eliminate the power-up delay associated with the current limit circuitry on the +20V regulator.

The delayed power-up is usually caused by the series pass transistor (A3Q3) on the +20V regulator. A higher than normal base to emitter voltage causes the current limit circuit to clamp the regulated +20V momentarily low when the instrument is cold.

Changing the value of R4 from 619 ohms to 750 ohms increases the the turn-on threshold of the current limit circuit from 3A to 4A, which is still well below the maximum current rating of the pass transistor A3Q3.

E/OF/WN

12/87-04/DS

HEWLETT PACKARD

SERVICE NOTE

SUPERSEDES:
None

HP MODEL 8671B SYNTHESIZED SIGNAL GENERATOR

Serial Prefix 2703A and below

INSULATORS FOR A3A12CR13 AND A3A12CR14

If during normal trouble shooting of the Rectifier Assembly A3A12 (08673-60133) it is found that regulator U1 is defective, the most probable cause of the defect is that the anode of CR13 or CR14 has shorted through the anodized surface of the heat sink MP9 (HP part number 86701-00018) to the case of regulator U1. This may be verified by using a digital multimeter to measure the resistance between the case of U1 and the Anodes of CR13 and CR14. If the measured resistance is less than 1 K Ohms, then the anodized surface of the heat sink (MP9) may have been damaged. If the anodized surface has been damaged, it is recommended that a mica insulator (HP part number 3050-0876) be added between the heat sink (MP9) and each of the rectifiers, CR13 and CR14.

Procedure

1. Remove the mains source from the instrument. For procedure to remove the Top cover. Refer to Section VIII of the Operating and Service Manual.

2. Remove the Rectifier Assembly A3A12 (08673-60133) from the unit, refer to Section VIII of the Operating and Service Manual.

NOTE

Use proper ESD precautions when removing and handling static sensitive devices or assemblies. Ensure that all work is done at an ESD certified work station.

3. Using a 3/8 inch open-end wrench remove the two 10-32 nuts securing CR13 and CR14 to the assembly. Carefully remove CR13 and CR14 from the rectifier assembly. It may be necessary to desolder the wires from the cathodes of the diodes to facilitate the removal of CR13 and CR14.

4. Place the two mica insulators (HP part number 3050-0876) between the heat sink (MP9) and anodes of CR13 and CR14.

E/PM/WA

12/87-04/DS

HEWLETT PACKARD

5. Reinstall CR13 and CR14 using the two 10-32 nuts removed in step 3.

6. Using a digital multimeter, measure the resistance between the anodes of CR13 and CR14 and the case of U1. The resistance measured should be greater than 10 Megohms.

7. Reinstall the rectifier assembly A3A12 into the unit.

8. Reapply the mains power source to the instrument.

9. Turn on the instrument and enter RCL "0", to preset the instrument.

10. Verify that the Signal Generator presets correctly. Refer to the Operating and Service Manual Section III or the information pullout card for proper preset conditions.

Adjustment

Refer to Section V of the Operating and Service Manual for Post-Repair Adjustments of the Power Supplies.

SERVICE NOTE

SUPERSEDES:
8671B-03

HP MODEL 8671B SYNTHESIZED SIGNAL GENERATOR

All Serials

PREFERRED REPLACEMENT FOR PRECISION RESISTORS

The precision resistors listed in this change are the preferred replacement. This change is being made to improve the reliability of circuits using precision resistors. The preferred replacement precision resistors are thin film and much more reliable.

The precision resistors should be replaced with the new type only if the resistor has failed. It is not the intent of this change to remove all resistors, but only the ones that have failed.

Readjustment of the circuits involved in this change may be necessary. Be sure to update the parts list in the operating and service manual with the new part numbers.

Preferred replacement by assembly

The following tables list the preferred replacement parts by assembly within the HP 8671B Synthesized Signal Generator.

Table 1. A1A6 Detector Board Assembly (08672-60197)

CIRCUIT SYMBOL	OLD	NEW	DESCRIPTION
R37	0811-3249	0699-2422	RF-17.74K 0.1%
R40	0811-3202	0699-2376	RF-30.615K 0.1%
R41	0811-1176	0699-0780	RF-10K 0.1%

E/OF/WO

05/88-04/DS

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Table 4. A3A5 Digital to Analog Converter Assembly (86701-60015)

CIRCUIT SYMBOL	OLD	NEW	DESCRIPTION
R1	0811-3404	0698-8478	RF-3.5K 0.1%
R2	0811-3358	0699-2379	RF-7.2K 0.1%
R11	0811-3357	0699-2378	RF-6.25K 0.1%
R14	0811-3359	0699-2373	RF-12.5K 0.1%
R15	0811-3357	0699-2378	RF-6.25K 0.1%
R17	0811-3359	0699-2373	RF-12.5K 0.1%
R19	0811-3359	0699-2373	RF-12.5K 0.1%
R21	0811-3360	0699-0104	RF-25K 0.1%
R23	0811-3361	0699-0473	RF-50K 0.1%
R25	0811-2919	0699-0790	RF-100K 0.1%
R26	0811-2037	0698-3762	RF-2.4K 0.5%
R27	0811-3235	0699-2447	RF-7.5K 1.0%
R30	0811-1185	0699-0144	RF-10K 0.01%
R31	0811-3359	0698-2373	RF-12.5K 0.1%
R32	0811-3138	0699-0104	RF-25K 1.0%
R33	0811-0647	0699-0473	RF-50K 0.1%
R35	0811-3362	0699-0143	RF-825 0.1%
R37	0811-3359	0699-2373	RF-12.5K 0.1%
R51	0811-3356	0699-0305	RF-5.9K 0.1%
R55	0811-3325	0699-2374	RF-312 1.0%

S E R V I C E   N O T E

SUPERSEDES:
None

HP MODEL 8671B SYNTHESIZED SIGNAL GENERATOR

Serial Prefixes 2752A and below

PREFERRED REPLACEMENT FOR THE A3A5 DAC ASSEMBLY

A new DAC Board Assembly (HP part number 08673-60229) is the preferred replacement for A3A5 DAC Assembly (HP part number 86701-60015). The new DAC Board Assembly uses a Monolithic DAC to replace 21 precision resistors and reduce the adjustments from 9 interactive adjustments to 2 non-interactive adjustments.

The DAC Board Assembly (A3A5) should only be replaced by the new part number when the assembly has failed.

The following part will need to be ordered to complete the conversion.

A3A5 YTO DAC Board Assembly   08673-60229

Adjustment of the new YTO DAC assembly will be necessary. Be sure to update the parts list in the operating and service manual with the new part number.

Adjustment Procedure

1. Preset the Signal Generator and set the frequency to 6198.00 MHz.
2. Connect the DVM ground lead to the reference ground, A3A6TP5. (The ground lead remains connected here for the rest of the procedure).
3. Check the voltage of the Reference Voltage Buffer at A3A5TP4. Verify that the voltage is -6.300 +/-0.063 Vdc. Make repairs if necessary.
4. Connect the DVM to the YTO Pretune Output, A3A5TP5.
5. Connect test points A3A5TP1 and A3A5TP2 together with an alligator clip.
6. Adjust A3A5R15 (OFFSET) to obtain a DVM reading +6.00 mV +/-0.02 mVdc.

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7. Remove the alligator clip from testpoints A3A5TP1 and A3A5TP2.

8. Adjust A3A5R8 (GAIN) to obtain a voltage of -18.594 +/-0.001 Vdc.

9. Tune the Signal Generator to 4466.000 MHz. Verify that the voltage at A3A5TP5 is -13.398 +/-0.03 Vdc.

10. Tune the Signal Generator to 4049.000 MHz. Verify that the voltage at A3A5TP5 is -12.147 +/-0.03 Vdc.

SERVICE NOTE

SUPERSEDES:
None

HP MODEL 8671B SYNTHESIZED SIGNAL GENERATOR

Serial Prefixes 2708A through 2823A

IMPROVED RELIABILITY OF THE 20-30 MHz PHASE DETECTOR

On some units it has been determined that under certain conditions the notch filter on the A2A4 Phase Detector (HP part number 08672-60211) may break into oscillations causing the 20 - 30 MHz reference loop to go unlocked. Changing the value of C21 from 47 pF to 10 pF on the A2A4 Assembly will prevent undesired oscillations.

The following part will be needed to complete the change.

10 pF capacitor   HP part number 0160-5901

Procedure

1. Remove the mains power from the instrument by unplugging the power cable.
2. Remove the top cover of the instrument.
3. Remove the A2A4 Phase Detector Assembly from the A2 Controller by removing 12 screws.
4. Replace C21 with HP part number 0160-5901 (10 pF +/-0.5 pF).
5. Reinstall A2A4 Phase Detector Assembly and instrument top cover.

Adjustments

There are no adjustment for this assembly.

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S E R V I C E   N O T E

SUPERSEDES None

8671B Synthesized CW Generator

Serial Numbers: 2823A00785/2933A01027

HP 10811-60102 Quartz Oscillator Faulty Thermal Fuse Causes Early Failures

Duplicate Service Notes:

8673B-19A
8673C-22
8673H-01
8673D-23
8673G-01
8673E-12
8672A-24

Improved Reliability

To Be Performed By: Customer or HP-Qualified Personnel

This note provides ordering information for replacing faulty fuse with Fuse Upgrade Kit, HP 10811-67001 or 08671-60025.

Parts Required:

HP P/N	Description	Qty
10811-67001	Fuse Upgrade Kit	1
OR		
08671-60025	Fuse Upgrade Kit	1

(Which includes 10811-67001 and an instrument-specific installation note)

DATE 01 August 1990

Continued

ADMINISTRATIVE INFORMATION

SERVICE NOTE CLASSIFICATION:

MODIFICATION RECOMMENDED

ACTION CATEGORY:	☐ IMMEDIATELY ■ ON SPECIFIED FAILURE ■ AGREEABLE TIME	STANDARDS: LABOR: 1.5 Hours	
LOCATION CATEGORY:	■ CUSTOMER INSTALLABLE ☐ ON-SITE ■ HP LOCATION	SERVICE INVENTORY: ☐ RETURN ☐ SCRAP ■ SEE TEXT	USED PARTS: ☐ RETURN ■ SCRAP ■ SEE TEXT
AVAILABILITY:	PRODUCT'S SUPPORT LIFE	RESPONSIBLE ENTITY: 0400	UNTIL: 01 August 1992
AUTHOR: DH	ENTITY: 0400	ADDITIONAL INFORMATION:	

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Situation:

The HP 8671B has 10811-60102 as its 10 MHz reference oscillator. A thermal fuse in this oscillator is failing prematurely and causing the oscillator's oven circuitry to lose power. These fuses have been observed to fail as early as three months after delivery of the signal generator.

When the fuse fails, the oven cools down and the oscillator drifts off frequency. Indications of this are as follows:

- The OVEN COLD annunciator will come on and remain on. Normally the OVEN COLD annunciator will turn off within 15 minutes of a cold start.
- The signal generator's output frequency will drift in an unstable manner with changes to its internal temperature.
- The nominal frequency of the reference oscillator will drift out of range of FREQUENCY ADJUST.

Solution/Action:

Order kit 10811-67001 if you already have the installation note 08671-90025 which comes in kit 08671-60025. This installation note contains the following instrument-specific instructions:

- How to determine if a faulty fuse exists
- How to disassemble the instrument
- How to replace the fuse
- How to place new labels identifying the upgrade (Instructions in kit 10811-67001 are incorrect for this signal generator. They cause a label to be placed where it cannot be seen.)
- How to test the instrument after the repair (This involves checking that the OVEN COLD annunciator goes out and performing the the output level and flatness tests found in chapter 4 of the instrument's manual.)

If you don't already have a copy of installation note 08671-90025, order kit 08671-60025 or request a copy directly from the factory customer support engineer. Thereafter, save the installation note for future repairs.

Time required to complete the repair/upgrade and testing is about 1.5 hours.

S E R V I C E   N O T E

SUPERSEDES

HP 8671B Synthesized CW Generator

Duplicate Service Notes: 8672A-25

Serial Numbers: 0000A00000 / 3119A99999

Modification to improve power supply reliability

To Be Performed By: HP-qualified personnel

Situation:

It has been determined that connectors (HP part number 1251-2313) may not have been installed correctly during the fabrication process of the Synthesized CW Generator. This results in intermittent opens between the connectors and transistor leads which then results in blown fuses.

The connectors have been eliminated on newer instruments and the transistor leads are being soldered directly to the mother boards.

Continued

DATE: 15 September 1991

ADMINISTRATIVE INFORMATION

SERVICE NOTE CLASSIFICATION: **MODIFICATION RECOMMENDED**					
ACTION CATEGORY:	☐ IMMEDIATELY ■ ON SPECIFIED FAILURE ☐ AGREEABLE TIME	STANDARDS: LABOR 0.5 Hours			
LOCATION CATEGORY:	☐ CUSTOMER INSTALLABLE ☐ ON-SITE ■ HP LOCATION	SERVICE INVENTORY:	☐ RETURN ☐ SCRAP ■ SEE TEXT	USED PARTS:	☐ RETURN ☐ SCRAP ■ SEE TEXT
AVAILABILITY:	PRODUCT'S SUPPORT LIFE	RESPONSIBLE ENTITY: 0400		UNTIL: September 1993	
AUTHOR: D.H.	ENTITY: 0400	ADDITIONAL INFORMATION:			

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Solution:

A fix for intermittent fuse blowing has been made available. Check the Single Contact connectors (HP part number 1251-2313) for proper mechanical fit. The emitter and base leads of the power supply pass transistors (A3Q1 through A3Q4) may make intermittent contact with the surface of the connectors, causing current surges, which open up the power supply fuses.

If it is determined that the connectors are at fault, the pass transistor leads should be soldered directly to the board assembly. Because one faulty connector probably means that all of the connectors were installed wrong, we recommend that the leads of all four transistors be soldered.

There are no parts needed and no inventory involved with this modification.

Solution:

A fix for intermittent fuse blowing has been made available. Check the Single Contact connectors (HP part number 1251-2313) for proper mechanical fit. The emitter and base leads of the power supply pass transistors (A3Q1 through A3Q4) may make intermittent contact with the surface of the connectors, causing current surges, which open up the power supply fuses.

If it is determined that the connectors are at fault, the pass transistor leads should be soldered directly to the board assembly. Because one faulty connector probably means that all of the connectors were installed wrong, we recommend that the leads of all four transistors be soldered.

There are no parts needed and no inventory involved with this modification.

Return to Bench · Support Strategy

Sho

HEWLETT PACKARD

PRODUCT SUPPORT DIVISION 19310 Pruneridge Avenue, Cupertino, CA 95014 Telephone (408) 996-9800

FROM: Ann Elmore DATE: January 27, 1986

TO: W/W Area CE Managers SUBJ: HP 8671B PSP
W/W FRC Managers
W/W CSC Managers
W/W Area/Country Logistics Mgrs

cc:

Paul Balnys	(ICON)	Walter Wolf	(CSE)
Dave Fullerton	(SCRC)	Mike George	(CSE)
Tom Crosby	(SCRC)	Nick Voight	(ATLRC)
John Barclay	(PRSD)	Dave Jakubowski	(ATLRC)
Ed Blair	(SDC)	Graham Long	(ERC)
Jorge Arreygue	(SMR)	Kurt Gressman	(SMR)
Michel Bernard	(SMG)	Peter Sander	(CSR)
Pierre Ollivier	(SMG)	Bernard Meric	(CSG)
Bernard Bruand	(SMG)	Judy Hayner	(PRSD)
Barb Lawler	(PRSD)	Spencer Chan	(Geneva)
Klaus Lang	(SDE)	Marc-Henry Bricquet	(SDE)
Kelly O'Brien	(SPD)		

Product Support Plan for the HP 8671B

Attached is a Product Support Plan and Management Summary for the HP 8671B Synthesized Signal Generator from Stanford Park Division (SPD).

Please forward the Product Support Plan and Summary to appropriate personnel in your area.

Your comments are welcome.

Best Regards,

Ann Elmore

Ann Elmore
PRSD Support Planning

MANAGEMENT SUMMARY

HP 8671B SYNTHESIZED SIGNAL GENERATOR

1.0 PRODUCT DESCRIPTION

The HP 8671B from Stanford Park Division (SPD) is a broadband microwave synthesized CW generator which covers a frequency range of 2 to 18 GHz. A synthesized frequency source with calibrated +8 to -120 dBm output level makes the 8671B ideal for applications requiring a CW source.

The 8671B is very similar to the HP 8672A. Differences are outlined in the PSP.

2.0 MARKETING DATA

First shipments were in January, 1986.

The 8671B is targeted for the price sensitive customer in radar, EW, communication and automatic test systems applications.

3.0 SUPPORT STRATEGY

The 8671B will be supported as a member of the HP 8670 family of microwave synthesizers and is part of the 10-year support program.

The 8671B is warranted for 1-year bench repair. Bench repair will be to the component level and service contracts are available.

4.0 SUPPORT MATERIALS

A Parts Stocking recommendation has been made for CPC and PCE. The amplifier in the 8671B is available as a blue stripe part.

The recommended field service inventory follows the recommendations for the 8672A. The major differences in parts are detailed in Attachment 1 to the PSP.

5.0 TRAINING

Training for the 8671B will be a subset of the training for the 8672A. Technicians capable of servicing the 8672A will not require training on the 8671B due to the small number of differences between the two instruments.

Customer Engineers and Systems Engineers familiar with the 8672A should have no difficulty working with the 8671B.

The customer training course for the 8672A will include references to the 8671B.

6.0 DOCUMENTATION

The Operating Manual became available at the time of first customer shipments. The Service Manual will be available by June, 1986. The Service Manual for the 8672A can be used in the interim due to the small number of differences between the two instruments.

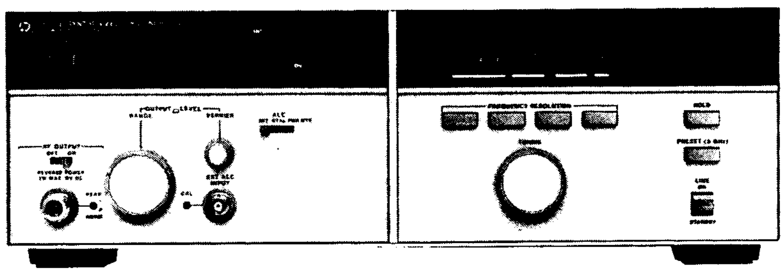
PRODUCT SUPPORT PLAN

January 21, 1986
Supersedes:
None

To: DISTRIBUTION

From: STANFORD PARK DIVISION (0400) PALO ALTO, CALIFORNIA

Subject: HP **8671B** SYNTHESIZED SIGNAL GENERATOR



DESCRIPTION

General Description

The HP 8671B is a broadband microwave synthesized CW generator which covers a frequency range of 2 to 18 GHz. A synthesized frequency source with calibrated +8 to -120 dBm output level makes the HP 8671B ideal for applications requiring a CW source.

The HP 8671B is the perfect choice for a synthesized local oscillator where low phase noise and spurious are important. Radar/EW, Communications and Component Test are prime applications for the HP 8671B. Automated test software now using an HP 8672A can use the HP 8671B as a direct replacement if modulation is not required. If program codes are included to turn off HP 8672A modulation, software developed for the HP 8671B or the HP 8672A can be used with either instrument with no modifications.

All front panel functions except the main line switch, the Peak-Norm adjustment and the ALC calibration adjustment are fully programmable over the HP-IB bus. The HP-IB program codes for the HP 8671B are a direct subset of the HP 8672A program codes. Modulation codes for the HP 8672A will be accepted by the HP 8671B but not executed.

Mechanical Description

The instrument is enclosed in a full width, 5.25 inch high System II cabinet. The net weight of the HP 8671B is 27.2 kg. Overall dimensions are 146 X 425 X 620 mm (5.8 X 16.8 X 24.4 in.) including the instrument feet or 133 X 425 X 603 mm (5.25 X 16.8 X 23.8 in.) without the instrument feet.

Kelly O'Brien

HEWLETT PACKARD

Environmental Description

The HP 8671B is designed to operate in the Hewlett-Packard class-B environment.

Temperature range: 0-55 deg C
Altitude: Operating: 0-4570 meters (15000 ft.)
Not Operating: 0-15300 meters (50000 ft.)
Humidity: <95% Relative

Electrical Characteristics

The HP 8671B has the following power mains requirements:

Line voltage: 110, 120,220,240 Vac +5%,-10%
Line frequency: 48-66 Hz
Power dissipation: 300 VA maximum
EMC specification: MIL-I-6181D

Product Configuration

There are no electrical options available for the HP 8671B. The mechanical options available include rack flange mount kit and front handles (option 907), rack flange mount kit (option 908), front handles (option 909) and extra operating and service manual (option 910).

Comparison with Similar HP Products

The HP 8671B is very similar to the HP 8672A Synthesized Signal Generator. The major electrical differences are the use of a new amplifier for output power specifications equal to the HP 8672A Option 008, the deletion of the A1A9 Metering Control board, and a modification to the A3A7 FM Driver board. The FM Driver board is called the YTO High Frequency Driver in the HP 8671B.

The major functional differences between the HP 8671B and the HP 8672A are the inclusion of the Option 008 specifications and the deletion of all modulation capability. External ALC and calibrated output level are still available on the HP 8671B. The HP 8671B is directly software compatible with the HP 8672A. Software written for the HP 8672A can be used with the HP 8671B with no modifications. The only HP-IB functional difference is the deletion of the FM overmodulation status bit from the status byte. The HP 8671B will accept all HP 8672A modulation codes without executing the codes so the HP 8672A and HP 8671B can be used interchangeably in software applications that do not require modulation.

The HP 8671B is the direct replacement for the HP 8671A except for applications requiring FM modulation. For these applications, the HP 8672A may be substituted. When using programs written for the HP 8671A with the HP 8671B, some minor modifications are required. Since the HP 8671A has no output level programming, the software will have to be modified to set the HP 8671B to the desired level. Note that an HP-IB clear will reset the HP 8671B output level to -70 dBm and going from local to remote will reset the vernier to -10 dBm but not change the range setting. The FM overmodulation bit in the status byte is not present in the HP 8671B status byte and the HP 8671B has an additional status bit for ALC unleveled conditions.

Target Market

The HP 8671B is targeted for the price sensitive customer in radar, EW, communication and automatic test systems applications. Excellent frequency accuracy and stability and a wide output power range coupled with full programmability make the HP 8671B an ideal choice in automated test systems and applications requiring synthesized frequency and calibrated output levels.

Using a synthesized local oscillator in Radar/EW applications allows more accurate and repeatable measurements. The HP 8671B can be used in applications such as receiver testing, two tone testing, general purpose downconversion and any other applications that require a high quality synthesized source.

Precise in-channel testing applications are easily accomplished with the excellent frequency settability of the HP 8671B. Even systems with narrow phase locked loop ranges can be used with the HP 8671B. Coherent measurements for modulation/demodulation and upconversion/downconversion are possible by using two HP 8671Bs with a common time base.

The programmability of the HP 8671B makes it an ideal choice for automated testing systems and use with other instruments such as the HP 8970A Noise Figure Meter and the HP 8901A/B Modulation Analyzers or HP 8902A Measuring Receiver. With +8 dBm of output power available, the HP 8671B is ideal for automated systems where losses are encountered in cabling and switches. The HP 8970A will directly control the HP 8671B with no modifications to the existing firmware. Extending the range of the HP 8901A/B and HP 8902A to 18 GHz is easily accomplished with an HP 8671B and an external mixer.

SUPPORT STRATEGY

Sales Support Strategy

The HP 8671B will be supported as a member of the HP 8670 family of microwave synthesizers and is part of the 10-year support program. Product notes for the HP 8672A can be used for the HP 8671B and any future product notes will include the HP 8671B where applicable.

Sales training literature for the HP 8671B includes a technical data sheet and a flyer. Any additional sales literature for the HP 8670 family should include the HP 8671B.

Hardware Support Strategy

Repair strategy:

Bench repair of the HP 8671B will follow the HP 8670 family strategy of repair to the component level. Troubleshooting for the HP 8671B to circuit level is included in the operating and service manual. The troubleshooting procedures are similar to the HP 8672A and the HP 8672A manual may be used for servicing until the service section of the manual is available. The Operating Manual (Section I through IV) will be available at the time of first shipment. The full operating and service manual will be available June 1986.

Performance Evaluation Strategy:

Full manual performance test procedures are contained in the HP 8671B Operating and Service Manual. Many of the performance tests have been automated using the HP 8952S Signal Generator Test System.

The automated performance tests (HP 11795A Option 317) test RF flatness, maximum RF power, and RF level accuracy. The additional tests are used to test the modulation capabilities of the HP 8672A. These tests are performed using the HP 8952S Signal Generator Test System which includes the HP 8902A Measuring Receiver, HP 8903A Audio Analyzer, HP 11792A Sensor Module, HP 11793A Microwave Converter and a local oscillator with a frequency range of 2 to 18 GHz and a power level of at least 7 dBm over the full range.

A full set of automated performance tests are planned using the Microwave Work Station with two additional instruments. The HP 11793A Microwave Converter and a programmable low frequency spectrum analyzer (such as the HP 3585) will be required for full automated testing. The planned full performance tests will support the entire HP 8670 family of microwave synthesizers.

Calibration Strategy:

The calibration procedures are outlined in the HP 8671B Operating and Service Manual supplement. Post-repair calibration will be performed only at the customer's request.

Software Support Strategy

The HP 8671B will be supported by any future HP 8672A adjustment software and performance test software. The HP 11795A Option 317 Performance Verification software for the HP 8672A may be used to test the HP 8671B for all RF output power specifications. The UUT should be identified as an HP 8672A Option 008 to compare to the correct specifications.

A full performance test software package for the HP 8670 family is under development and should be ready by the second quarter of FY 86. The software package will be designed around the Microwave Work Station and will require the HP 11793 Microwave Converter and the HP 3585A Spectrum Analyzer. The software is being developed using the TAIPAN software architecture to allow a variety of test equipment to be used. The software will be available to domestic Hewlett-Packard service centers for beta testing and will be directly supported by the factory. The software will be commercially available in FY 87.

Applications Support Strategy

Application Notes written for the HP 8672A can be applied to the HP 8671B in most cases. There are no new Application Notes currently planned for the HP 8671B. Any new application notes for the HP 8672A family will include the HP 8671B.

Customer Self-support

Customer service training for the HP 8671B will be offered only if enough demand is generated. The customer can choose to support the HP 8671B in the same manner as a customer can support the HP 8672A.

Third Party Support

There are no plans for third party support for the HP 8671B.

WARRANTY

Type of Warranty

The HP 8671B is warranted for 1 year bench repair. Recalibration within the warranty period is not normally included in warranty unless needed as the result of a warranty repair. Repair required due to abuse of the instrument is not covered under warranty.

Product Replacement

According to the terms of HP's warranty, we may replace a product rather than repair it. All requests for product replacement must be explicitly approved by the Marketing Manager for Stanford Park Division in advance of any replacement. Product replacement is considered to be absolutely a last resort to be used only when all other remedies have failed to resolve a serious problem and only after a factory repair attempt.

Warranty Conversion

The warranty for the HP 8671B will be limited to 1 year bench repair only. There are no alternates or upgrades offered.

TRAINING

Bench Technician Training

Training for the HP 8671B will be a subset of the training for the HP 8672A. Technicians capable of servicing the HP 8672A will not require training to service the HP 8671B due to the small number of differences between the two instruments.

Customer Engineer Training

There is no plan to offer Customer Engineer training for the HP 8671B. Customer Engineers familiar with the HP 8672A should have no trouble working with the HP 8671B.

System Engineer Training

No training will be offered for System Engineers. System Engineers who have experience with the HP 8672A should not have trouble working with the HP 8671B.

Customer Training

Customer service training for the HP 8671B will be offered only if enough demand is generated. Customer training courses for the rest of the HP 8670 family will include references to the HP 8671B. Attending a customer training course for the HP 8672A will cover the service training needs for the HP 8672A and HP 8671B.

Self-study Training

There is no self-study training material available at this time. Any self-training material developed will cover the HP 8672A and HP 8671B.

Video Tapes

No video tapes are currently planned for the HP 8671B.

LITERATURE

Demonstration Support Literature

There is no demonstration support literature planned for the HP 8671B.

Operating and Service Literature

A final Operating Manual will be available at the time of first shipment. The Service Manual will be available in June of 1986 and will contain Block Diagrams similar to the HP 8673E and troubleshooting procedures to the circuit level. The format of the manual follows the format of the HP 8673E Operating and Service Manual.

Product Notes

There are no product notes planned for the HP 8671B.

Application Notes

There are no application notes planned for the HP 8671B.

Programming Notes

There are no programming notes planned for the HP 8671B. Programming notes for the HP 8672A will apply for similar functions.

Other Software Support Literature

There is no other software support literature planned for the HP 8671B.

BASIC SUPPORT DATA

Expected Serviceability Performance

Item	Goal
Failure Rate	20%
Mean Time Between Failures	10000 hours
Mean Time To Repair	6 hours
Average Parts Cost	$420
Average Repair Cost	$800
Turn Around Time	18 days
Calibration Frequency	Annually
Mean Time To Calibrate	6 hours
Operational Verification Time	1 hour
Periodic Maintainance Schedule	Annually

Operation verification consists of performing two performance tests outlined in Section IV of the Operating and Service Manual. This procedure may be performed by the customer. A Functional test is also included in Section III of the Operating and Service Manual that may be performed by the operator with only a 20 dB attenuator and an HP-IB controller (for remote operation checks). The functional test takes about 30 minutes.

The periodic maintainance can be done by the customer. This maintainance procedure requires the covers of the instrument to be removed and should only be performed by service trained personnel who are aware of the hazards involved.

Use of a static free workstation is advised when performing the maintainance procedure.

The figure given for calibration is only the time required for a full performance test of the instrument. A calibration involving adjustments will require another 3 hours and a calibration requiring a repair will require another 6 hours. The mean time to repair includes an operation verification.

Software Update Schedule

Any updates of adjustment and performance test software for the HP 8672A will include the HP 8671B.

Sales and Repair Forecast by Region

The following forecast is based on a failure rate of 20%, each region's percent of total sales for FY 86, and production's quarterly shipping forecasts. Failures are assumed to be distributed in proportion to the total number of instruments sold in each region.

Repair Region (% of sales)	2 QTR Repairs (FY 1986)	3 QTR Repairs	4 QTR Repairs	1 QTR Repairs (FY 1987)	2 QTR Repairs
East (18%)	0	1	2	2	3
Neely (28%)	1	2	3	4	5
Midwest (6%)	0	0	0	0	1
South (13%)	0	1	1	2	2
Canada (1%)	0	0	0	0	0
HPSA (19%)	0	1	2	3	3
ICON (7%)	0	0	0	0	0
JAPAN (8%)	0	0	0	0	1

SUPPORT EQUIPMENT

Expensed Items

Attenuator, 3 dB	HP 8491A Opt. 003
Attenuator, 20 dB	HP 8491B Opt. 020
Crystal Detector	HP 8470B Opt. 012
Current Probe	HP 1110B
Mixer	RHG DMS1-18
Probe, 10:1	HP 10017A
50 Ohm Termination (BNC)	HP 11593A
600 Ohm Feedthrough	HP 11095A
Probe, High Impedance	HP 1121A

Capital Items

AC Voltmeter	HP 400E
Controller, HP-IB	HP 85B/82937A/ or HP 9826A or HP 9836A
Digital Voltmeter	HP 3455A or HP 3456A*
Frequency Counter	HP 5343A*
Frequency Standard	HP 5065A
Local Oscillator	HP 8340A Opt. H01*
Logic State Analyzer	HP 1630A (Troubleshooting)
Logic Pulser	HP 546A
Oscilloscope	HP 1980B*
Power Meter	HP 436A
Power Sensor	HP 8481A
Power Supply	HP 6200B
Variable Power Source	Cal. Instr. 501TC/800T
20 dB Amplifier	HP 8447A
Preamp-Power Amp	HP 8447F
Signal Generator	HP 8640B or HP 8340A*
Spectrum Analyzer	HP 8556A/8552B/141T
Spectrum Analyzer	HP 3580A
Spectrum Analyzer	HP 8566B*
Sweep Oscillator	HP 86222B/8620C or HP 8340A*
Test Oscillator	3335A*

* Instrument is part of the Microwave Workstation (MWS)

Service Support Software

There are no plans for service support software at this time. The operating and service manual contains listings for all software required to maintain and service the instrument. The HP 85 and series 200 controllers are supported using the BASIC language.

Any future service software will include the HP 8671B and the HP 8672A and will be documented separately. The service software contained in the HP 11712A Support Kit can be used with the HP 8671B for applicable procedures.

PARTS SUPPORT

A parts stocking recommendation has been sent to CPC, with recommendations for both CPC and PCE. The stocking list has components necessary to repair the instrument to the component level. Attachment 1 is a listing of the components of the HP 8671B that are different from the HP 8672A.

The amplifier used in the HP 8671B is the equivalent of the preamp, power amplifier and ALC modulator in a single package. The cost of the new assembly is comparable to the cost of the ALC modulator alone. This assembly will be available as a bluestripe part and should help to reduce the average repair cost.

Recommended Field Service Inventory

The recommended field service inventory for the HP 8671B follows the recommendations for the HP 8672A. The major differences in parts are detailed in Attachment 1.

Unique Parts

There are no unique or special parts for the HP 8671B.

Consumable Parts

There are no consumable parts for the HP 8671B.

ATTACHMENT 1

HP 8671B PARTS DIFFERENT FROM THE HP 8672A

08671-60016 YTO Phase Detector (FM circuitry removed)

08671-60017 YTO High Frequency Driver Board

08671-60018 Front Panel Board Assembly

08671-67005 Amplifier Assembly (replaces preamp, power amp and ALC modulator)

HP 8671B Synthesized CW Generator
HP 8672A Synthesized Signal Generator

Replacing Faulty Thermal Fuse on Internal Reference Oscillator Using Kit 08671-60025

Serial Numbers Affected

8671B: 2823A00785 To 2933A01027
8672A: 2823A05482 To 2934A05688

The Situation

The HP 8671B and 8672A signal generators have 10811-60102 as their 10 MHz reference oscillators. A thermal fuse in the these oscillators is failing prematurely and causing the oscillator's oven circuitry to lose power. These fuses have been observed to fail as early as three months after delivery of the signal generator.

When the fuse fails, the oven cools down and the oscillator drifts off frequency. Indications of this are as follows:

The OVEN COLD annunciator will come on and remain on. Normally the OVEN COLD annunciator will turn off within 15 minutes of a cold start.

The signal generator's output frequency will drift in an unstable manner with changes to its internal temperature.

The nominal frequency of the reference oscillator will drift out of range of FREQUENCY ADJUST.

5/90-04/DH

Printed in USA

HP Part Number 08671-90025

HEWLETT PACKARD

Inspection To See If You Have a Faulty Fuse

Here is how to determine if your signal generator has a faulty thermal fuse.

1. If your signal generator's serial number is within the range shown on the first page of this installation note, it was probably shipped from the factory with a faulty fuse. Continue with step 2.

2. Inspect the rear panel of the signal generator for a label reading, "10811 OSC. SERIES 3010". If this label exists, the faulty fuse has already been replaced. If the label does not exist, continue with step 3.

3. Remove the signal generator's top cover. This is done by first removing the rear feet and then backing out the screw at the rear of the cover.

4. Refer to figure 1 and locate the A3A8 10 MHz reference oscillator. The oscillator has a serial number. It is on a label on the right side of the oscillator as viewed from the front of the signal generator. The first five characters of the serial number is the serial number prefix. If the serial number prefix is anything other than 2850A, the oscillator does not have a faulty fuse. If the prefix is 2850A, continue with step 5.

5. Inspect the top of the reference oscillator for a label reading, "UPGRADED TO SERIES 3010". This label might be easy to see or it might be hidden under the oscillator's top mounting bracket. Even if the label is under the bracket, you can still see it by pressing down on the oscillator, moving it towards its bottom shock mount.

   If the label exists, the faulty fuse has already been replaced. However, you should still do three things. First, if the label is not easy to see, take the "UPGRADED TO ..." label from the kit and place it on the oscillator in an easy to see location. Second, take the "10811 OSC ..." label from the kit and place it near the serial number on the rear panel of the signal generator. Finally, replace the top cover and rear feet.

   If the label does not exist, the faulty fuse is still in the oscillator and should be replaced. (The replacement fuse is in the kit.) This job can be done by your own service-trained technicians or it can be done by an HP technician at an HP service center. If you choose to have HP perform the replacement, parts and labor will be covered by the signal generator's warranty.

Contents of 08671-60025 Kit

Thermal Fuse (10811-80008)
Label, "UPGRADED TO SERIES 3010" (10811-80006)
Label, "10811 OSC. SERIES 3010" (10811-80007)
Installation Note (08671-90025)

Replacing the Faulty Fuse

To gain access to the fuse, you must remove top and bottom covers of the signal generator, raise the YTO loop assembly, remove the reference oscillator, and open it up. The fuse is a plug-in type that is easily replaceable. Afterwards, the signal generator must be tested for reference oscillator oven operation, phase locking, output level, and flatness. For most of these procedures, you will be referred to chapter 4 of the signal generator's manual. Equipment required for this testing is a power meter such as the HP 436A, 437B or 438A, and a power sensor such as the HP 8481A.

The entire procedure plus testing should take a little over one hour.

WARNING

This procedure should only be performed by service trained personnel who understand the dangers of working on electronic equipment. This procedure does not require power to be supplied to the signal generator. Therefore, the line switch should be set to the standby position and the power cord should be removed. This will eliminate the possibility of electrical shock.

CAUTION

To prevent damage to the signal generator from electrostatic discharge (ESD), appropriate precautions should be exercised. This usually requires that the work is done at a properly grounded ESD work station, with the technician grounded through appropriate resistance, and with power completely removed from the signal generator.

1. Remove top and bottom covers.

2. Follow these procedures to remove the YTO loop assembly and place it in the service position.

    a. Place the signal generator on its right side.

    b. From the bottom of the signal generator, remove two YTO mounting screws and lockwashers. (These are marked "A" on the A3A10 mother board.)

    c. Refer to figure 1. Remove screw, MP665, near directional coupler A3A9A1, that secures the YTO assembly to the center divider.

    d. Disconnect the semi-rigid cable A1W1 from A3A9A1J1. Loosen the cable at amplifier A1A12 and rotate it up and away from the YTO assembly.

    e. Refer to figure 2. Lift the assembly out until it is clear. Rotate the back of the assembly up and forward, then hook it over the DCU divider as shown in the figure. Secure the assembly with the captive Service Support Screw as shown.

3. Follow these procedures to remove the reference oscillator.

   a. Refer to figure 1. Remove the two nuts that secure the reference oscillator Top Mounting Bracket to the center divider MP45.

   b. Remove flexible cable A3W2 (gray-violet) from the reference oscillator.

   c. Disconnect wire bundle and connector from mother board connector A3A10J3.

   d. Lift reference oscillator from the signal generator.

4. Follow these procedures to replace the faulty fuse.

   a. Refer to figure 3. Remove the four screws holding the cover in place.

   CAUTION

   In the following step, do not disassemble the oscillator more than explicitly instructed. Removal of extra parts can adversely affect the performance of your oscillator and void the warranty.

   b. Remove the cover.

   c. Using a long nose pliers, carefully remove the fuse from the socket and replace it with the fuse in the kit. The fuse is located adjacent to the 7-conductor flex connector.

   d. Replace the cover and screws.

5. Install the oscillator in the signal generator by reversing the procedure in step 3.

6. Install the YTO loop assembly in the signal generator by reversing the procedure in step 2. The connectors on the semi-rigid coaxial cable should be carefully torqued to 8 inch-pounds.

7. Locate the label in the kit that reads, "UPGRADED TO SERIES 3010". Place the label on the reference oscillator in an easy to see location.

8. Locate the label in the kit that reads, "10811 OSC. SERIES 3010". Place it on the rear panel of the signal generator near the serial number.

9. Replace the top and bottom covers and the rear feet.

Testing For Output Level, Flatness, and Phase Locking

After the signal generator has been reassembled, plug in the power cord and turn the line switch to on. The OVEN COLD annunciator should come on. This annunciator should turn off within 15 minutes indicating that the reference oscillator oven circuitry is working properly.

At this point, you should perform the output level and flatness tests in chapter 4 of the signal generator's manual. It is not necessary to perform portions of output level tests that check the steps of the attenuator. It is only necessary to check for maximum specified power. Where available, use the procedures in the abbreviated test section or the operational verification section.

As you perform the output level and flatness tests, observe the signal generator's ø UNLOCKED annunciator. It should remain off at all frequencies. However, it is normal for the annunciator to turn on briefly during rapid frequency switching.

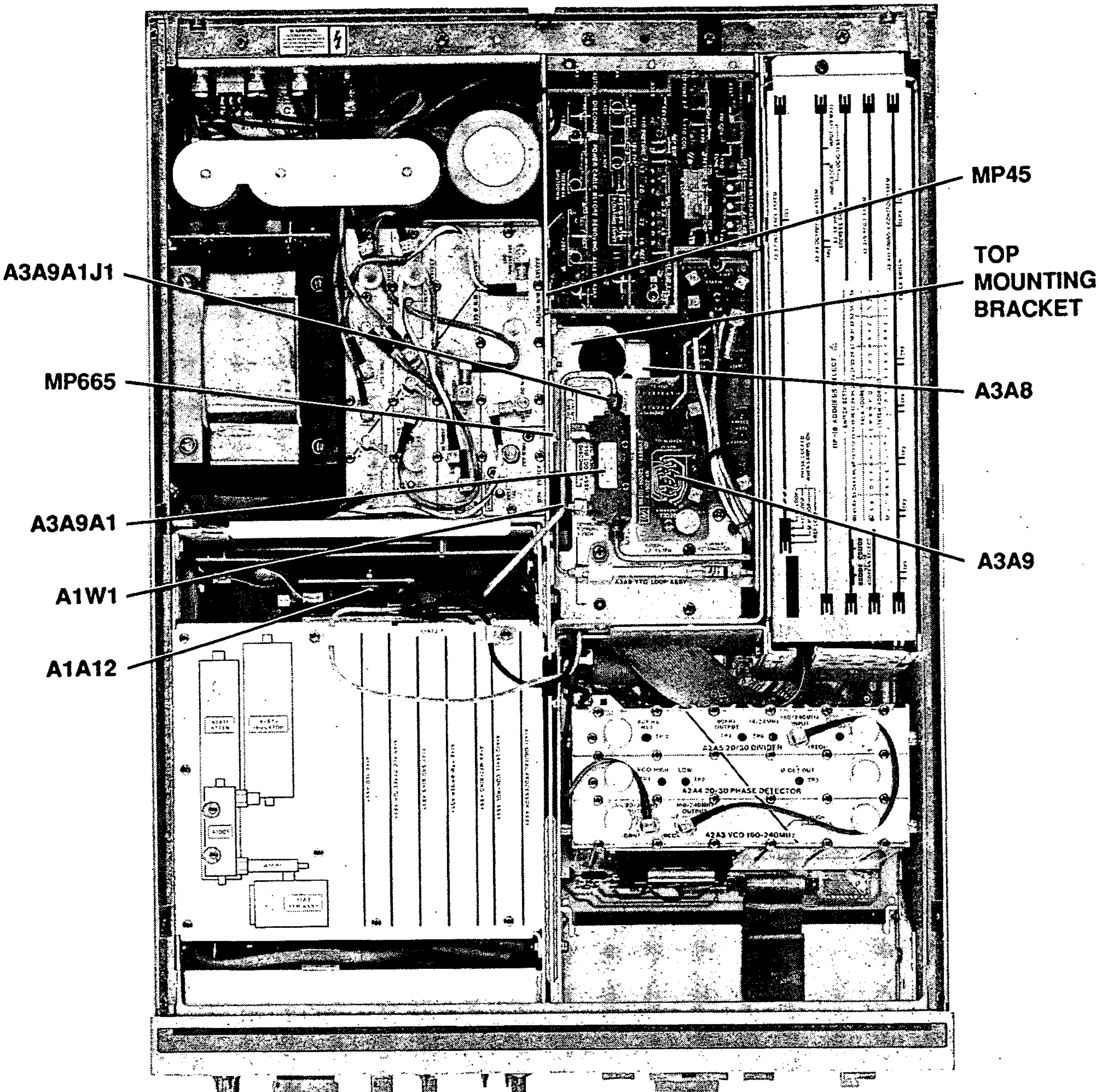


Figure 1. Locations of Reference Oscillator and YTO Loop Assembly

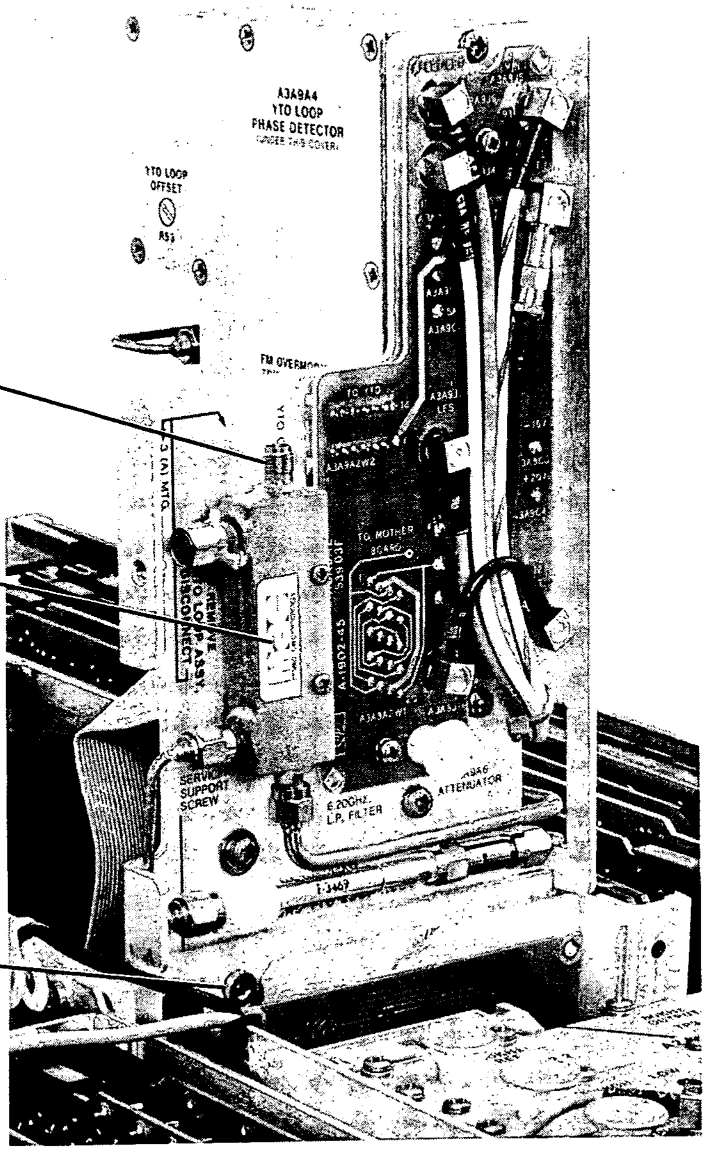


Figure 2. YTO Loop Assembly in Service Position

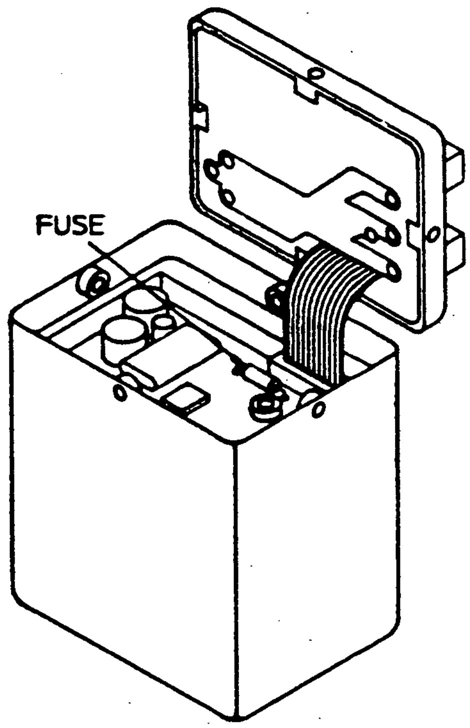


Figure 3. Location of Fuse in the Reference Oscillator

HEWLETT PACKARD

Printed in USA 06/90

**Manufacturing
Part No.
08671-90025**

ENGLEWOOD

INSTRUMENT SERVICE MGR

INTER-OFFICE SERVICE MEMO

Date: 2/21/78

TO: Distribution

FROM: Stanford Park Division

SUBJECT: Blue Stripe YTO

The YIG Tuned Oscillator used in the 8671A Synthesizer and 8672A Synthesized Signal Generator has been set up on the Blue Stripe exchange program. The restored assembly part number is 5086-6131. It can be used to replace either the 5086-7131 or 5086-7242.

Please begin using the restored part immediately since the cost savings is quite significant.

Steve Thomas

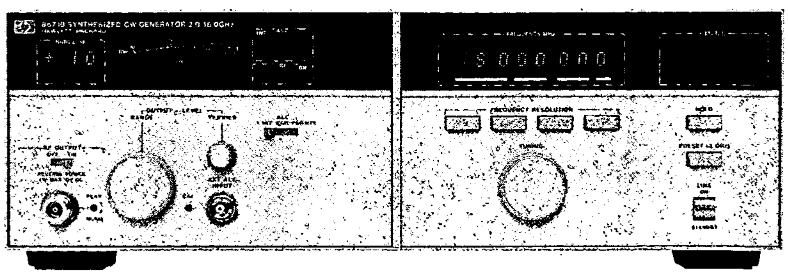
2/78–04

HEWLETT hp PACKARD

HP 8671B

OPERATING MANUAL

HP 8671B
SYNTHESIZED CW GENERATOR
2.0—18.0 GHz



HEWLETT PACKARD

HP 8671B

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

FOLD AND TAPE SECURELY

IMPORTANT

HELP US HELP YOU

We welcome your evaluation of this manual. Your comments and suggestions will help us improve our publications to serve you better.

THEN FOLD HERE

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SPD Product Support

FOLD HERE FIRST

We would like to respond to your comments and suggestions. Please fill out the following address information so that we can.

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STREET & NUMBER ....

CITY (TOWN) ....

STATE (PROVINCE) ....

COUNTRY .... ZIP (POSTAL CODE) ....

To assist us in providing information of most interest to you, please fill in the reverse side of this card.

Reader Comment Card

HP 8671B
OPERATING AND SERVICE MANUAL

Please check one or more of the following that describes your function.

________ Engineer	________ Incoming Inspection
________ Technician	________ Maintenance/Repair
________ Scientist	________ Metrology
________ Programmer	________ Military
________ Research and Development	________ Civilian
________ Production Test	Other ________________________

For each of the following questions, please use the space below to provide additional comments or information.

A. Do you primarily use the manual's service information?	Yes	No
B. Do you primarily use the manual's operating-programming information?	Yes	No
C. Is material missing from the manual that you think should be there?	Yes	No
D. Have you had troubles finding material that is in the manual?	Yes	No
E. Have you discovered any test or troubleshooting procedures that are not as complete as you expect?	Yes	No
F. Have you discovered any technical errors?	Yes	No
G. Are any parts of the manual difficult to read?	Yes	No
H. Are the HP-IB (IEEE Std. 488) instructions appropriate for your needs?	Yes	No
I. Do any parts of this manual fail to serve your particular needs?	Yes	No
J. Do any parts of this manual serve your needs particularly well?	Yes	No

Comments

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OPERATING MANUAL

HP 8671B
SYNTHESIZED CW GENERATOR
2.0 — 18.0 GHz

HEWLETT
PACKARD

OPERATING MANUAL PART NO. 08671-90019
Operating and Service Manual Part No. 08671-90017
Microfiche Part No. 08671-90018

Printed: December 1985

CONTENTS

Page

Section I
GENERAL INFORMATION

Introduction 1-1
Specifications 1-1
Safety Considerations 1-1
Instruments Covered by This Manual 1-1
Manual Changes Supplement 1-1
Description 1-2
Options 1-2
Mechanical Options 1-2
Accessories Supplied 1-2
Accessories Available 1-3
Electrical Equipment Available 1-3
Recommended Test Equipment 1-3

Section II
INSTALLATION

Introduction 2-1
Initial Inspection 2-1
Preparation For Use 2-1
Power Requirements 2-1
Line Voltage and Fuse Selection 2-1
Power Cables 2-1
⚠ HP-IB Address Selection 2-2
Interconnections 2-3
Mating Connectors 2-3
Operating Environment 2-3
Bench Operation 2-4
Rack Mounting 2-4
Storage and Shipment 2-4
Environment 2-4
Packaging 2-4

Section III
OPERATION

Introduction 3-1
Panel Features 3-1
Operating Characteristics 3-1
Local Operation 3-1
Remote (HP-IB) Operation 3-1
Operator's Checks 3-1
Operator's Maintenance 3-1
Turn-On Instructions 3-1
Turn-On 3-1
Frequency Standard Selection 3-1
Simplified Operation 3-3
Frequency 3-3
Output Level 3-3
ALC 3-3

Page

ALC Control 3-4
Frequency Control 3-8
Level Control 3-12
Peak-Norm Adjustment 3-15
RF ON/OFF Switch 3-16
Remote (HP-IB) Operation 3-17
HP-IB Compatibility 3-17
Remote Mode 3-17
Local Mode 3-17
Addressing 3-17
Data Messages 3-17
Receiving Data Messages 3-19
The Complete Data Message 3-19
The Abbreviated Data Message 3-19
Receiving the Clear Message 3-19
Receiving the Trigger Message 3-20
Receiving the Remote Message 3-20
Receiving the Local Message 3-20
Receiving the Local Lockout Message 3-20
Receiving the Clear Lockout/Set Local Message 3-20
Receiving the Pass Control Message 3-20
Sending the Require Service Message 3-20
Sending the Status Byte Message 3-20
Sending the Status Bit Message 3-20
Receiving the Abort Message 3-20
Operator's Checks 3-22
Basic Functional Checks 3-22
HP-IB Checks 3-26

Section IV
PERFORMANCE TESTS

Introduction 4-1
Abbreviated Performance Test 4-1
Calibration Cycle 4-1
Performance Test Record 4-1
Equipment Required 4-1
Test Procedures 4-1
Frequency Range and Resolution Test 4-2
Frequency Switching Time Test 4-5
Output Level, High Level Accuracy and Flatness Test 4-11
Low Level Accuracy Test 4-16
Output Level Switching Time Test 4-20
Harmonics, Subharmonics & Multiples Test 4-23
Non-Harmonically Related Spurious Signals Test 4-26
Power Line Related Spurious Signals Test 4-28
Single-Sideband Phase Noise Test 4-31
Internal Time Base Aging Rate 4-36

ILLUSTRATIONS

Figure		Page
1-1.	HP Model 8671B Accessories Supplied, and Options 907, 908, and 909	1-0
2-1.	Line Voltage and Fuse Selection	2-2
2-2.	Power Cable and Mains Plug Part Numbers	2-2
2-3.	HP-IB Address Switches Shown as Set by the Factory	2-3
2-4.	Hewlett-Packard Interface Bus Connection	2-5
3-1.	Front Panel Features	3-2
3-2.	Rear Panel Features	3-2
3-3.	External Leveling with a Crystal Detector	3-4
3-4.	External Leveling with a Power Meter	3-5
3-5.	Frequency Programming Codes and Arguments	3-10
3-6.	Frequency Switching Time Showing Worst Case	3-11
3-7.	Frequency Checks Test Setup	3-23
4-1.	Frequency Range and Resolution Test Setup	4-2
4-2.	Frequency Switching Time Test Setup	4-6
4-3.	Frequency Switching Time Measurement Waveform	4-8
4-4.	Amplitude Recover Measurement Waveform	4-10
4-5.	Output Level, High Level Accuracy and Flatness Test Setup	4-12
4-6.	Low Level Accuracy Test Setup	4-17
4-7.	Output Level Switching Time Test Setup	4-20
4-8	Output Level Switching Time Measurement Waveform	4-22
4-9.	Harmonics, Subharmonics, and Multiples Test Setup	4-23
4-10.	Non-Harmonically Related Spurious Test Setup	4-26
4-11.	Power Line Related Spurious Signals Test Setup	4-29
4-12.	Single-Sideband Phase Noise Test Setup	4-32
4-13.	Internal Time Base Aging Rate Test Setup	4-36

TABLES

Table		Page
1-1.	Specifications	1-4
1-2.	Supplemental Characteristics	1-7
1-3.	Recommended Test Equipment	1-8
2-1.	Allowable HP-IB Address Codes	2-3
3-1.	Operating Characteristics	3-1
3-2.	Index of Detailed Operating Instructions	3-1
3-3.	Message Reference Table	3-18
3-4.	Programming Quick Reference Guide	3-21
4-1.	Output Level, High Level Accuracy and Flatness Test Record	4-14
4-2.	Low Level Accuracy Test Record	4-19
4-3.	Harmonics, Subharmonics & Multiples Test Record	4-25
4-4.	Performance Test Record	4-38

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

SAFETY SYMBOLS

⚠ Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (see Table of Contents for page references).

⚡ Indicates hazardous voltages.

⏚ Indicates earth (ground) terminal.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

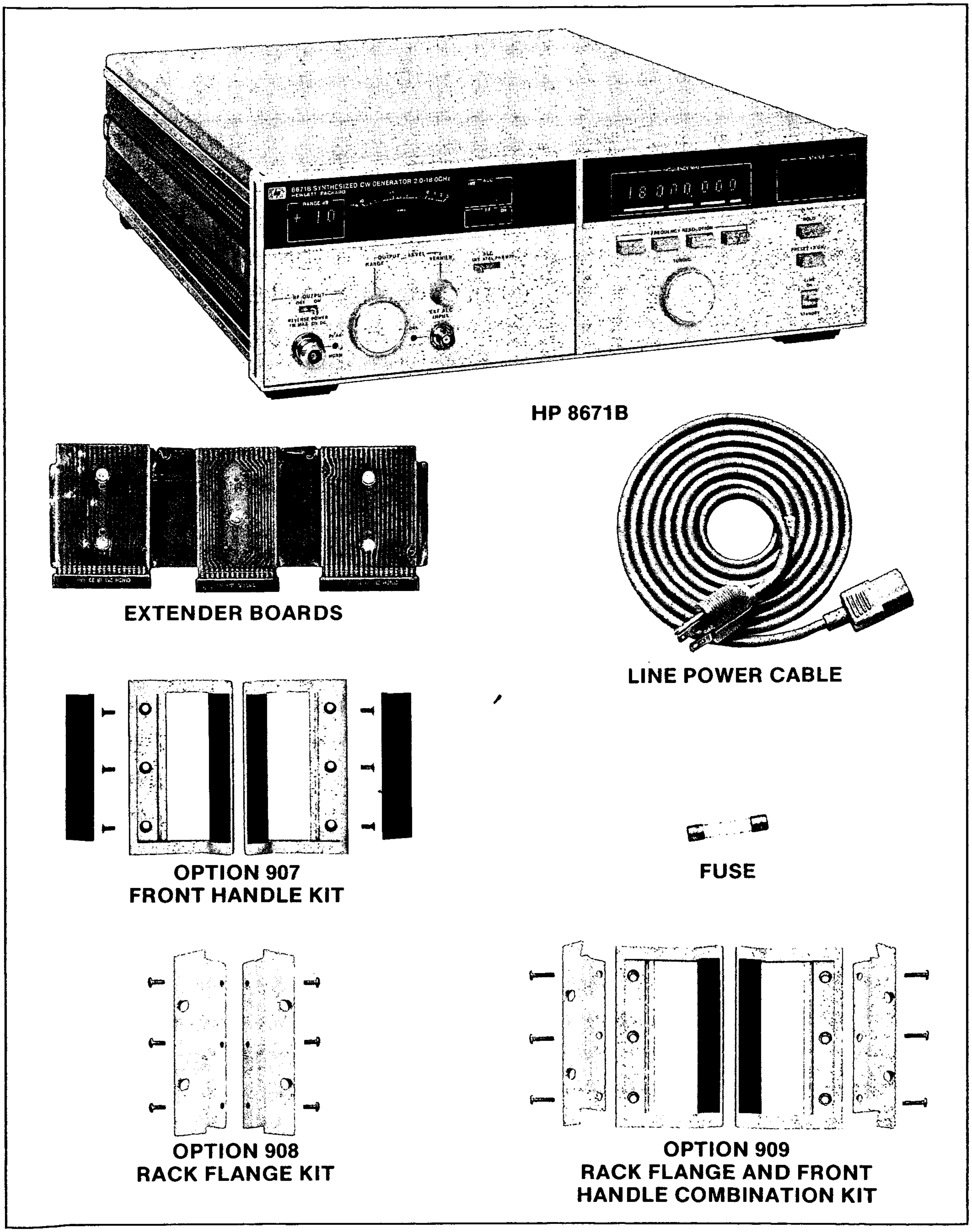


Figure 1-1. HP Model 8671B Accessories Supplied, and Options 907, 908, and 909

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust and service the Hewlett-Packard 8671B Synthesized CW Generator. Figure 1-1 shows the CW Generator with all of its externally supplied accessories.

The 8671B Operating and Service manual has eight sections. The subjects addressed are:

Section I, General Information
Section II, Installation
Section III, Operation
Section IV, Performance Tests
Section V, Adjustments
Section VI, Replaceable Parts
Section VII, Manual Changes
Section VIII, Service

Two copies of the operating information are supplied with the CW Generator. One copy is in the form of an Operating Manual. The Operating Manual is a copy of the first four sections of the Operating and Service Manual. The Operating Manual should stay with the instrument for use by the operator. Additional copies of the Operating Manual can be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

Also listed on the title page of this manual, below the manual part number, is a microfiche part number. This number may be used to order 100 x 150 millimetre (4 x 6 inch) microfilm transparencies of this manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement, as well as all pertinent Service Notes.

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested. Supplemental characteristics are listed in Table 1-2. Supplemental characteristics are not warranted specifications, but are typical characteristics included as additional information for the user.

1-3. SAFETY CONSIDERATIONS

This product is a Safety Class I instrument, that is, one provided with a protective earth terminal. The CW Generator and all related documentation should be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information for installation, operation, performance testing, adjustment, or service is found in appropriate places throughout this manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-5. MANUAL CHANGES SUPPLEMENT

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in this manual. The manual for this newer instrument is accompanied by a Manual Changes supplement. The supplement contains "change information" that explains how to adapt this manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep the manual as current and as accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual print date and part number, both

MANUAL CHANGES SUPPLEMENT (cont'd)

of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-6. DESCRIPTION

The HP 8671B Synthesized CW Generator has a frequency range of 2.0 to 18.0 GHz. The output is leveled and calibrated from +8 dBm to −120 dBm. Frequency, output level, and ALC modes can be remotely programmed via HP-IB.

The frequency can be tuned with one of four frequency resolutions. Tuning resolutions of 100 MHz, 1 MHz, 10 kHz or 1 kHz are selected by front panel pushbuttons. The 1 kHz tuning resolution will give tuning resolutions of 1 kHz for frequencies from 2.0 to 6.2 GHz, 2 kHz for frequencies from 6.2 to 12.4 GHz, and 3 kHz for frequencies from 12.4 to 18.599997 GHz.

Long-term frequency stability is dependent on the time base, either an internal or external reference oscillator. The internal crystal reference oscillator operates at 10 MHz while an external oscillator may operate at 5 or 10 MHz.

The output of the CW Generator is exceptionally flat due to the action of the internal automatic leveling control (ALC) loop. External leveling control using a diode detector or a power meter to sense output power can be used to level the output at a remote load.

The output level is set using the OUTPUT LEVEL RANGE switch and the OUTPUT LEVEL VERNIER. The OUTPUT LEVEL RANGE switch changes the output level in 10 dB increments (+10 to −110 dB). The OUTPUT LEVEL VERNIER is then used to adjust the output level over a continuous 13 dB range (−10 to +3 dBm). The output level is read by adding the vernier setting to the range setting.

The CW Generator is compatible with HP-IB to the extent indicated by the following codes: SH1, AH1, T6, TE0, L4, LE0, SR1, RL2, PP2, DC1, DT0, and C0. An explanation of the compatibility code can be found in IEEE Standard 488 (1978), "IEEE Standard Digital Interface for Programmable Instrumentation" or the identical ANSI Standard MC1.1. For more detailed information relating to programmable control of the CW Generator, refer to Remote Operation, Hewlett-Packard Interface Bus in Section III of this manual.

1-7. OPTIONS

1-8. Mechanical Options

The following options may have been ordered and received with the CW Generator. If they were not ordered with the original shipment and are now desired, they can be ordered from the nearest Hewlett-Packard office using the part numbers included in each of the following paragraphs.

Option 907 (Front Handle Kit). Ease of handling is increased with the front panel handles. The Front Handle Kit part number is 5061-9689.

Option 908 (Rack Flange Kit). The CW Generator can be solidly mounted to the instrument rack using the flange kit. The Rack Flange Kit part number is 5061-9677.

Option 909 (Rack Flange and Front Handle Combination Kit). This is a unique part which combines both functions. It is not simply a front handle kit and a rack flange kit packaged together. The Rack Flange and Front Panel Combination Kit part number is 5061-9683.

1-9. ACCESSORIES SUPPLIED

The accessories supplied with the CW Generator are shown in Figure 1-1.

a. The line power cable is supplied in several configurations, depending on the destination of the original shipment. Refer to Power Cables in Section II of this manual.

b. An additional fuse is shipped only with instruments that are factory configured for 100/120 Vac operation. This fuse has a 1.5A rating and is for reconfiguring the instrument for 220/240 Vac operation.

c. Four extender boards are supplied for performance testing, adjusting, and troubleshooting the instrument.

1. One 30-pin (15 x 2) extender board, HP part number 08672-60117.

ACCESSORIES SUPPLIED (cont'd)

2. Two 36-pin (18 x 2) extender boards, HP part number 08672-60020.

3. One 3-section, 30-pins (15 x 2) per section, extender board, HP part number 08672-60016 (for use in the A2 Assembly).

1-10. ACCESSORIES AVAILABLE

Chassis Slide Mount Kit. This kit is not available as a factory installed option. However, it is extremely useful when the CW Generator is rack mounted. Access to internal circuits and components or the rear panel is possible without removing the CW Generator from the rack. Order HP part number 1494-0059. If the instrument rack mounting slides are to be mounted in a standard EIA rack, then an adapter (HP Part No. 1494-0061) is needed. The slides without the adapter can be directly mounted in the HP system enclosures.

1-11. ELECTRICAL EQUIPMENT AVAILABLE

The CW Generator has an HP-IB interface and can be used with any HP-IB compatible computing controller or computer for automatic systems applications.

The HP-IB Controller is needed for Flatness and ALC adjustment procedures and for performance testing. Controllers that are supported by this manual include the HP 9826A, 9836A, and HP 85B/82937A.

The HP 11720A Support Kit is available for maintaining and servicing the CW Generator. It includes a special test extender board, cables and adapters.

1-12. RECOMMENDED TEST EQUIPMENT

Table 1-3 lists the test equipment recommended for testing, adjusting and servicing the CW Generator. Essential requirements for each piece of test equipment are described in the Critical Specifications column. Other equipment can be substituted if it meets or exceeds these critical specifications.

Table 1-1. Specifications (1 of 3)

Note: Specifications apply after 1-hour warm-up, over the temperature range 0 to 55°C (except specifications for RF output level which apply over the range 15 to 35° C). Specifications for output flatness and absolute level accuracy apply only when internal leveling is used.

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—18.0 GHz (Overrange to 18.599997 GHz)	
Resolution	1 kHz	2.0 to 6.2 GHz
	2 kHz	6.2 to 12.4 GHz
	3 kHz	12.4 to 18.0 GHz
Accuracy and Stability	Same as reference oscillator	
Switching Time		
Frequency (to be within the specified resolution −1 kHz in 2.0 to 6.2 GHz range, etc.)	<15 ms	
Amplitude (after switching frequency) to be within ±3 dB of final level	<15 ms	When switching within the same range
Reference Oscillator		
Frequency	10 MHz	
Aging Rate	$<5 \times 10^{-10}$/day	After a 10 day warmup (typically 24 hours in a normal operating environment)
SPECTRAL PURITY		
Single-sideband Phase Noise		1 Hz bandwidth
2.0—6.2 GHz	<−58 dBc	10 Hz offset from carrier
	<−70 dBc	100 Hz offset from carrier
	<−78 dBc	1 kHz offset from carrier
	<−86 dBc	10 kHz offset from carrier
	<−110 dBc	100 kHz offset from carrier
6.2—12.4 GHz	<−52 dBc	10 Hz offset from carrier
	<−64 dBc	100 Hz offset from carrier
	<−72 dBc	1 kHz offset from carrier
	<−80 dBc	10 kHz offset from carrier
	<−104 dBc	100 kHz offset from carrier
12.4—18.0 GHz	<−48 dBc	10 Hz offset from carrier
	<−60 dBc	100 Hz offset from carrier
	<−68 dBc	1 kHz offset from carrier
	<−76 dBc	10 kHz offset from carrier
	<−100 dBc	100 kHz offset from carrier
Harmonics	<−25 dBc	At +8 dBm

Table 1-1. Specifications (2 of 3)

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY (cont'd)		
Subharmonics and multiples thereof	<−25 dBc	At +8 dBm
Spurious Signals, non-harmonically related, except power line and fan rotation related	<−70 dBc	2.0—6.2 GHz
	<−64 dBc	6.2—12.4 GHz
	<−60 dBc	12.4—18.0 GHz
Power line related and fan rotation related within 5 Hz below line frequencies and multiples thereof		
2.0—6.2 GHz	<−50 dBc	<300 Hz offset from carrier
	<−60 dBc	300 Hz to 1 kHz offset from carrier
	<−65 dBc	>1 kHz offset from carrier
6.2—12.4 GHz	<−44 dBc	<300 Hz offset from carrier
	<−54 dBc	300 Hz to 1 kHz offset from carrier
	<−59 dBc	>1 kHz offset from carrier
12.4—18.0 GHz	<−40 dBc	<300 Hz offset from carrier
	<−50 dBc	300 Hz to 1 kHz offset from carrier
	<−55 dBc	>1 kHz offset from carrier
RF OUTPUT		
Output Power	+8 dBm to −120 dBm	+15 to +35°C
Remote Programming Absolute Level Accuracy		
2.0—6.2 GHz	±1.00 dB	+10 dB output level range
	±1.00 dB	0 dB output level range
	±1.50 dB	−10 dB output level range
	±1.70 dB	−20 dB output level range
	±1.90 dB	−30 dB output level range
	±1.90 dB & ±0.3 dB per 10 dB step	<−30 dB output level range
6.2—12.4 GHz	±1.25 dB	+10 dB output level range
	±1.25 dB	0 dB output level range
	±1.75 dB	−10 dB output level range
	±1.95 dB	−20 dB output level range
	±2.15 dB	−30 dB output level range
	±2.15 dB & ±0.3 dB per 10 dB step	<−30 dB output level range
12.4—18.0 GHz	±1.50 dB	+10 dB output level range
	±1.50 dB	0 dB output level range
	±2.10 dB	−10 dB output level range
	±2.30 dB	−20 dB output level range
	±2.40 dB	−30 dB output level range
	±2.40 dB & ±0.4 dB per 10 dB step	<−30 dB output level range

Table 1-1. Specifications (3 of 3)

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT (cont'd)		
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement uncertainty.
Remote Programming Output Level Resolution	1 dB	
Flatness (total variation)		0 dBm Range, +15°C to +35°C
	1.50 dB	2.0 to 6.2 GHz
	2.00 dB	2.0 to 12.4 GHz
	2.50 dB	2.0 to 18.0 GHz
Output Leveling Switching Time (to be within ±1 dB of final level)	<20 ms	
REMOTE OPERATION		
Frequency	Programmable over the full range with the same resolution as manual mode.	
Output Level	Programmable in 1 dB steps, +8 to −120 dBm, plus 5 dB of overrange	
RF Output	Programmable to either ON or OFF.	
ALC	Programmable for internal, crystal diode, or power meter leveling.	
Interface Function Codes	SH1, AH1, T6, TE0, L4, LE0, SR1, RL2, PP2, DC1, DT0, and C0.	
GENERAL		
Operating Temperature	0 to +55°C (see note at the beginning of this table).	
Power	100, 120, 220, or 240V, +5%, −10%, 48—66 Hz, 300 VA maximum.	
E.M.I.	Conducted and radiated interference is within the requirements of MIL-I-6181D.	
Net Weight	27.2 kg (60 lbs)	
Dimensions: Height	146 mm (5.7 in.)	
Width	425 mm (16.8 in.)	
Depth	620 mm (24.4 in.) For ordering cabinet accessories, module sizes are 5-1/4H, 1 MW, 23D, System II	
Accessories	Power Cord, Operating and Service Manual, and four extender boards.	

Table 1-2. Supplemental Characteristics

Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

FREQUENCY

Internal Reference: The internal reference oscillator accuracy is a function of time base calibration ± aging rate, ± temperature effects, and ± line voltage effects. Typical temperature and line voltage effects are $<1 \times 10^{-7}/°C$ and $<5 \times 10^{-10}/+5\%$ to -10% line voltage change. Reference oscillator is kept at operating temperature in STANDBY mode with the instrument connected to mains power. The aging rate is $<1.5 \times 10^{-9}$/day after a 24 hour warmup.

External Reference Input: 5 or 10 MHz at a level of 0.1 to 1 Vrms into 50Ω. Stability and spectral purity of the microwave output will be partially determined by characteristics of the external reference frequency.

Reference Outputs: 10 MHz at a level of 0.2 Vrms into 50Ω. 100 MHz at a level of 0.2 Vrms into 50Ω.

SPECTRAL PURITY

Residual FM: 80 Hz rms in a 50 Hz—15 kHz Post-detection bandwidth from 2—6.2 GHz. Residual FM doubles in the 6.2—12.4 GHz range and triples in the 12.4—18.0 GHz range.

RF OUTPUT

For power settings >+3 dBm, changes in frequency from <10 GHz to >16 GHz may require a settling period for the power to stabilize at the set level. Spurious output oscillations may occur for settings above +8 dBm.

External leveling device characteristics will determine output flatness, absolute level accuracy, and switching time in external leveling modes.

Maximum Reverse Power: 1W RF input; 1 MHz—20 GHz, 0 Vdc.

Impedance: 50Ω.

Source SWR: ≤2.0:1.

Table 1-3. Recommended Test Equipment (1 of 3)

Instrument	Critical Specifications	Recommended Model	Use*
AC Voltmeter	Range: 1 mV to 10V Accuracy: ±1.5% of full scale ±1.5% of reading Frequency Response: 3 kHz to 3 MHz	HP 400E	A
Attenuator, Fixed 3 dB	Range: dc to 1 GHz Accuracy: ±0.5 dB SWR: < 1.3	HP 8491A Option 003	A
Attenuator, Fixed 20 dB	Range: dc to 18 GHz Accuracy: ±1.0 dB SWR: < 1.6	HP 8491B Option 020	C, P
Cable, Special Interconnect	See YTO Loop Phase Detector Adjustments in Section V	Locally Fabricated	A
Controller, HP-IB	HP-IB compatibility as defined by IEEE Standard 488-1978 and the identical ANSI Standard MC1.1: SH1, AH1, T2, TE0, L2, LE0, SR0, RL0, PP0, DC0, DT0, and C1, 2, 3, 4, 5.	HP 85B/82937A or 9826A Option 011 or 9836A with BASIC 2.0 Operating System	C, A, T, P
Crystal Detector	Frequency Range: 2 to 18 GHz Frequency Response: ±1.5 dB	HP 8470B Option 012	P, A
Current Probe	Frequency Range: 2 to 35 MHz	HP 1110B	A
Digital Voltmeter (DVM)	Range: −60V to +40V dc Resolution: 100 μV on 1V dc range	HP 3456A or HP 3455A	A, T
Foam Pads (2 required)	43 × 58 cm (17 × 23 in.), 5 cm (2 in.) thick		P
Frequency Counter	Range: 2 to 18 GHz Resolution: 1 kHz 10 MHz Frequency Standard Output: ≥0.1 Vrms	HP 5343A	P, A, T
Frequency Standard	Long Term Stability: Better than 10^{-10}/day	HP 5065A	P, A
High Impedance Probe	Frequency: 400 MHz Output Impedance: 50Ω (compatible with Spectrum Analyzer).	HP 1121A	T
Local Oscillator	Range: 2 to 18 GHz Level: +7 dBm Single Sideband Phase Noise and Spurious Signals: Same as HP 8340A	HP 8340A	P, A
Logic State Analyzer	8 Bit Display, Triggerable	HP 1630A	T

Table 1-3. Recommended Test Equipment (2 of 3)

Instrument	Critical Specifications	Recommended Model	Use*
Logic Pulser	TTL compatible	HP 546A	T
Mixer	Response: 2 to 18 GHz VSWR, LO: ≤ 2.5:1 VSWR, RF: ≤ 4.0:1	RHG DMS1—18[1]	P, A
Oscilloscope	Bandwidth: 50 MHz Vertical Sensitivity: 50 mV/div Vertical Input: 50Ω ac or dc coupled External Trigger Capability	HP 1980B	P, A, T
Power Meter	Frequency: 2 to 18 GHz Range: +17 to −25 dBm	HP 436A	P, A, T
Power Sensor	Frequency: 2 to 18 GHz Input Impedance: 50Ω SWR: < 1.28 Range: +17 to −25 dBm Must be compatible with power meter	HP 8481A	P, A, T
Power Source, Variable Frequency AC	Range: 110 to 120 Vac Frequency: 52 to 58 Hz Accuracy ± 2 Hz	California Instruments 501TC/800T[2]	P
Power Supply	0 to 40 Vdc	HP 6200B	A, T
Amplifier, 20 dB	Frequency: 100 kHz Gain: 20 ± 5 dB Output Power: > −10 dBm Noise Figure: < 5 dBm Impedance: 50Ω	HP 8447A	P
Amplifier, 40 dB	Frequency: 100 kHz Gain: 45 ± 5 dB Output Power: > −10 dBm Impedance: 50Ω	HP 8447D and HP 8447E or HP 8447F	P
Probe, 10:1	Must be compatible with the oscilloscope.	HP 10017A	A
Signal Generator	Output Level: −5 to −20 dBm at 240 MHz	HP 8640B or HP 8340A	A
Spectrum Analyzer (with Tracking Generator)	Frequency Range: 20 Hz to 300 kHz Frequency Span/Division: 20 Hz minimum Noise Sidebands: > 90 dB below CW signal, 3 kHz offset, 100 Hz IF bandwidth Input Level Range: −10 to −60 dBm Log Reference Control: 70 dB dynamic range in 10 dB steps Accuracy: ± 0.2 dB	HP 8556A/8552B/141T	A

Table 1-3. Recommended Test Equipment (3 of 3)

Instrument	Critical Specifications	Recommended Model	Use*
Spectrum Analyzer	Frequency Range: 5 Hz to 50 kHz Resolution Bandwidth: 1 Hz minimum Frequency Span/Division: 5 Hz to 500 Hz Amplitude Range: 0 to −70 dB	HP 3580A	P, T
Spectrum Analyzer	Frequency Range: 100 kHz to 22 GHz Frequency Span/Division: 2 kHz minimum Amplitude Range: +10 to −90 dBm Noise Sideband: > 75 dB down 30 kHz from signal at 1 kHz resolution bandwidth Resolution Bandwidth: 30 Hz to 300 kHz	HP 8566B	P, A
Sweep Oscillator	Center Frequency: 150 to 200 MHz Center Frequency Resolution: 0.1 MHz Sweep Range: 10 and 200 MHz	HP 86222B/8620C or HP 8340A	A
Termination	50Ω BNC	HP 11593A	A
Termination	600Ω BNC Feedthrough	HP 11095A	P, A
Test Coupler Adapter	See YTM Adjustments in Section V	Locally fabricated	A
Test Oscillator	Level: 0 to 3V into 50Ω or 300Ω Range: 60 Hz to 10 kHz	HP 3335A	A, T

* C = Operator's Check, P = Performance Tests, A = Adjustments, T = Troubleshooting

[1] RHG Electronics Laboratory, Inc., 161 East Industry Court, Deer Park, NY 11729, Tel. (516) 242-1100, TWX 510-227-6083.

[2] California Instruments, 5150 Convoy Street, San Diego, CA 92111, Tel. (714) 279-8620.

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides the information needed to install the CW Generator. Included is information pertinent to initial inspection, power requirements, line voltage selection, power cables, interconnection, environment, instrument mounting, storage and shipment.

2-2. INITIAL INSPECTION

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, meters).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE

2-4. Power Requirements

The CW Generator requires a power source of 100, 120, 220 or 240 Vac, +5% to −10%, 48 to 66 Hz single phase. Power consumption is 300 VA maximum.

WARNINGS

This is a Safety Class I product (that is, provided with a protective earth terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an external autotransformer, make sure the autotransformer's common terminal is connected to the neutral (that is, the grounded side of the mains supply).

2-5. Line Voltage and Fuse Selection

CAUTION

BEFORE PLUGGING THIS INSTRUMENT into the mains (line) voltage, be sure the correct voltage and fuses have been selected.

Verify that the line voltage selection cards and the fuses are matched to the power source. Refer to Figure 2-1, Line Voltage and Fuse Selection.

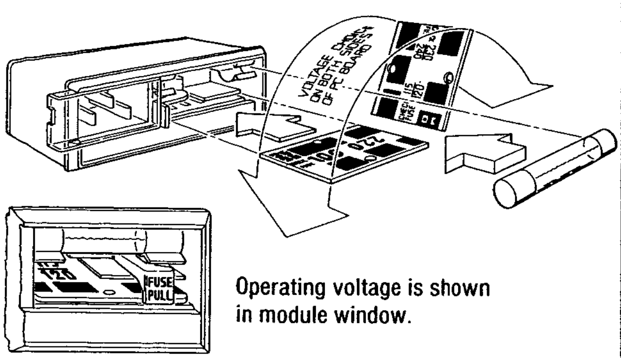
Fuses may be ordered under HP part numbers 2110-0003, 3.0A (250V) for 100/120 Vac operation and 2110-0043, 1.5A (250V) for 220/240 Vac operation.

2-6. Power Cables

WARNING

BEFORE CONNECTING THIS INSTRUMENT, the protective earth terminal of this instrument must be connected to the protective conductor of the (mains) power cables. The mains plug shall only be inserted in socket outlets provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding).

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument



SELECTION OF OPERATING VOLTAGE

1. Open cover door, pull the FUSE PULL lever and rotate to left. Remove the fuse.
2. Remove the Line Voltage Selection Card. Position the card so the line voltage appears at top-left corner. Push the card firmly into the slot.
3. Rotate the FUSE PULL lever to its normal position. Insert a fuse of the correct value in the holder. Close the cover door.

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz [leakage currents at these line settings may exceed 3.5 mA].

Figure 2-1. Line Voltage and Fuse Selection

Power Cables (cont'd)

cabinet. The power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of power cables available.

2-7. HP-IB Address Selection ⚠

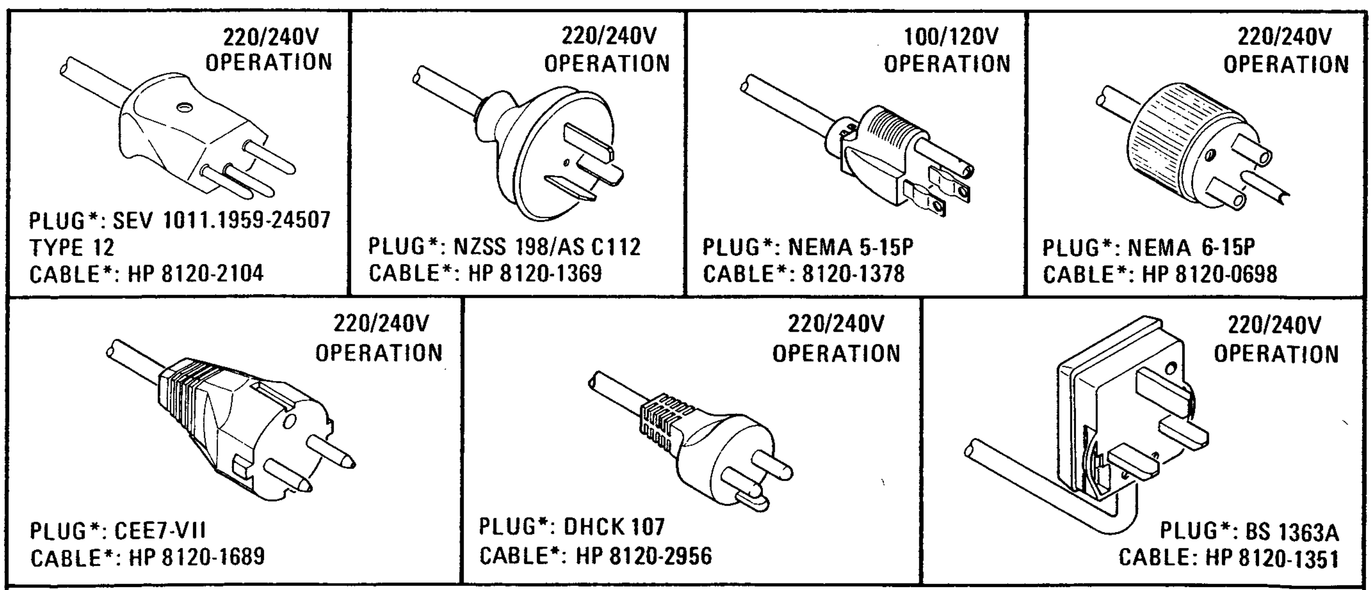
In the CW Generator, the HP-IB talk and listen addresses and the parallel poll sense and response line can be selected by internal switches. Refer to Table 2-1 for a listing of talk and listen addresses. The address is factory set for a Talk address of "S" and a Listen address of "3". (In octal this is 23; in decimal this is 19.)

To change the HP-IB address or to select a different parallel poll response, proceed as follows:

WARNINGS

Internal switch settings should be changed only by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

To avoid hazardous electrical shock, the line (mains) power cable should be disconnected before attempting to change any internal switch settings.



*The number shown for the plug is the industry identifier for the plug only.
The number shown for the cable is an HP part number for a complete cable including the plug.

Figure 2-2. Power Cable and Mains Plug Part Numbers

Table 2-1. Allowable HP-IB Address Codes

Address Switches (Octal)		Talk Address Character	Listen Address Character	Decimal Equivalent
S1	S2			
0	0	@	SP	0
0	1	A	!	1
0	2	B	"	2
0	3	C	#	3
0	4	D	$	4
0	5	E	%	5
0	6	F	&	6
0	7	G	'	7
1	0	H	(	8
1	1	I	)	9
1	2	J	*	10
1	3	K	+	11
1	4	L	,	12
1	5	M	–	13
1	6	N	.	14
1	7	O	/	15
2	0	P	0	16
2	1	Q	1	17
2	2	R	2	18
2	3	S	3	19
2	4	T	4	20
2	5	U	5	21
2	6	V	6	22
2	7	W	7	23
3	0	X	8	24
3	1	Y	9	25
3	2	Z	:	26
3	3	[	;	27
3	4	\	<	28
3	5	]	=	29
3	6	^	>	30

HP-IB Address Selection (cont'd)

a. Set the LINE switch to STANDBY. Disconnect the line power cable.

b. Remove the CW Generator's top cover by removing the two plastic standoffs from the rear of the top cover and loosening the screw at the middle of the rear edge of the top cover. Then remove the A2 Assembly's protective cover. Refer to the Disassembly Procedures in Section VIII, Service Sheet A.

c. Select the new address as shown in Table 2-1. The switches are shown in Figure 2-3. The HP-IB ADDRESS SELECT switch settings (for S1 and S2) are in the octal code. For example, the factory selected addresses are set to 23 (decimal 19). Therefore, the listen address is '3' and the talk address is 'S'.

d. If the parallel poll sense or response switches are to be changed, remove any HP-IB cables or connectors from the HP-IB connector, and remove the HP-IB connector. Then remove the A2A9 Board Assembly.

e. The PARALLEL POLL SENSE switch (S4) is set to either the OFF, 0 (zero) or 1 (one) position. The zero position provides a false (+2.5 to 5 volts) output on the asserted HP-IB data line; the one position provides a true (0 to +0.4V) output on the asserted HP-IB data line.

f. The PPR (Parallel Poll Response) switch (S3) is set to select one of eight lines (one of 1 through 8 of the HP-IB data bus). The selected line passes the CW Generator's parallel poll response to the HP-IB controller.

g. Re-install the A2A9 Assembly and HP-IB connector.

h. Replace the A2 Assembly's internal cover, the instrument's top cover, and rear standoffs.

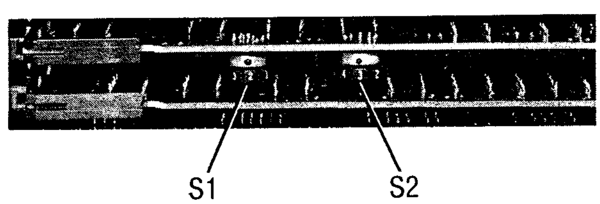


Figure 2-3. HP-IB Address Switches Shown as Set by the Factory

2-8. Interconnections

Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-4.

2-9. Mating Connectors

HP-IB Interface Connector. The HP-IB mating connector is shown in Figure 2-4. Note that the two securing screws are metric.

Coaxial Connectors. Coaxial mating connectors used with the CW Generator RF output should be 50Ω Type N male connectors.

2-10. Operating Environment

The operating environment should be within the following limitations:

Operating Environment (cont'd)

Temperature .... 0 to +55°C
Humidity .... <95% relative
Altitude .... <4570 metres (15,000 feet)

NOTE

Specifications for RF Output apply only between +15 and +35°C.

2-11. Bench Operation

The instrument cabinet has plastic feet and fold-away tilt stands for convenience in bench operation. (The plastic feet are shaped to ensure self-aligning of the instruments when stacked.) The tilt stands raise the front of the instrument for easier viewing of the front panel.

2-12. Rack Mounting

WARNING

The CW Generator weighs 27.2 kg (60 lbs), therefore extreme care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting the instrument.

Rack mounting information is provided with the rack mounting kits. If the kits were not ordered with the instrument as options, they may be ordered through the nearest Hewlett-Packard office. Refer to the paragraph entitled Mechanical Options in Section I.

2-13. STORAGE AND SHIPMENT

2-14. Environment

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature .... −55 to +75°C
Humidity .... <95% relative
Altitude .... 15,300 metres (50,000 feet)

2-15. Packaging

Preparation for Packaging. Remove handles and/or rack mount flanges before packaging instrument for shipping.

Tagging for Service. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the back of this manual and attach it to the instrument.

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. Mark the container "FRAGILE" to assure careful handling. In any correspondence refer to the instrument by model number and full serial number.

Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

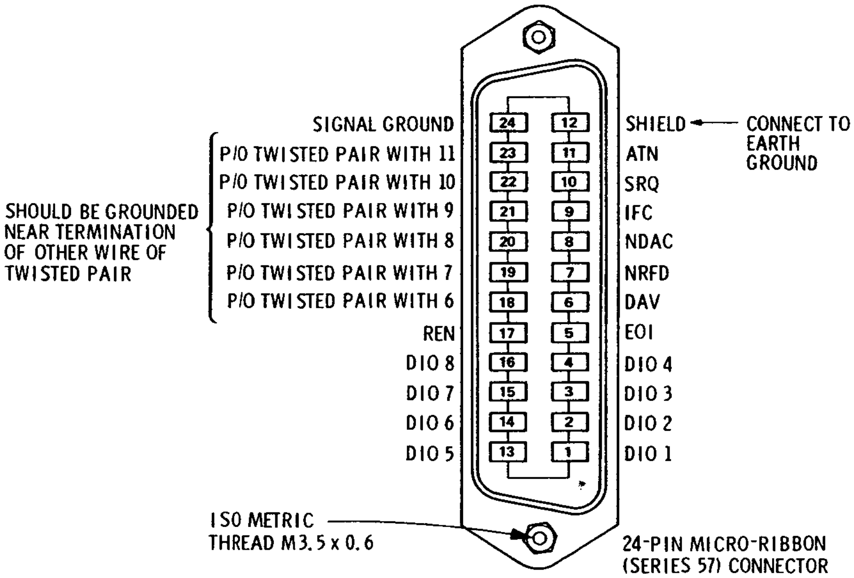
a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, complete one of the blue tags mentioned above and attach it to the instrument.)

b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use enough shock-absorbing material (75 to 100 mm layer; 3 to 4 inches) around all sides of the instrument to provide firm cushion and prevent movement in the container. Protect the front panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container "FRAGILE" to assure careful handling.



Logic Levels

The Hewlett-Packard Interface Bus Logic Levels are TTL compatible, i.e., the true (1) state is 0.0 Vdc to +0.4 Vdc and the false (0) state is +2.5 Vdc to +5.0 Vdc.

Programming and Output Data Format

Refer to Section III, Operation.

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10833A, 1 metre (3.3 ft), HP 10833B, 2 metres (6.6 ft)
HP 10833C 4 metres (13.2 ft), HP 10833D, 0.5 metres (1.6 ft)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus system may contain no more than 2 metres (6 ft) of connecting cable per instrument.

2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus system is 20.0 metres (65.6 ft).

Figure 2-4. Hewlett-Packard Interface Bus Connection

SECTION III
OPERATION

3-1. INTRODUCTION

This section provides complete operating information for the CW Generator. Included are both simplified and detailed operating instructions, detailed descriptions of the front and rear panel, local and remote operator's checks, and operator's maintenance.

3-2. Panel Features

Front and rear panel features are described in detail in Figures 3-1 and 3-2.

3-3. Operating Characteristics

Table 3-1 briefly summarizes the major operating characteristics of the CW Generator. This table is not intended to be a complete listing of all operations and ranges, but gives a general idea of the instrument's capabilities. For more information on the CW Generator's capabilities, refer to Table 1-1, Specifications, and Table 1-2, Supplemental Characteristics. For information on HP-IB capabilities, refer to Table 3-3, Message Reference Table.

3-4. Local Operation

Information covering front panel operation of the CW Generator is given in the sections described below. To quickly learn the operation of the instrument, begin with Operating Characteristics and Simplified Operation. (Operator's Checks can also be used to gain familiarity with the instrument.) Once familiar with the general operation of the instrument, use the Detailed Operating Instructions as a reference for more complete operating information.

Turn-On Information. Instructions relating to the CW Generator turn-on procedure and frequency standard selection are presented to acquaint the user with the general operation of the instrument.

Simplified Operation. The instructions located on the inside of the fold provide a quick introduction to the operation of the CW Generator. In addition, an index to the Detailed Operating Instructions is provided to direct the user to the more complete discussion of the topic of interest.

Detailed Operating Instructions. The Detailed Operating Instructions provide the complete operating reference for the CW Generator user. The instructions are organized alphabetically by subject. They are indexed by function in Table 3-2.

3-5. Remote (HP-IB) Operation

The CW Generator is capable of remote operation via the Hewlett-Packard Interface Bus (HP-IB).

HP-IB is Hewlett-Packard's implementation of the IEEE Standard 488, "IEEE Standard Digital Interface for Programmable Instrumentation", also described by the identical ANSI Standard MC1.1. For a more detailed information relating to programmable control of the CW Generator, refer to Remote (HP-IB) Operation in this section.

This section includes discussions on capabilities, addressing, input and output formats, the status byte and service request. In Table 3-4 is a complete summary of programming codes. In addition, programming examples are given in HP-IB Checks and in the Detailed Operating Instruction.

3-6. Operator's Checks

Operator's Checks are procedures designed to verify proper operation of the CW Generator's main functions. Two procedures are provided as described below.

Basic Functional Checks. This procedure requires only a 50 ohm load or attentuator to perform. For greater assurance, a microwave counter and a power meter can be used. This procedure assures that most front panel controlled functions are being properly executed by the CW Generator.

HP-IB Checks. This procedure assumes that front panel operation has been verified with the Basic Functional Checks. The procedure checks all of the applicable bus messages summarized in Table 3-3.

Table 3-1. Operating Characteristics

Frequency	Range: 2.0 to 18.0 GHz (Overrange to 18.599997 GHz) Resolution: 1 kHz 2.0 to 6.2 GHz 2 kHz 6.2 to 12.4 GHz 3 kHz 12.4 to 18.0 GHz
Output Level	Range: −120 to +8 dB in 10 dB steps Vernier: −10 to +3 dBm continuously variable
ALC	Internal, external crystal detector, or external power meter leveling.

Table 3-2. Index of Detailed Operating Instructions

3-14	ALC CONTROL	
	Local Procedure	3-4
	Internal Leveling	3-4
	External Crystal Detector Leveling	3-4
	External Power Meter Leveling	3-4
	Remote Procedure	3-5
	Comments	3-7
3-15	FREQUENCY CONTROL	3-8
	Local Procedure	3-8
	Remote Procedure	3-8
	Comments	3-10
3-16	LEVEL CONTROL	3-12
	Local Procedure	3-12
	Remote Procedure	3-12
	Comments	3-13
3-17	PEAK-NORM ADJUSTMENT	3-15
	Local Procedure	3-15
	Comments	3-15
3-18	RF ON-OFF SWITCH	3-16
	Local Procedure	3-16
	Remote Procedure	3-16
	Comments	3-16

3-7. Operator's Maintenance

WARNING

For continued protection against fire hazard, replace the line fuse with a 250V fuse of the same rating only. Do not use repaired fuses or short-circuited fuseholders.

Operator's maintenance consists of replacing defective primary fuses. This fuse is located in the line module assembly. Refer to Figure 2-1 for instructions on changing the fuse.

3-8. TURN-ON INSTRUCTIONS

WARNINGS

Before the instrument is switched on, all protective earth terminals, extension cords, autotransformers and devices connected to it should be connected to a protective earth grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

Only 250V normal blow fuses with the required rated current should be used. Do not use repaired fuses or short circuit fuseholders. To do so could cause a shock or fire hazard.

CAUTIONS

Before the instrument is switched on, it must be set to the voltage of the power source or damage to the instrument may result.

⚠ *The CW Generator's RF OUTPUT is protected against reverse power applications up to 1W. However, for greatest protection of expensive internal components, be careful not to apply any reverse power to the RF OUTPUT.*

3-9. Turn-On

Turn-On Procedure. The CW Generator has a STANDBY state and an ON state. Whenever the power cable is plugged in, an oven is energized to keep the reference oscillator at a stable operating temperature. If the CW Generator is already plugged in, set the LINE switch to ON.

If the power cable is not plugged in, follow these instructions.

On the rear panel:

1. Check the line voltage switch for correct voltage selection.
2. Check that the fuse rating is appropriate for the line voltage used (see Figure 2-1).
3. Plug in the power cable.

On the front panel, set the LINE switch to ON.

NOTE

The OVEN status annunciator should light to indicate that the CW Generator requires warming up. The annunciator should turn off within fifteen minutes and the CW Generator should be ready for general use.

Turn-On Configuration. The CW Generator turns on at the same frequency as before it was switched to STANDBY or even completely off (that is, if line power was removed).

3-10. Frequency Standard Selection

A FREQ STANDARD INT/EXT switch and two connectors are located on the rear panel. A jumper normally connects the FREQ STANDARD INT connector (A3J9) to the FREQ STANDARD EXT connector (A3J10). The

Frequency Standard Selection (cont'd)

FREQ STANDARD EXT connector can accept a reference signal to be used instead of the CW Generator's internal reference oscillator.

When the FREQ STANDARD INT/EXT switch is in the INT position and the jumper is connected between A3J9 and A3J10, the internal reference oscillator is enabled.

When the FREQ STANDARD INT/EXT switch is in the EXT position and the jumper is disconnected from the FREQ STANDARD EXT connector, a frequency standard of 5 or 10 MHz at 0 dBm (nominal) can be connected.

NOTE

The INTERNAL REF OFF status annunciator on the front panel will light when an external reference is being used. Also, the NOT PHASE LOCKED status annunciator may light if the external reference is not of sufficient accuracy in frequency or has an insufficient power level. The external reference must be within ±200 Hz of 10 MHz or ±100 Hz of 5 MHz for reliable locking to occur. If the external reference level is not within the specified limits (0.1 to 1 Vrms into 50 ohms), its level may be sufficient to turn off the NOT PHASE LOCKED status annunciator. However, the phase noise of the CW Generator may be degraded.

FRONT PANEL FEATURES

LEVEL meter reads output level over a 13 dB range (-10 to +3 dBm). The actual output level is the sum of the RANGE dB and meter dBm readings.

ALC and RF annunciators indicate ALC mode and operational status. RF annunciator indicates whether RF is ON or OFF. LVL UNCAL annunciator indicates that the RF output is not leveled and not calibrated.

FREQUENCY RESOLUTION display (light bars) indicates tuning resolution selected by frequency resolution keys.

FREQUENCY MHz display indicates RF output frequency.

STATUS annunciators indicate operational status of instrument.

OVEN indicates that the internal reference oscillator's oven is not up to operating temperature.

OUT OF RANGE indicates that an out-of-range frequency has been remotely programmed.

REMOTE indicates that the instrument is set to remote operation by an HP-IB controller.

STANDBY indicates that power is connected but the LINE switch is in the STANDBY position.

NOT PHASE LOCKED indicates that the output frequency is not correct or the RF OUTPUT switch is in the OFF position.

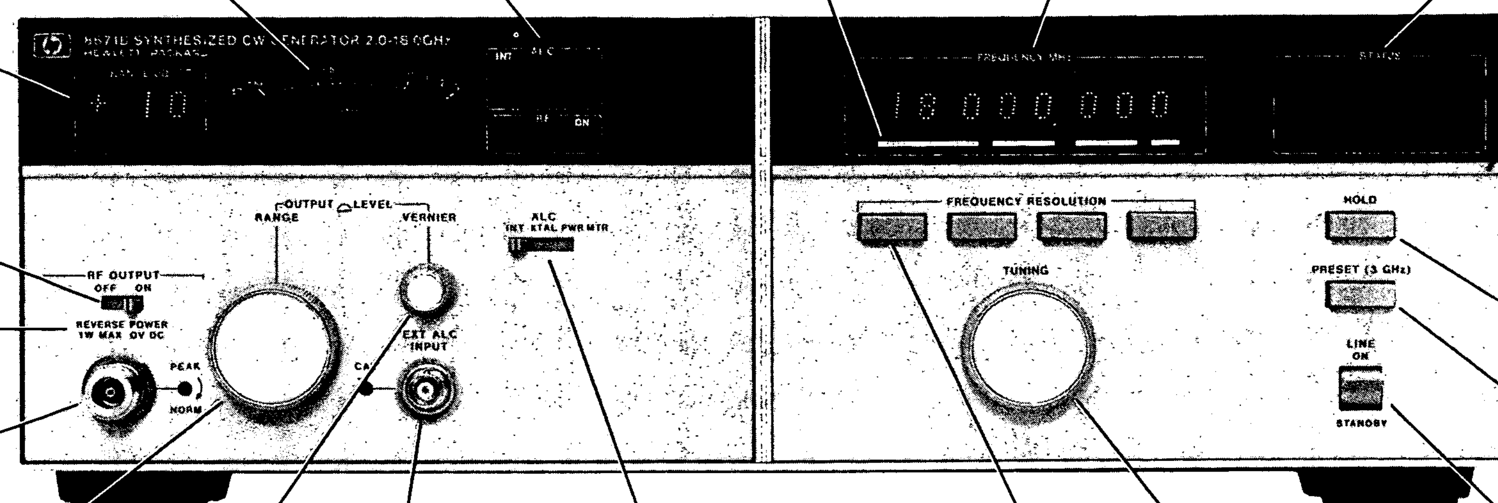
INTERNAL REF OFF indicates that the rear panel FREQUENCY STANDARD INT-EXT SWITCH is in the EXT position.

RANGE dB display indicates selected range (+10 to -110 dB).

RF OUTPUT ON-OFF switch turns off the RF output when in the OFF position. The NOT PHASE LOCKED and LVL UNCAL annunciators are turned on when RF OUTPUT is OFF.

⚠ The RF OUTPUT is protected from reverse power applications up to 1W. However, for best protection of internal circuitry, do not apply any reverse power.

RF OUTPUT connector. Output is controlled in 10 dB steps from +8 to -120 dBm with RANGE and VERNIER knobs, over frequency range of 2.0 to 18.0 GHz. PEAK-NORM control peaks power output at any one frequency. Use NORM position for best overall performance.



HOLD key disables frequency tuning control and extinguishes the frequency resolution display.

PRESET key sets frequency to 3000.000 MHz. It also disables the tuning control and extinguishes the frequency resolution display.

OUTPUT LEVEL RANGE sets output from +13 to -120 dBm in 10 dB steps.

OUTPUT LEVEL VERNIER adjusts output over a continuous -10 to +3 dBm range. Resolution is 1 dB under HP-IB control.

EXT ALC INPUT connector accepts external ALC leveling signal. CAL control adjusts external leveling calibration.

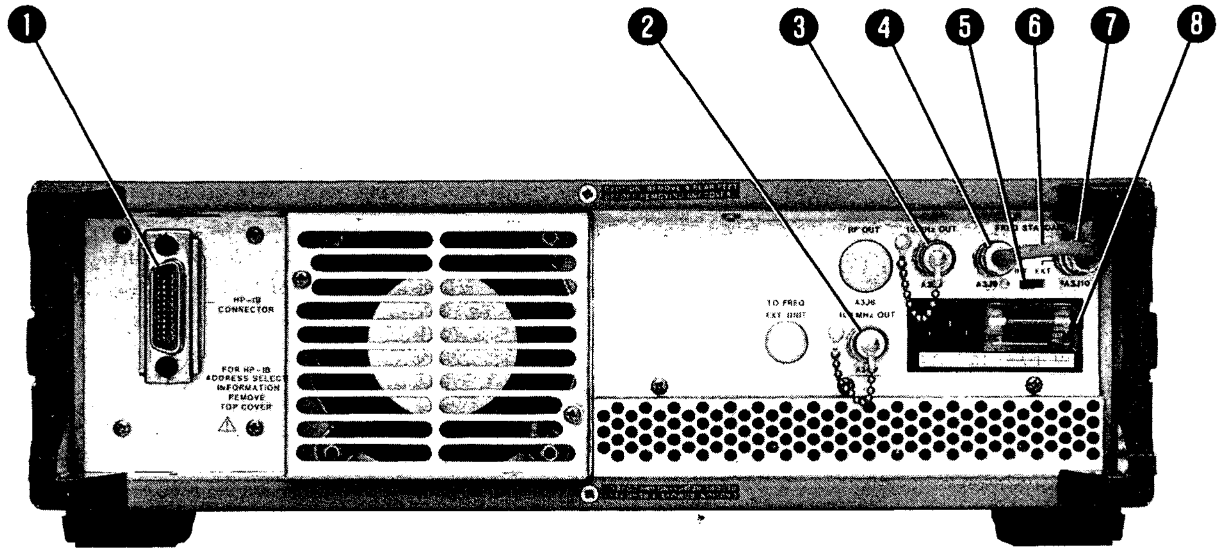
ALC switch selects internal, external diode, or external power meter leveling.

FREQUENCY RESOLUTION keys select tuning resolution (from left to right) of 100 MHz, 1 MHz, 10 kHz or 1 kHz.

TUNING control changes frequency with user-selected tuning resolution.

LINE switch turns the instrument on and off. It also keeps the internal reference oscillator oven on while in STANDBY position.

Figure 3-1. Front Panel Features



1 **HP-IB CONNECTOR:** connects the CW Generator to the Hewlett-Packard Interface Bus for remote operation. When in remote operation, the 7 REMOTE annunciator illuminates.

2 **100 MHz OUT (A3J7):** 0 dBm (nominal) into 50 ohms, can be used as an external timebase and for troubleshooting.

3 **10 MHz OUT (A3J8):** 0 dBm (nominal) into 50 ohms, can be used as an external timebase and for troubleshooting.

4 **FREQ STANDARD Output (A3J9):** 10.000 MHz into 50 ohms at +7 dBm (nominal) from the internal reference oscillator except when INT/EXT switch 5 is in the EXT position.

5 **FREQ STANDARD INT/EXT switch:** normally set to the INT position. Removes power from internal reference oscillator when in the EXT position.

6 **Jumper (A3W3):** normally connects the Internal Frequency Standard Output (A3J9) to the External Frequency Standard Input (A3J10).

7 **FREQ STANDARD Input (A3J10):** normally connected by A3W3 to A3J9. Also used to connect an external frequency standard of 5 or 10 MHz at 0 dBm to the CW Generator.

8 **Line Power Module:** permits operation from 100, 120, 220, or 240 Vac. The number visible in the window displays the nominal line (Mains) voltage for which the CW Generator is set (see Figure 2-1). The protective grounding conductor connects to the CW Generator through this module. The line power fuse (A3F1) is inside this module and is the only part to be changed by the operator.

Figure 3-2. Rear Panel Features

3-11. SIMPLIFIED OPERATION

3-12. Frequency

Frequency is set using the FREQUENCY RESOLUTION keys and the TUNING knob. For example, to set the frequency to 15345.678 MHz:

Press PRESET (3 GHz). This is not always necessary, but it will set the right-hand six digits to 0, and may provide a convenient starting point.

Select the 100 MHz FREQUENCY RESOLUTION key and adjust the TUNING knob for a frequency of 15300.000 MHz.

Select the 1 MHz FREQUENCY RESOLUTION key and adjust the TUNING knob for a frequency of 15345.000 MHz. Select the 10 kHz FREQUENCY RESOLUTION key and adjust the TUNING knob for a frequency of 15345.670 MHz.

Select the 1 kHz FREQUENCY RESOLUTION key and adjust the TUNING knob for a frequency of 15345.678 MHz.

Press HOLD to disable the TUNING knob.

3-13. Output Level

The output level is set with the OUTPUT LEVEL RANGE and VERNIER controls.

First, adjust RANGE to step the output level up or down by increments of 10 dB. The selected range is shown in the RANGE dB display.

Adjust VERNIER between −10 and +3 dBm, as read on the meter, for the desired output level.

The output level is determined by adding the RANGE dB display to the LEVEL dBm meter reading.

3-14. ALC

ALC (automatic level control) has three modes of operation. They are:

INT (Internal leveling)

XTAL (External leveling using a crystal diode detector)

PWR MTR (External leveling using a power meter)

Internal leveling is selected for most applications. In this mode, an internal detector senses the level at the input of the 10 dB step attenuator, and the internal leveling circuitry keeps the output level constant. Loss of leveling is indicated by the LVL UNCAL annunciator.

For external leveling a crystal diode detector or power meter can be used. Operation is described further in the Detailed Operating Instructions.

3-15. ALC CONTROL

Description

The Synthesized CW Generator has three modes of Automatic Level Control (ALC):

INT (Internal leveling)
XTAL (External leveling using a crystal diode detector)
PWR MTR (External leveling using a power meter)

For most applications internal ALC (INT) will be used. With internal ALC the output power remains flat over the entire 2 to 18 GHz frequency range.

External ALC is used when the power level at a remote point must be kept constant. External ALC reduces power variations due to external cables and connectors.

The ALC switch selects the leveling mode. Positive or negative detectors can be used to supply the external ALC input voltage. A calibration adjustment allows the externally leveled power to be adjusted to match the VERNIER setting over a limited output power range. The calibration adjustment does not affect internal leveling.

ALC mode and status are indicated by the ALC display. The display indicates which leveling source is selected and when the output is unleveled. The status of the ALC, whether leveled or unleveled, can also be determined remotely by reading the status byte.

Local Procedure

To use Internal Leveling:

Set the ALC selector to INT. The output level will be the sum of the range and VERNIER settings.

To use XTAL (External Crystal) Leveling:

1. Connect the crystal detector and the 10 dB coupler as shown in Figure 3-3.
2. Set the ALC selector to INT and adjust the VERNIER to read 0 dBm on the meter. This allows calibration of the meter to the leveled point.
3. Set the output level range to 0 dB and the ALC selector to XTAL.
4. Adjust the ALC CAL control to set the level read on the power meter to the nearest 10 dBm. If the ALC control does not have enough range for a low power level adjustment, step the RANGE down until the adjustment can be made.

This level should be within −3 dB and +10 dB of the desired level. This calibrates the meter to agree with the leveled power. If the detector is operating in the square law

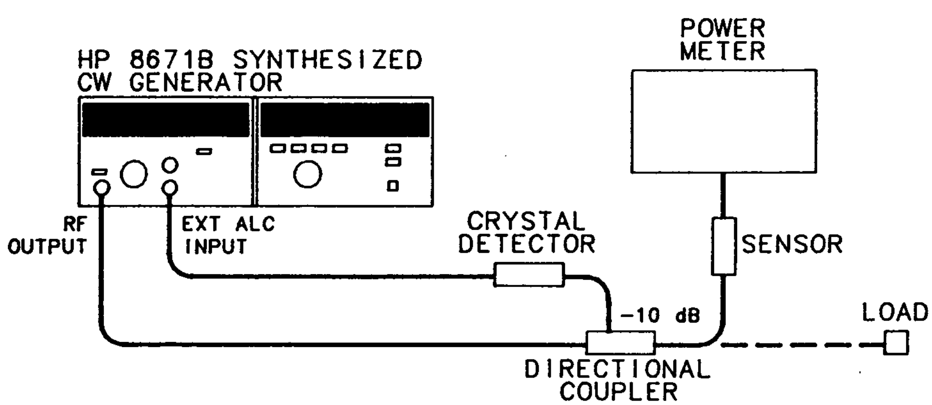


Figure 3-3. External Leveling with a Crystal Detector

ALC CONTROL (cont'd)

Local Procedure (cont'd)

region, the VERNIER will now control the level over a continuous 13 dB range, and the CW Generator's meter reading will track with the power meter reading as the VERNIER control is varied through the −10 to +3 dBm range.

To use external power meter leveling:

1. Set the ALC selector to INT and adjust the VERNIER to read 0 dBm on the meter. This allows calibration of the CW Generator's meter to the leveled point.
2. Connect power meter to the point where leveling is to be used as shown in Figure 3-4. A directional coupler can be used to sample the power at the desired point. Set the output level to the desired power and select the range hold function on the power meter. This disables range changes and keeps the leveled power from oscillating.
3. Connect the recorder output of the power meter to the external ALC input connector. The recorder output is a voltage that is proportional to the measured power in watts. This voltage varies from 0 to 2 volts for each power meter range. Leveling as low as −60 dBm can be accomplished with a sensitive power sensor using this method.
4. Set the output level range to 0 dB and the ALC selector to PWR MTR.
5. Adjust the ALC CAL controls to set the level read on the power meter to the nearest 10 dBm. This level should be within −3 dB and +10 dB of the desired level (minus the coupling factor of the directional coupler). This calibrates the CW Generator's meter to agree with the leveled power. This power leveling method has a slow settling time but has the advantage of high sensitivity and temperature compensation.

   If the ALC CAL control does not have enough range for a low power level adjustment, step the RANGE down until the adjustment can be made.

Remote Procedure

The ALC program code controls the function of the RF output ON/OFF switch, the ALC selector and the +10 dB range of output power. The program string consists of the letter O followed by a single argument representing the desired combination of the control positions.

To set the CW Generator to the +10 dB range, you must first set it to 0 dB with the range command (code and argument) K0. Then you can set the +10 dB range with the appropriate ALC command.

The codes are summarized in the table under Program Codes.

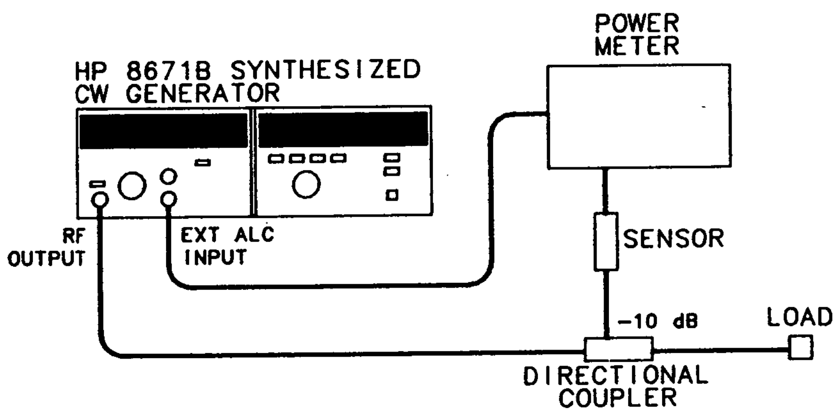


Figure 3-4. External Leveling with a Power Meter

ALC CONTROL (cont'd)

Example

To set internal ALC with an output level of +3 dBm:

Local

Set ALC selector to INT, RF output to ON, range to 0 dB and VERNIER for +3 dBm.

Or

Set ALC selector to INT, RF output to ON, range to +10 dB and VERNIER to −7 dBm.

HP-IB

```
K 0 L 0 O 1
| | | | | └── Argument for ALC (INT, NORMAL)
| | | | └──── Code for ALC
| | | └────── Argument for VERNIER (+3 dBm)
| | └──────── Code for VERNIER
| └────────── Argument for RANGE (0 dB)
└──────────── Code for RANGE
```

```
K 0 L : O 3
| | | | | └── Argument for ALC (INT, +10 dB Range)
| | | | └──── Code for ALC
| | | └────── Argument for VERNIER (−7 dBm)
| | └──────── Code for VERNIER
| └────────── Argument for RANGE (0 dB)
└──────────── Code for RANGE
```

Program Codes HP-IB

Program Code	ALC Mode			Argument
	RF	RANGE	ALC	
O or _ (letter O, not zero)	OFF	NORM	INT XTAL PWR MTR	0 4 <
		+10	INT XTAL PWR MTR	2 6 >
	ON	NORM	INT XTAL PWR MTR	1 5 =
		+10	INT XTAL PWR MTR	3 7 ?

ALC CONTROL (cont'd)

Comments

Output level flatness is dependent on the ALC circuitry and the maximum available power. In order to have a leveled output it is necessary for the ALC circuitry to continuously control the output level. This can only occur if the selected output power is below the maximum power level available at each frequency. For leveled output power in the +10 dB range, it is necessary that the LVL UNCAL annunciator remain off.

External ALC leveling also requires that the CW Generator can produce enough power to overcome losses in the intervening circuitry. The LVL UNCAL annunciator must remain off to achieve leveling. The 0 dB range should be used when using external leveling. If any of the lower ranges are used, the CW Generator must produce a higher level to overcome the attenuation introduced by the range selected.

For output level settings above +8 dBm, spurious oscillations can occur, resulting in sidebands on the carrier at a level of 30 to 50 dBc. These oscillations occur only over small portions of the frequency range. They can usually be eliminated by performing a PEAK-NORM adjustment or by reducing the output level VERNIER setting 1 or 2 dB.

Typical output level switching times are detailed under Level Control. Enabling the RF output requires less than 30 milliseconds. Disabling the RF output can be accomplished in less than 5 milliseconds.

The state of the RF output (on or off) and the status of the +10 dB range (selected or not selected) can be obtained by reading the status byte. The status of the ALC circuitry (leveled or not leveled) can also be monitored by reading the status byte. Once the status byte indicates that the output is leveled, an application can continue without waiting the specified time for the output level to settle.

Related Sections

Level Control
PEAK-NORM Adjustment

3.16 FREQUENCY CONTROL

Description

The CW Generator uses a simple, convenient frequency tuning system.

All frequencies can be remotely programmed or entered manually by a tuning knob. The knob can be turned in either direction without encountering a mechanical stop. Also, the faster it is turned the greater the frequency change per revolution.

In addition, four degrees of coarse to fine tuning can be selected. Frequency resolution keys located above the tuning knob select 100 MHz, 1 MHz, 10 kHz or 1 kHz tuning increments. Due to frequency multiplication to generate frequencies above 6.2 GHz, the minimum tuning increment (resolution) is 2 kHz above 6.2 GHz and 3 kHz above 12.4 GHz.

Once a desired frequency has been set, pressing the HOLD key will disable the tuning control and prevent unintentional changes in the frequency. The preset key sets the output frequency to 3000.000 MHz for conveniently setting the least significant digits to zeroes.

When the CW Generator is turned off or the power cable is removed, the last frequency setting is stored in battery-powered memory. When the instrument is powered up, the frequency returns to the stored value. This feature maintains the frequency setting even after power failures or extended periods without power.

Local Procedure

To set the output frequency to any desired frequency:

1. Press PRESET (3 GHz). This is not always necessary, but it will set the right-hand six digits to 0, and may provide a convenient starting point.
2. Select the desired tuning increment (100 MHz, 1 MHz, 10 kHz, or 1 kHz) by pressing the appropriate FREQUENCY RESOLUTION key, and use the TUNING knob to set the frequency digits above the rightmost lighted segment in the frequency resolution display.
3. Once the desired frequency is set, press the HOLD key to disable the TUNING knob.

Remote Procedure

The CW Generator accepts any frequency within its range (2000.000 to 18599.997 MHz) to 8 significant digits. Above 6.2 GHz the frequency is randomly rounded up or down to be compatible with the 2 kHz or 3 kHz resolution at the programmed frequency.

The CW Generator ignores spaces, commas, decimal points, carriage returns and line feeds.

Within the CW Generator, frequency information is stored in two separate blocks of four digits each. The effects of programming codes on the two internal frequency data blocks are shown in Figure 3-5. One block contains the 10 GHz through 10 MHz frequency digits and the other contains the 1 MHz through 1 kHz digits. Programming within one block does not change the other blocks unless it is necessary to round off a frequency above 6.2 GHz. The programming codes indicate the most significant digit being programmed.

The output frequency does not change until the frequency execute command (Z1) is received by the CW Generator. This command must be sent sometime after the frequency data has been sent.

FREQUENCY CONTROL (cont'd)

Example

To change frequency from 3000.231 MHz to 3450.001 MHz:

Local

1. Press the 100 MHz (leftmost) FREQUENCY RESOLUTION key. Adjust TUNING for a frequency of 3400.000 MHz.
2. Press the 1 MHz (next) FREQUENCY RESOLUTION key. Adjust TUNING for a frequency of 3450.000 MHz.
3. Press the 1 kHz (rightmost) FREQUENCY RESOLUTION key. Adjust TUNING for a frequency of 3450.001 MHz.

HP-IB Q 3450001 Z 1

- 1 — Dummy Argument for Frequency Execute
- Z — Code for Frequency Execute Command
- 3450001 — Argument for 1 GHz Frequency Resolution
- Q — Code for 1 GHz Frequency Resolution

— or —

R 450001 Z 1

- 1 — Dummy Argument for Frequency Execute
- Z — Code for Frequency Execute Command
- 450001 — Argument for 100 MHz Frequency Resolution
- R — Code for 100 MHz Frequency Resolution

— or —

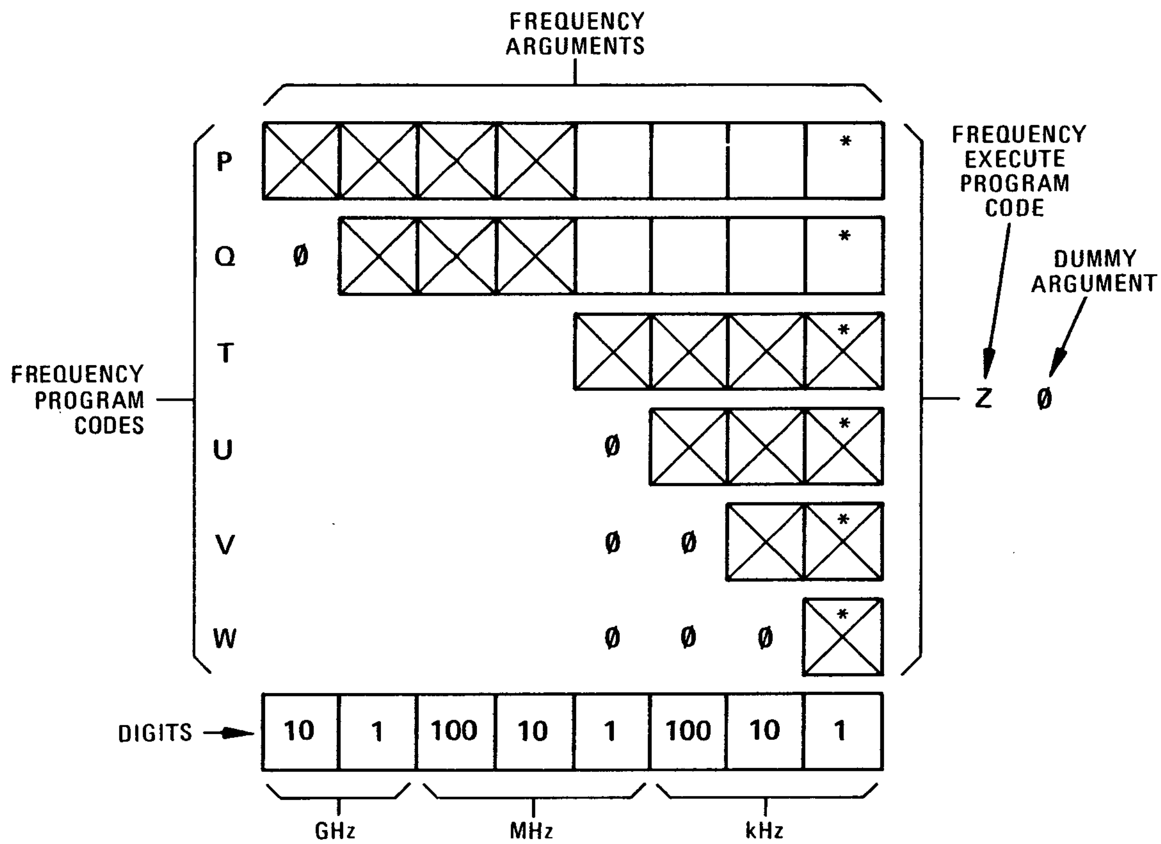
R 45 W 1 Z 1

- 1 — Dummy Argument for Frequency Execute
- Z — Code for Frequency Execute Command
- 1 — Argument for 1 kHz Frequency Resolution
- W — Code for 1 kHz Frequency Resolution
- 45 — Argument for 100 MHz Frequency Resolution
- R — Code for 100 MHz Frequency Resolution

Program Codes HP-IB

	PROGRAM CODES		ARGUMENTS
FREQUENCY	10 GHz	@ or P	0 THROUGH 9
	1 GHz	A or Q	
	100 MHz	B or R	
	10 MHz	C or S	
	1 MHz	D or T	
	100 kHz	E or U	
	10 kHz	F or V	
	1 kHz	G or W	
	EXECUTE	J or Z	

FREQUENCY CONTROL (cont'd)



☒ means that for a given program code, this digit *will* change (to zero if not programmed).

☐ means that the digit will change only if programmed.

* means that above 6.2 GHz this digit may change due to random rounding (however, it will always be within 2 kHz of programmed value).

Ø means that for a given program code, the leading zero is supplied by the instrument's hardware.

Figure 3-5. Frequency Programming Codes and Arguments

Comments

Due to the use of frequency multiplication to generate frequencies above 6.2 GHz, the frequency sometimes cannot be set precisely to a desired value. Frequencies between 2 and 6.2 GHz can be set to the nearest 1 kHz. All frequencies between 6.2 and 12.4 GHz can be set within 1 kHz of the desired value. All frequencies between 12.4 and 18 GHz can be set within 2 kHz of the desired frequency.

When the CW Generator is programmed to a frequency that is not evenly divisible, a random roundoff occurs. To prevent this, remote programming one should perform a calculation to determine whether the frequency can be set exactly.

To determine whether a frequency can be set to a given value, divide the desired frequency (in kHz) by two if it is between 6.2 and 12.4 GHz, or by three if it is above 12.4 GHz. IF the result is a whole number (with no remainder) the frequency can be set to the

FREQUENCY CONTROL (cont'd)

Comments (cont'd)

desired value. For example, 16 GHz divided by three (it is above 12.4 GHz) is 5333333.33 kHz, so this frequency cannot be set exactly. The nearest frequencies that can be set are 15.999999 GHz (5.333333 × 3) and 16.000002 GHz (5.333334 × 3).

The time it takes to switch from one frequency to the next depends on the largest frequency digit being changed. Generally, the smaller the digit being changed, the shorter the switching time. Typical switching times by largest digit being changed for frequencies between 2 and 6.2 GHz can be summarized as follows:

Largest Digit Changed	Time to be Within 1 kHz
100 MHz	10 ms
10 MHz	10 ms
1 MHz	10 ms
100 kHz	5 ms
10 kHz	3 ms
1 kHz	1.5 ms

For frequencies above 6.2 GHz, actual frequency digits being changed must be determined by dividing the output frequency by two (6.2 to 12.4 GHz) or three (12.4 to 18 GHz). The actual data transfer time is only a small portion of the frequency switching time and can be ignored.

For applications that require fast execution, the status byte can be checked until the frequency is phase locked. Once the status byte indicates that the CW Generator is phase locked, the application may continue with the assurance that the frequency is correct. Figure 3-6 shows the typical worst case lock and settling times.

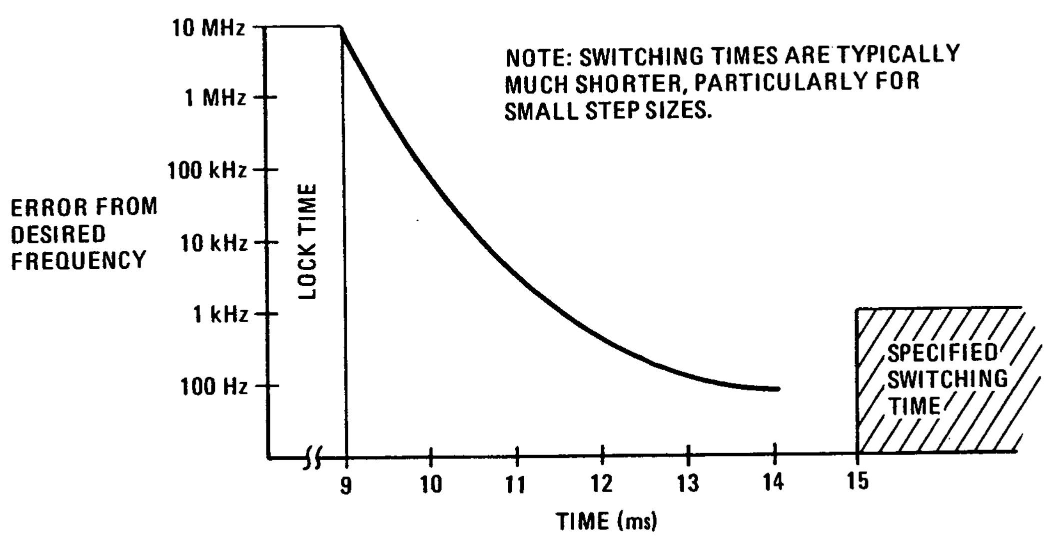


Figure 3-6. Frequency Switching Time Showing Worst Case

3-17. LEVEL CONTROL

Description

The Synthesized CW Generator is calibrated over a wide range of output power levels from +8 dBm to −120 dBm. The output level is set with a RANGE selector and a VERNIER control. The output level is the sum of the settings of these two controls.

The RANGE selector varies the output level in 10 dB steps. The selected range (+10 dB to −110 dB) is digitally displayed in the RANGE display. This display indicates the selected range in both local and remote modes. Output level ranges of 0 dB to −110 dB are programmable with the range program code. The +10 dB range is selected using the ALC program code.

The VERNIER knob continuously varies the output level in the 0 dB range from −10 to +3 dBm. The VERNIER setting is indicated by the front panel meter.

In local mode the VERNIER can be varied continuously over the full 13 dB range. In remote mode the VERNIER can be programmed in fourteen 1 dB steps from −10 dBm to +3 dB. Because the VERNIER can be controlled over greater than 10 dB in both local and remote mode, it is possible to overlap range settings by 3 dB. This is useful in applications where the ability to vary the output power continuously about a given level is critical.

Local Procedure

To set the output level to any desired value:

1. Set the CW Generator ALC mode to internal (INT).
2. Set the OUTPUT LEVEL RANGE to within −3 to +10 dB of the desired output level. For example, for a −56 dBm output level choose the −50 dB range.
3. Adjust the OUTPUT LEVEL VERNIER setting until the sum of the range display and the meter is equal to the desired output level.

Some output levels may be set using either of two adjacent ranges. Either range may be used. For example, +3 dBm may be set with a 0 dB range and +3 dBm VERNIER setting or a +10 dB range and −7 dBm VERNIER setting.

Setting output levels above +8 dBm may cause an ALC unleveled condition due to insufficient power available. The meter will indicate the actual power available when the unleveled condition occurs.

Remote Procedure

The 0 dB to −110 dB ranges and the VERNIER setting are programmed with the output level program codes. The VERNIER setting is programmed in 1 dB steps from −10 dBm to +3 dBm. The range is programmed in 10 dB steps from 0 dB to −110 dB. The +10 dB range is programmed by setting RANGE to 0 dBm and ALC to +10 dB.

When switching from local to remote mode, the VERNIER is reset to −10 dB and the range remains unchanged.

Example

To set the output level to +3 dBm:

Local
Set RANGE to 0 dB and VERNIER to +3 dBm.

Or

Set RANGE +10 dB and VERNIER to −7 dBm.

LEVEL CONTROL (cont'd)

Example (cont'd) HP-IB

K 0 L 0

- Argument for VERNIER (+3 dBm)
- Code for VERNIER
- Argument for RANGE (0 dB)
- Code for RANGE

K 0 L : O 3

- Argument for ALC (INT, +10 dB Range)
- Code for ALC
- Argument for VERNIER (−7 dBm)
- Code for VERNIER
- Argument for RANGE (0 dB)
- Code for RANGE

Program Codes HP-IB

OUTPUT LEVEL RANGE	Program Codes	Arguments	
	K	0 dBm	0
		−10	1
		−20	2
		−30	3
		−40	4
		−50	5
		−60	6
		−70	7
		−80	8
		−90	9
		−100	:
		−110	;

OUTPUT LEVEL VERNIER	Program Codes	Arguments	
	L	+3 dB	0
		+2	1
		+1	2
		0	3
		−1	4
		−2	5
		−3	6
		−4	7
		−5	8
		−6	9
		−7	:
		−8	;
		−9	<
		−10	=

Comments

Output level flatness is dependent on the ALC circuitry and the maximum available power. In order to have a leveled output it is necessary for the ALC circuitry to continuously control the output level. This can only occur if the selected output power is below the maximum power level available at each frequency. For leveled output power in the +10 dB range, it is necessary that the LVL UNCAL annunciator remain off. If it lights, adjust the PEAK-NORM control, or reduce the VERNIER setting.

For output level settings above +8 dBm, spurious oscillations can occur, resulting in sidebands on the carrier at a level of 30 to 50 dBc. These oscillations occur only over small portions of the frequency range.

LEVEL CONTROL (cont'd)

Comments (cont'd)

They can usually be eliminated by performing a PEAK-NORM adjustment or by reducing the OUTPUT LEVEL VERNIER setting 1 or 2 dB.

External ALC leveling also requires that the CW Generator can produce enough power to overcome losses in the intervening circuitry. The LVL UNCAL annunciator must remain off to achieve leveling. If it lights adjust the PEAK-NORM control, or decrease the the VERNIER setting.

Typical output level range change execution time for a 10 dB step is less than 20 milliseconds. An output level VERNIER change of 1 dB will take less than 10 milliseconds. These times are typical for remote programming. The actual data transfer time is a very small part of the execution time and may be ignored for most controllers.

The RF output changing from enabled to disabled takes less than 5 milliseconds. To enable the RF output from a disabled state requires less than 30 milliseconds.

The state of the RF output (on or off) and the +10 dB range (selected or not selected) can be obtained by reading the status byte. These two functions are programmed along with the ALC mode. For more information see ALC Control.

Related Sections

ALC Control
PEAK-NORM Adjustment

3-18. PEAK-NORM ADJUSTMENT

Description

The PEAK-NORM control adjusts an internal filter for maximum power output at a single frequency. This filter is adjusted for best over-all performance with the control in the detent position (NORM), but can be adjusted for maximum power (and reduced harmonics and sub-harmonics) at any one frequency. This adjustment will result in lower maximum power at most other frequencies, and therefore should be left in the NORM position except when maximum power is needed. It should only be required at power levels above +8 dBm.

Local Procedure

To maximize the output power at a set frequency:

Adjust the PEAK-NORM adjustment until the LVL UNCAL annunciator turns off, or for maximum meter reading with the VERNIER fully clockwise.

Remote Procedure

This adjustment cannot be remotely programmed.

Example

To peak an output level of +10 dBm at 8 GHz due to a LVL UNCAL indication:

1. Adjust the PEAK-NORM adjustment until the LVL UNCAL annunciator turns off, or for maximum meter reading with the VERNIER fully clockwise.
2. Return the PEAK-NORM adjustment to NORM (detented) position before resuming normal instrument operation. The +8 dBm output power level is affected by this adjustment and is only specified with the PEAK-NORM adjustment set to NORM.

Comments

For output level settings above +8 dBm, spurious oscillations can occur, resulting in sidebands on the carrier at a level of 30 to 50 dBc. These oscillations occur only over small portions of the frequency range.

They can usually be eliminated by performing a PEAK-NORM adjustment or by reducing the output level VERNIER setting 1 or 2 dB.

The PEAK-NORM adjustment must be in the NORM (detented) position to guarantee the specified +8 dBm level over the entire frequency range.

3-19. RF ON/OFF SWITCH

Description

The RF ON/OFF switch provides a convenient way of turning off the output signal. This is useful when calibrating detectors, zeroing power meters, or making noise measurements with no signal applied. With the switch in the off position the internal 2 to 6.2 GHz oscillator is turned off to prevent any signal leakage to the RF output connector.

The RF annunciator indicates the position of the RF ON/OFF switch in local mode and the programmed state when in remote mode. With the internal 2 to 6.2 GHz oscillator turned off, the CW Generator is no longer phase locked or leveled so the LVL UNCAL and NOT PHASE LOCKED annunciators are lighted.

Local Procedure

To disable the RF output:

Set the RF ON/OFF switch to OFF. Note that the OFF, LVL UNCAL and NOT PHASE LOCKED annunciators should be lighted.

To enable the RF output:

Set the RF ON/OFF switch to ON. The LVL UNCAL and NOT PHASE LOCKED annunciators should extinguish and the ON annunciator should light.

Remote Procedure

See ALC Control for a description of how to program the RF ON/OFF switch function.

Program Codes
HP-IB

See ALC Control

Comments

The status of the RF output (on or off) can be determined by reading the status byte. A service request is not generated for LVL UNCAL or NOT PHASE LOCKED when the RF output is set to OFF.

The RF output off-to-on transition typically requires less than 30 milliseconds when remotely programmed. The on-to-off transition typically requires less than 5 milliseconds.

3-20. REMOTE (HP-IB) OPERATION

The CW Generator can be operated through the Hewlett-Packard Interface Bus (HP-IB). HP-IB compatibility, programming and data formats are described in the following paragraphs.

All front panel functions except that of the ALC CAL control, PEAK-NORM control, and LINE switch are programmable via HP-IB.

A quick test of the CW Generator's HP-IB interface is described in this section under HP-IB Checks. These checks verify that the CW Generator can respond to or send each of the applicable bus messages described in Table 3-3.

3-21. HP-IB Compatibility

The CW Generator's programming capability is described by the twelve HP-IB messages listed in Table 3-3. The CW Generator's compatibility with HP-IB is further defined by the following list of interface functions: SH1, AH1, T6, TE0, L4, LE0, SR1, RL2, PP2, DC1, DT0, and C0. A more detailed explanation of these compatibility codes can be found in IEEE Standard 488-1978 and the identical ANSI Standard MC1.1.

3-22. Remote Mode

Remote Capability. The CW Generator communicates on the bus in both remote and local modes. In remote, the CW Generator's front panel controls are disabled except for the LINE switch. However, front panel displays remain active and valid. In remote, the CW Generator can be addressed to talk or listen. When addressed to listen, the CW Generator automatically stops talking and responds to the following messages: Data, Clear (SDC), Remote, Local, and Abort. When addressed to talk, the CW Generator automatically stops listening and sends one of the following messages: Data, Require Service, or Status Byte. Whether addressed or not, the CW Generator responds to the Clear (DCL), Clear Lockout/Set Local, and Abort messages. In addition, the CW Generator can issue the Require Service message and the Status Bit message.

Local-to-Remote Mode Changes. The CW Generator switches to remote operation upon receipt of the Remote message. The Remote message has two parts. They are:

a. Remote enable bus control line (REN) set true.

b. Device listen address received once (while REN is true).

When the CW Generator switches to remote, the REMOTE annunciator on the front panel turns on. With the exception of VERNIER, which will reset to −10 dBm, the CW Generator's control settings remain unchanged with the Local-to-Remote transition.

3-23. Local Mode

Local Capability. In local, the CW Generator's front panel controls are fully operational and the instrument will respond to a Remote message. The CW Generator can send a Require Service message, a Status Byte message, and a Status Bit message while in the Local mode.

Remote-to-Local Mode Changes. The CW Generator switches to local from remote whenever it receives a Local (GTL), Universal Unlisten address, Abort, or Clear Lockout/Set Local message. (The Clear Lockout/Set Local message sets the Remote Enable control line [REN] false.) The CW Generator can also be switched to local by turning the LINE switch to STANDBY, and then to ON.

With the Remote-to-Local transition, the frequency will remain the same. All other functions will return to the front panel settings. Power may go up, go down, or stay the same.

3-24. Addressing

When the Remote Enable line (REN) and the Attention control line (ATN) are true and the Interface Clear control line (IFC) is false, the CW Generator interprets the byte on the eight HP-IB data lines as an address or a command.

The CW Generator's Talk and Listen addresses can be set by switches located inside the instrument. The address selection procedure is described in Section II. Refer to Table 2-1 for a comprehensive listing of all valid HP-IB address codes.

3-25. Data Messages

The CW Generator communicates on the interface bus primarily with Data messages. Data messages consist of one or more bytes sent over the bus' data lines when the bus is in the data mode (attention control line [ATN] false). The CW Generator receives Data messages when addressed to listen, and sends the Status Byte message when addressed to talk. All instrument operations available in

Table 3-3. Message Reference Table (1 of 2)

HP-IB Message	Applicable	Response	Related Commands and Controls	Interface Functions*
Data	Yes	Frequency, Output level (RANGE and VERNIER), and ALC mode can be programmed. The CW Generator sends the status byte when addressed to talk.		AH1 SH1 T6, TE0 L4, LE0
Trigger	No	The CW Generator does not respond to the Group Execute Trigger (GET) bus command	GET	DT0
Clear	Yes	Sets frequency to 3000.000 MHz, RF output to off, ALC mode to Internal, and VERNIER to −10 dBm.	DCL SDC	DC1
Remote	Yes	Remote mode is enabled when the REN bus control line is true. However, remote mode is not entered until the first time the CW Generator is addressed to listen. The front panel REMOTE annunciator lights when the instrument is actually in the remote mode. The VERNIER is set to −10 dBm.	REN	RL1
Local	Yes	The CW Generator returns to local mode (front panel control). The CW Generator returns to the previous front panel settings, except for frequency.	GTL	RL2
Local Lockout	No	The CW Generator does not respond to the local lockout command.	LLO	RL2
Clear Lockout/ Set Local	Yes	The CW Generator returns to local (front panel control) when the REN bus control line goes false.	$\overline{\text{REN}}$	RL2
Pass Control/ Take Control	No	The CW Generator has no controller capability.		C0
Require Service	Yes	The CW Generator sets the SRQ bus control line true if one of the following conditions exists: frequency out of range, not phase locked with RF output on, or RF power level uncalibrated with RF power on.	SRQ	SR1
Status Byte	Yes	The CW Generator responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit status byte when addressed to talk. If the instrument is holding the SRQ control line true (issuing the Require Service message), the RQS bit and the bit representing the condition causing the Require Service message to be issued will both be true.	SPE SPD	T5
Status Bit	Yes	The CW Generator responds to a Parallel Poll Enable (PPE) bus command by sending a status bit on a switch selected HP-IB data line.	PPE	PP2

Table 3-3. Message Reference Table (2 of 2)

HP-IB Message	Appli-cable	Response	Related Commands and Controls	Interface Functions*
Abort	Yes	The CW Generator stops talking and listening.	IFC	T6, TE0 L4, LE0

*Commands, Control lines, and Interface Functions are defined in IEEE Std 488-1978. Knowledge of these may not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column.

Complete HP-IB capability as defined in IEEE Std 488 and ANSI Std MC1.1 is: SH1, AH1, T6, TE0, L4, LE0, DT0, DC1, RL2, C0, SR1, and PP2.

Data Messages (cont'd)

local mode can be performed in remote mode via Data messages except changing the ALC CAL and PEAK-NORM controls and the LINE switch setting.

3-26. Receiving Data Messages

The CW Generator responds to Data messages when it is enabled to remote (REN control line true) and addressed to listen. The instrument remains addressed to listen until it receives an Abort message or until its talk address or a universal unlisten command is sent by the controller.

A data message is a string of alternate codes and arguments, where a code is an ASCII character representing a function, such as frequency, RF output level, or ALC mode, and an argument is an ASCII digit representing a selection of the function. Each code and its argument make a command.

A complete summary of programming formats, codes and arguments is given in Table 3-4. In addition, programming examples are given in HP-IB Checks, and in the Detailed Operating Instructions.

The Complete Data Message. The following program string is a complete data message. It lists the commands in the order that the CW Generator decodes them, along with arguments that will be explained.

"P1Q2R3S4T5U6V7W8Z1K9L7M0N7O1"

The commands preceeding Z1 program a frequency of 12345.678 MHz. Z1 is a frequency execute command which is required to execute a string of frequency commands. K9 and L7 program output RANGE and VERNIER to −90 dB and −4 dBm respectively. M0 and N7 are used to program AM and FM in the HP 8672A (a similar synthesized signal generator with AM and FM capabilities) and are used as dummy commands to make program strings compatible with the HP 8672A. The O1 command programs ALC to internal leveling.

The Abbreviated Data Message. If functions are programmed in the order listed, codes can be omitted from the string, except for the first code, and Z1, the frequency execute command, if programming frequency. Thus, the following string is equivalent to the one above.

"P12345678Z197071"

Furthermore, the string can begin with any code and end with any argument, and can be composed of combinations of this syntax. Thus, the following string will program the CW Generator to a frequency of 2345 MHz, with a VERNIER setting of 0 dBm, without changing the output level RANGE setting.

"Q2345Z1L3"

3-27. Receiving the Clear Message

The CW Generator responds to the Clear message by setting the frequency to 3 GHz, ALC to internal, and RF power off. The message can take two forms: Device Clear which the CW Generator re-

Receiving the Remote Message (cont'd)

sponds to only when addressed, and Selected Device Clear, which it responds to whether addressed or not. The Device Clear message does not affect addressing, while the Selected Device Clear message leaves the CW Generator addressed to listen.

3-28. Receiving the Trigger Message

The CW Generator does not respond to the Trigger message.

3-29. Receiving the Remote Message

The Remote message has two parts. First, the remote enable bus control line (REN) is held true; second, the device listen address is sent by the controller. These two actions combine to place the CW Generator in remote mode. Thus, the CW Generator is enabled to go into remote when the controller begins the Remote message, but it does not actually switch to remote until addressed to listen the first time. When actually in remote, the CW Generator's front panel REMOTE annunciator lights.

3-30. Receiving the Local Message

The Local message is the means by which the controller sends the Go To Local (GTL) bus command. The CW Generator returns to front panel control when it receives the Local message.

When the CW Generator goes to local mode, the front panel REMOTE annunciator turns off. However, even in local, the CW Generator sends the status byte when addressed to talk.

3-31. Receiving the Local Lockout Message

The CW Generator does not respond to the Local Lockout message.

3-32. Receiving the Clear Lockout/ Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable (REN) bus control line false. The CW Generator returns to local mode (full front panel control) when it receives the Clear Lockout/Set Local message. When the CW Generator goes to local mode, the front panel REMOTE annunciator turns off.

3-33. Receiving the Pass Control Message

The CW Generator does not respond to the Pass Control message because it does not have this controller capability.

3-34. Sending the Require Service Message

The CW Generator sends a Require Service message if one or more of the following conditions exists for more than 50 ms:

1) Frequency programmed out of range
2) Not phase locked with RF output on
3) RF power level uncalibrated (LVL UNCAL) with RF power on.

The CW Generator can send a Require Service message in either the local or remote mode, and whether or not addressed. It sends the message by setting the Service Request (SRQ) bus line true.

Once the CW Generator is addressed to talk, the RQS bit is latched, even though CW Generator's need for service may have changed.

3-35. Sending the Status Byte Message

After receiving a Serial Poll Enable bus command (SPE) and when addressed to talk, the CW Generator sends a Status Byte message. The message consists of one 8-bit byte which corresponds to the pattern shown in Table 3-4, Programming Quick Reference Guide.

3-36. Sending the Status Bit Message

The CW Generator sends the Status Bit message in response to the Parallel Poll Enable (PPE) bus command (whether or not it is addressed to talk). If the CW Generator is sending the Require Service message, it will set its assigned status bit true.

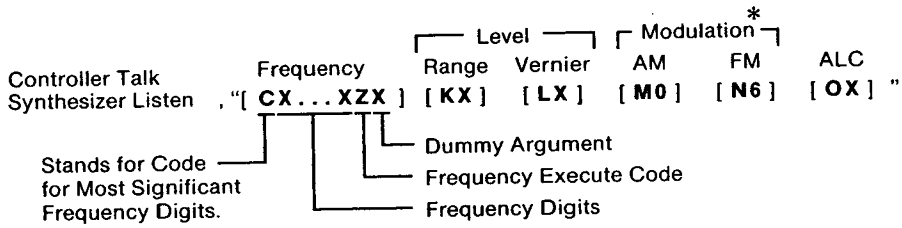
The data line that the parallel poll is assigned to respond on, and the sense (active high or active low) can be set from switches located inside the instrument. The selection procedure is described in Section II.

3-37. Receiving the Abort Message

The Abort message is the means by which the controller sets the Interface Clear (IFC) bus control line true. When the Abort message is received, the CW Generator becomes unaddressed and stops talking or listening.

Table 3-4. Programming Quick Reference Guide

PROGRAM STRING SYNTAX



WHERE: **C** = PROGRAM CODE
X = ARGUMENT OR FREQUENCY DIGIT

	PROGRAM CODES		ARGUMENTS	
FREQUENCY	10 GHz	@ or P	0 THROUGH 9	
	1 GHz	A or Q		
	100 MHz	B or R		
	10 MHz	C or S		
	1 MHz	D or T		
	100 kHz	E or U		
	10 kHz	F or V		
	1 kHz	G or W		
	EXECUTE	J or Z		
OUTPUT LEVEL RANGE	K or [		0 dB	0
			−10	1
			−20	2
			−30	3
			−40	4
			−50	5
			−60	6
			−70	7
			−80	8
			−90	9
			−100	:
			−110	;

	PROGRAM CODES	ARGUMENTS	
OUTPUT LEVEL VERNIER	L or \	+3 dBm	0
		+2	1
		+1	2
		0	3
		−1	4
		−2	5
		−3	6
		−4	7
		−5	8
		−6	9
		−7	:
		−8	;
		−9	<
		−10	=
AM	M or]*	OFF	0 or 1
FM	N or ⌢*	OFF	6 or 7

	PROGRAM CODES	ARGUMENTS: ALC	RF OFF	RF ON
ALC	O or _	INT NORMAL	0	1
		INT, +10 RANGE	2	3
		XTAL, NORMAL	4	5
		XTAL, +10 RANGE	6	7
		MTR, NORMAL	<	=
		MTR, +10 RANGE	>	?

STATUS BYTE

Bit Number	8	7	6	5	4	3	2	1
Decimal Value	128	64	32	16	8	4	2	1
Function	CRYSTAL OVEN COLD	REQUEST SERVICE	OUT OF RANGE (Frequency)	RF OFF	NOT PHASE LOCKED	LEV UNCAL	0 (NOT USED)	+10 dBm OVER RANGE

*Dummy codes for 8672A program compatibility.

OPERATOR'S CHECKS

3-38. OPERATOR'S CHECKS

3-39. Basic Functional Checks

Description

The purpose of these checks is to give reasonable assurance that the instrument is operating properly.

Each check has been designed to be performed with a minimum of test equipment, and in as short a time as possible. Therefore, although these checks are extremely valuable in identifying malfunctions, they are not a substitute for the Performance Tests in Section IV, which verify that the instrument is performing within its published specifications.

Each check is independent of the others and can be performed separately.

If a malfunction is suspected and the CW Generator is being returned to Hewlett-Packard for service, perform the entire procedure. Document the checks that failed on a blue repair tag located at the rear of this manual and attach the tag to the instrument. This will help ensure that the malfunction has been accurately described to service technicians for the best possible service.

Equipment

Attenuator, 10 dB .... HP 8491B, Option 010

Procedure

Turn-On Check

1. Set the LINE switch to STANDBY. Remove all external cables from the front and rear panels of the CW Generator, including the power cable connecting the instrument to mains power.
2. Set the rear panel FREQ STANDARD INT/EXT switch to INT and connect the JUMPER (A3W3) between A3J9 and A3J10.
3. After the power cable has been disconnected from the CW Generator for at least 1 minute, reconnect it to the CW Generator. Check the front panel of the instrument to verify that the STANDBY and OVEN status annunciators are on.
4. Leave the instrument's LINE switch set to STANDBY until the OVEN status annunciator turns off. This should occur in 15 minutes or less, depending upon how long the CW Generator was disconnected from mains power. (The OVEN annunciator may flicker off and on temporarily just as the oven stabilization temperature is reached. This is normal operation.) Once the OVEN status annunciator is off set the LINE switch to ON.
5. Set the RF OUTPUT switch to ON. Set the FREQ STANDARD INT/EXT switch to EXT. Verify that the INTERNAL REF OFF and NOT PHASE LOCKED status annunciators turn on. Set the switch back to INT. The status annunciators shold then turn off.

Frequency Check

The FREQUENCY MHz display and NOT PHASE LOCKED status annunciator are used to check that the internal phase-lock loops remain phase locked across their tuning range. The actual frequency at the RF OUTPUT connector is not

OPERATOR'S CHECKS

Procedure (cont'd) (cont'd)

checked. However, the frequency can be monitored with a microwave frequency counter or spectrum analyzer for greater assurance that the CW Generator is operating properly.

If a frequency counter is to be used to check frequency, disconnect the jumper from the rear panel connector A3J10 and connect the frequency counter as shown in Figure 3-7. Set the CW Generator rear panel INT-EXT switch to EXT.

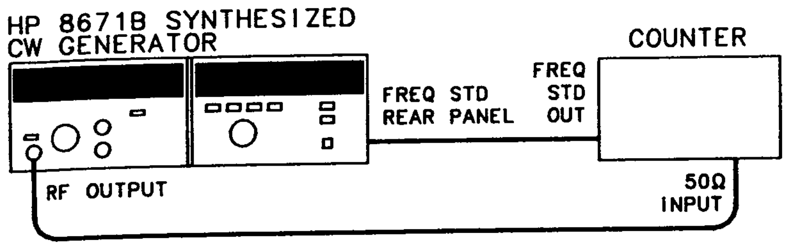


Figure 3-7. Frequency Checks Test Setup

6. Set the CW Generator as follows:

RF OUTPUT	OFF
PEAK-NORM control	NORM (in detent)
OUTPUT LEVEL RANGE selector	fully counter-clockwise
OUTPUT LEVEL VERNIER	fully counter-clockwise
ALC selector	INT
ALC CAL control	fully clockwise

7. Press the HOLD key. Verify that the CW Generator's displays indicate the following conditions:

RANGE dB display	−110 dB
Meter	<−10 dBm
ALC annunciator	INT and LVL UNCAL
RF annunciator	OFF
FREQUENCY MHz display	some frequency between 2.0 and 18.599997 GHz. If the display is not stable, press the PRESET (3 GHz) key.
FREQUENCY RESOLUTION display	All four segments extinguished.
STATUS annunciators:	
OVEN	may be on but should extinguish within 15 minutes after line cord is connected.
NOT PHASE LOCKED annunciator	ON

All other annunciators should be extinguished.

OPERATOR'S CHECKS

Procedure (cont'd)

8. Press the PRESET (3 GHz) key and then the 100 MHz FREQUENCY RESOLUTION key. Verify that the leftmost segment in the FREQUENCY RESOLUTION display lights and that the other segments are extinguished.

NOTE

Do not tune above 6199.999 MHz in steps 9 through 17.

9. Verify that the displayed frequency can be tuned in 100 MHz increments using the TUNING knob.
10. Press the 1 MHz FREQUENCY RESOLUTION key. Verify that the two leftmost segments in the FREQUENCY RESOLUTION display are lighted and that the other segments are extinguished.
11. Verify that the displayed frequency can be tuned in 1 MHz increments using the TUNING knob.
12. Press the 10 kHz FREQUENCY RESOLUTION key. Verify that the three leftmost segments in the FREQUENCY RESOLUTION display are lighted and that the other segment is extinguished.
13. Verify that the displayed frequency can be tuned in 10 kHz increments using the TUNING knob.
14. Press the 1 kHz FREQUENCY RESOLUTION key. Verify that all segments in the FREQUENCY RESOLUTION display are lighted.
15. Verify that the displayed frequency can be tuned in 1 kHz increments using the TUNING knob.
16. Tune the frequency to 4 GHz and press the HOLD key. Verify that the four segments of the FREQUENCY RESOLUTION display are extinguished.
17. Press the PRESET (3 GHz) key and verify that the FREQUENCY RESOLUTION display indicates 3000.000 MHz.
18. Set the CW Generator as follows:

RF OUTPUT	ON
PEAK-NORM control	NORM (in detent)
OUTPUT LEVEL RANGE selector	0 dB range
OUTPUT LEVEL VERNIER	for 0 dBm reading on meter
ALC selector	INT
ALC CAL control	fully clockwise

19. Tune the CW Generator frequency to 2 GHz and select 1 kHz FREQUENCY RESOLUTION. Slowly tune from 2000.000 MHz to 2000.010 MHz. Verify that the NOT PHASE LOCKED annunciator remains off at each step.
20. Set the frequency tuning resolution to the values shown in the following table. For each tuning resolution, slowly tune from the corresponding start frequency to the stop frequency. Each time, verify that the NOT PHASE LOCKED annunciator remains off. (Each phase-locked loop is tuned over its entire range.)

OPERATOR'S CHECKS

Procedure (cont'd)

FREQUENCY RESOLUTION	Start Frequency	Stop Frequency
10 kHz	2000.010 MHz	2001.000 MHz
1 MHz	2001.000 MHz	2100.000 MHz
100 MHz	2100.000 MHz	6200.000 MHz

21. Set the frequency to 18599.997 MHz (overrange). Verify that the NOT PHASE LOCKED annunciator remains off.

Output Level Check

The CW Generator's internal output leveling loop (ALC) is checked to ensure that it remains locked at all specified power levels. The internal output leveling loop monitors most of the RF output circuitry. The output level can be monitored with a power meter for greater assurance that the CW Generator is operating properly.

22. Press PRESET (3 GHz). Set the CW Generator as follows:

RF OUTPUT	ON
PEAK-NORM control	NORM (in detent)
OUTPUT LEVEL RANGE selector	fully counter-clockwise
OUTPUT LEVEL VERNIER	fully counter-clockwise
ALC selector	INT
ALC CAL control	fully clockwise

23. Connect a 50 ohm load or attenuator to the CW Generator's RF OUTPUT connector. This reduces unwanted power reflections back into the RF OUTPUT connector, thus avoiding a false LVL UNCAL annunciator indication.

24. Tune the frequency to 6200.000 MHz.

25. Using the OUTPUT LEVEL RANGE selector, step the output level range from −110 to +10 dB. Verify that the LVL UNCAL annunciator remains off.

26. Set OUTPUT LEVEL RANGE to 0 dBm and sweep the OUTPUT LEVEL VERNIER across its entire range. Verify that the annunciator remains off at all VERNIER settings.

27. Select 100 MHz frequency tuning resolution and set the output level to +8 dBm. Tune slowly from 2000.000 MHz to 18000.000 MHz. Verify that the indicated power level on the CW Generator's meter remains constant and stable and that the LVL UNCAL annunciator remains off. This ensures that the instrument can generate specified output power and remain leveled.

NOTE

Momentary flashing of the LVL UNCAL when tuning is normal. Make sure that it remains off after the meter has settled, at each frequency.

OPERATOR'S CHECKS

3-40. HP-IB Checks

DESCRIPTION: These procedures check the CW Generator's ability to process or send the HP-IB messages described in Table 3-3. Only the CW Generator, a controller, and an HP-IB controller interface (for the HP-85B) are needed to perform these checks.

These procedures do not check that all the CW Generator's program codes are being properly executed by the instrument. However, if the Basic Functional Checks and the HP-IB Checks all pass, then the instrument will probably execute all commands.

If the CW Generator fails any of these HP-IB checks, make sure the controller and interface are working properly.

The select code of the controller's HP-IB interface is assumed to be 7. The address of the CW Generator is assumed to be 19 (its factory-set address). This particular select code-address combination (that is, 719) is not necessary for these checks to be valid. However, the program lines presented here must be modified for any other combination.

Instructions for changing the address are in Section II, Installation.

These checks can be performed together or separately. Any special requirements for a check are described at the beginning of the check.

INITIAL SETUP: The test setup is the same for all of the HP-IB Checks. Connect the the CW Generator to the controller and set the CW Generator as follows:

RF Output switch	ON
PEAK-NORM control	NORM (in detent)
OUTPUT LEVEL RANGE selector	fully counter-clockwise
OUTPUT LEVEL VERNIER	fully clockwise
ALC selector	INT
CAL control	fully clockwise
Frequency	6000.000 MHz

EQUIPMENT: HP-IB Controller/Interface HP-85B/82937A
— or —
HP 9826A Option 011
(BASIC 2.0 ROM Operating System)
— or —
HP 9836A with BASIC 2.0
Operating System

Remote and Local Message

NOTE: This check determines whether the CW Generator properly switches from local to remote control and from remote to local control. If the instrument is in remote, switch the LINE switch to STANDBY, then to ON.

OPERATOR'S CHECKS

HP-IB Checks (cont'd)

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the Remote message (by setting the Remote Enable bus control line, REN, true and addressing the CW Generator to listen).	REMOTE 719	REMOTE 719

OPERATOR'S RESPONSE: Check that the CW Generator's REMOTE annunciator is on and the OUTPUT LEVEL meter reads −10 dBm.

Send the Local message to the CW Generator.	LOCAL 719	LOCAL 719

OPERATOR'S RESPONSE: Check that the CW Generator's REMOTE annunciator is off and the OUTPUT LEVEL meter reads +3 dBm.

Receiving the Data Message

NOTE: This check determines whether the CW Generator properly receives Data messages.

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the first part of the Remote message (enabling the CW Generator to remote.)	REMOTE 7	REMOTE 7
Address the CW Generator to listen (completing the Remote message), then send a Data message.	OUTPUT 719; "P18W0Z173075"	OUTPUT 719; "P18W0Z173075"

OPERATOR'S RESPONSE: Check that the CW Generator's REMOTE annunciator is on, RANGE dB indicates −70 dB, ALC annunciators show XTAL mode and LVL UNCAL, and the FREQUENCY MHz display shows 18000 MHz.

Sending the Data Message

NOTE: This check determines whether the CW Generator properly issues a Data message when addressed to talk. Before beginning this test, set the LINE switch to OFF, then to ON. (If an HP 9826A or 9836A controller is used, a short program is required to perform this check.)

OPERATOR'S CHECKS

HP-IB Checks (cont'd)

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the Remote message.	REMOTE 719	10 REMOTE 719
Send a Data message to set the status byte.	OUTPUT 719; "M070"	20 OUTPUT 719; "M070"
Address the CW Generator to talk and store its output in variable V.	ENTER 719 using "#,B";V	30 V=0 40 ENTER 719 using "#,B";V
Display the value of V.	DISP V	50 DISP V 60 END

OPERATOR'S RESPONSE: Check that the CW Generator's REMOTE annunciator is on. The controller should display 28.

Receiving the Clear Message

NOTE: This check determines whether the CW Generator responds properly to the Clear message. This Check assumes that the CW Generator is in remote mode.

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send a Data message to initialize the CW Generator	Output 719; "P18W0Z173075"	Output 719; "P18W0Z173075"

OPERATOR'S RESPONSE: Check that the CW Generator is set to 18000 MHz, XTAL ALC mode, and RF OUTPUT ON.

Send the Clear message	CLEAR 719	CLEAR 719

OPERATOR'S RESPONSE: Check that the CW Generator is set to 3000 MHz, INT ALC mode, and RF OUTPUT OFF.

Receiving the Abort Message

NOTE: This check determines whether the CW Generator becomes unaddressed when it receives the Abort message. This check assumes the CW Generator is in remote mode and at a frequency other than 2000 MHz.

OPERATOR'S CHECKS

HP-IB Checks (cont'd)

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Address the CW Generator to listen and send part of a frequency message.	OUTPUT 719; "A2000"	OUTPUT 719; "A2000"
Send the Abort message, unaddressing the CW Generator from listening.	ABORTIO 7	ABORT 7
Address the controller to talk. The CW Generator is not addressed to listen.	SEND 7; MTA	SEND 7; MTA
Attempt to execute the previous frequency command by sending the frequency execute command.	OUTPUT 7; "Z1"	OUTPUT 7; "Z1"

OPERATOR'S RESPONSE: Check that the CW Generator does not display 2000 MHz output frequency. If the controller is an HP 9826A or 9836A, press the CLR I/O key to continue the checks.

Status Byte Message

NOTE: This check determines whether the CW Generator sends the Status Byte message. This check assumes that the Clear message has been sent.

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the Serial Poll message to the CW Generator (causing it to send the Status Byte message). Display the value of the status byte.	SPOLL(719)	SPOLL(719)

OPERATOR'S RESPONSE: Check that the controller's display reads 28.

Require Service Message

NOTE: This check determines whether the CW Generator can issue the Require Service message (set the SRQ bus control line true). This check can be performed in either local or remote mode.

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Send the Clear message	CLEAR 719	CLEAR 719
Send a Data message containing an out-of-range frequency. This causes the Require Service message to be sent.	OUTPUT 719; "P35Z1"	OUTPUT 719; "P35Z1"

OPERATOR'S CHECKS

HP-IB Checks (cont'd)

NOTE: If an HP 9826A or 9836A controller is being used, a short program is required for the next part of this check.

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Read the binary status of the controller's HP-IB interface and store the data in variable V. In this step, 7 is the interface's select code, and 2 (HP-85B) and 7 (HP 9826A) are status registers for bus control lines.	STATUS 7,2;V	10 V=0 20 STATUS 7,7; V
Display the value of the SRQ bit. In this step, 5 (HP-85B) and 10 (HP 9826A or HP 9836A) are the SRQ bits for the controller, numbered from 0.	DISP "SRQ="; BIT(V,5)	30 DISP "SRQ =";BIT(V,10) 40 END

OPERATOR'S RESPONSE: Check that the SRQ value is 1, indicating that the CW Generator issued the Require Service message.

Status Bit Message

NOTE: This check determines whether the CW Generator sends the Status Bit message. This check can be performed in either local or remote mode. This check assumes that the Clear message has been sent.

Description	HP-85B (BASIC)	HP 9826A (BASIC) HP 9836A (BASIC)
Set up a Service Request condition by programming an illegal frequency.	OUTPUT 719; "P99Z1"	OUTPUT 719; "P99Z1"
Send the parallel poll message to the CW Generator (causing it to send the Status Bit message).	PPOLL(7)	PPOLL(7)

OPERATOR'S RESPONSE: Check that the controller displays 128, or the value of the bit that parallel poll switch is set to.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. These tests are suitable for incoming inspection, troubleshooting, and preventive maintenance. All tests can be performed without accessing the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

4-2. ABBREVIATED PERFORMANCE TEST

In most cases, it is not necessary to perform all of the tests in this section. The following tests should be performed after repairing the CW Generator or to verify instrument operation:

FREQUENCY RANGE AND RESOLUTION, OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS

These tests can also be used for incoming inspections and preventative maintenance. They are not intended to be a complete check of specifications, but will provide 90% confidence that the CW Generator is meeting its major performance specifications. These tests can be performed with less time and equipment than the full Performance Tests.

NOTE

To consider the performance tests valid, the following conditions must be met:

a. The CW Generator must have a 1-hour warmup for all specifications.

b. The line voltage must be 100, 120, 220, or 240 Vac +5%, −10%.

c. The ambient temperature must be +15 to +35°C for the Output Level Flatness and RF Output Level and Accuracy tests; 0 to 55°C for all other tests.

4-3. CALIBRATION CYCLE

This instrument requires periodic verification of performance to ensure that it is operating within specified tolerances. The performance tests described in this section should be performed at least once each year; under conditions of heavy usage or severe operating environments, the tests should be more frequent. Adjustments that may be required are described in Section V, Adjustments.

4-4. PERFORMANCE TEST RECORD

Results of the performance tests may be tabulated in Table 4-3, Performance Test Record. The Performance Test Record lists all of the performance test specifications and the acceptable limits for each specification. If performance test results are recorded during an incoming inspection of the instrument, they can be used for comparison during periodic maintenance or troubleshooting. The test results may also prove useful in verifying proper adjustments after repairs are made.

4-5. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-3, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted.

4-6. TEST PROCEDURES

It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the CW Generator, are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the sweep time would not be specified and the operator would be expected to set that control and other controls as required to obtain an optimum display. It is also assumed that the technician will select the cables, adapters, and probes (listed in Table 1-3) required to complete the test setups illustrated in this section.

PERFORMANCE TESTS

4-7. FREQUENCY RANGE AND RESOLUTION TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—18.0 GHz (Overrange in 18.599997 GHz)	
Resolution	1 kHz 2 kHz 3 kHz	2.0 to 6.2 GHz 6.2 to 12.4 GHz 12.4 to 18.0 GHz

Description

This test checks the resolution in each of three internal frequency bands using a frequency counter. The performance test is divided into a baseband check (2.0 to 6.2 GHz) and a check for bands 2 and 3 (6.2 to 12.4 GHz and 12.4 to 18.0 GHz respectively).

Equipment

Frequency Counter .... HP 5343A

Procedure

Baseband Test

1. Connect the equipment as shown in Figure 4-1. Set the CW Generator rear panel INT/EXT switch to EXT. Remove FREQ STANDARD jumper and connect A3J10 to the 10 MHz frequency standard output of the frequency counter.

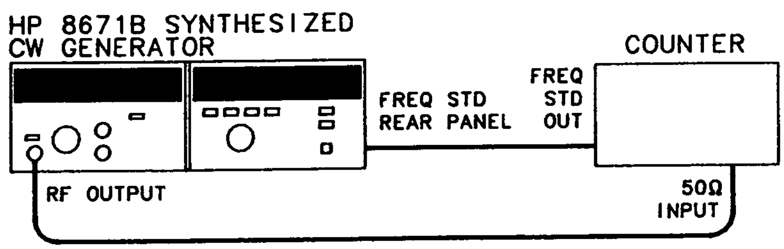


Figure 4-1. Frequency Range and Resolution Test Setup

2. Select 1 kHz display resolution on the counter.
3. Press the CW Generator's PRESET (3 GHz) key and set the output power to 0 dBm.
4. Verify that the frequency counter reads 3 000.000 MHz ±1 count.

   2 999.999 MHz ________ 3 000.001 MHz

5. Set the CW Generator frequency to 2 000.000 MHz.
6. Tune to each of the frequencies listed below. Verify that the CW Generator remains phase locked at all frequencies and that the frequency counter agrees with the CW Generator frequency display ±1 count.

PERFORMANCE TESTS

FREQUENCY RANGE AND RESOLUTION (cont'd)

Procedure (cont'd)

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
2 000.000	1 999.999	______	2 000.001
2 000.001	2 000.000	______	2 000.002
2 001.112	2 001.111	______	2 001.113
2 002.223	2 002.222	______	2 002.224
2 003.334	2 003.333	______	2 003.335
2 004.445	2 004.444	______	2 004.446
2 005.556	2 005.555	______	2 005.557
2 006.667	2 006.666	______	2 006.668
2 007.778	2 007.777	______	2 007.779
2 008.889	2 008.888	______	2 008.890
2 009.999	2 009.998	______	2 010.000

7. Set the CW Generator to 2 000.000 MHz.

8. Tune the CW Generator to each of the frequencies listed below and read the frequency counter at each step. The frequency counter reading should agree with the CW Generator front panel reading within ±1 count. In addition, the CW Generator NOT PHASE LOCKED front panel annunciator should remain off at all frequencies.

NOTE

Fast tuning of frequency may cause the NOT PHASE LOCKED annunciator to flash on momentarily. This is normal and does not indicate a malfunction.

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
2 090.000	2 089.999	______	2 090.001
2 280.000	2 279.999	______	2 280.001
2 470.000	2 469.999	______	2 470.001
2 660.000	2 659.999	______	2 660.001
2 850.000	2 849.999	______	2 850.001
3 040.000	3 039.999	______	3 040.001
3 230.000	3 229.999	______	3 230.001
3 420.000	3 419.999	______	3 420.001

(cont'd)

PERFORMANCE TESTS

FREQUENCY RANGE AND RESOLUTION (cont'd)

Procedure (cont'd)

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
3 610.000	3 609.999	________	3 610.001
3 800.000	3 799.999	________	3 800.001
3 990.000	3 989.999	________	3 990.001
4 180.000	4 179.999	________	4 180.001
4 370.000	4 369.999	________	4 370.001
4 560.000	4 559.999	________	4 560.001
4 750.000	4 749.999	________	4 750.001
4 940.000	4 939.999	________	4 940.001
5 130.000	5 129.999	________	5 130.001
5 320.000	5 319.999	________	5 320.001
5 510.000	5 509.999	________	5 510.001
5 700.000	5 699.999	________	5 700.001
5 900.000	5 899.999	________	5 900.001
6 100.000	6 099.999	________	6 100.001

Bands 2 and 3 Test

9. Tune the CW Generator to 10 000.000 MHz and select 1 kHz tuning resolution.

10. Tune the frequency down one increment and verify that the CW Generator frequency display changes to 9 999.998 MHz and the frequency counter reading agrees within one count.

11. Tune the frequency up two increments and verify that the CW Generator frequency display changes to 10 000.002 MHz. Verify also that the frequency counter reading agrees within one count.

    10 GHz frequency resolution, 2 kHz ______ (√)

12. Tune the CW Generator to 18 000.000 MHz and select 1 kHz tuning resolution.

13. Tune the frequency down one increment and verify that the CW Generator frequency display indicates 17 999.997 MHz and the frequency counter reading agrees within one count.

14. Tune the frequency up two increments and verify that the CW Generator frequency display indicates 18 000.003 MHz and the frequency counter reading agrees within one count.

    18 GHz frequency resolution, 3 kHz ______ (√)

15. Disconnect the frequency standard cable and replace the FREQ STANDARD JUMPER between A3J9 and A3J10. Set the INT/EXT switch to INT.

PERFORMANCE TESTS

4-8. FREQUENCY SWITCHING TIME TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SWITCHING TIME		
Frequency to be within the specified resolution.	<15 ms	
Amplitude to be within ±3 dB of final level after switching frequency.	<15 ms	When switching within the same frequency resolution range.

Description

This test measures the frequency switching speed. The CW Generator is remotely programmed to continuously switch between two frequencies. Its output is mixed with a local oscillator whose output frequency is set to 1 kHz above the second (or destination) frequency. The difference frequency (IF) is displayed on an oscilloscope.

Frequency switching speed is first measured in the CW Generator's base band (2.0—6.2 GHz) using an IF frequency of 1 kHz (which is the specified resolution for the base band). As the unit under test is switched from the starting frequency to the destination frequency the oscilloscope is triggered by the HP-IB controller.

As the CW Generator output changes between the two programmed frequencies the IF signal will pass through zero. This will generate a phase reversal, as shown in Figure 4-3. The last phase change of the IF frequency is the point that the frequency of the unit under test is within the specified resolution.

The amplitude recovery time is tested using the same measurement setup. The ±3 dB amplitude points of the IF signal are calibrated on the oscilloscope display and the amplitude recovery time is tested to ensure that the IF level is within ±3 dB of the final level (see Figure 4-4). The amplitude recovery time is only specified for frequency changes within the same frequency resolution range.

NOTE

A digitizing oscilloscope will make this measurement easier due to the ability to store and view the switching process. The test may be performed without a digitizing oscilloscope by repetitively switching the frequency of the unit under test.

Equipment

HP-IB Controller .... HP 85B/82903 or HP 9836A
Local Oscillator .... HP 8340A
Mixer .... RHG DMS1-18
Oscilloscope .... HP 1980B

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure

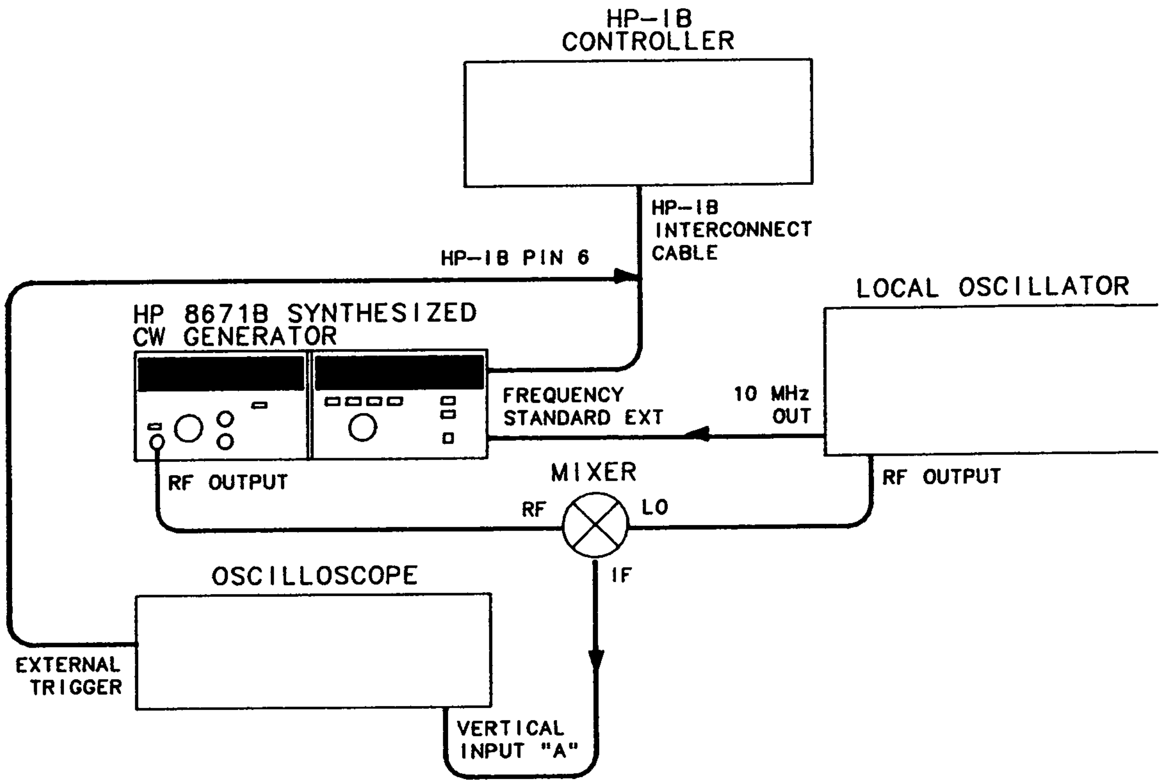


Figure 4-2. Frequency Switching Time Test Setup

Frequency Switching Time

1. Set up the equipment as shown in Figure 4-2. The external trigger input of the oscilloscope should be connected to pin 6 of the HP-IB cable. An HP-IB adapter (HP 10834A) can be used to make a permanent adapter for this test. This test may be performed by connecting the external trigger input of the oscilloscope to A2A7TP1. The test results should be identical for both methods of oscilloscope triggering.

WARNING

To access A2A7TP1 the instruments protective covers must be removed. This should only be done by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

2. Set the local oscillator to 2 100.001 MHz with an output level between +5 dBm and +8 dBm.

3. Set the oscilloscope to external trigger, positive slope trigger, triggered sweep mode (or NORMAL) and 2 ms per division sweep time.

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

NOTE

The following programs are for the HP 9826 or HP 9836 controller. For use with the HP 85B controller, increase the wait statements by a factor of 1000. This is done because the HP 85B executes wait commands in milliseconds while the HP 9836 and HP 9826 execute wait commands in seconds.

4. Load and run the following HP-IB controller program. As the program is executing, adjust the trigger controls for a stable 1 kHz sine wave display.

```
10   CLEAR 719
20   OUTPUT 719;"A2100000Z100075"      2.1 GHz, +3 dBm, Ext ALC
30   GOTO 20
40   END
```

5. Press the pause key on the controller to stop the program. Load and run the following program. The program will continue switching the CW Generator between 18 GHz and 2.1 GHz until the pause key is pressed. If necessary, adjust the oscilloscope triggering to obtain a display similar to that shown in Figure 4-3.

```
10   SEND 7;MTA LISTEN 19            Controller talk, CW Generator listen
20   OUTPUT 7;"K00075"               0 dB range, Ext ALC
30   OUTPUT 7;"P18000000Z1"          Set to 18 GHz
40   WAIT .005                       5 for HP 85B (5 ms)
50   OUTPUT 7;"A2100000Z"            Ready for change to 2.1 GHz
60   WAIT .7                         700 for HP 85B (700 ms)
70   OUTPUT 7;"1"                    Change frequency
80   WAIT .05                        50 for HP 85B (50 ms)
90   GOTO 30
100  END
```

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

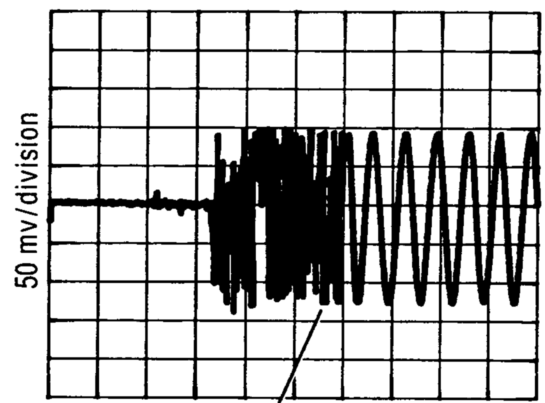


Figure 4-3. Frequency Switching Time Measurement Waveform

6. Measure the switching time by observing the signal on the oscilloscope display. The external trigger is the reference for determining switching speed. The switching time is measured from the display's left graticule to the last phase reversal (as the CW Generator passes the local oscillator frequency) before the IF signal settles into a steady frequency. Refer to Figure 4-3. Record the frequency switching time.

   ______ <15 ms

7. Modify lines 30 and 50 to read as follows:

   Frequency 2.1 GHz
```
30   OUTPUT 7;"A2100000Z1"

50   OUTPUT 7;"P18000000Z"
```
   Frequency 18 GHz

8. Set the local oscillator frequency to 17 999.997 MHz.

9. Run the modified program and measure the switching time to the last phase reversal

   ______ <15 ms

Amplitude Recovery Time

10. Set the local oscillator to 6 100.001 MHz.

11. Load and run the following program. Adjust the vertical sensitivity and position of the display until the displayed signal indicates a peak-to-peak change of exactly 2 divisions in amplitude. This calibrates the oscilloscope to ±3 dB about 0 dBm. The smaller signal represents −3 dBm and the larger signal represents +3 dBm.

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

```
10   CLEAR 719
                                        Frequency 6.1 GHz
20   OUTPUT 719;"A6100000Z1"
30   FOR X=1 TO 100
                                        Level +3 dBm
40   OUTPUT 719;"K00071"
                                        Trigger oscilloscope
50   NEXT X
60   FOR Y=1 TO 100
70   OUTPUT 719;"K06071"
                                        Level -3 dBm
80   NEXT Y
90   GOTO 30
100  END
```

12. Set the top of the displayed signal to a convenient reference near the center of the display. Note the two levels for reference. The measurement will be determined by the time required before the amplitude of the IF signal stays between these two levels.

13. Press the pause key on the controller. Enter and run the following program. Run the program by typing RUN 110 and pressing the EXECUTE key (END LINE for the HP 85).

```
                                        2.0 GHz, 0 dBm, internal ALC
110  OUTPUT 719;"A2000000Z103071"
                                        Controller talk, CW generator listen
120  SEND 7;MTA LISTEN 19
                                        Frequency 2.1 GHz
130  OUTPUT 7;"A2100000Z1"
                                        5 for HP 85B (5 ms)
140  WAIT .005
                                        Frequency 6.1 GHz
150  OUTPUT 7;"A6100000Z"
160  WAIT .7
                                        700 for HP 85B (700 ms)
170  OUTPUT 7;"1"
                                        Change frequency
180  WAIT .05
                                        50 for HP 85B (50 ms)
190  GOTO 130
200  END
```

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

14. Measure the amplitude recovery time. The measurement is the time from the left graticule of the display to the last time the IF signal amplitude is outside of the reference points noted in step 13. If necessary, adjust the oscilloscope triggering to obtain a display similar to that shown in Figure 4-4.

______ <15 ms

(Record Results for Step 17) ______ <15 ms

(Record Results for Step 20) ______ <15 ms

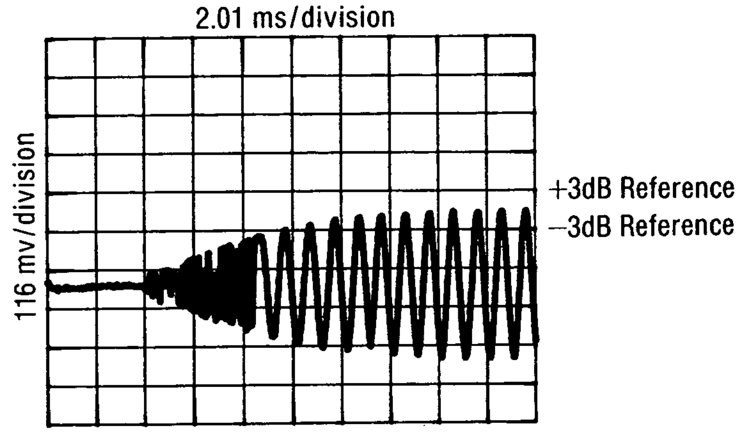


Figure 4-4. Amplitude Recovery Measurement Waveform

15. Set the local oscillator to 12 300.002 MHz.
16. Modify lines 20, 130, and 150 of the program as follows:

```
20   OUTPUT 719;"P12300000Z1"     Frequency 12.3 GHz
130  OUTPUT 7;"A6200000Z1"        Frequency 6.2 GHz
150  OUTPUT 7;"P12300000Z1"       Frequency 12.3 GHz
```

17. Repeat steps 11 through 14 using the modified programs. The amplitude recovery time will be measured for the 2 kHz resolution band.
18. Set the local oscillator to 18.000 003 GHz.
19. Modify lines 20, 130, and 150 of the program as follows:

```
20   OUTPUT 719;"P18000000Z1"     Frequency 18.0 GHz
130  OUTPUT 7;"P12400000Z1"       Frequency 12.4 GHz
150  OUTPUT 7;"P1800000Z"         Frequency 18.0 GHz
```

20. Repeat steps 11 through 14 using the modified program. The amplitude recovery time will be measured for the 3 kHz resolution band.
21. Disconnect the frequency reference from the rear panel and replace the jumper. Set the switch to INT.

PERFORMANCE TESTS

4-9. OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Output Level:		
Leveled Output	+8 dBm to −120 dBm	+15 to +35°C
Remote Programming Absolute Level Accuracy (+15°C to +35°C)		**2.0—6.2 GHz**
	±1.00 dB	+10 dB output level range
	±1.00 dB	0 dB output level range
	±1.50 dB	−10 dB output level range
	±1.70 dB	−20 dB output level range
		6.2—12.4 GHz
	±1.25 dB	+10 dB output level range
	±1.25 dB	0 dB output level range
	±1.75 dB	−10 dB output level range
	±1.95 dB	−20 dB output level range
		12.4—18.0 GHz
	±1.50 dB	+10 dB output level range
	±1.50 dB	0 dB output level range
	±2.10 dB	−10 dB output level range
	±2.30 dB	−20 dB output level range
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement uncertainty.
Flatness (0 dBm range; 15 to +35°C)	1.50 dB	2.0 to 6.2 GHz
	2.00 dB	2.0 to 12.4 GHz
	2.50 dB	2.0 to 18.0 GHz

Description

This test checks output level (maximum leveled power), absolute level accuracy between +8 dBm and −20 dBm, and output level flatness. The output level test uses a power meter to verify that +8 dBm can be generated over the full 2 to 18 GHz frequency range. Level flatness measures the variation in level over the various specified ranges. The high level accuracy test verifies that power levels between +8 dBm and −20 dBm are within the manual absolute level accuracy specification.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8481A

Procedure

Output Level Test

1. Connect the power sensor to the power meter. Calibrate and zero the power meter.
2. Connect the power sensor to the RF OUTPUT connector of the CW Generator as shown in Figure 4-5.

PERFORMANCE TESTS

OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)

Procedure (cont'd)

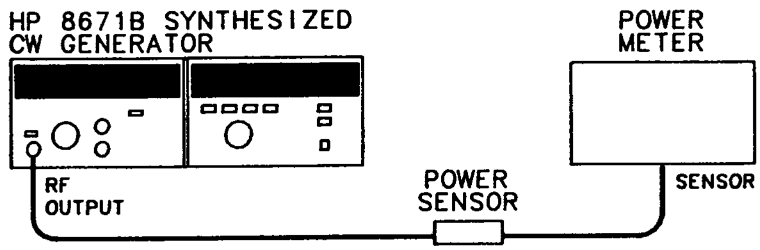


Figure 4-5. Output Level, High Level Accuracy and Flatness Test Setup

3. Set the CW Generator frequency to 2.0 GHz and the output level range to +10 dB.

4. Adjust the VERNIER control to give a power meter reading of +8 dBm.

5. Tune the CW Generator in 100 MHz steps from 2 to 18 GHz, adjusting the power meter's calibration factor and recording the frequency at which minimum power occurs. Reset VERNIER to read +8 dBm on the power meter at the recorded frequency to ensure that the +8 dBm power level can be met.

Frequency ______

Minimum Power >+8 dBm ______

Level Flatness

6. Set the CW Generator frequency to 2 GHz, output level to −5 dBm, and power meter to dB Relative. Slowly tune to 6.2 GHz in 100 MHz steps and record the maximum and minimum relative power outputs. Set the power meter calibration factor appropriate for each frequency. Maximum variation should be within 1.5 dB (highest point to lowest point). Continue to tune to 12.4 GHz. Maximum variation should be within 2 dB. Continue to tune to 18.0 GHz and note level variation. Maximum variation should be less than 2.5 dB.

NOTE

The specification for power output flatness is not referenced to a particular frequency. The specification represents the total power variation over the entire frequency range.

2.0—6.2 GHz

Minimum ______

Maximum ______

Total Variation ______ <1.50 dB

2.0—12.4 GHz

Minimum ______

Maximum ______

Total Variation ______ <2.00 dB

PERFORMANCE TESTS

OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)

Procedure (cont'd)

2.0—18.0 GHz

Minimum ______
Maximum ______
Total Variation ______ <2.50 dB

High Level Accuracy Test

7. Connect the power sensor to the power meter. Calibrate and zero the power meter in the dBm mode.

8. Connect the power sensor to the RF OUTPUT connector of the CW Generator.

9. Set the CW Generator frequency to 2.0 GHz and output level to +8 dBm (+10 dB range and −2 dBm front panel meter setting).

10. Tune the CW Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency in Table 4-1. The power meter readings should be within the limits specified.

11. Repeat steps 9 and 10 for an output level of +3 dBm (+10 dB range, −7 dBm VERNIER).

12. Set the CW Generator frequency to 2.0 GHz and output level to 0 dBm (0 dB range, 0 dBm VERNIER).

13. Tune the CW Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency in Table 4-1. The power meter readings should be within the limits specified.

14. Repeat steps 12 and 13 for output levels of −5 dBm and −10 dBm (0 dB range).

15. Set the CW Generator frequency to 2.0 GHz and output level to −10 dBm (−10 dB range, 0 dBm VERNIER).

16. Tune the CW Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency in Table 4-1. The power meter readings should be within the limits specified.

17. Repeat steps 15 and 16 for an output level of −20 dBm (−20 dB range, 0 dBm vernier).

PERFORMANCE TESTS

OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)

Table 4-1. Output Level, High Level Accuracy and Flatness Test Record (1 of 2)

Test		Results		
		Min.	Actual	Max.
High Level Accuracy				
+8 dBm (+10 dB range)	2 GHz	+6.25 dBm	________	+9.75 dBm
	4 GHz	+ 6.25 dBm	________	+9.75 dBm
	6 GHz	+ 6.25 dBm	________	+9.75 dBm
	8 GHz	+ 6.00 dBm	________	+10.00 dBm
	10 GHz	+ 6.00 dBm	________	+10.00 dBm
	12 GHz	+ 6.00 dBm	________	+10.00 dBm
	14 GHz	+ 5.75 dBm	________	+10.25 dBm
	16 GHz	+ 5.75 dBm	________	+10.25 dBm
	18 GHz	+ 5.75 dBm	________	+10.25 dBm
+3 dBm (+10 dB range)	2 GHz	+ 1.25 dBm	________	+4.75 dBm
	4 GHz	+ 1.25 dBm	________	+4.75 dBm
	6 GHz	+ 1.25 dBm	________	+4.75 dBm
	8 GHz	+ 1.00 dBm	________	+5.00 dBm
	10 GHz	+ 1.00 dBm	________	+5.00 dBm
	12 GHz	+ 1.00 dBm	________	+5.00 dBm
	14 GHz	+ 0.75 dBm	________	+5.25 dBm
	16 GHz	+ 0.75 dBm	________	+5.25 dBm
	18 GHz	+ 0.75 dBm	________	+5.25 dBm
0 dBm (0 dB range)	2 GHz	− 1.75 dBm	________	+1.75 dBm
	4 GHz	− 1.75 dBm	________	+1.75 dBm
	6 GHz	− 1.75 dBm	________	+1.75 dBm
	8 GHz	− 2.00 dBm	________	+2.00 dBm
	10 GHz	− 2.00 dBm	________	+2.00 dBm
	12 GHz	− 2.00 dBm	________	+2.00 dBm
	14 GHz	− 2.25 dBm	________	+2.25 dBm
	16 GHz	− 2.25 dBm	________	+2.25 dBm
	18 GHz	− 2.25 dBm	________	+2.25 dBm
−5 dBm (0 dB range)	2 GHz	−6.75 dBm	________	−3.25 dBm
	4 GHz	− 6.75 dBm	________	−3.25 dBm
	6 GHz	− 6.75 dBm	________	−3.25 dBm
	8 GHz	− 7.00 dBm	________	−3.00 dBm
	10 GHz	− 7.00 dBm	________	−3.00 dBm
	12 GHz	− 7.00 dBm	________	−3.00 dBm
	14 GHz	− 7.25 dBm	________	−2.75 dBm
	16 GHz	− 7.25 dBm	________	−2.75 dBm
	18 GHz	− 7.25 dBm	________	−2.75 dBm
−10 dBm (0 dB range)	2 GHz	−11.75 dBm	________	−8.25 dBm
	4 GHz	−11.75 dBm	________	−8.25 dBm
	6 GHz	−11.75 dBm	________	−8.25 dBm
	8 GHz	−12.00 dBm	________	−8.00 dBm
	10 GHz	−12.00 dBm	________	−8.00 dBm

PERFORMANCE TESTS

OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)

Table 4-1. Output Level, High Level Accuracy and Flatness Test Record (2 of 2)

Test		Results		
		Min.	Actual	Max.
High Level Accuracy (cont'd)				
−10 dBm (0 dB range) (cont'd)	12 GHz	−12.00 dBm	________	−8.00 dBm
	14 GHz	−12.25 dBm	________	−7.75 dBm
	16 GHz	−12.25 dBm	________	−7.75 dBm
	18 GHz	−12.25 dBm	________	−7.75 dBm
−10 dBm (−10 dB range)	2 GHz	−12.25 dBm	________	−7.75 dBm
	4 GHz	−12.25 dBm	________	−7.75 dBm
	6 GHz	−12.25 dBm	________	−7.75 dBm
	8 GHz	−12.50 dBm	________	−7.50 dBm
	10 GHz	−12.50 dBm	________	−7.50 dBm
	12 GHz	−12.50 dBm	________	−7.50 dBm
	14 GHz	−12.85 dBm	________	−7.15 dBm
	16 GHz	−12.85 dBm	________	−7.15 dBm
	18 GHz	−12.85 dBm	________	−7.15 dBm
−20 dBm (−20 dB range)	2 GHz	−22.45 dBm	________	−17.55 dBm
	4 GHz	−22.45 dBm	________	−17.55 dBm
	6 GHz	−22.45 dBm	________	−17.55 dBm
	8 GHz	−22.70 dBm	________	−17.30 dBm
	10 GHz	−22.70 dBm	________	−17.30 dBm
	12 GHz	−22.70 dBm	________	−17.30 dBm
	14 GHz	−23.05 dBm	________	−16.95 dBm
	16 GHz	−23.05 dBm	________	−16.95 dBm
	18 GHz	−23.05 dBm	________	−16.95 dBm

PERFORMANCE TESTS

4-10. LOW LEVEL ACCURACY TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Remote Programming Absolute Level Accuracy (+15 to +35°C)		2.0—6.2 GHz
	±1.90 dB	−30 dB output level range
	±1.90 dB plus ±0.3 dB per 10 dB step	<−30 dB output level range
		6.2—12.4 GHz
	±2.15 dB	−30 dB output level range
	±2.15 dB plus ±.3 dB per 10 dB step	<−30 dB output level range
		12.4—18.0 GHz
	±2.40	−30 dB output level range
	±2.40 dB plus ±0.4 dB per 10 dB step	<−30 dB output level range
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy and measurement uncertainty.

Description

This test checks absolute level accuracy between −30 dBm and −110 dBm. An IF signal is calibrated to the spectrum analyzer by measuring the CW Generator's RF output at −20 dBm. A reference level corresponding to the −20 dBm output is set on the spectrum analyzer and each 10 dB decrease in range is checked for a 10 dB decrease on the spectrum analyzer display.

Equipment

Power Meter ....HP 436A
Power Sensor ....HP 8481A
Local Oscillator ....HP 8340A
Mixer ....RHG DMS 1—18
Spectrum Analyzer ....HP 8566B
40 dB Amplifier ....HP 8447F
20 dB Attenuator ....HP 8491B Option 020
20 dB Preamplifier ....HP 8447A

Procedure

1. Calibrate and zero the power meter in the dBm mode.
2. Connect the equipment as shown in Figure 4-6.

NOTE

Connect the mixer directly to the local oscilator to avoid any power loss.

PERFORMANCE TESTS

LOW LEVEL ACCURACY TEST (cont'd)

Procedure (cont'd)

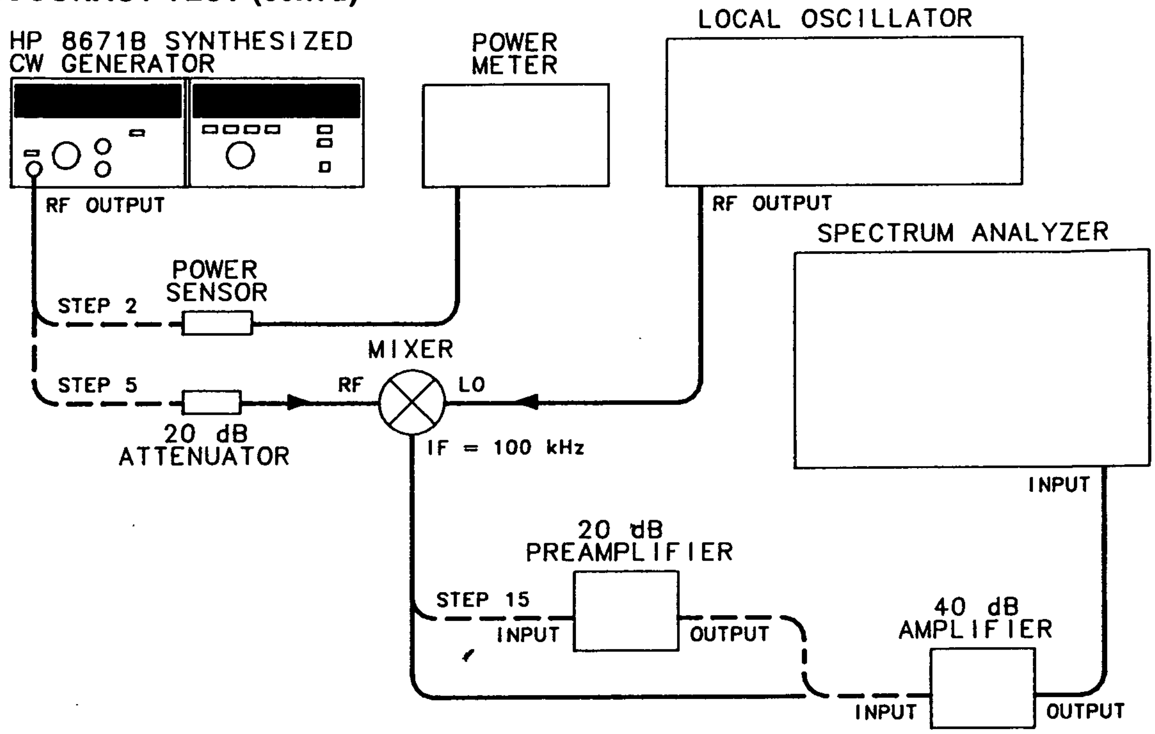


Figure 4-6. Low Level Accuracy Test Setup

3. Set the CW Generator frequency to 2 000.000 MHz, RANGE to −20 dB, and set the VERNIER for 0 dBm.

4. Adjust the VERNIER for a power meter reading of −20.00 dBm ±0.01 dB.

5. Disconnect the power meter and connect the CW Generator to the mixer as shown in Figure 4-6.

6. Set the local oscillator to 2 000.100 MHz and output power to maximum but not greater than +8 dBm.

7. Set the resolution bandwidth on the spectrum analyzer to 300 Hz or less. Adjust the reference level so that the amplitude of the 100 kHz IF signal is set to a convenient horizontal graticule as a reference. This calibrates the graticule line for an absolute reference power level of −20 dBm. Enable the Delta Marker function on the spectrum analyzer, if available, for highest accuracy.

8. Set the range of the CW Generator 10 dB lower and adjust the CW Generator's VERNIER for a front panel meter reading of 0 dBm.

9. Set the spectrum analyzer reference level 10 dB lower to bring the signal level near the reference graticule line.

PERFORMANCE TESTS

LOW LEVEL ACCURACY TEST (cont'd)

Procedure (cont'd)

10. Read the difference between the displayed level and the reference graticule. Calculate the actual power as follows:

    NOTE

    The difference is positive if the signal is above the reference graticule line, and negative if below.

    ________ *Output level set in step 8.*
    +________ *Difference measured in step 10.*
    ________ *Actual level.*

    Record the actual level calculated in Table 4-2. The level reading should be within the limits specified.

11. Repeat steps 8 through 10, with CW Generator range settings of −40 dB and −50 dB in step 8. Record the output level readings in Table 4-2.

12. Note the CW Generator's signal level (at −50 dBm) on the spectrum analyzer display. Remove the 20 dB attenuator, set the spectrum analyzer reference level 20 dB higher, and adjust the spectrum analyzer to bring the peak of the IF signal back to the same reference level.

13. Repeat steps 8 through 10 with CW Generator settings of −60 dB through −90 dB. Record the output level readings in Table 4-2.

14. Note the CW Generator's level (at −90 dBm) on the spectrum analyzer display. This will be the reference in step 15.

15. Connect the 20 dB Preamplifier as shown in Figure 4-6. Set the spectrum analyzer IF sensitivity 20 dB higher, and set the vertical sensitivity to bring the signal back to the reference level noted in step 14.

16. Repeat steps 8 through 10, with CW Generator range settings of −100 dB and −110 dB. Record the output level readings in Table 4-2.

17. Repeat steps 3 through 16 for CW Generator frequencies of 10 GHz and 18 GHz. Record the output level readings in Table 4-2.

PERFORMANCE TESTS

LOW LEVEL ACCURACY TEST (cont'd)

Table 4-2. Low Level Accuracy Test Record

Test	Results		
	Min.	Actual	Max.
2.0 GHz			
−30 dBm	−32.65 dBm	________	−27.35 dBm
−40 dBm	−42.95 dBm	________	−37.05 dBm
−50 dBm	−53.25 dBm	________	−46.75 dBm
−60 dBm	−63.55 dBm	________	−56.45 dBm
−70 dBm	−73.85 dBm	________	−66.15 dBm
−80 dBm	−84.15 dBm	________	−75.85 dBm
−90 dBm	−94.45 dBm	________	−85.55 dBm
−100 dBm	−104.75 dBm	________	−95.25 dBm
−110 dBm	−115.05 dBm	________	−104.95 dBm
10.0 GHz			
−30 dBm	−32.90 dBm	________	−27.10 dBm
−40 dBm	−43.20 dBm	________	−36.80 dBm
−50 dBm	−53.50 dBm	________	−46.50 dBm
−60 dBm	−63.80 dBm	________	−56.20 dBm
−70 dBm	−74.10 dBm	________	−65.90 dBm
−80 dBm	−84.40 dBm	________	−75.60 dBm
−90 dBm	−94.70 dBm	________	−85.30 dBm
−100 dBm	−105.00 dBm	________	−95.00 dBm
−110 dBm	−105.30 dBm	________	−104.70 dBm
18.0 GHz			
−30 dBm	−33.45 dBm	________	−26.55 dBm
−40 dBm	−43.85 dBm	________	−36.15 dBm
−50 dBm	−54.25 dBm	________	−45.75 dBm
−60 dBm	−64.65 dBm	________	−55.35 dBm
−70 dBm	−75.05 dBm	________	−64.95 dBm
−80 dBm	−85.45 dBm	________	−74.55 dBm
−90 dBm	−95.95 dBm	________	−84.15 dBm
−100 dBm	−106.35 dBm	________	−93.75 dBm
−110 dBm	−107.75 dBm	________	−103.35 dBm

PERFORMANCE TESTS

4-11. OUTPUT LEVEL SWITCHING TIME TEST

Specification Less than 20 ms to be within ±1 dB of the final level.

Description This test measures the output level switching speed. The measuring system is set up to trigger the oscilloscope when the unit under test has finished accepting the output level data from the controller. The R.F. output is detected and coupled to the oscilloscope's vertical input. The time to complete switching (which includes settling time) is viewed on the oscilloscope display.

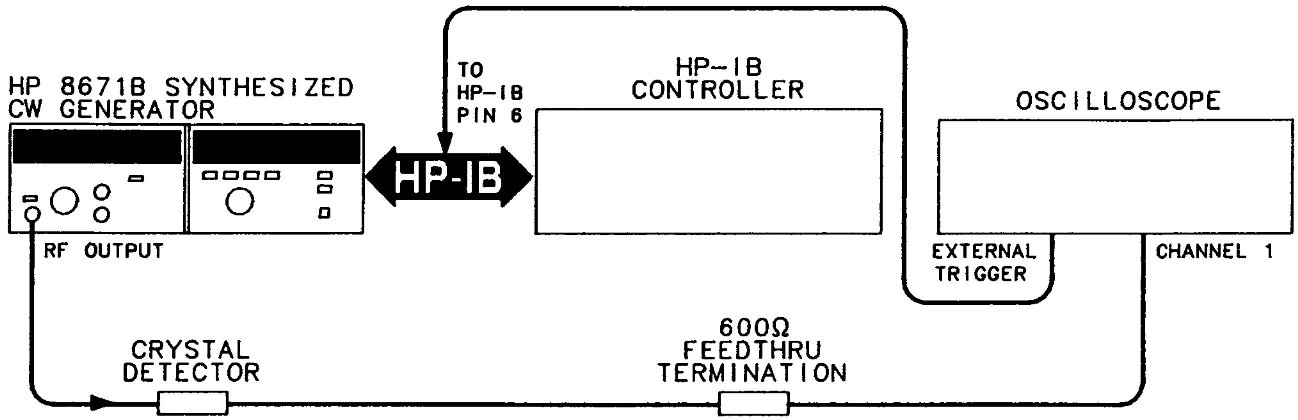


Figure 4-7. Output Level Switching Time Test Setup

Equipment

Oscilloscope	HP 1980B
HP-IB Controller	HP 9836A or HP 85B/82903
Crystal Detector	HP 8470B Opt. 012
600Ω Feedthru Termination	HP 11095A

Procedure

1. Set up the equipment as shown in Figure 4-7. The external trigger input of the oscilloscope should be connected to pin 6 of the HP-IB cable or A2A9U14, pin 15. An HP-IB adapter (HP 10834A) can be used to make a permanent trigger adapter for this test.

WARNING

To access A2A9U14 the instrument's protective cover must be removed. This should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

PERFORMANCE TESTS

OUTPUT LEVEL SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

2. Set the oscilloscope for external triggering, positive trigger slope, triggered sweep mode (or NORM) and 2 ms per division sweep time.

NOTE

The following programs are for the HP 9826 or HP 9836 controller. For use with the HP 85B controller, increase the wait statements by a factor of 1000. This is necessary because the HP 9826 and HP 9836 execute wait commands in seconds while the HP 85B executes wait commands in milliseconds.

3. Load and run the following HP-IB controller program. As the program is executing, adjust the trigger controls for a stable oscilloscope display.

```
                                        3.0 GHz, +3 dBm, Ext ALC
20   OUTPUT 719;"A3000000Z103075"
10   CLEAR 719
30   GOTO 20
40   END
```

4. Press the pause key on the controller. Load the following HP-IB controller program.

```
                                        Controller talk, CW Generator listen
10   SEND 7;MTA LISTEN 19
20   FOR X=1 TO 50
                                        0 dB range, Ext ALC
30   OUTPUT 7;"K0"
                                        30 for HP 85B (30 ms)
40   WAIT .03
                                        Ready for change to -110 dB Range
50   OUTPUT 7;"K"
60   WAIT .7
                                        700 for HP 85B (700 ms)
70   OUTPUT 7;";"
                                        Change to -110 dB Range
80   WAIT .05
                                        50 for HP 85B (50 ms)
90   NEXT X
100  END
```

PERFORMANCE TESTS

OUTPUT LEVEL SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

NOTE

Run this program only as long as necessary to make the level switching measurements. This measurement cycles the attenuator which causes mechanical wear. The program limits the number of cycles to 50, however, if a digitizing oscilloscope is available only one cycle is needed.

5. Run the program and measure the switching time by observing the signal on the oscilloscope display. Refer to Figure 4-8.

_________ <20 ms

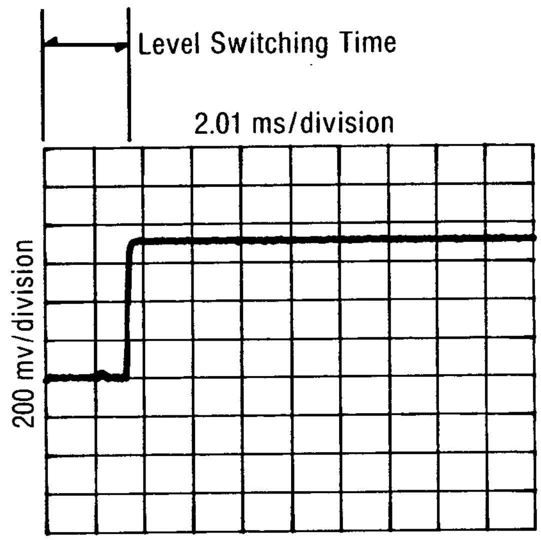


Figure 4-8. Output Level Switching Time Measurement Waveform

PERFORMANCE TESTS

4-12. HARMONICS, SUBHARMONICS, & MULTIPLES TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Harmonics	<−25 dBc	Output level +8 dBm
Subharmonics and Multiples Thereof	<−25 dBc	Output level +8 dBm

Description

This test checks the amplitude of various harmonics of the CW Generator's output signal in the multiplied frequency bands (>6.2 GHz), subharmonics and multiples (harmonics of the internal fundamental signal) are also checked for specific levels. Reasonable care must be taken to ensure that the harmonics are not being generated by the spectrum analyzer.

Equipment

Spectrum Analyzer ....HP 8566B

Procedure

1. Connect the CW Generator RF OUTPUT to the input of the spectrum analyzer as shown in Figure 4-9.

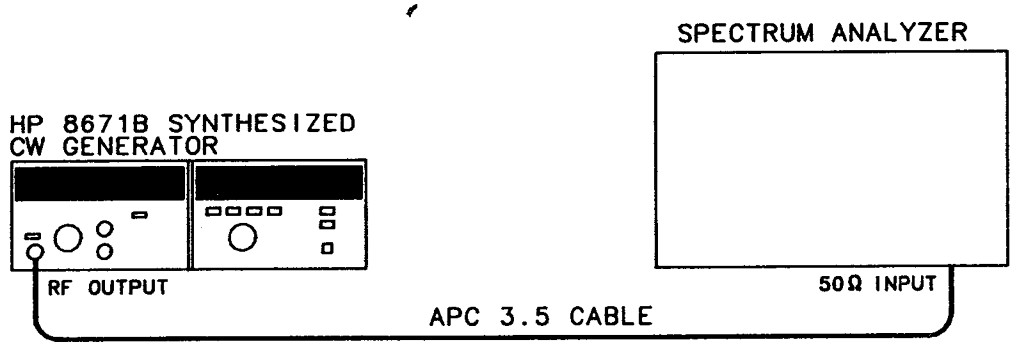


Figure 4-9. Harmonics, Subharmonics, and Multiples Test Setup

2. Tune the CW Generator to 4 000.000 MHz and output level of +8 dBm.

3. Set the spectrum analyzer controls to display the fundamental signal. Set the resolution bandwidth to 10 kHz and the input attenuation to 40 dB. Adjust the log reference level to set the displayed signal at the top graticule line of the display.

4. Tune the CW Generator to 2 000.000 MHz. The second harmonic, now displayed at 4 000.000 MHz, should be greater than 25 dB below the reference.

_________<−25 dBc

5. Repeat steps 2 through 4, at the other CW Generator frequencies listed, to check each harmonic, subharmonic, and multiple listed in the following table. Record the measurements in Table 4-3.

PERFORMANCE TESTS

HARMONICS, SUBHARMONICS, & MULTIPLES TEST (cont'd)

Procedure (cont'd)

NOTE

This procedure may be repeated for any fundamental frequency of interest within the CW Generator frequency range.

Harmonics, Subharmonics, and Multiples

Set Signal Generator to	Check Harmonic Levels at:			
FUNDAMENTAL	HARMONIC	SUBHARMONIC		MULTIPLE
(GHz)	(GHz)	1/3	1/2	2/3
2.000 000	4.000 000			
4.000 000	8.000 000			
6.000 000	12.000 000			
8.000 000	16.000 000		4.000 000	
10.000 000	20.000 000		5.000 000	
11.000 000	22.000 000		5.500 000	
14.000 000		4.666 667		9.333 333
16.000 000		5.333 333		10.666 667
18.000 000		6.000 000		12.000 000
LIMITS	<−25 dBc	−25 dBc		

PERFORMANCE TESTS

HARMONICS, SUBHARMONICS, & MULTIPLES TEST (cont'd)

Table 4-3. Harmonics, Subharmonics & Multiples Test Record

Test		Results		
		Min.	Actual	Max.
Fundamental	**Harmonic or Subharmonic**			
2.000 000 GHz	4.000 000 GHz 2f		_______	−25 dBc
4.000 000 GHz	8.000 000 GHz 2f		_______	−25 dBc
6.000 000 GHz	12.000 000 GHz 2f		_______	−25 dBc
8.000 000 GHz	16.000 000 GHz 2f		_______	−25 dBc
8.000 000 GHz	4.000 000 GHz 1/2f		_______	−25 dBc
10.000 000 GHz	20.000 000 GHz 2f		_______	−25 dBc
10.000 000 GHz	5.000 000 GHz 1/2f		_______	−25 dBc
11.000 000 GHz	22.000 000 GHz 2f		_______	−25 dBc
11.000 000 GHz	5.000 000 GHz 1/2f		_______	−25 dBc
14.000 000 GHz	4.666 667 GHz 1/3f		_______	−25 dBc
14.000 000 GHz	9.33 3333 GHz 2/3f		_______	−25 dBc
16.000 000 GHz	5.333 333 GHz 1/3f		_______	−25 dBc
16.000 000 GHz	10.666 667 GHz 2/3f		_______	−25 dBc
18.000 000 GHz	6.000 000 GHz 1/3f		_______	−25 dBc
18.000 000 GHz	12.000 000 GHz 2/3f		_______	−25 dBc

PERFORMANCE TESTS

4-13. NON-HARMONICALLY RELATED SPURIOUS SIGNALS TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Spurious Non-Harmonically Related	<−70 dBc	2.0 to 6.2 GHz
	<−64 dBc	6.2 to 12.4 GHz
	<−60 dBc	12.4 to 18.0 GHz

Description

This test checks for any spurious signals in the CW Generator's RF output signal. The spectrum analyzer is calibrated for a reference level of −50 dBc and is tuned to any frequency from 2.0 to 6.2 GHz in search of spurious signals.

NOTE

The non-harmonically related spurious signals will always increase in amplitude above 6.2 GHz, due to multiplication in the internal YIG tuned multiplier. The increase is determined by a strict mathematical relationship. Therefore, satisfactory performance in the 2 to 6.2 GHz range will always ensure meeting the less stringent specification in the multiplied ranges, that is, from 6.2 to 18.0 GHz.

Equipment

Spectrum Analyzer .... HP 8566B

Procedure

1. Connect the CW Generator's RF OUTPUT to the input of the spectrum analyzer as shown in Figure 4-10.

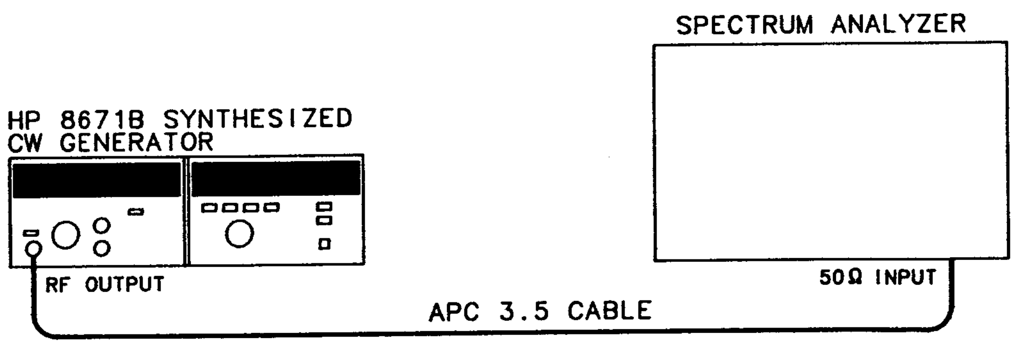


Figure 4-10. Non-Harmonically Related Spurious Signals Test Setup

2. Tune the CW Generator to 3 000.000 MHz and set the output level to −50 dBm.
3. Set the spectrum analyzer controls to display the fundamental signal. Set the resolution bandwidth to 1 kHz and the frequency span per division to 10 kHz.
4. Set the spectrum analyzer controls so that the carrier signal is at the top graticule line.

NON-HARMONICALLY RELATED SPURIOUS SIGNALS TEST (cont'd)

Procedure (cont'd)

5. Using the RANGE selector, increase the CW Generator's output level to 0 dBm. Do not adjust the spectrum analyzer amplitude calibration. The top graticule line now represents −50 dBc.

6. Tune the spectrum analyzer to any desired frequency in search of non-harmonically related spurious signals. Verify that any signals found are non-harmonically related and are not generated by the spectrum analyzer. Verify that the spurious signals are below the specified limits. Record the results.

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Level
3 000 MHz	________	________
3 000 MHz	________	________

7. Repeat step 2 through 6 for any desired carrier frequency from 2 000.000 to 6 199.999 MHz. Record the results. (Checking non-harmonically related spurious signals from 2.0 to 6.2 GHz provides a high level of confidence that the instrument meets its published specifications from 2 to 18 GHz.)

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Level
________	________	________
________	________	________
________	________	________
________	________	________

PERFORMANCE TESTS

4-14. POWER LINE RELATED SPURIOUS SIGNALS TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		**2.0—6.2 GHz**
Power line related and fan rotation related within 5 Hz below line frequencies and multiples therof	−50 dBc	<300 Hz offset from carrier
	−60 dBc	300 Hz to 1 kHz offset from carrier
	−65 dBc	>1 kHz offset from carrier
		6.2—12.4 GHz
	−44 dBc	<300 Hz offset from carrier
	−54 dBc	300 Hz to 1 kHz offset from carrier
	−59 dBc	>1 kHz offset from carrier
		12.4—18.0 GHz
	−40 dBc	<300 Hz offset from carrier
	−50 dBc	300 Hz to 1 kHz offset from carrier
	−55 dBc	>1 kHz offset from carrier

Description

The Unit Under Test and local oscillator are isolated from vibration by placing the instruments on two-inch thick foam pads. This eliminates the effects of microphonic spurious signals due to vibrations..

The primary power source is isolated from the power source used for the spectrum analyzer and the local oscillator to differentiate the power line related spurious signals from other power line related spurious signals.

NOTE

The Unit Under Test must be operated at a power line frequency different than that of the local oscillator and spectrum analyzer. This avoids the summing of the power line spurious signals.

Equipment

Local Oscillator .... HP 8340A
Spectrum Analyzer .... HP 3580A
Mixer .... RHG DMS1-18
Variable Frequency AC Power Source .... 501TC/800T, California Instruments

Procedure

1. Place the CW Generator on a 2-inch foam pad. Connect the equipment as shown in Figure 4-11.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

PERFORMANCE TESTS

POWER LINE RELATED SPURIOUS SIGNALS TEST (cont'd)

Procedure (cont'd)

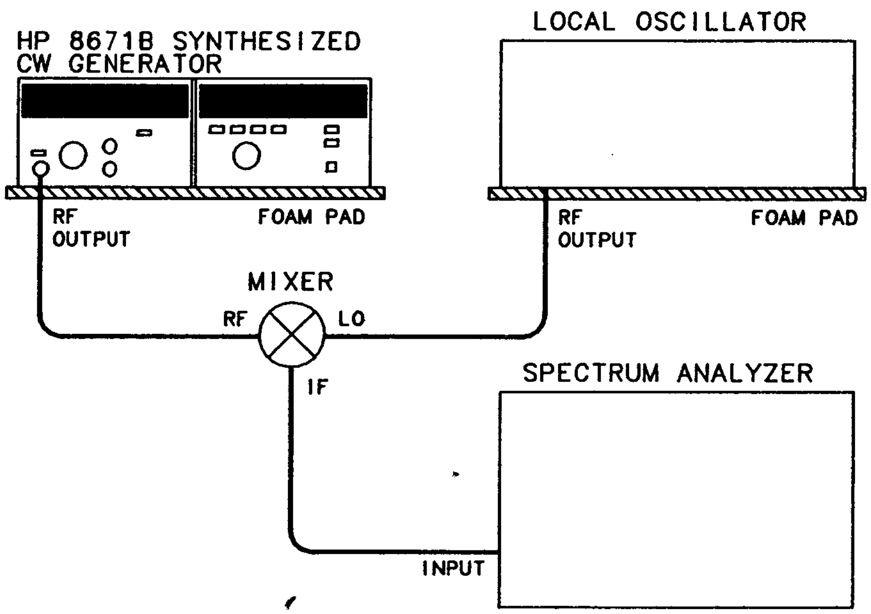


Figure 4-11. Power Line Related Spurious Signals Test Setup

2. Tune the CW Generator to 3 000.000 MHz and set the output level to −20 dBm.

3. Set the local oscillator to 3 000.020 MHz at +7 dBm.

4. Set the spectrum analyzer start frequency to 20 kHz, resolution bandwidth to 3 Hz.

5. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so the peak of the 20 kHz signal is at the top graticule line. Verify that the line related spurious signals of the CW Generator do not exceed the values shown below. Record the highest spurious signal level in each offset band.

   2.0 — 6.2 GHz <300 Hz offset ________ −50 dBc

   300 Hz — 1 kHz offset ________ −60 dBc

6. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the highest spurious signal level.

   2.0 — 6.2 GHz >1 kHz offset ________ −65 dBc

7. Tune the CW Generator and the local oscillator to 7 000.000 MHz and 7 000.020 MHz respectively.

PERFORMANCE TESTS

POWER LINE RELATED SPURIOUS SIGNALS TEST (cont'd)

Procedure (cont'd)

8. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so that the peak of the 20 kHz signal is at the top graticule line. Verify that the line related spurious signals of the CW Generator do not exceed the values shown below. Record the highest spurious signal level in each offset band.

   6.2 — 12.4 GHz <300 Hz offset frequency ________ −44 dBc

   300 Hz — 1 kHz offset frequency ________ −54 dBc

9. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the spurious signal levels.

   6.2 — 12.4 GHz >1 kHz offset frequency ________ −59 dBc

10. Tune the CW Generator and the local oscillator to 16 000.000 MHz and 16 000.020 MHz respectively.

11. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so that the 20 kHz signal is at the top graticule line. Verify that the line related spurious signals of the CW Generator do not exceed the values shown in the table. Record the highest spurious signal level in each offset band.

    12.4 — 18.0 GHz <300 Hz offset frequency ________ −40 dBc

    300 Hz — 1 kHz offset frequency ________ −50 dBc

12. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the spurious signal levels.

    12.4 — 18.0 GHz >1 kHz offset frequency ________ −55 dBc

PERFORMANCE TESTS

4-15. SINGLE-SIDEBAND PHASE NOISE TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Single-sideband Phase Noise (1 Hz bandwidth)		**2.0 — 6.2 GHz**
	−58 dBc	10 Hz offset from carrier
	−70 dBc	100 Hz offset from carrier
	−78 dBc	1 kHz offset from carrier
	−86 dBc	10 kHz offset from carrier
	−110 dBc	100 kHz offset from carrier
		6.2 — 12.4 GHz
	−52 dBc	10 Hz offset from carrier
	−64 dBc	100 Hz offset from carrier
	−72 dBc	1 kHz offset from carrier
	−80 dBc	10 kHz offset from carrier
	−104 dBc	100 kHz offset from carrier
		12.4 — 18.0 GHz
	−48 dBc	10 Hz offset from carrier
	−60 dBc	100 Hz offset from carrier
	−68 dBc	1 kHz offset from carrier
	−76 dBc	10 kHz offset from carrier
	−100 dBc	100 kHz offset from carrier

Description

The RF output of the CW Generator is mixed with a local oscillator to obtain a 40 kHz or 200 kHz IF signal. The phase noise sidebands are observed on a spectrum analyzer. Correction factors are applied to compensate for using the spectrum analyzer in the log mode, for local oscillator noise contributions, and for using bandwidths wider than 1 Hz.

NOTE

Normally, phase quadrature needs to be maintained between the CW Generator and the local oscillator for true phase noise measurement. However, the additional amplitude noise components are so small that they are not significant in these tests.

Equipment

Local Oscillator .... HP 8340A
Low Frequency Spectrum Analyzer .... HP 3580A
High Frequency Spectrum Analyzer ...... HP 8566B
Mixer .... RHG DMS1-18

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

NOTE

The signal-to-phase noise ratio as measured must be corrected to compensate for 3 errors contributed by the measurement system. These are

a. Using the spectrum analyzer in the log mode requires a +2.5 dB correction.

b. Equal noise contributed by the local oscillator requires a −3 dB correction.

c. The spectrum analyzer noise measurement must be normalized to a 1 Hz noise equivalent bandwidth. The noise equivalent bandwidth for HP spectrum analyzers is 1.2 times the 3 dB bandwidth.

For a 3 Hz bandwidth, the correction factor for the normalized measurement bandwidth would be:

$$\text{Normalizing Factor dB} = 10 \log (1.2 \times 3\ \text{Hz}/1\text{Hz}) = 5.56\ \text{dB}.$$

The total correction for 3 Hz bandwidth would be:

True measurement (dBc) = Reading (dBc) − 5.56 + 2.5 − 3 = Reading (dBc) *−6.06 dB.*

Procedure

1. Set the low frequency spectrum analyzer's start frequency to 40 kHz, resolution bandwidth to 1 Hz, and frequency span per division to 5 Hz.

2. Connect the equipment as shown in Figure 4-12.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

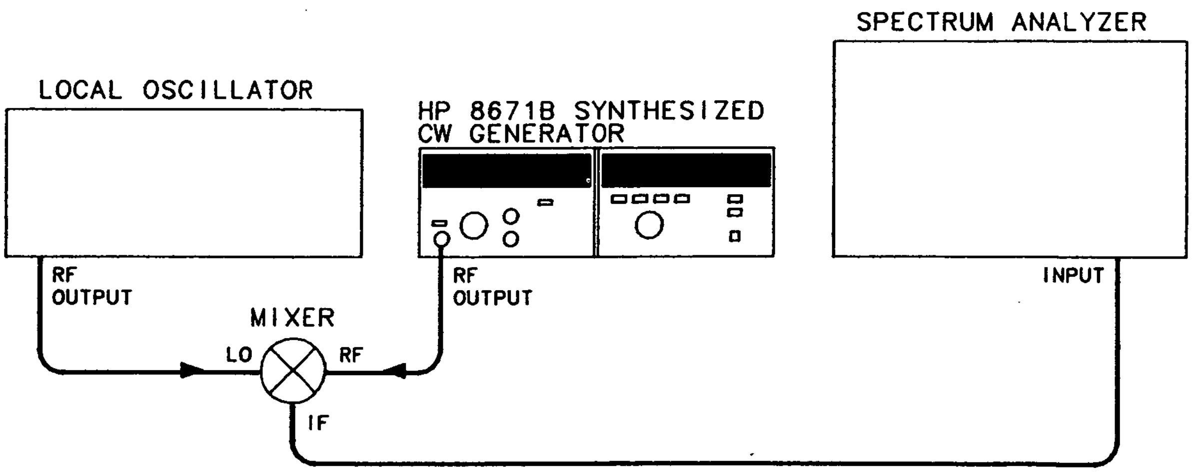


Figure 4-12. Single-Sideband Phase Noise Test Setup

3. Tune the CW Generator to 6 100.000 MHz and set the output level to −20 dBm.

4. Set the local oscillator to 6 100.040 MHz at +8 dBm.

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

5. Set the spectrum analyzer controls so that the peak of the 40 kHz signal is at the top graticule line.

6. Observe the phase noise level 10 Hz from the carrier. It should be greater than 56.7 dB below the carrier. Record the measured level.

   Measured __________
   Correction −1.30 dB
   Actual level __________ <−58 dBc

7. Tune the CW Generator and the local oscillator to 12 200.000 MHz and 12 200.040 MHz respectively.

8. Observe the phase noise level 10 Hz from the carrier. It should be greater than 50.07 dB below the carrier. Record the measured level.

   Measured __________
   Correction −1.30 dB
   Actual level __________ <−52 dBc

9. Tune the CW Generator and the local oscillator to 18 000.000 MHz and 18 000.039 MHz respectively.

10. Observe the noise level 10 Hz from the carrier. It should be greater than 46.7 dB below the carrier. Record the measured level.

    Measured __________
    Correction −1.30 dB
    Actual level __________ <−48 dBc

11. Set the spectrum analyzer controls for a resolution bandwidth of 3 Hz and a frequency span per division of 20 Hz. Using a 3 Hz bandwidth requires a 6.06 dB correction factor.

12. Repeat steps 3 through 10 except observe the noise 100 Hz from the carrier. Record the results below.

Frequency	Measured	Correction	Actual	Limit
6100.000 MHz	______	−6.06 dB =	______	−70 dBc
12 200.000 MHz	______	−6.06 dB =	______	−64 dBc
18 000.000 MHz	______	−6.06 dB =	______	−60 dBc

13. For the remainder of this procedure, use the high frequency spectrum analyzer. Set the spectrum analyzer resolution bandwidth to 30 Hz and frequency span per division to 200 Hz. The 30 Hz bandwidth requires 16.06 dB correction.

14. Tune the CW Generator and the local oscillator to 6 100.000 MHz and 6 100.200 MHz respectively.

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

15. Tune the spectrum analyzer to place the 200 kHz IF signal at the left edge of the display. Set the spectrum analyzer controls to place the peak of the signal at the top graticule line. Increase the log reference level control to move the peak of the carrier 20 dB above the top graticule line. (The top graticule line is now −20 dBc.)

16. Observe the phase noise level 1 kHz from the carrier. The observed level should be greater than 62 dB below the carrier. Record the measured level.

    Measured ________
    Correction −16.06 dB
    Actual Level ________ <−78 dBc

17. Tune the CW Generator and the local oscillator to 12 200.000 MHz and 12 200.200 MHz respectively.

18. Observe the noise level 1 kHz from the carrier. The observed level should be greater than 56 dB below the carrier. Record the measured level.

    Measured ________
    Correction −16.06 dB
    Actual Level ________ <−72 dBc

19. Tune the CW Generator and the local oscillator to 18 000.000 MHz and 18 000.200 MHz respectively.

20. Observe the noise level 1 kHz from the carrier. The observed level should be greater than 52 dB below the carrier. Record the measured level.

    Measured ________
    Correction −16.06 dB
    Actual Level ________ <−68 dBc

21. Set the spectrum analyzer for a resolution bandwith of 300 Hz and a frequency span per division of 2 kHz. Using a 300 Hz bandwidth requires a 26.06 dB correction factor.

22. Repeat steps 14 through 20 except observe the noise 10 kHz from the carrier. Record the results below.

Frequency	Measured	Correction	Actual	Limit
6100.000 MHz	________	−26.06 dB	________	−86 dBc
12 200.000 MHz	________	−26.06 dB =	________	−80 dBc
18 000.000 MHz	________	−26.06 dB =	________	−76 dBc

23. Set the spectrum analyzer controls for a resolution bandwidth of 3 kHz and a frequency span per division of 20 kHz. Using a 3 kHz bandwidth requires a 36.06 dB correction factor.

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

24. Repeat steps 14 through 20 except observe the noise 10 kHz from the carrier. Record the results below.

Frequency	Measured	Correction	Actual	Limit
6100.000 MHz	________	−36.06 dB =	________	−110 dBc
12 200.000 MHz	________	−36.06 dB =	________	−100 dBc
18 000.000 MHz	________	−36.06 dB =	________	−100 dBc

PERFORMANCE TESTS

4-16. INTERNAL TIME BASE AGING RATE

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Reference Oscillator		
Frequency	10 MHz	After a 10 day warmup (typically 24 hours in a normal operating environment)
Aging Rate	$<5 \times 10^{-10}$/day	
Accuracy and Stability	Same as reference oscillator	

Description A reference signal from the CW Generator (10 MHz OUT) is connected to the oscilloscope's vertical input. A frequency standard (with long term stability greater than 1×10^{-10}) is connected to the trigger input. The time required for a specific phase change is measured immediately and after a period of time. The aging rate is inversely proportional to the absolute value of the difference in the measured times.

Equipment

Frequency Standard .... HP 5065A
Oscilloscope .... HP 1980B

NOTE

Be sure the CW Generator has had 10 days to warm up before beginning this test. If the CW Generator was disconnected from the power line for less than 24 hours, only a 24 hour warm-up is needed.

Procedure

1. Set the rear panel FREQ REFERENCE INT-EXT switch to the INT position.
2. Connect the equipment as shown in Figure 4-13.

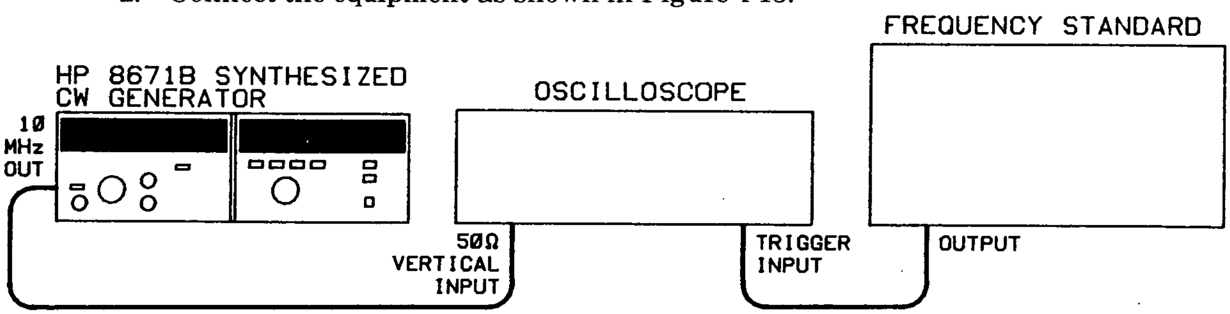


Figure 4-13. Internal Time Base Aging Rate Test Setup

3. Adjust the oscilloscope controls for a stable display of the 10 MHz CW Generator output.

PERFORMANCE TESTS

INTERNAL TIME BASE AGING RATE (cont'd)

Procedure (cont'd)

4. Measure the time required for a phase change of 360°. Record the time (T_1) in seconds.

   T_1 = ________ s

5. Wait for a period of time (from 3 to 24 hours) and re-measure the phase change time. Record the period of time between measurements (T_2) in hours and the new phase change time (T_3) in seconds.

   T_2 = ________ h

   T_3 = ________ s

6. Calculate the aging rate from the following equation:

$$\text{Aging Rate} = \left| \left(\frac{1 \text{ cycle}}{f} \right) \left(\frac{1}{T_1} - \frac{1}{T_3} \right) \left(\frac{T}{T_2} \right) \right|$$

where: 1 cycle = the phase change reference for the time measurement (in this case, 360°)
f = CW Generator's reference output frequency (10 MHz)
T = specified time for aging rate (24h)
T_1 = initial time measurement(s) for a 360° (1 cycle) change
T_2 = time between measurements (h)
T_3 = final time measurement(s) for a 360° (1 cycle) change

for example:

if T_1 = 351s
T_2 = 3h
T_3 = 349s

then:

$$\text{Aging Rate} = \left| \left(\frac{1 \text{ cycle}}{10 \text{ MHz}} \right) \left(\frac{1}{351\text{s}} - \frac{1}{349\text{s}} \right) \left(\frac{24\text{h}}{3\text{h}} \right) \right|$$

$$= 1.306 \times 10^{-11}$$

7. Verify that the aging rate is less than 5×10^{-10}.

NOTE

If the absolute frequencies of the frequency standard and the CW Generator's reference oscillator are extremely close, the measurement time in steps 5 and 6 (T_1 and T_3) can be reduced by measuring the time required for a phase change of something less than 360°. Change 1 cycle in the formula (i.e., 180° = 1/2 cycle, 90° = 1/4 cycle).

Aging Rate ________ $<5 \times 10^{-10}$/day

Table 4-4. Performance Test Record (1 of 6)

Hewlett-Packard Company
Model 8671B
Synthesized CW Generator
Serial Number ______________

Tested by ______________

Date ______________

Para. No.	Test		Results Min.	Results Actual	Results Max.
4-7.	FREQUENCY RANGE AND RESOLUTION TEST				
	Range (MHz)				
	Baseband Test	3 000.000	2 999.999	______	3 000.001
		2 000.000	1 999.999	______	2 000.001
		2 000.001	2 000.000	______	2 000.002
		2 001.112	2 001.111	______	2 001.113
		2 002.223	2 002.222	______	2 002.224
		2 003.334	2 003.333	______	2 003.335
		2 004.445	2 004.444	______	2 004.446
		2 005.556	2 005.555	______	2 005.557
		2 006.667	2 006.666	______	2 006.668
		2 007.778	2 007.777	______	2 007.779
		2 008.889	2 008.888	______	2 008.890
		2 009.999	2 009.998	______	2 010.000
		2090.000	2089.999	______	2090.001
		2 280.000	2 279.999	______	2 280.001
		2 470.000	2 469.999	______	2 470.001
		2 660.000	2 659.999	______	2 660.001
		2 850.000	2 849.999	______	2 850.001
		3 040.000	3 039.999	______	3 040.001
		3 230.000	3 229.999	______	3 230.001
		3 420.000	3 419.999	______	3 420.001
		3 610.000	3 609.999	______	3 610.001
		3 800.000	3 799.999	______	3 800.001
		3 990.000	3 989.999	______	3 990.001
		4 180.000	4 179.999	______	4 180.001
		4 370.000	4 369.999	______	4 370.001
		4 560.000	4 559.999	______	4 560.001
		4 750.000	4 749.999	______	4 750.001
		4 940.000	4 939.999	______	4 940.001
		5 130.000	5 129.999	______	5 130.001
		5 320.000	5 319.999	______	5 320.001
		5 510.000	5 509.999	______	5 510.001
		5 700.000	5 699.999	______	5 700.001
		5 900.000	5 899.999	______	5 900.001
		6 100.000	6 099.999	______	6 100.001
	Bands 2 and 3 Test	10 GHz, 2 kHz Resolution		______ (√)	
		18 GHz, 3 kHz Resolution		______ (√)	

Table 4-4. Performance Test Record (2 of 6)

Para. No.	Test		Results Min.	Results Actual	Results Max.
4-8.	**FREQUENCY SWITCHING TIME TEST**				
	Frequency Switching				
	18 GHz to 2.1 GHz			________	15 ms
	2.1 GHz to 18 GHz			________	15 ms
	Amplitude Recovery				
	2.1 to 6.1 GHz, 1 kHz resolution band			________	15 ms
	6.2 to 12.3 GHz, 2 kHz resolution band			________	15 ms
	12.4 to 18.0 GHz, 3 kHz resolution band			________	15 ms
4-9.	**OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST**				
	Output Level				
	Frequency and Power at Minimum Power Point				
	2.0—18.0 GHz				
	Frequency ________				
	Minimum power		+8 dBm	________	
	Level Flatness (total variation)				
	2.0—6.2 GHz			________	1.50 dB
	2.0—12.4 GHz			________	2.00 dB
	2.0—18.0 GHz			________	2.50 dB
	High Level Accuracy				
	+8 dBm (+10 dB range)	2 GHz	+6.25 dBm	________	+ 9.75 dBm
		4 GHz	+6.25 dBm	________	+ 9.75 dBm
		6 GHz	+6.25 dBm	________	+ 9.75 dBm
		8 GHz	+6.00 dBm	________	+10.00 dBm
		10 GHz	+6.00 dBm	________	+10.00 dBm
		12 GHz	+6.00 dBm	________	+10.00 dBm
		14 GHz	+5.75 dBm	________	+10.25 dBm
		16 GHz	+5.75 dBm	________	+10.25 dBm
		18 GHz	+5.75 dBm	________	+10.25 dBm
	+3 dBm (+10 dB range)	2 GHz	+1.25 dBm	________	+4.75 dBm
		4 GHz	+1.25 dBm	________	+4.75 dBm
		6 GHz	+1.25 dBm	________	+4.75 dBm
		8 GHz	+1.00 dBm	________	+5.00 dBm
		10 GHz	+1.00 dBm	________	+5.00 dBm
		12 GHz	+1.00 dBm	________	+5.00 dBm
		14 GHz	+0.75 dBm	________	+5.25 dBm
		16 GHz	+0.75 dBm	________	+5.25 dBm
		18 GHz	+0.75 dBm	________	+5.25 dBm
	0 dBm (0 dB range)	2 GHz	−1.75 dBm	________	+1.75 dBm
		4 GHz	−1.75 dBm	________	+1.75 dBm
		6 GHz	−1.75 dBm	________	+1.75 dBm
		8 GHz	−2.00 dBm	________	+2.00 dBm

Table 4-4. Performance Test Record (3 of 6)

Para. No.	Test		Results Min.	Results Actual	Results Max.
4-9.	**OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TEST (cont'd)**				
	High Level Accuracy (cont'd)				
	0 dBm (0 dB range) (cont'd)	10 GHz	−2.00 dBm	________	+2.00 dBm
		12 GHz	−2.00 dBm	________	+2.00 dBm
		14 GHz	−2.25 dBm	________	+2.25 dBm
		16 GHz	−2.25 dBm	________	+2.25 dBm
		18 GHz	−2.25 dBm	________	+2.25 dBm
	−5 dBm (0 dB range)	2 GHz	−6.75 dBm	________	−3.25 dBm
		4 GHz	−6.75 dBm	________	−3.25 dBm
		6 GHz	−6.75 dBm	________	−3.25 dBm
		8 GHz	−7.00 dBm	________	−3.00 dBm
		10 GHz	−7.00 dBm	________	−3.00 dBm
		12 GHz	−7.00 dBm	________	−3.00 dBm
		14 GHz	−7.25 dBm	________	−2.75 dBm
		16 GHz	−7.25 dBm	________	−2.75 dBm
		18 GHz	−7.25 dBm	________	−2.75 dBm
	−10 dBm (0 dB range)	2 GHz	−11.75 dBm	________	−8.25 dBm
		4 GHz	−11.75 dBm	________	−8.25 dBm
		6 GHz	−11.75 dBm	________	−8.25 dBm
		8 GHz	−12.00 dBm	________	−8.00 dBm
		10 GHz	−12.00 dBm	________	−8.00 dBm
		12 GHz	−12.00 dBm	________	−8.00 dBm
		14 GHz	−12.25 dBm	________	−7.75 dBm
		16 GHz	−12.25 dBm	________	−7.75 dBm
		18 GHz	−12.25 dBm	________	−7.75 dBm
	−10 dBm (−10 dB range)	2 GHz	−12.25 dBm	________	−7.75 dBm
		4 GHz	−12.25 dBm	________	−7.75 dBm
		6 GHz	−12.25 dBm	________	−7.75 dBm
		8 GHz	−12.50 dBm	________	−7.50 dBm
		10 GHz	−12.50 dBm	________	−7.50 dBm
		12 GHz	−12.50 dBm	________	−7.50 dBm
		14 GHz	−12.85 dBm	________	−7.15 dBm
		16 GHz	−12.85 dBm	________	−7.15 dBm
		18 GHz	−12.85 dBm	________	−7.15 dBm
	−20 dBm (−20 dB range)	2 GHz	−22.45 dBm	________	−17.55 dBm
		4 GHz	−22.45 dBm	________	−17.55 dBm
		6 GHz	−22.45 dBm	________	−17.55 dBm
		8 GHz	−22.70 dBm	________	−17.30 dBm
		10 GHz	−22.70 dBm	________	−17.30 dBm
		12 GHz	−22.70 dBm	________	−17.30 dBm
		14 GHz	−23.05 dBm	________	−16.95 dBm
		16 GHz	−23.05 dBm	________	−16.95 dBm
		18 GHz	−23.05 dBm	________	−16.95 dBm

Table 4-4. Performance Test Record (4 of 6)

Para. No.	Test		Results: Min.	Actual	Max.
4-10.	LOW LEVEL ACCURACY				
	2.0 GHz				
		−30 dBm	−32.65 dBm	________	−27.35 dBm
		−40 dBm	−42.95 dBm	________	−37.05 dBm
		−50 dBm	−53.25 dBm	________	−46.75 dBm
		−60 dBm	−63.55 dBm	________	−56.45 dBm
		−70 dBm	−73.85 dBm	________	−66.15 dBm
		−80 dBm	−84.15 dBm	________	−75.85 dBm
		−90 dBm	−94.45 dBm	________	−85.55 dBm
		−100 dBm	−104.75 dBm	________	−95.25 dBm
		−110 dBm	−115.05 dBm	________	−104.95 dBm
	10.0 GHz				
		−30 dBm	−32.90 dBm	________	−27.10 dBm
		−40 dBm	−43.20 dBm	________	−36.80 dBm
		−50 dBm	−53.50 dBm	________	−46.50 dBm
		−60 dBm	−63.80 dBm	________	−56.20 dBm
		−70 dBm	−74.10 dBm	________	−65.90 dBm
		−80 dBm	−84.40 dBm	________	−75.60 dBm
		−90 dBm	−94.70 dBm	________	−85.30 dBm
		−100 dBm	−105.00 dBm	________	−95.00 dBm
		−110 dBm	−105.30 dBm	________	−104.70 dBm
	18.0 GHz				
		−30 dBm	−33.45 dBm	________	−26.55 dBm
		−40 dBm	−43.85 dBm	________	−36.15 dBm
		−50 dBm	−54.25 dBm	________	−45.75 dBm
		−60 dBm	−64.65 dBm	________	−55.35 dBm
		−70 dBm	−75.05 dBm	________	−64.95 dBm
		−80 dBm	−85.45 dBm	________	−74.55 dBm
		−90 dBm	−95.95 dBm	________	−84.15 dBm
		−100 dBm	−106.35 dBm	________	−93.75 dBm
		−110 dBm	−107.75 dBm	________	−103.35 dBm
4-11.	OUTPUT LEVEL SWITCHING TIME				
		<20 ms		________	20 ms
4-12.	HARMONICS, SUBHARMONICS, AND MULTIPLES				
	Fundamental	**Harmonic or Subharmonic**			
	2.000000 GHz	4.000000 GHz 2f		________	−25 dBc
	4.000000 GHz	8.000000 GHz 2f		________	−25 dBc
	6.000000 GHz	12.000000 GHz 2f		________	−25 dBc

Table 4-4. Performance Test Record (5 of 6)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-12.	**HARMONICS, SUBHARMONICS, AND MULTIPLES (cont'd)**			
	Fundamental — **Harmonic or Subharmonic**			
	8.000 000 GHz — 16.000 000 GHz 2f		______	−25 dBc
	8.000 000 GHz — 4.000 000 GHz 1/2f		______	−25 dBc
	10.000 000 GHz — 20.000 000 GHz 2f		______	−25 dBc
	10.000 000 GHz — 5.000 000 GHz 1/2f		______	−25 dBc
	11.000 000 GHz — 22.000 000 GHz 2f		______	−25 dBc
	11.000 000 GHz — 5.500 000 GHz 1/2f		______	−25 dBc
	14.000 000 GHz — 4.666 667 GHz 1/3f		______	−25 dBc
	14.000 000 GHz — 9.333 333 GHz 2/3f		______	−25 dBc
	16.000 000 GHz — 5.333 333 GHz 1/3f		______	−25 dBc
	16.000 000 GHz — 10.666 667 GHz 2/3f		______	−25 dBc
	18.000 000 GHz — 6.000 000 GHz 1/3f		______	−25 dBc
	18.000 000 GHz — 12.000 000 GHz 2/3f		______	−25 dBc
4-13.	**NON-HARMONICALLY RELATED SPURIOUS SIGNALS (CW AND AM MODES)**			
	Carrier Frequency — **Spurious Signal Frequency**		**Spurious Signal Level**	
	2.0 to 6.2 GHz			
	3 000 MHz — ______		______	−70 dBc
	______ — ______		______	−70 dBc
	______ — ______		______	−70 dBc
	______ — ______		______	−70 dBc
	______ — ______		______	−70 dBc
	______ — ______		______	−70 dBc
4-14.	**POWER LINE RELATED SPURIOUS SIGNALS**			
	Offset Frequency			
	2.0—6.2 GHz			
	<300 Hz offset — ______		______	−50 dBc
	300 Hz—1 kHz offset — ______		______	−60 dBc
	>1 kHz offset — ______		______	−65 dBc
	6.2—12.4 GHz			
	<300 Hz offset — ______		______	−44 dBc
	300 Hz—1 kHz offset — ______		______	−54 dBc
	>1 kHz offset — ______		______	−59 dBc
	12.4—18.0 GHz			
	<300 Hz offset — ______		______	−40 dBc
	300 Hz—1 kHz offset — ______		______	−50 dBc
	>1 kHz offset — ______		______	−55 dBc

Table 4-4. Performance Test Record (6 of 6)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-14.	**SINGLE-SIDEBAND PHASE NOISE**			
	10 Hz offset from carrier 6100 MHz		________	−58 dBc
	12 200 MHz		________	−52 dBc
	18 000 MHz		________	−48 dBc
	100 Hz offset from carrier 6100 MHz		________	−70 dBc
	12 200 MHz		________	−64 dBc
	18 000 MHz		________	−60 dBc
	1 kHz offset from carrier 6100 MHz		________	−78 dBc
	12 200 MHz		________	−72 dBc
	18 000 MHz		________	−68 dBc
	10 kHz offset from carrier 6100 MHz		________	−86 dBc
	12 200 MHz		________	−80 dBc
	18 000 MHz		________	−76 dBc
	100 kHz offset from carrier 6100 MHz		________	−110 dBc
	12 200 MHz		________	−104 dBc
	18 000 MHz		________	−100 dBc
4-15.	**INTERNAL TIME BASE AGING RATE**		________	5×10^{-10}/day