HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

8671A
SYNTHESIZER
(Including Options 002, 003 and 005)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1704A.

With the changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1701A, 1702A, and 1703A.

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

MANUAL PART NO. 08671-90006
Operating Information Supplement Part No. 08671-90007
Microfiche Part No. 08671-90008

Printed: MAY 1978

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MANUAL CHANGES

MANUAL IDENTIFICATION	
Model Number:	8671A
Date Printed:	May 1978
Part Number:	08671-90006

SYNTHESIZER

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1705A	1	1845A	1 through 7
1706A	1, 2	1904A	1 through 8
1751A	1, 2, 3	1905A	1 through 9
1819A	1 through 4	►1913A	1 through 10
1834A	1 through 5		
1841A	1 through 6		

► NEW ITEM

ERRATA

Page 1-4, Paragraph 1-42:

Add: If the instrument rack mounting slides are to be mounted in a standard E.I.A. rack, then an adapter (HP part number 1494-0023) is needed. The slides without the adapter can be directly mounted in the Hewlett-Packard system enclosures.

►Page 4-14, PROCEDURE, Step 4:

Change in the last sentence 0.17 Vrms to 0.017 Vrms.

► Page 4-23, Paragraph 4-23, DESCRIPTION:

Change in the first sentence, 100 MHz OUT to 10 MHz OUT.

Page 5-9, PROCEDURE, Step 7 (Table of A3A1A2L4 Inductor Values):

Change the HP part number of the .68 μH inductor to 9140-0141.

► Page 8-43, Figure 8-35, (Service Sheet 3-A2):

Change in lower right corner, the off page connection to KX 9-A3.

Page 8-51, Figure 8-47 (Service Sheet 7-A2):

Delete, on A2A10U25, the connections between pins 1 and 2, 3 and 4, 5 and 6, 7 and 12. Show pins 2, 4, 5, and 12 as no connection (NC).

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.

27 March 1979
8 Pages

HEWLETT hp PACKARD

Printed in U.S.A.

ERRATA (Cont'd)

Page 8-59, Figure 8-59 (Service Sheet 11-A2):

Change label on P/O A2A8U17 pin 11 to DAC 3200 MHz and label pin 12 NDAC 4800 MHz

Change mnemonics on connections between P/O A2A12 and P/O A3A10:

N0 to N1 (XA2A8B pin 28 and P/O J4 pin 7)
N1 to N2 (XA2A8B pin 27 and P/O J4 pin 37)
N2 to N3 (XA2A8C pin 4 and P/O J4 pin 8)
N3 to N4 (XA2A8C pin 6 and P/O J4 pin 38)
N4 to N5 (XA2A8B pin 26 and P/O J4 pin 9)
N5 to N6 (XA2A8B pin 14 and P/O J4 pin 39)
DAC 1600 MHz to DAC 3200 MHz (XA2A8B pin 29 and P/O J4 pin 22)
DAC 3200 MHz to DAC 4800 MHz (XA2A8B pin 13 and P/O J4 pin 52).

Page 8-74, Figure 8-81:

Change the adjustment A3A5R18 to 3.2 GHz.

Page 8-75, Figure 8-83 (Service Sheet 6-A3):

Change labels on P/O A3A10 XA3A5 pin 7 to DAC 4800 MHz and pin 8 to DAC 3200 MHz.

Page 8-81, Figure 8-92 (Service Sheet 9-A3):

Change the output pin numbers of A3A9A4U5, pin 12 should be pin 3 and pin 3 should be pin 12.

CHANGE 1

Page 6-21, Table 6-3:
Add A3A1A1C4 0160-3879 CD 7 CAPACITOR-FXD 0.01 UF ±20% 100 WVDC CER.

Page 8-65, Figure 8-68 (Service Sheet 1-A3):
Add A3A1A1C4 0.01 UF, connected in parallel with A3A1A1C1.

CHANGE 2

Page 6 -29, Table 6-3:
Change A3A1A5Q5, Q6, Q8 and Q9 to 1854-0546 CD 1 TRANSISTOR NPN SI TO-72 PD=200 MW FT = 1 GHz.

Page 8-73, Figure 8-80 (Service Sheet 5-A3):
Change the part number of A3A1A5Q5, Q6, Q8 and Q9 to 1854-0546.

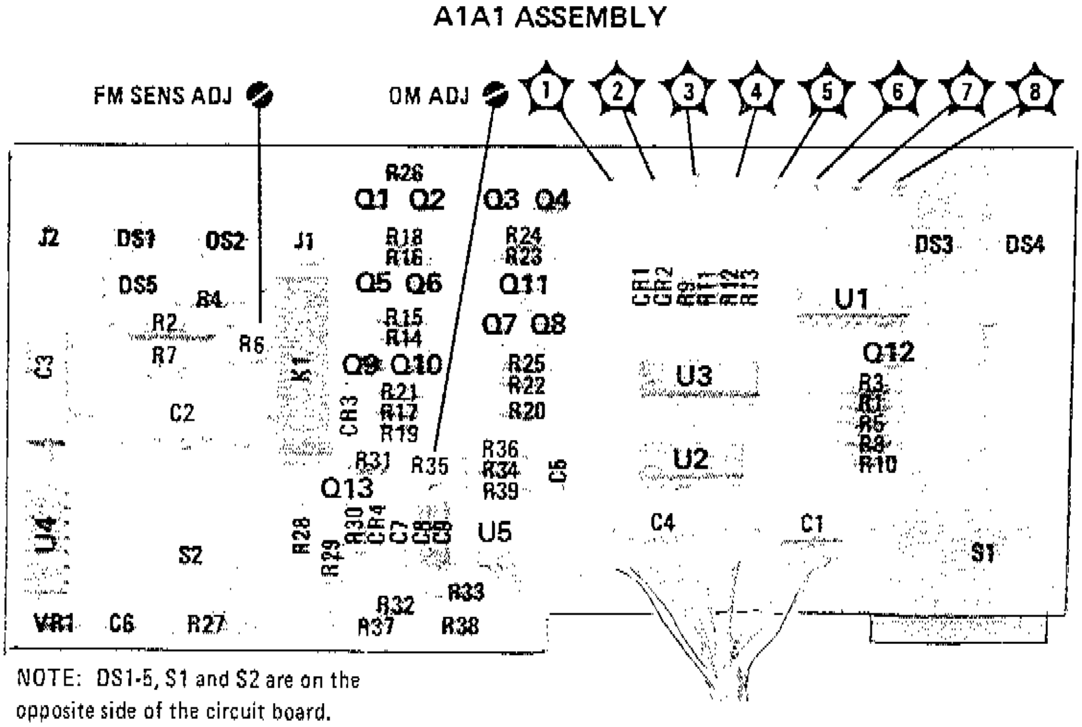
CHANGE 3

Page 6-5, Table 6-3:
Add the following components to the A1A1 Assembly:
C4 0180-1746 CD 5 CAPACITOR-FXD 15 UF ±10% 20 VDC TA.
C5, C6 0160-4084 CD 8 CAPACITOR—FXD 0.1 UF ±20% 50 VDC CER.
C7 0180-0197 CD8 CAPACITOR-FXD 2.2 UF ±10% 20 VDC TA.
C8, C9 0160-0174 CD 9 CAPACITOR-FXD 0.47 UF +80% —20% 25 VDC CER.
CR4 1901-0535 CD 9 DIODE SCHOTTKY.
Q13 1854-0019 CD 3 TRANSISTOR NPN SI TO-18 PD = 360 MW.
R27 0698-3399 CD 5 RESISTOR 133 1% .5W F TC = 0 ±100.
R28 0757-0418 CD 9 RESISTOR 619 1% .125W F TC = 0 ±100.
R29 0698-3402 CD 1 RESISTOR 316 1% .5W F TC = 0 ±100.
R30 0757-0416 CD 7 RESISTOR 511 1% .125W F TC = 0 ±100.
R31 0757-0401 CD 0 RESISTOR 100 1% .125W F TC = 0 ±100.
R32 0757-0442 CD 9 RESISTOR 10K 1% .125W F TC = 0 ±100.
R33 0757-0280 CD 3 RESISTOR 1K 1% .125W F TC = 0 ±100.
R34 0698-3150 CD 6 RESISTOR 2.37K 1% .125W F TC = 0 ±100.
R35 2100-1986 CD 9 RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN
R36 0757-0420 CD 3 RESISTOR 750 1% .125W F TC = 0 ±100.
R37 0757-0424 CD 7 RESISTOR 1.1K 1% .125W F TC = 0 ±100.
R38 0698-3442 CD 9 RESISTOR 237 1% .125W F TC = 0 ±100.
R39 0698-3455 CD 4 RESISTOR 261K 1% .125W F TC = 0 ±100.
U4 1820-0919 CD 1 IC COMPTR ECL A/D DUAL
U5 1826-0013 CD 8 IC 741 OP AMP TO-99
VR1 1902-3082 CD 9 DIODE-ZNR 4.64V 5% DO-7 PD = .4W TC = —0.023%.

Page 8-37, Figure 8-25:
Change the component location diagram as shown in this supplement (Part of Change 3).

Page 8-37, Figure 8-26, (Service Sheet 1-A1):
Change to the schematic diagram shown in this supplement (Part of Change 3).

CHANGE 3 (Cont'd)



NOTE: DS1-5, S1 and S2 are on the opposite side of the circuit board.

Figure 8-25. A1A1 Front Panel Assembly Component, Adjustment and Test Point Location (Part of Change 3)

CHANGE 4

Page 6-17, Table 6-3:
Change A2A11C18 to 0160-0570 CD 9 CAPACITOR-FXD 220 PF ±20% 100 VDC.

Page 6-21, Table 6-3:
Change A3A1A1C39 to 0160-3454 CD 4 CAPACITOR-FXD 220 PF ±10% 1 KVDC.

Page 6-29, Table 6-3:
Change A3A1A5Q7 to 1854-0546 CD 1 TRANSISTOR NPN SI TO-72 PD = 200 MW.

Page 6-37, Table 6-3:
Change A3A7C23 to 0180-1719 CD 2 CAPACITOR-FXD 22 UF ±10% 25V TA.

Page 6-39, Table 6-3:
Add A3A7R47 0757-0420 CD 3 RESISTOR 750 1% .125W F TC = 0 ±100.
Change A3A7R52 to 0757-0420 CD 3 RESISTOR 750 1% .125W F TC = 0 ±100.
Change A3A7R73 to 0757-0802 CD 5 RESISTOR 162 1% .5W F TC = 0 ±100.
Change A3A7R77 to 0757-0420 CD 3 REISISTOR 750 1% .125W F TC = 0 ±100.
Change A3A7R78 to 0757-0802 CD 5 RESISTOR 162 1% .5W F TC = 0 ±100.

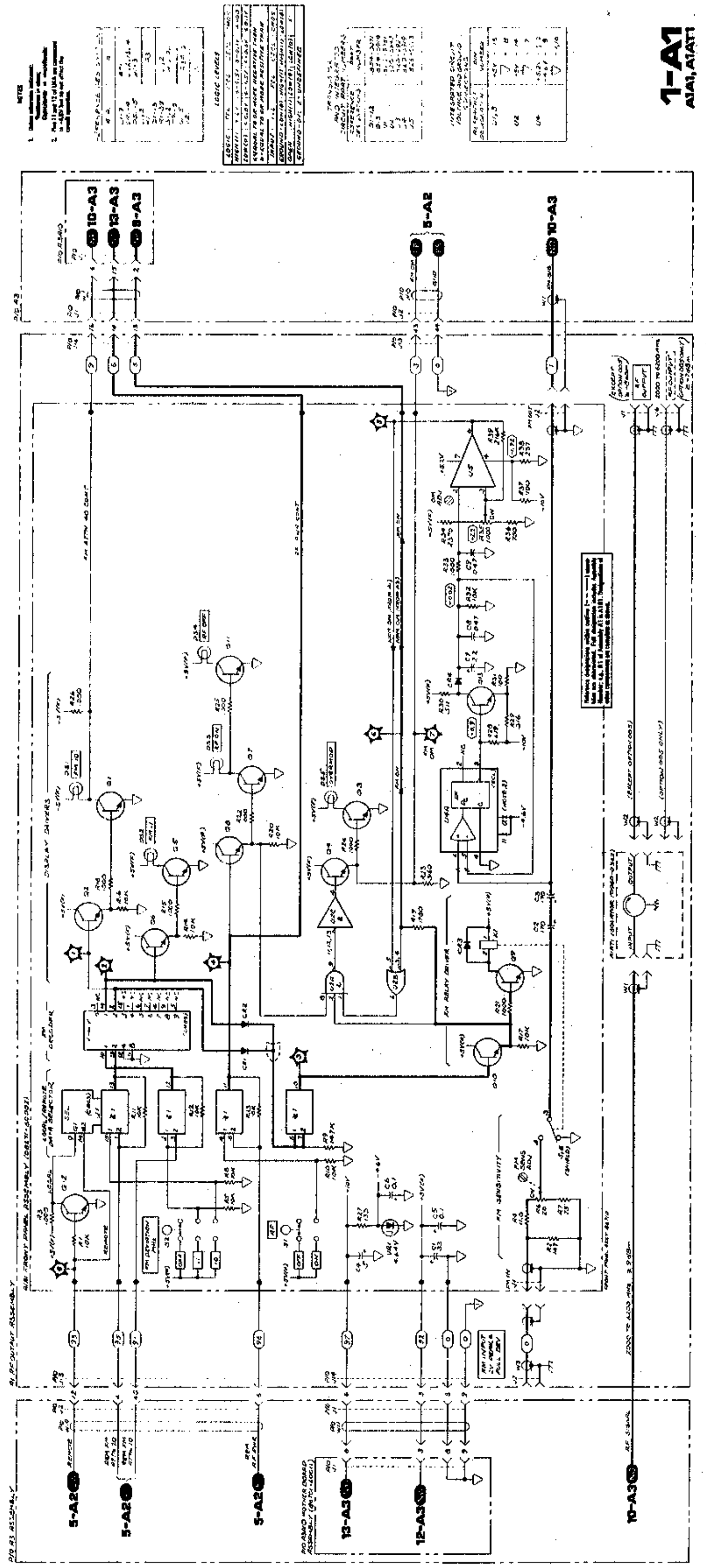


Figure 8-26. A1A1 Front Panel Assembly Schematic Diagram (Part of Change 3)

CHANGE 4 (Cont'd)

Page 8-55, Figure 8-53 (Service Sheet 9-A2):
Change C18 to 220 pF.

Page 8-73, Figure 8-80 (Service Sheet 5-A3):
Change Q5 to 1854-0546.

Page 8-83, Figure 8-95 (Service Sheet 10-A3):
Add R47, 750. Show the three resistors R47, R52, and R77 as being connected in series.
Change R52 and R77 to 750.
Change R73 and R78 to 162 and show as being connected in parallel.

CHANGE 5

Page 6-17, Table 6-3:
Change A2A10U24 to 1820-0946 CD4 IC GATE CMOS NOR QUAD 2-INP

Page 8-51, Figure 8-47 (Service Sheet 7-A2):
In the table of Transistor and Integrated Circuit Part Numbers:
Delete U24
Add U24 1820-0946.

CHANGE 6

Page 6-23, Table 6-3:
Change A3A1A2C8 to 0160-2257 CD3 CAPACITOR-FXD 10 PF ±5% 500 VDC CER 0±60.

Page 6-24, Table 6-3:
Change A3A1A2L4 to 9100-2254 CD3 COIL-MLD 390 NH 10% Q=35 .095D x .25LG - NOM.

Page 6-35, Table 6-3:
Change A3A5R13 to 2100-1657 CD1 RESISTOR-TRMR 1K 5% WW SIDE-ADJ 22-TRN.
Change A3A5R16 to 0699-0271 CD8 RESISTOR 715 1% .125W F TC=0±100.
Change A3A5R52 to 0698-6360 CD6 RESISTOR 10K .1% .125W F TC=0±25.
Change A3A5VR1 to 1902-0692 CD1 DIODE-ZNR 6.3V 1% DO-7 PD=.4W TC=+.001%.

Page 6-40, Table 6-3:
Change A3A9J1 through J6 to 1250-0691 CD7 CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM.

Page 8-67, Figure 8-71 (Service Sheet 2-A3):
Change A3A1A2C8 to 10.0 pF.
Change A3A1A2L4 to 0.39 μH.

Page 8-75, Figure 8-83 (Service Sheet 6-A3):
Change A3A5VR1 to 6.3V.
Change A3A5R13 to 1 kΩ.
Change A3A5R16 to 715Ω.
Change A3A5R52 to 10 kΩ.

CHANGE 7

Page 1-2, Table 1-1:
Change, under SPECTRAL PURITY CHARACTERISTICS Single-Sideband Noise (1 Hz BW, CW mode), as shown.

SSB Phase Noise Ratio (in 1 Hz BW, CW mode) at Specified Offset Frequency				
10 Hz	100 Hz	1 kHz	10 kHz	100 kHz
−58 dB	−70 dB	−78 dB	−86 dB	−110 dB

Page 4-10, Paragraph 4-18:
Change the SPECIFICATION table as shown in the above table.

Page 4-11, PROCEDURE, step 7:
Change 57.6 to 55.6 dB down.

Page 4-12, PROCEDURE, steps 9, 15, and 17:
Change 60.8 to 62.8 dB down.

Change 61.8 to 58.8 dB down.

Change 71.8 to 72.8 dB down.

Page 4-26, Table 4-3 (Para. No. 4-18):
Change per the following:

Test		Results Min.
10 Hz	−58 dB	55.6 dB down
100 Hz	−70 dB	62.8 dB down
1 kHz	−78 dB	60.8 dB down
10 kHz	−86 dB	58.8 dB down
100 kHz	−110 dB	72.8 dB down

CHANGE 8

Page 6-38, Table 6-3:
Change A3A7Q3 to 1854-0401 CD7 TRANSISTOR NPN SI TO-72 PD=175 mW.

Page 8-83, Figure 8-95:
Change, in the table of TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS, Q3 to 1854-0401.

CHANGE 9

Page 6-10, Table 6-3:
Change A2A4R23 to 0757-0819 CD4 RESISTOR 909 1% 0.5W F TC=0±100.

Page 8-41, Figure 8-32 (Service Sheet 2-A2):
Change R23 to 909Ω.

➤ CHANGE 10

Page 6-40, Table 6-3:
Change A3A9W1 to 86701-20064 CD2.
Change A3A9W2 to 86701-20066 CD4.
Change A3A9W3 to 86701-20065 CD3.
Change under A3A9 MISCELLANEOUS; 86701-00009 to 86701-00058 CD2 DECK YTO PHASE LOCK.
Change A3A9A1 to 0955-0098 CD1 same description.

Page 8-83, Figure 8-95 (Service Sheet 10-A3):
Change A3A9A1 Directional Coupler to 0955-0098.

CONTENTS

CONTENTS (Cont'd)

SERVICE SHEETS

ILLUSTRATIONS

ILLUSTRATIONS (Cont'd)

ILLUSTRATIONS (Cont'd)

TABLES

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

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 in order to protect against damage (refer to Table of Contents).

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.

SAFETY EARTH GROUND

This is a Safety Class I product (provided with a protective earthing 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 impared, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an auto-transformer make sure the common terminal is connected to the neutral (grounded side of mains supply).

SERVICING

WARNINGS

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

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

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

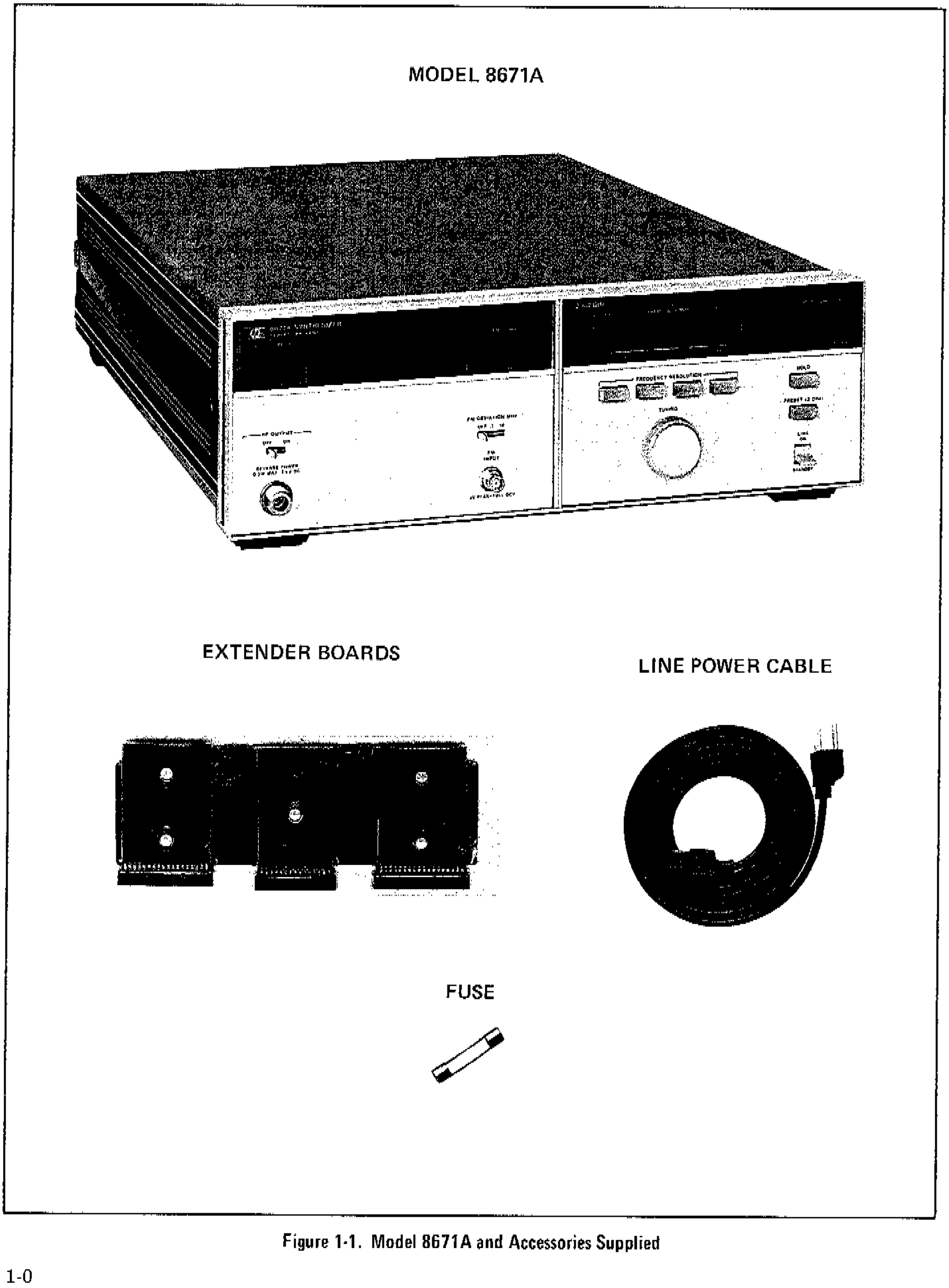


Figure 1-1. Model 8671A and Accessories Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains information pertinent to installing, operating, testing, adjusting, and servicing the Hewlett-Packard Model 8671A Synthesizer. The Model 8671A will generally be referred to as the Synthesizer throughout this manual.

1-3. Information pertaining to the Hewlett-Packard Interface Bus (HP-IB) as it relates to the Synthesizer is found in various sections of this manual. Section VIII contains a diagnostic program for checkout of HP-IB functions. A remote Operator's Check is also found in Section VIII.

1-4. Figure 1-1 shows the Synthesizer with all supplied accessories.

1-5. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. This supplement should stay with the instrument for use by the operator. Additional copies of the Operating Information Supplement may be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

1-6. 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 mm (4- x 6-inch) microfilm transparencies of the manual. Each microfiche contains up to 96 photoduplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-7. SPECIFICATIONS

1-8. Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested.

1-9. SAFETY CONSIDERATIONS

1-10. This product is a Safety Class I instrument (provided with a protective earth terminal). The instrument and manual should be reviewed for safety markings and instructions before operation.

1-11. The Synthesizer and all related documentation must 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.

1-12. Safety information pertinent to the task at hand (installation, operation, performance testing, adjustments, or service) is found throughout this manual.

1-13. INSTRUMENTS COVERED BY MANUAL

1-14. **Options.** Electrical options 002, 003, 005, and various mechanical options are documented in this manual. The differences are noted under the appropriate paragraph such as Options in Section I, the Replaceable Parts List and the schematic diagrams.

1-15. **Serial Numbers.** Attached to this instrument is a serial number plate. The serial number is in the form 1234A00123. The first four digits and the letter comprise the serial prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

1-16. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-17. MANUAL CHANGE SUPPLEMENTS

1-18. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

1-19. In addition to change information, the supplement may contain information for correcting

Table 1-1. Specifications (1 of 2)

FREQUENCY CHARACTERISTICS

Range: 2.0 to 6.2 (6.199 999) GHz .

Resolution: 1 kHz.

Time Base:

Internal: 10 MHz; Aging Rate is $<5 \times 10^{-10}$/day after 30 day warmup.[1,2]

External: 5 or 10 MHz; 0.1 to 1 Vrms nominal into 50 ohms.[3]

Reference Outputs: 10 MHz and 100 MHz, 0.2 Vrms nominal into 50 ohms.

Frequency Accuracy: same as time base.[2]

Switching Time (CW Mode): <15 ms to be within 1 kHz.

SPECTRAL PURITY CHARACTERISTICS

Harmonics(up to 18 GHz): <−15 dB.

Spurious (CW mode):

Non-harmonically related: < −70 dB.

Power Line Related and Spurious (Due to fan rotation within 5 Hz below line frequency, and multiples):

Except Option 003 instruments (400 Hz operation)

Power Line Related and Spurious Levels at Frequency Offset (f_o) from Carrier (F_c)		
f_o <300 Hz	300 Hz $\leq f_o \leq$ 1 kHz	f_o >1 kHz
−50 dB	−60 dB	−65 dB

Option 003 instruments only (400 Hz operation):

Power Line Related and Spurious Levels at Frequency Offset (f_o) from Carrier (F_c)		
f_o <2 kHz	2 kHz $\leq f_o \leq$ 8 kHz	f_o >8 kHz
−40 dB	−50 dB	−65 dB

Single-Sideband Noise (1 Hz BW, CW mode):

SSB Phase Noise Ratio (in 1 Hz BW, CW mode) at Specified Offset Frequency				
10 Hz	100 Hz	1 kHz	10kHz	100 kHz
~~−60~~ dB	~~−68~~ dB	−78 dB	~~−89~~ dB	~~−109~~ dB
−58	−70		−86	−110

RF OUTPUT CHARACTERISTICS

* **Output Power** (unleveled)[4]: >+8 dBm, +15°C to +35°C.

Flatness: <6 dB total output power level variation with frequency across band.

Impedance: 50 ohms.

Source SWR: < 1.7.

[1] Reference is kept at operating temperature in STAND-BY mode with the instrument connected to Mains power. For instruments disconnected from Mains power less than 24 hours, the aging rate is $<5 \times 10^{-10}$/day after a 24 hour warmup.

[2] Overall accuracy of the internal reference oscillator is a function of the time base calibration ± aging rate ± temperature effects ± line voltage effects. Typical temperature and line voltage effects are $<1 \times 10^{-10}$/°C and $<5 \times 10^{-10}$ +5, −10% line voltage change.

[3] Stability and spectral purity will be partially determined by characteristics of external reference oscillator.

[4] For Option 005 instruments, >+7 dBm.

Table 1-1. Specifications (2 of 2).

FREQUENCY MODULATION CHARACTERISTICS

Peak Deviation (maximum): 10 MHz or f_{mod} x 5, whichever is smaller.

Rates (3 dB bandwidth typical): 100 kHz range, 50 Hz to 10 MHz; 10 MHz range, 1 kHz to 10 MHz.

Frequency Response (relative to 100 kHz rate):
100 kHz range, ±2.0 dB, 100 Hz to 3 MHz.
10 MHz range, ±2.0 dB, 3 kHz to 3 MHz.

Sensitivity[5] (peak deviation per Vpk):
50 kHz/V, 100 kHz range.
5 MHz/V, 10 MHz range (maximum input 2 Vpk into 50 ohms nominal).

Harmonic and Non-Harmonic Distortion:[6] <12% for rates <3 kHz, decreasing linearly with frequency to 5% at 20 kHz rate. <5% for 20 to 100 kHz rates.

Residual FM in FM and CW Modes (noise and power line related):

Mode/Range	Residual FM in Post Detection Bandwidth	
	20 Hz–1 kHz	20 Hz–3 kHz
CW and 100 kHz range	6 Hz–rms	12 Hz–rms
10 MHz range	10 Hz–rms	20 Hz–rms

Accuracy Relative to External Input Level (at 100 kHz rate):[7]
±7% of range, +15 to +35°C.
±10% of range, 0 to +55°C.

Incidental AM (rates ≤100 kHz): typically 1%.

REMOTE PROGRAMMING CHARACTERISTICS

Frequency: Programmable over full range, 1 kHz resolution.

Frequency Modulation: OFF, 100 kHz; 10 MHz ranges.

Other: RF ON/OFF.

Programming Format: HP-IB (Hewlett-Packard Interface Bus).

GENERAL CHARACTERISTICS

Operating Temperature Range: 0 to 55°C.

Leakage: Meets radiated and conducted limits of MIL-I-6181D.

Power: 100, 120, 220, or 240V, +5%, —10%, 48—66 Hz 300 VA maximum.

Net Weight: 24.0 kg (53 lb).

Dimensions: 613 mmD x 425 mmW x 146 mmH (24-1/8" x 16-3/4" x 5-3/4").

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[5] 2 Vpk gives maximum deviation on each range. Peak deviation is linearly controlled by varying input level between 0 and 2 Vpk.

[6] For certain FM modulating frequencies, spurious signals (non-harmonic distortion) may occur. After demodulation in an external FM discriminator, the contribution to distortion of these spurious FM signals is typically less than 0.6%.

[7] For FM rates other than 100 kHz, add FM frequency response specification.

MANUAL CHANGE SUPPLEMENTS (Cont'd)

errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-20. DESCRIPTION

1-21. The HP Model 8671A Synthesizer has a frequency range of 2000 to 6200 MHz. The output level is specified to be greater than +8 dBm. The frequency modulation mode is switch selectable at the front panel. The frequency, modulation and RF on/off can be remotely controlled using the HP-IB programming format.

1-22. Frequency

1-23. Frequencies from 2000 to 6199.999 MHz can be tuned from the front panel. Four frequency resolution switches (100 and 1 MHz, and 10 and 1 kHz) make it convenient to quickly tune any frequency. The HOLD pushbutton disables the TUNE control so the frequency cannot be changed accidently.

1-24. Frequency stability is dependent on the time base, that is, either an internal or external oscillator. The internal crystal oscillator operates at 10 MHz while an external oscillator must operate at 5 or 10 MHz. The heart of the Synthesizer, a YIG tuned oscillator (YTO), is phase locked to the time base oscillator.

1-25. Output Level

1-26. The unleveled output of the Synthesizer is at least +8 dBm. The level variation is less than 6 dB across the entire frequency range.

1-27. Frequency Modulation

1-28. Frequency modulation is obtained with an external modulation drive signal. The peak deviation is linearly controlled by the amplitude of the external signal. The switch selectable ranges are 0.1 and 10 MHz (sensitivity 0.05 and 5 MHz/Vpk). The maximum allowable input is 2 Vpk.

1-29. The peak deviation is limited to 10 MHz or a modulation index of 5, whichever is lower. Usable modulation rates fall between 50 Hz and 10 MHz.

1-30. Miscellaneous Outputs and Indicators

1-31. Phase-locked reference outputs of 10 and 100 MHz are available on the rear panel.

1-32. Six front panel status indicators make the Synthesizer operation easier and aid in reducing possible operator error.

1-33. Remote Operation

1-34. The Synthesizer is fully programmable via the Hewlett-Packard Interface Bus. In the remote mode, front panel controls are disabled except the LINE switch.

1-35. OPTIONS

1-36. Electrical Options

1-37. Option 002. The internal 10 MHz crystal reference is omitted.

1-38. Option 003. A special fan allows operation on 400 Hz Mains.

1-39. Option 005. The Synthesizer's RF output connector is located on the rear panel. The minimum output power is +7.0 dBm.

1-40. Mechanical Options

1-41. The following options may have been ordered and received with the Synthesizer. If they were not obtained with the original purchase, and are now required, they must be ordered from your nearest Hewlett-Packard office using the part number included in each of the following paragraphs.

1-42. Chassis Slide Mount Kit Option 006. This kit is extremely useful when the Synthesizer is rack mounted. Access to internal circuits and components, or the rear panel, is possible without removing the Synthesizer from the rack. Order HP part number 1494-0017. When this kit comes with the Synthesizer it is identified as Option 006.

1-43. Front Handle Kit Option 907. Ease of handling is increased with the front panel handles. Order HP part number 5061-0089.

1-44. Rack Flange Kit Option 908. The Synthesizer can be solidly mounted to the instrument rack using the kit. Order HP part number 5061-0077.

Mechanical Options (Cont'd)

1-45. Rack Flange and Front Handle Combination Kit Option 909. This kit is not a front handle kit and rack flange kit packaged together. The combination is made up of a unique part which accomplishes both functions. Order HP 5062-0083.

1-46. HP-IB COMPATIBILITY

1-47. The Synthesizer is compatible with HP-IB as indicated by the following code: AH1, CØ, DC1, DTØ, L4, LEØ, PP2, RL2, SH1, SR1, T6 and TEØ. An explanation of the compatibility code may be found in the IEEE Standard 488-1975, "IEEE Standard Digital Interface for Programmable Instrumentation."

1-48. For more detailed information relating to programmable control of the Synthesizer, refer to Section III in this manual.

1-49. SELECTING THE HP-IB ADDRESS

1-50. The HP-IB address switches are located within the Synthesizer. The switches represent a two-digital octal number. This number corresponds to talk and listen address characters which an HP-IB controller is capable of generating. A table in Section II shows all HP-IB talk and listen addresses. Also refer to the paragraph entitled HP-IB Address and Parallel Poll Response Selection in Section II.

1-51. ACCESSORIES SUPPLIED

1-52. The accessories supplied with the synthesizer are shown in Figure 1-1.

a. The line power cable may be supplied in several combinations of plugs. Refer to Power Cables in Section II.

b. Fuses with a 3.0A rating for 100/120 Vac (HP 2100-0003) and a 1.5A rating for 220/240 Vac (HP 2100-0003) are supplied. One fuse is factory installed according to the voltage available in the country of destination. Refer to Line Voltage Selection in Section II.

c. There are four extender boards supplied which aid in performance testing, adjusting, and troubleshooting the instrument.

1. One 30 (15 x 2) pin extender board, HP part number 08672-60117.
2. Two 36 (18 x 2) pin extender boards, HP part number 08672-60020.
3. One 3-section [30 (15 x 2) pins per section] extender board, HP part number 08672-60016 (for use in the A2 Assembly).

1-53. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-54. 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 and in particular, the frequency accuracy[1] and spectral purity of the HP Model 10544C Crystal Oscillator. When using an external oscillator, microphonics or line related spurious signals may increase.

1-55. An external signal source is required if frequency modulation is desired. The source should have a variable output of 0 to 2 Vpk into 50 ohms, modulation rates up to 10 MHz, and distortion of <1%. The HP 651B and 654A function generators are adequate for modulating the Synthesizer and meet the stated requirements.

1-56. A remotely programmable audio source would be convenient for full remote control of modulation levels and rates.

1-57. EQUIPMENT AVAILABLE

1-58. The Synthesizer has an HP-IB interface and can be used with any HP-IB compatible computing controller or computer for automatic systems applications.

1-59. The 11712A Support Kit is available to aid the user in maintaining and servicing the Synthesizer. It consists of cables, adapters, terminations, pre-recorded programs, extender boards and a test extender board.

1-60. The prerecorded programs are on tape cassettes and are for use with the HP 9830A Computing Controller. The Output Register Test Board is intended to aid in troubleshooting the frequency control circuits.

1-61. Refer to the 11712A Support Kit operating manual for additional information. It may be ordered through your nearest Hewlett-Packard office.

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[1] Frequency accuracy: needed 1 ppm; minimum requirement 10 ppm.

1-62. RECOMMENDED TEST EQUIPMENT

1-63. Table 1-2 lists the test equipment and accessories recommended for use in testing, adjusting, and servicing the Synthesizer. If any of the recommended equipment is unavailable, instruments with equivalent minimum specifications may be used.

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

Instrument	Critical Specifications	Recommended Model	Use*
Adapter (2 required)	APC-7 to Type-N Male Frequency Range: 2—6.2 GHz	HP 11525A	P
Amplifier,40 dB	Frequency Range: 5 Hz to 10 kHz Gain: 40 dB (x100) into open circuit	HP 465A	P
Analyzer, Logic State	8 Bit Display Triggerable	HP 1601A	T
Analyzer, Spectrum	Frequency Response: 20 to 40 kHz Bandwidth: 1 Hz minimum Frequency Span Per Division: 5 Hz minimum Amplitude Range: 0 to −70 dBm	HP 3580A	P
Analyzer, Spectrum	Frequency Range: 10 kHz—100 MHz Frequency Span: 0.1—100 MHz Resolution Bandwidth: 30 Hz—300 kHz Amplitude Range: +10 to −90 dBm Vertical Sensitivity: 2 dB per division minimum	HP 8553B/8552B/141T	A,T
	Frequency Range: 1 kHz—200 kHz Frequency Span: 0—50 kHz	HP 8556A	P,A,T
Analyzer, Spectrum	Frequency Range: 2—18 GHz Frequency Span: 50 kHz to 200 MHz per division Resolution Bandwidth: 30 Hz—300 kHz Amplitude Range: +10 to −90 dBm Vertical Sensitivity: 2 dB per division minimum	HP 8565A	P,A,T
Attenuator	10 dB Steps Range: 10 to 60 dB 2—6.2 GHz 50Ω	HP 8495B, Opt. 010	P
	3 dB, fixed, Type-N, 50Ω 10 dB, fixed, Type-N, 50Ω	HP 8491B, Opt. 003 HP 8491B, Opt. 010	A A
Cable, semi-rigid	50Ω, 3.6 mm (0.141 inch) diameter with compatible SMA connectors	Locally Fabricated	P
Cable, HP-IB Interconnect	HP-IB compatible	HP 10631A	P,T
Cable, Special Interconnect	(Special, see Figure 1-2)	Locally Fabricated	A

*P = Performance Tests, A = Adjustments, T = Troubleshooting

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

Instrument	Critical Specifications	Recommended Model	Use*
Controller, HP-IB	HP-IB Compatible	HP 9830A	P, T
Counter, Frequency	Range: 100 kHz to 6.2 GHz Resolution: 10 Hz	HP 5340A	P, A,T
Coupler, Directional	24 dB directivity minimum, 2 to 6.2 GHz Type N Connectors	HP 11691D	P, T
Current Probe, AC	Frequency Range: 2—35 MHz	HP 1110A	A
Discriminator, FM	Frequency Range: 10 kHz to 10 MHz Audio Frequency Response: to 3 MHz Sensitivity: 0.01V	HP 5210A	P
Low Pass Filters	1 MHz Butterworth 10 kHz Butterworth	Included with HP 5210A Included with HP 5210A	P P
Shorting Board		Included with HP 5210A	P
Filter, Low Pass	1 kHz Butterworth, 50 ohms Connectors: BNC jack, BNC plug	CIR-Q-TEL FLT/21B-1K-5/50-3A/3B	P
	3 kHz Butterworth, 50 ohms Connectors: BNC jack, BNC plug	CIR-Q-TEL FLT/21B-3K-5/50-3A/3B	P
Mixer, Double Balanced	2—6.2 GHz response	RHG DM1-18	P
Oscillator, Sweep	Center Frequency: 150—200 MHz Center Frequency Resolution: 0.1 MHz Sweep Range: 10 and 200 MHz	HP 86220A/8620C	A
Oscillator, Test	Level: 2 Vpk minimum into 50Ω Range: 2 kHz to 1 MHz	HP 651B	P,A,T
Oscilloscope	Vertical Amplifier Response: Dc to 50 MHz Vertical Amplifier Sensitivity: 0.05 to 0.5 V/div Dual Channel External Triggering Horizontal Input	HP 180C/1801A/1821A	P,A,T
Divide by 10 Probe	Compatible with 1801A	HP 10001A	A
Pads, Foam 2 required	43 x 58 cm (17 x 23 inches) 5 cm (2 inches) thick		P

*P = Performance Tests, A = Adjustments, T = Troubleshooting this data is the basis for all future frequency changes, it is also stored in the Protected Register (Register 1) and displayed by the front panel.

The frequency (2—6.2 GHz) is displayed and stored as 8 BCD digits (10 GHz* to 1 kHz) and the YTO Loop tunes from 2—6.2 GHz. 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 Controller 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 button.
- Update the display.
- Shift the new frequency data into Register 3.
- Stop!

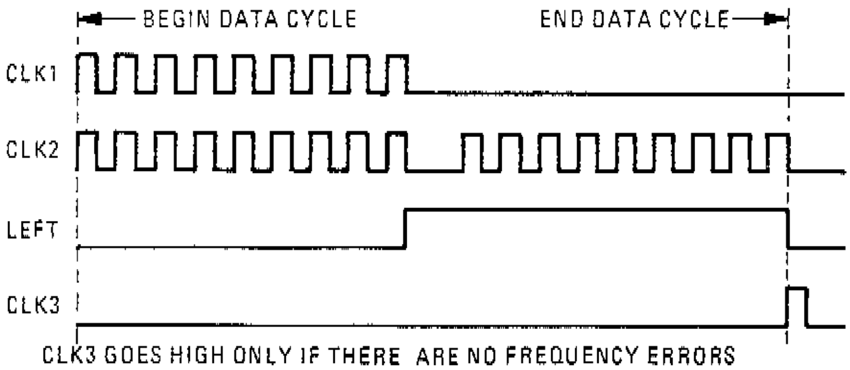
In Local when PRESET is pushed:

- Clear Register 1.
- Add 3 to the 1 GHz digit.
- Update the display.
- Shift the new frequency data (3 GHz) into Register 3.
- Stop!

In remote when a new frequency is programmed:

- Shift the new frequency into Register 1.
- Update the display.
- Shift the new frequency into Register 3.

A data cycle begins when the GO line goes true. The clock generator produces timing signals as shown below:



Clock Generator Outputs

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 buttons. The new frequency goes to three places: the front panel display, back into Register 1, and into Register 2. Then LEFT goes high, changing Register 2 to the left shift modes, 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 in 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-lock loops.

*Always zero.

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides the information needed to install the Synthesizer. Included is information pertinent to initial inspection, power requirements, line voltage selection, power cables, interconnection, environment, instrument mounting, storage and shipment.

2-3. 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).

2-4. 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.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The Synthesizer requires a power source of 100, 120, 220, or 240 Vac, +5% to −10%, 48 to 66 Hz single phase (for Option 003 instruments, 400 Hz single phase and 120 Vac, +5%, −10% only). Power consumption is approximately 300 volt-amperes.

WARNINGS

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the produce 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.

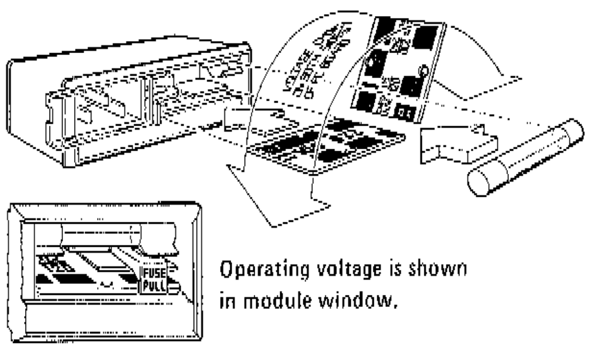
If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminal is connected to the earthed pole of the power source.

2-8. Line Voltage and Fuse Selection

CAUTION

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

2-9. Verify that the line voltage selection card and fuse are matched to the power source. Refer to the instructions in Figure 2-1, Line Voltage and Fuse Selection.



Operating voltage is shown in module window.

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.

Figure 2-1. Line Voltage and Fuse Selection

2-10. Power Cable

WARNING

BEFORE CONNECTING THIS INSTRUMENT, the protective earth terminals of this instrument must be connected to the protective conductor of the (Mains) power cord. The Mains plug shall only be inserted in a socket outlet 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).

2-11. This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of the power cable available:

2-12. HP-IB Address and Parallel Poll Response Selection

2-13. In the Synthesizer, the HP-IB talk and listen addresses and the parallel poll sense and response lines are switch selectable. The following procedure explains how the switches are to be set. Refer to Table 2-1 for a listing of the talk and listen addresses.

2-14. To change the HP-IB address or to select a different parallel poll response, the top cover of the Synthesizer and the A2 Assembly's protective cover must be removed.

a. Disconnect the line (Mains) power cable.

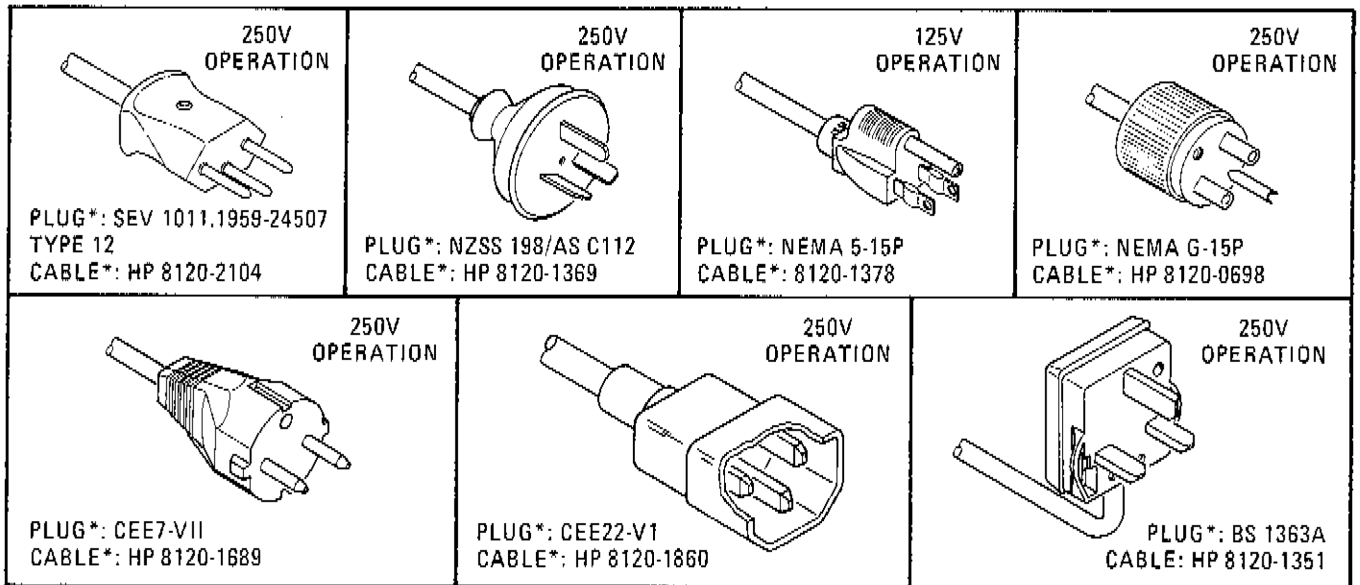
b. Remove any HP-IB cables or connectors from the HP-IB connector.

c. Remove the Synthesizer's top cover and the A2 Assembly's protective cover. Refer to the Disassembly and Reassembly Procedures in Section VIII.

d. If the parallel poll sense or response switches are to be changed, remove the A2A9 Board Assembly.

e. Select the new address as shown in Table 2-1. The locations of the switches are shown on Figure 2-3. The HP-IB ADDRESS SELECT switch settings (for S2 and S3) are in the octal code. For example, the factory selected addresses are set to 23 (binary 10 011; equivalent to bits b5 thru b1 on the table). Therefore, the listen address is '3' and the talk address is 'S'.

f. The PARALLEL POLL SENSE switch (S4) is set to either the OFF, 0 (zero), or 1 (one) position. In the zero position, the less positive level indicates an affirmative response to the poll.



*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. USA Standard Code for Information Interchange (ASCII)

b_7 b_6 b_5 BITS					$^{0}0_{0}$	$^{0}0_{1}$	$^{0}1_{0}$	$^{0}1_{1}$	$^{1}0_{0}$	$^{1}0_{1}$	$^{1}1_{0}$	$^{1}1_{1}$
b_4 ↓	b_3 ↓	b_2 ↓	b_1 ↓	Column→ Row↓	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	|
1	1	0	1	13	CR	GS	–	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	_	o	DEL

NOTE 3 (bits b_4–b_1) NOTE 1 (columns 2–3) NOTE 2 (columns 4–5) NOTE 3 (b_7 b_6 b_5)

NOTE 1: HP-IB valid LISTEN addresses
NOTE 2: HP-IB valid TALK addresses
NOTE 3: Logic 1 = V0, Logic 0 = +5V

HP-IB Address and Parallel Poll Response Selection (Cont'd)

g. The PPR (Parallel Poll Response) switch (S1) is used to select one of eight lines (one of 1 thru 8). The selected line passes the Synthesizer's response to the parallel poll to the HP-IB controller.

h. Re-install the A2A9 Assembly.

i. Replace the A2 Assembly's protective cover and the Synthesizer's top cover.

j. Connect the line (mains) power cable to the Line Power Module; connect the HP-IB cable to the HP-IB connector.

2-15. Interconnections. Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-4.

2-16. Mating Connectors

2-17. Interface Connector. The HP-IB mating connector is shown in Figure 2-4.

2-18. Coaxial Connectors. Coaxial mating connectors used with the Synthesizer should be 50-ohm Type-N and BNC male connectors that are compatible with those specified in US MIL-C-39012.

2-19. Operating Enviroment

2-20. The operation environment should be within the following limitations:

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

NOTE

Some output level and modulation characteristics are guaranteed only between 15 and 35°C. Refer to Table 1-1, Specifications.

2-21. Bench Operation

2-22. 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 control panel.

2-23. Rack Mounting

WARNING

The Synthesizer is heavy for its size 24.0 kg, 53 lb). Care must be exercised when lifting to avoid personal injury. Use the equipment slides when rack mounting.

2-24. 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 Options in Section I.

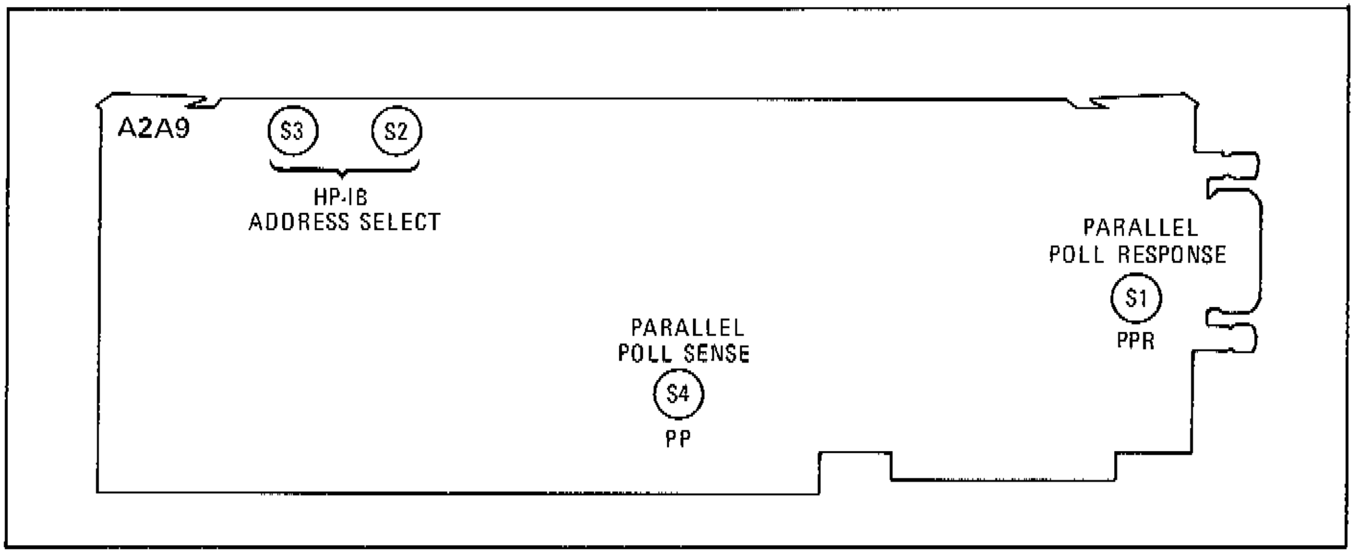
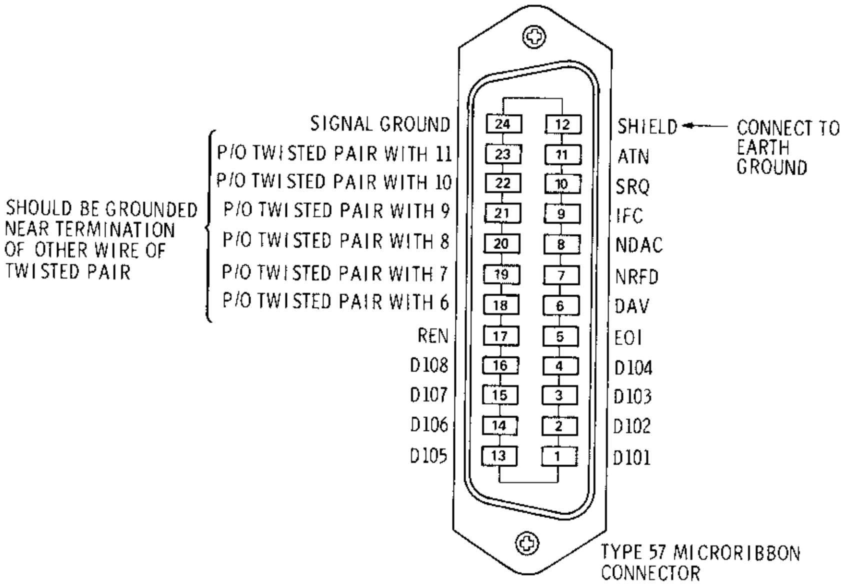


Figure 2-3. Location of HP-IB Address and Parallel Poll Switches



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 10631A, 0.9 metres (3 ft.), HP 10631B, 1.8 metres (6 ft.)
HP 10631C, 3.7 metres (12 ft.)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus System may contain no more than 1.8 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 ft).

Figure 2-4. Hewlett-Packard Interface Bus Connection

2-25. STORAGE AND SHIPMENT

2-26. Environment

2-27. 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).

2-28. Packaging

2-29. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also mark the container FRAGILE to assure careful handling. In any correspondence refer to the instrument by model number and full serial number.

2-30. 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, attach a tag indicating the service required, return address, model number, and full serial number.)

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 instrument to provide firm cushion and prevent movement in the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

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

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section explains how to operate the Synthesizer. Included are descriptions of front and rear panel controls, connectors and indicators, operator's checks, operating instructions, and operator's maintenance.

3-3. Local operating instructions begin with paragraph 3-8. Remote operation with the Hewlett-Packard Interface Bus (HP-IB) is explained beginning with paragraph 3-14.

3-4. PANEL FEATURES

3-5. The front and rear panel features of the Synthesizer are shown in Figures 3-1 and 3-2 and are described in Tables 3-1 and 3-2.

3-6. OPERATOR'S MAINTENANCE

3-7. The only maintenance the operator should normally perform is the replacement of the primary power fuse (F1) located in the Line Power Module Assembly 9 (A3A11) shown in Figure 3-2. For instructions on how to change the fuse, refer to Section II, Line Voltage Selection.

3-8. LOCAL OPERATION

3-9. A procedure for verifying the major functions of the Synthesizer is provided in Tables 3-3 and 3-4. The procedure is divided into two parts: Local Operator's Checks and Local Operating Instructions. The Local Operator's Checks should be performed first to verify proper operation of the Synthesizer. The Local Operating Instructions explain how to set and use the various controls on the Synthesizer.

WARNINGS

Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers 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 fuses with the required rated current and specified type should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

CAUTION

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

3-10. Local Operator's Check

3-11. Table 3-3 provides general instructions for checking the operation of the Synthesizer via the front and rear panel controls.

3-12. Local Operating Instructions

3-13. Table 3-4 provides general instructions for operating the Synthesizer via the front and rear panel controls.

3-14. REMOTE (HP-IB) OPERATION

3-15. The Synthesizer can be operated through the Hewlett-Packard Interface Bus (HP-IB). For further information about the HP-IB, refer to IEEE Standard 488-1975, the Hewlett-Packard catalog and the booklet "Improving Measurements in Engineering and Manufacturing" (HP part no. 5952-0058). Synthesizer compatibility, programming, and data format is described in the paragraphs which follow.

3-16. Synthesizer Talk and Listen address, and Parallel and Serial Poll response selection is described in Section II.

3-17. For Synthesizer remote checkout and troubleshooting, refer to the Remote Operator's Check and the HP-IB Diagnostic Program in Section VIII. The Remote Operator's Check verifies that the Synthesizer's functions can be programmed while the HP-IB Diagnostic Program tests the Bus functions of the Synthesizer.

3-18. Compatibility

3-19. The Synthesizer is fully programmable with

FIG. 3-1, Sht 1 of 2

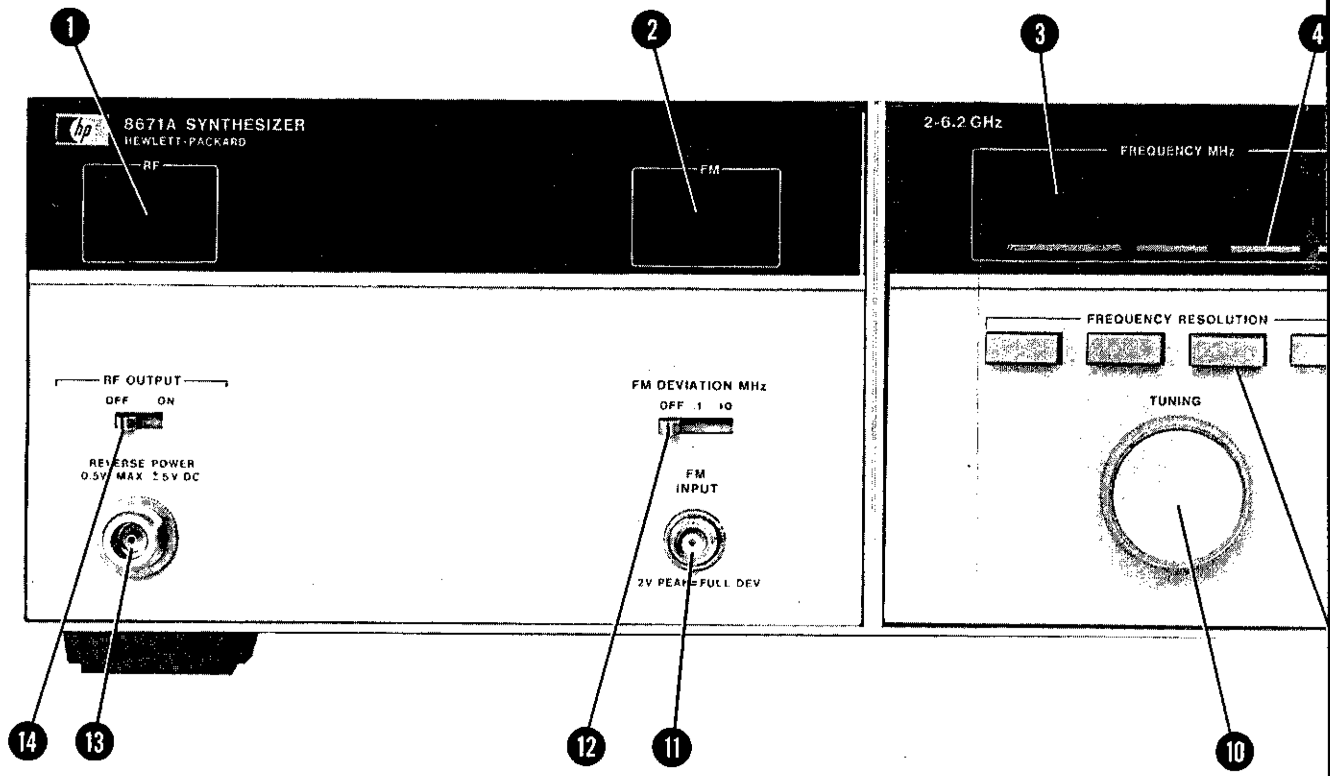


Figure 3-1. Front Panel Connectors, Controls, Switches, and Displays

FIG. 3-1, Sht 2 of 2

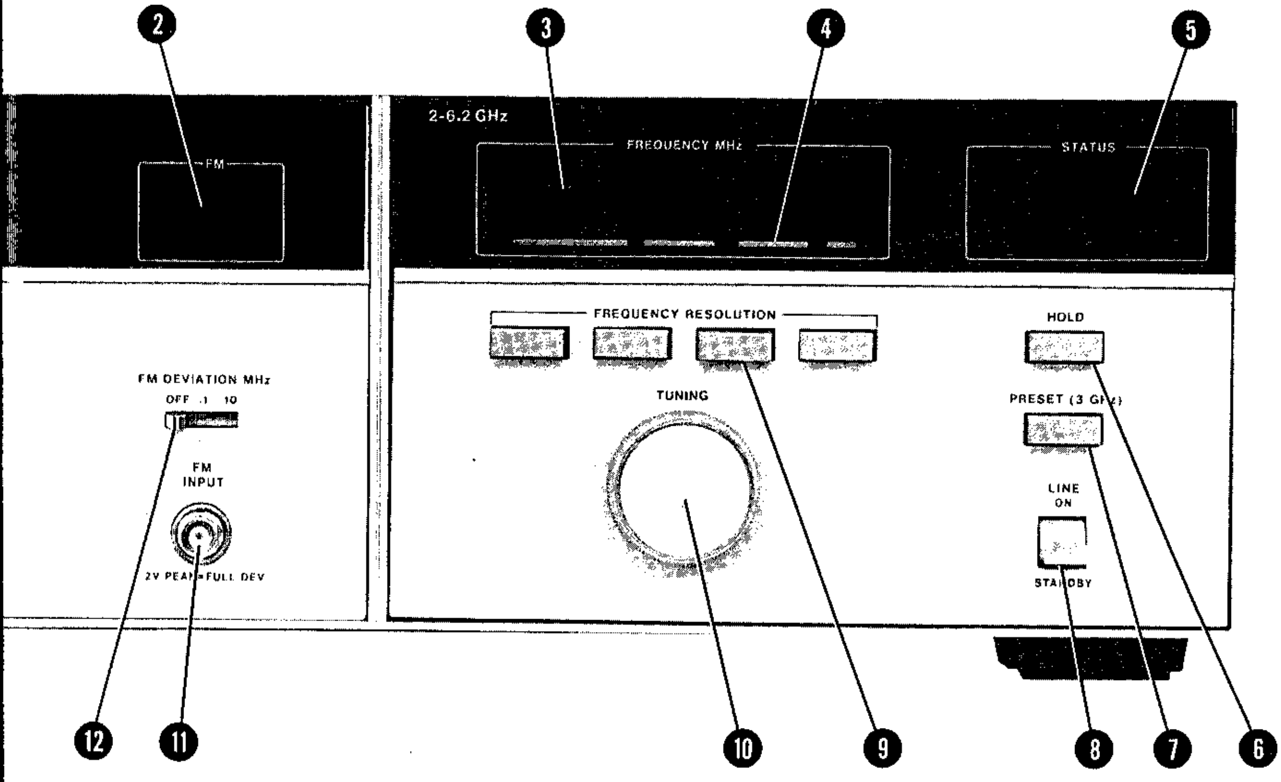


Figure 3-1. Front Panel Connectors, Controls, Switches, and Displays

Table 3-1. Front Panel Features

FRONT PANEL FEATURES

1 **RF annunciator:** ON-OFF indicates whether the RF OUTPUT 13 is on or off. This can be controlled by the RF switch 14 or remotely programmed.

2 **FM annunciator:** indicates either a 0.1 or 10 MHz deviation range for 2 Vpk as determined by the position of the FM DEVIATION MHz switch 12 or remotely programmed. OVER MOD indicates an input signal greater than 2 Vpk at the FM INPUT connector 11 or the modulation index is greater than 5.

3 **FREQUENCY MHz:** LED display indicates the selected frequency.

4 **Frequency Resolution Light Bars:** indicate the frequency tuning resolution selected by the FREQUENCY RESOLUTION keys 9 . The first light bar indicates 100 MHz resolution, the second indicates 1 MHz, the third indicates 10 kHz, and the fourth indicates 1 kHz resolution. All the light bars to the left of the one selected will light when the selected FREQUENCY RESOLUTION key 9 is pressed.

5 **STATUS Block:** annunciators display the internal conditions of the Synthesizer.

OVEN: indicates that the crystal oven has not reached operating temperature when lit.

OUT OF RANGE: indicates an out of range (illegal) frequency has been remotely programmed when lit.

REMOTE: indicates the Synthesizer has been set to remote operation by an HP-IB controller when lit.

STANDBY: indicates that power has been applied but the LINE switch 8 is in the STANDBY position when lit.

NOT PHASE LOCKED: indicates that one or more of the phase lock loops are unlocked or the RF switch 14 is in the OFF position.

INTERNAL REF OFF: indicates when the rear panel INT-EXT switch 6 (see Figure 3-2) is in the EXT position when lit.

6 **HOLD key:** disables the TUNING control 10 on the front panel to hold the selected freqnecy and extinguishes the Frequency Resolution Light Bars

7 **PRESET (3 GHz) key:** sets frequency to 3 GHz and extinguishes the Frequency Resolution Light Bars without changing any other front panel controls.

8 **LINE switch:** applies power to the Synthesizer when set to the ON position; power is supplied to the crystal oven and the battery charger circuit in the STANDBY position.

9 **FREQUENCY RESOLUTION keys:** selects tuning resolution in 100 MHz, 1 MHz, 10 kHz, or 1 kHz steps. The HOLD key 6 clears any frequency resolution selected.

10 **TUNING control:** changes the Synthesizer's output frequency in the resolution selected by the FREQUENCY RESOLUTION keys 9 .

11 **FM INPUT connector:** accepts a maximum 2 Vpk external modulation signal with a 50 ohm impedance. Deviation varies linearly with the input signal. Deviation ranges are controlled by the FM DEVIATION switch 12 .

12 **FM DEVIATION switch:** selects the peak deviation that is obtained with a signal applied to the FM INPUT connector 11 . The peak deviation range is displayed on the FM annunciator 2 . FM deviation range is a programmable function.

13 **RF OUTPUT connector:** 50 ohm type-N female connector supplies the RF output over the entire frequency range of 2 to 18 GHz.

RF switch: completely turns off the RF output when in the OFF position. This condition is displayed in the RF annunciator 1 and causes the NOT PHASE LOCKED annunciator in the STATUS Block 5 to illuminate. When the ON position is selected, the Synthesizer returns to normal operation. The functions of the RF switch are programmable.

Table 3-2. Rear Panel Features

REAR PANEL FEATURES

1 **HP-IB connector:** connects the Synthesizer to Hewlett-Packard Interface Bus for remote operation. When in remote operation, the STATUS Block 5 (see Figure 3-1) REMOTE annunciator illuminates.

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

3 **RF OUT (A3J6):** only for Option 004 and 005, 50 ohm type N output connector (see Table 1-1 for Option information).

4 **10 MHz OUT (A3J8):** 0 dBm (nominal) into 50 ohms. Can be used as an external time base and for troubleshooting.

5 **FREQ STANDARD Output (A3J9):** 10 000 MHz into 50 ohms at +7 dBm (nominal) from the internal frequency standard except when INT/EXT switch 6 is in the EXT position.

6 **FREQ STANDARD INT/EXT switch:** normally left in INT position. Removes power from internal frequency standard in EXT position.

7 **Jumper (A3W3):** normally connects Frequency Standard Output (A3J9) to Frequency Standard Input (A3J10).

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

9 **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 Synthesizer is set (see Figure 2-1). The protective grounding conductor connects to the Synthesizer through this module. The line power fuse (A3F1) is part of this module and is the only part to be changed by the operator.

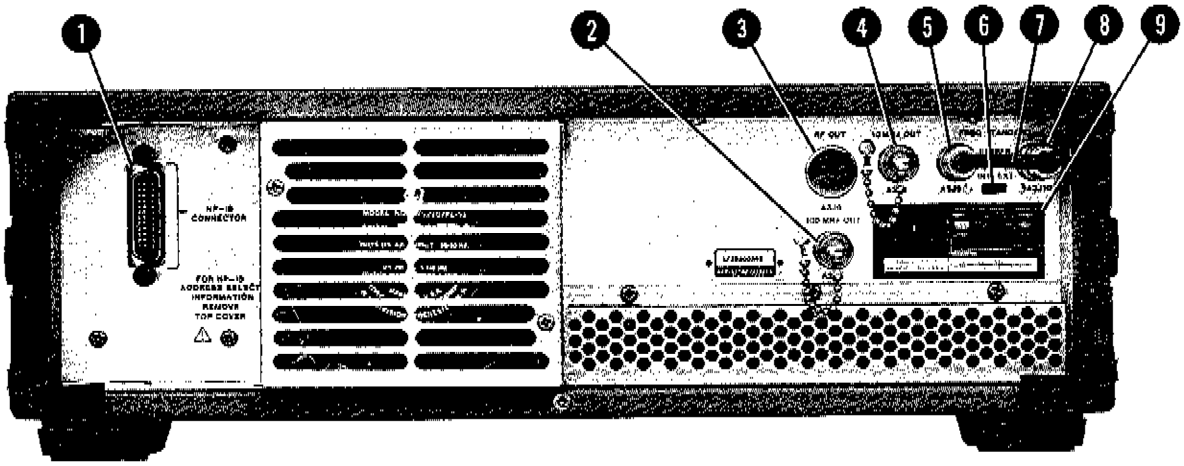


Figure 3-2. Rear Panel Controls, Connectors, and Indicators

Table 3-3. Local Operator's Checks (1 of 2)

INITIAL CONDITIONS

1. Check that the LINE switch 8 (Figure 3-1) is in STANDBY and remove the power cable from the Line Power Module 9 (see Figure 3-2).

2. Check that Line Power Module 9 (see Figure 3-2) is set to the nominal line voltage to be used and that the fuse is the correct value and type.

3. Set the front panel controls and switches as follows:

   12 FM DEVIATION MHz selector . . . . OFF

   14 RF switch . . . . OFF

4. Set the rear panel controls and cables as follows:

   6 FREQ STANDARD INT/EXT switch . . . . . . INT

   7 Jumper (A3W3) . . . . Connects A3J9 to A3J10

OPERATION

1. Set the LINE switch 8 to ON and check for the following conditions:

   1 RF annunciator . . . . OFF

   2 FM annunciator . . . . OFF

   3 FREQUENCY MHz display . . . . some frequency between 2—6.2 GHz (if frequency display is not stable, press PRESET (3 GHz) 7).

   4 Frequency Resolution Light Bars . . . . extinguished

   5 STATUS annunciators

   OVEN . . . . may be lit and will extinguish when the reference oscillator oven operating temperature is reached.

   NOT PHASE LOCKED . . . . illuminated

2. Press PRESET (3 GHz) key 7 and FREQUENCY display 3 should now indicate 3000.000 MHz.

3. Press one at a time, the four FREQUENCY RESOLUTION keys 9 and the Frequency Resolution Light Bars 4 should light one at a time and remain lit. Rotate the TUNING contol 10 clockwise and then counterclockwise and note that the digits displayed in the FREQUENCY display 3 increase and then decrease in order as the TUNING control 10 is turned. Perform this step as each of the four FREQUENCY RESOLUTION keys 9 are pressed. The first key on the left produces resolution in 100 MHz steps, the second key 1 MHz steps, the third key 10 kHz steps, and the fourth key 1 kHz steps. Pressing the fourth key first will cause all four of the Frequency Light Bars 4 to light and will produce 1 kHz tuning resolution. Pressing the HOLD 6 key causes the Light Bars 4 to extinguish and prevents the TUNING control 10 from changing the frequency displayed.

4. Connect the microwave frequency counter to the Synthesizer as shown in Figure 3-3.

Table 3-3. Local Operator's Checks (2 of 2)

5. Set the RF switch 14 to ON. If the STATUS Block 5 annunciator OVEN is extinguished, the NOT PHASE LOCKED annunciator should also extinguish. The frequency counter should indicate the same frequency (±1 count) as shown on the Synthesizer's display 3.

6. Note the frequency on the FREQUENCY MHz display 3. Disconnect Mains power. Leave the Synthesizer in the unplugged condition for at least 30 seconds.

7. Reconnect Mains power. The FREQUENCY MHz display 3 should display the same frequency as was displayed in step 6. The STATUS Block 5 annunciator OVEN should light for a few seconds.

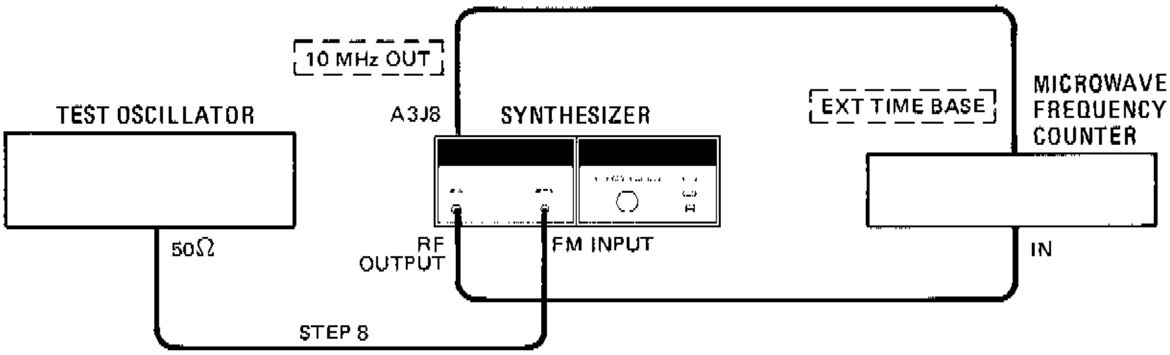


Figure 3-3. Operator's Frequency and Modulation Checks Test Setup

8. Connect the test setup as shown in Figure 3-3. Set the test oscillator's frequency to 2 MHz.

9. Set the FM DEVIATION switch 12 to 10 MHz. The FM annunciator 2 10 will light.

10. Increase the test oscillator's output from 0 Vrms to approximately 2 Vrms. The FM annunciator 2 OVERMOD will light when there is over modulation or an input signal greater than 2 Vpk.

11. Disconnect the test setup.

Table 3-4. Local Operating Instructions (1 of 2)

SETTING FREQUENCY

1. Be sure Synthesizer is set to local. Make sure the internal reference is selected or an external reference is connected to A3J10.

2. Set front panel controls and switches to the following positions:

8 LINE switch	ON
9 FREQUENCY RESOLUTION keys	to resolution desired and displayed on Frequency Resolution Light Bars 4
10 TUNING control	to frequency desired as displayed on Frequency readout 3
6 HOLD key.	press pushbutton, the frequency desired is now held
14 RF switch	ON
12 FM DEVIATION	as desired

SETTING FREQUENCY MODULATION

1. Connect a modulation source with a 50 ohm output impedance to the FM INPUT connector 11. Set the oscillator's output to less than 2 Vpk and at the modulation frequency desired.

2. Set the FM DEVIATION switch 12 to correspond to the desired deviation range.

3. An input of 2.0 Vpk or 1.414 Vrms represents full scale modulation voltage. Adjust the input voltage to obtain the desired deviation.

4. The FM annunciator 2 OVERMOD and possibly the STATUS Block 5 annunciator NOT PHASE LOCKED will light to indicate that an over-modulation condition exists. This can occur if an input signal of greater than 2 Vpk is applied, or if the maximum allowable modulation index is exceeded.

Table 3-4. Local Operating Instructions (2 of 2)

OPERATION WITH AN EXTERNAL STANDARD

1. Remove Jumper 7 (A3W3) from the FREQ STANDARD EXT connector 8 (A3J10), and set the FREQ STANDARD INT/EXT switch 6 to EXT.

2. Connect an external frequency standard of 5 or 10 MHz, 0 dBm (nominal) into 50 ohms impedance to the FREQ STANDARD EXT connector 8 (A3J10).

3. On the front panel (see Figure 3-1) set all switches and controls as follows:

8 LINE switch	ON
12 FM DEVIATION switch.	as desired
14 RF switch	ON

4. The front panel displays should indicate as follows:

1 RF annunciator	ON
2 FM annunciator	as desired
3 FREQUENCY MHz display	frequency desired, set by the TUNING control
4 Frequency Resolution Light Bars . . .	bars lighted for resolution desired selected by Frequency Resolution selectors
5 STATUS annunciator	INTERNAL REF OFF

The NOT PHASE LOCKED annunciator will light if the external reference is not of sufficient accuracy in frequency or has an insufficient power level. The external reference must be within ±100 Hz of 10 MHz for reliable locking to occur.

5. The Synthesizer may now be used for any of its normal operations.

Compatibility (Cont'd)

the HP-IB. Front panel functions except the LINE switch ⓬ can be programmed.

3-20. The programming capability of the Synthesizer will be described in terms of the twelve bus messages found in Table 3-5.

3-21. Local/Remote and Remote/Local Mode Changes

3-22. The Synthesizer can communicate over the bus when in remote or local. In remote, the Synthesizer's controls are disabled and the Synthesizer can be addressed to talk or listen. When addressed to listen the Synthesizer will respond to the Data, Clear (SDC), Local, Clear Lockout/Set Local, and Abort Messages. When addressed to talk, the Synthesizer automatically stops listening and sends a status byte over the eight data lines and will respond to the Abort message. Also, the Synthesizer can send a service request (SRQ) and respond to serial and parallel polls. In local, the Synthesizer is fully controlled by the front panel but will respond to serial or parallel polls, its talk address, and will send a service request (SRQ).

3-23. Addressing. The Synthesizer interprets the byte on the bus' eight data lines as an ASCII address or command if the remote enable line (REN) is true, the bus is in the command mode — attention line (ATN) is true, and interface clear line (IFC) is false. The Synthesizer's talk and listen addresses are switch selectable as described in Section II. Referring to Table 2-1, characters in columns 2 or 3 are valid listen addresses, characters in columns 4 and 5 are talk addresses, and characters in column 1 are commands: device clear (DC), serial poll enable (SPE), and serial poll disable (SPD).

3-24. Programming the Local to Remote Mode Change. The Synthesizer will switch to Remote only when addressed to listen. When first switched to remote the REMOTE lamp lights but nothing else will change from the front panel control settings until the Synthesizer receives a data message string. Once in remote, the Synthesizer can be unaddressed with the unlisten clear or abort messages, addressed to talk, re-addressed to listen, or programmed to return to local.

3-25. Programming the Remote to Local Mode Change. The Synthesizer will return to local when the local or clear lockout/set local messages are sent by the controller. The clear lockout/set local message sets the remote enable line (REN) false.

3-26. DATA Messages

3-27. The Synthesizer communicates on the bus primarily with data messages. It responds to data messages that program frequency, RF output, and FM. (It sends a byte that describes status.) Data messages consist of one or more bytes sent over the bus' 8 data lines when the bus is in the data mode. The Synthesizer receives data messages when addressed to listen and sends a status byte when addressed to talk.

3-28. Receiving DATA Messages

3-29. The Synthesizer will receive data messages when addressed to listen. The data message string or program string consists of one or more ASCII characters arranged as a program code followed by arguments or as program code alone or argument alone depending on the desired results.

3-30. Data Input Format. The program string syntax is as shown below.

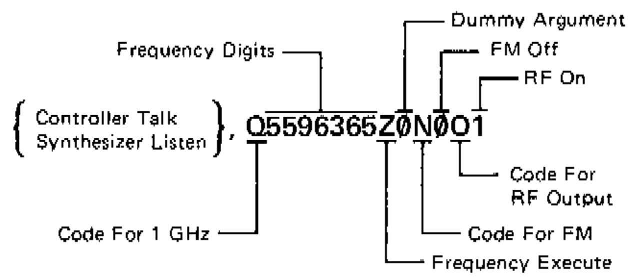
Frequency FM RF Output

{ Controller Talk, Synthesizer Listen }, [CX . . . XCX] [CX] [CX]

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

(The brackets are not included in an actual string. They are shown to clarify the example.)

For example, to program the three functions for 5.596365 GHz, FM OFF, and RF ON, write the string as shown in the example below.



The Synthesizer ignores carriage returns, line feeds, spaces, commas, and decimal points. Paragraph 3-34 has more information on program codes. All functions may be programmed together as shown or separately as will be described in detail in the following paragraphs.

3-31. Programming Frequency. The Synthesizer accepts any frequency within its range to 8 signifi-

Table 3-5. Message Reference Table

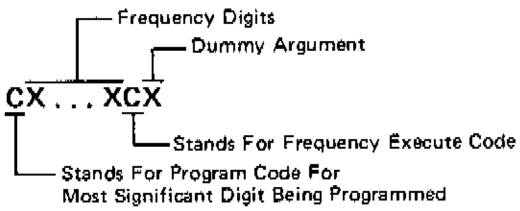
Message and Identification	Applicable	Command and Title	Response
Data	Yes	T6 Talker, L4 Listener, AH1 Acceptor Handshake SH1 Source Handshake	Synthesizer changes frequency, RF output, and modulation.
Trigger (DTØ)	No	Device Trigger	Synthesizer does not respond to a Device Trigger.
Clear (DC1)	Yes Yes	DCL Device Clear SDC Selected Device Clear	The Synthesizer responds to a DCL or SDC command by setting frequency to 3 GHz, modulation to off, and RF off.
Remote (RL2)	Yes	REN Remote Enable	Synthesizer goes to remote when the REN line is true and the Synthesizer is first addressed to listen.
Local (RL2)	Yes	GTL Go to Local	Synthesizer goes to local when a GTL command is received. The frequency does not change but the front panel controls determine the other functions.
Local Lockout (RL2)	No	LLO Local Lockout	Synthesizer does not respond to the LLO command.
Clear Lockout/ Set Local (RL2)	Yes	REN Not Remote Enable	Synthesizer goes to local when REN goes false.
Pass Control/Take Control (CØ)	No	Controller	The Synthesizer cannot act as a controller.
Require Service (SR1)	Yes	SRQ Service Request	The Synthesizer sets the SRQ line true when unlocked, FM overmodulated, or out of range (frequency).
Status Byte	Yes Yes	SPE Serial Poll Enable SPD Serial Poll Disable	The Synthesizer responds to a serial poll by sending a status byte.
Status Bit (PP2)	Yes	PP Parallel Poll	The Synthesizer responds to a parallel poll by sending a status bit on a switch-selected data line.
Abort	Yes	IFC Interface Clear	The Synthesizer stops listening or talking.

NOTE

Complete HP-IB capability as defined in IEEE Std. 488 is DC1, RL2, SR1, PP2, T6, L4, AH1, SH1, PT Ø, CØ.

Receiving Data Messages (Cont'd)

cant digits. Use the information in Figure 3-4 and Table 3-6 to write the program string with the following syntax:

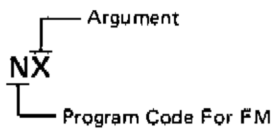


Within the Synthesizer, frequency information is stored in two separate blocks. One block is for the 1 GHz through 10 MHz digits; the other block is for the 1 MHz through 1 kHz digits. Programming within one block does not change the other block. Figure 3-4 illustrates this; use it as a guide to make frequency programming more efficient.

Table 3-6. Frequency Program Codes and Arguments

	Program Codes		Arguments
Frequency	1 GHz	Q	Ø through 9
	1 MHz	T	
	100 kHz	U	
	10 kHz	V	
	1 kHz	W	
	EXECUTE	Z	

3-32. Programming FM. The Synthesizer responds to a program code for FM and arguments for two ranges of modulation or FM off (Table 3-7). The program string is arranged as follows:



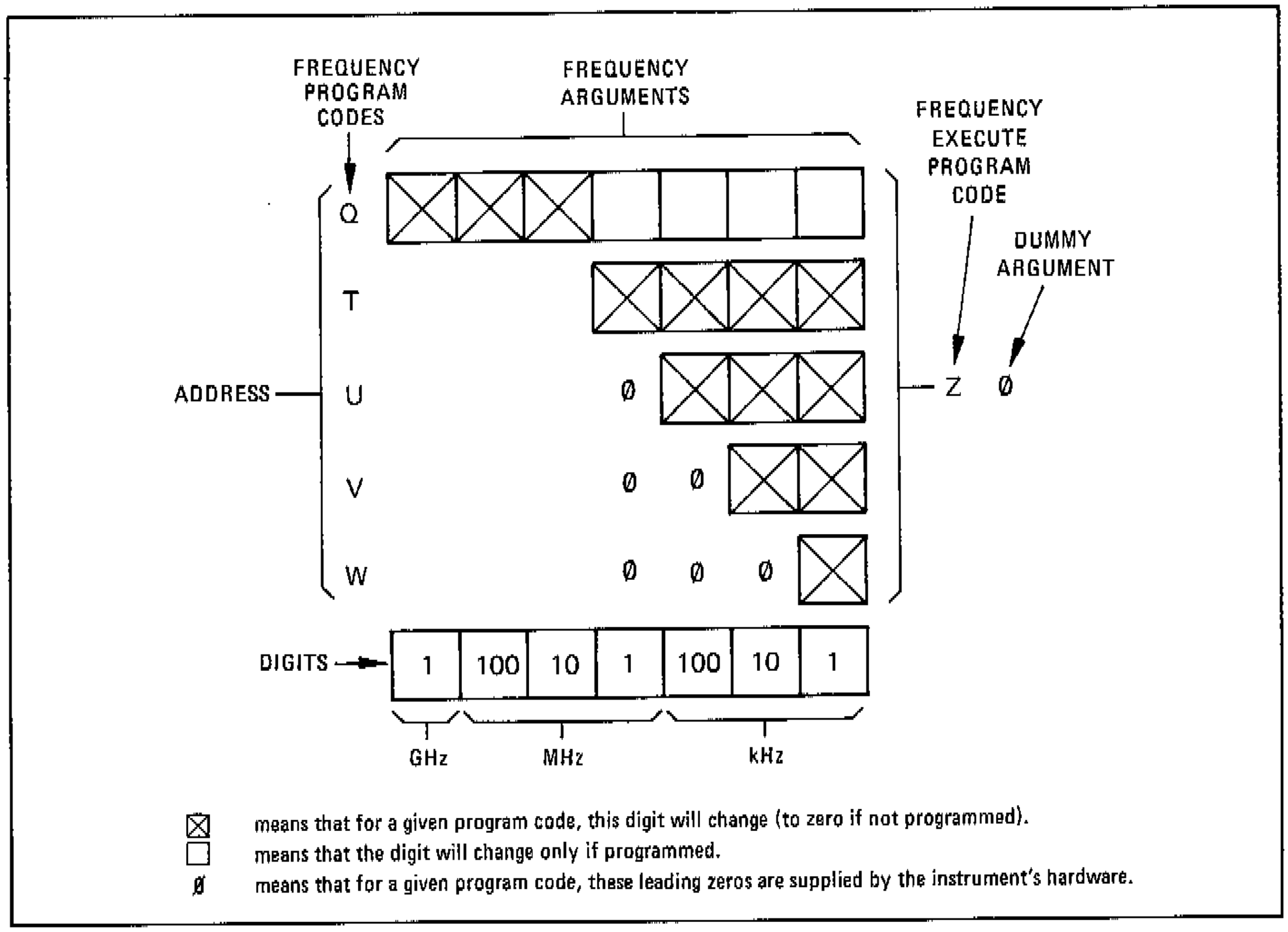


Figure 3-4. Frequency Programming

Table 3-7. FM Program Codes and Arguments

	Program Code	Arguments	
FM	N	OFF	0
		100 kHz	1
		10 MHz	2

3-33. **Programming RF Output.** The Synthesizer's RF ON-OFF switch function can be programmed using the program code and arguments in Table 3-8. The program string is shown below:

```
 ┌── Argument
OX
└── Program Code For RF Output
```

Table 3-8. RF Output Program Code

	Program Code	Arguments	
RF	O or ___	RF OFF	0
		RF ON	1

3-34. **Abbreviated Program String.** The Synthesizer accepts and processes the characters of a program string in a left to right sequence. It also automatically counts program codes in the sequence shown in Table 2-1, colums 4 and 5 (see note below). This sequence is equivalent to the program string order shown in paragraph 3-30. If done in that sequence, program strings for FM and RF output can be written like those for frequency. The program string will consist of the program code for the first function being programmed followed by arguments for all functions as shown below:

```
 ┌──── Argument For FM
 │ ┌── Argument For RF Output
NXX
└── Program Code For FM
```

3-35. **Programming Execution Time.** Programming execution time is determined by two parameters: the rate at which data can be input into the synthesizer over the interface and the time it takes the synthesizer to reach the desired output state. The 8671A can typically accept data at rates up to 80 kilobytes/second. This is generally a much shorter time than it then takes the Synthesizer to reach the desired output state. If the controller and all other instruments on the bus are fast enough, data transfer is then only a small fraction of the total program execution time. Typical execution times for the various functions of the 8671A are as follows:

a. **Frequency Switching.** 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 worst case frequency lock and setting times are shown in Figure 3-5. If FM is on during frequency change, switching time will increase.

b. **Modulation Programming.** An FM range change or center frequency change when FM is on typically takes less than 50 ms.

3-36. Sending the Data Message

3-37. The Synthesizer sends a status byte when addressed to talk. This byte is also the Synthesizer's response to a serial poll which will be explained in paragraph 3-55. The Synthesizer can talk when in local as well as remote.

3-38. Receiving the Trigger Message

3-39. The Synthesizer doesn't respond to the TRIGGER message.

3-40. Receiving the Clear Message

3-41. The Synthesizer responds to the Clear message by setting the frequency to 3 GHz, RF power OFF, and FM off. This message can take two forms: Device Clear, which the Synthesizer responds to when not addressed, and Selected Device Clear which the Synthesizer responds to when addressed to listen. The Device Clear messages do not affect addressing.

3-42. Receiving the Remote Message

3-43. The Synthesizer is enabled to go into remote when the controller sends the Remote message, but does not actually switch to remote until first addressed to listen. The Remote message is the means by which the controller sets the remote enable line (REN) true. Some controllers send this message automatically when first turned on or reset.

3-44. Receiving the Local Message

3-45. The Synthesizer returns to local front panel control when it receives the Local message. The frequency will not change from the last programmed value but the other functions will correspond to the front panel control settings.

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

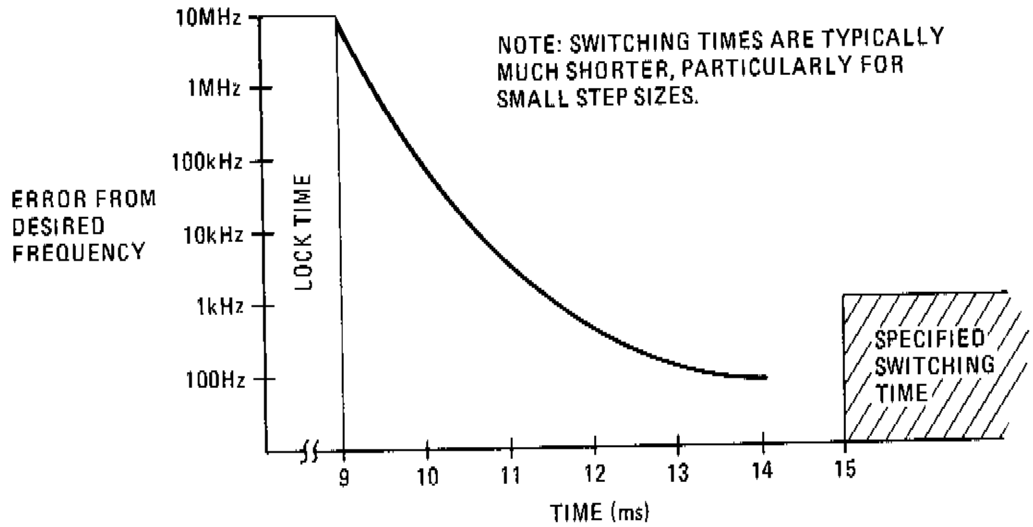


Figure 3-5. Typical Frequency Switching Time for the 8671A Synthesizer Showing Worst Case Lock and Settling Times

3-46. Receiving the Local Lockout Message

3-47. The Synthesizer does not respond to the Local Lockout message.

3-48. Receiving the Clear Lockout/Set Local Message

3-49. The Synthesizer responds to the Clear Lockout/Set Local message in the same way as to the Local message. The Synthesizer need not be addressed to listen. This message sets the REN line false.

3-50. Receiving the Pass Control Message

3-51. The Synthesizer does not respond to the Pass Control message as it cannot act as a controller.

3-52. Sending the Require Service Message

3-53. The Synthesizer sends the Require Service message to the controller when one of the following conditions exists for more than 50 ms:

1) Not phase locked with RF power on.
2) Frequency programmed out of range.
3) FM overmodulated with RF power on.

The Synthesizer sends this message by setting the service request line (SRQ) true. It will request service in local or remote whether or not it is addressed.

3-54. Sending the Status Byte Message

3-55. The Synthesizer sends the status byte when addressed to talk. This byte is the Synthesizer's response to a serial poll. The Synthesizer responds to a serial poll when the controller sends a serial poll enable command (SPE), then addresses the Synthesizer to talk. The SPE command enables the Synthesizer to clear the service request (SRQ) when addressed to talk. Also, when the Synthesizer receives its talk address, bit 7 of the status byte is latched. The Controller can then determine the status of the Synthesizer by converting the status byte to a decimal value. Status byte coding is as shown below.

3-56. The RSV (Request Service) bit is true whenever any of the three conditions that cause a request for service exists (even during the first 50 ms after a programming change). Once the Synthesizer is addressed to talk, the RSV line is latched even though the Synthesizer's need for service may have changed.

3-57. The status byte is useful for determining when a given programming change has been executed. For example, if the synthesizer is addressed to talk immediately after a frequency change, the status byte can be used to determine when the synthesizer has re-acquired lock. A frequency change might be followed by status bytes of 72, 72, and then 64, indicating the synthesizer is now locked.

3-58. Sending the Status Bit Message

3-59. The Synthesizer outputs a status bit on one of the Bus data lines in response to a parallel poll (see controller manual). The line is switch selectable (see Section II) as is the level of the bits logic. The status bit is true when any of the conditions for a service request exist. Addressing or local/remote conditions for a service request exist. Addressing or local/remote state does not affect sending the status bit.

3-60. Receiving the Abort Message

3-61. The Synthesizer stops talking or listening when it receives the Abort message.

3-62. Programming Quick Reference Guide

3-63. Table 3-9 shows program string syntax, program codes and arguments, and the status byte. All possible program codes are shown, but the recommended codes are in bold face type.

3-64. Programming Examples

3-65. Figure 3-6 is a flowchart showing how to program all of the Synthesizer functions and the twelve bus messages in HPL (9825 computing controller), and BASIC (9830 computing controller).

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	RSV REQUEST SERVICE	OUT OF RANGE (frequency)	RF OFF	NOT PHASE LOCKED	NOT USED	FM OVER-MOD	NOT USED

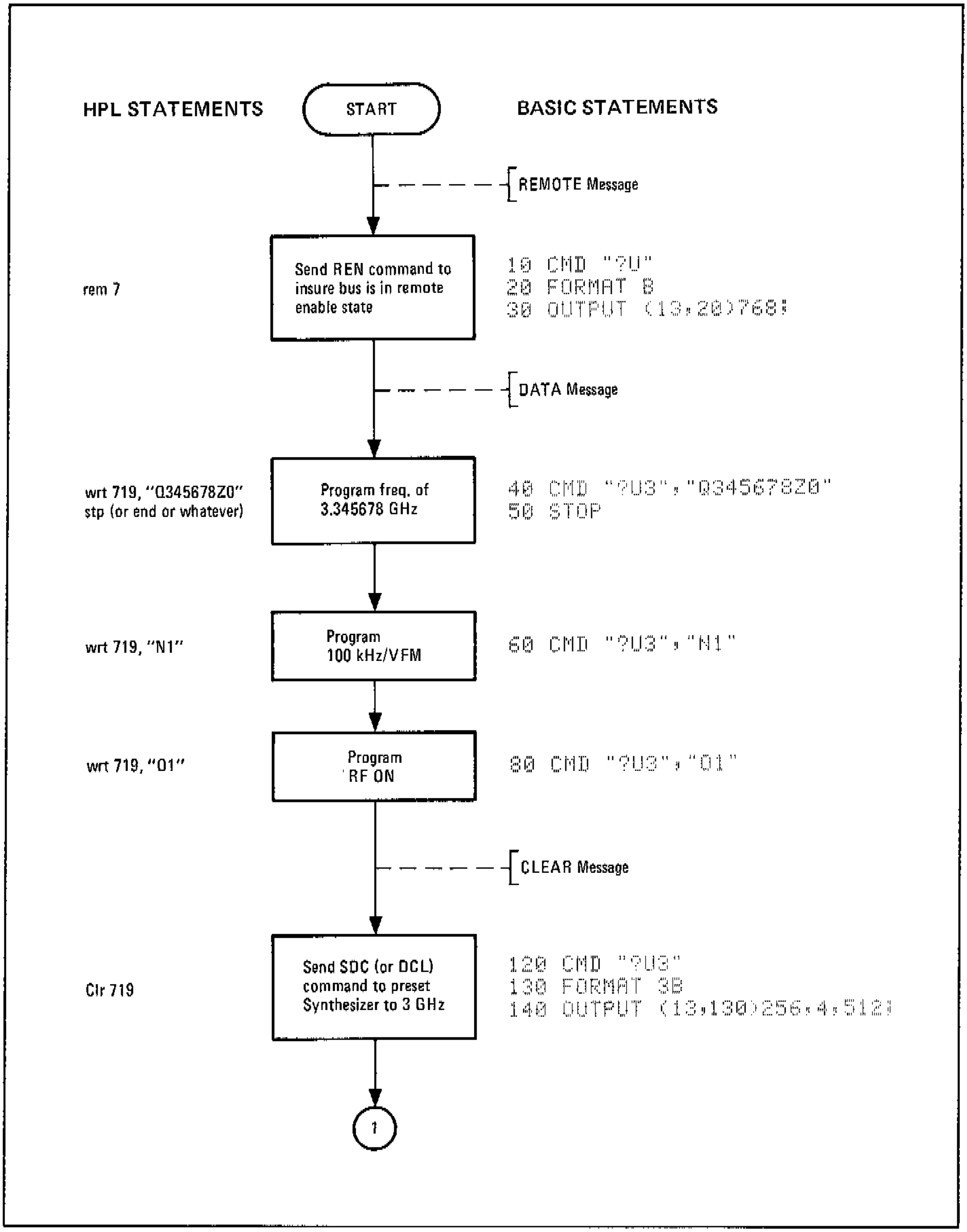


Figure 3-6. Programming Examples (1 of 2)

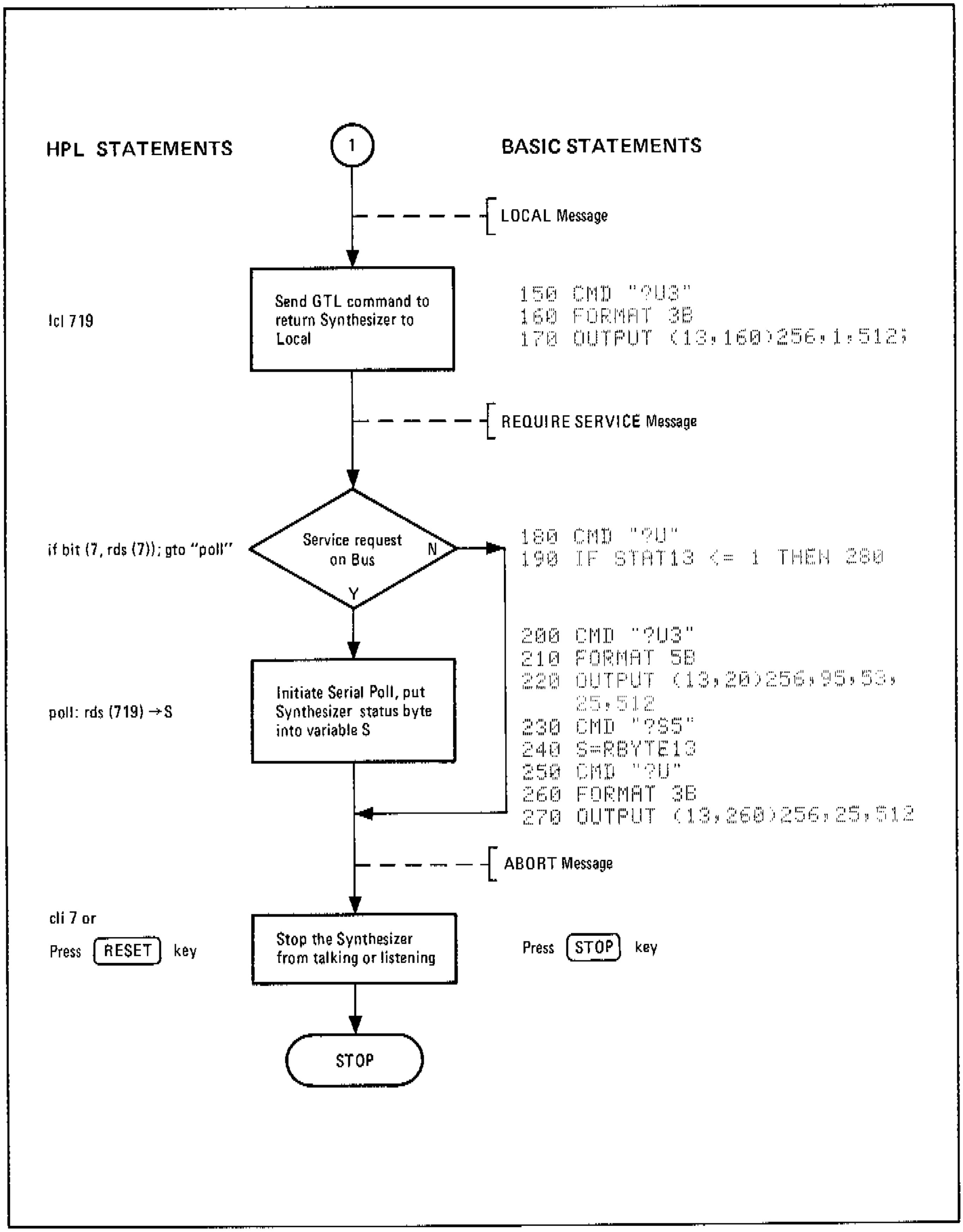


Figure 3-6. Programming Examples (2 of 2)

Table 3-9. Programming Quick Reference Guide

	PROGRAM CODES	ARGUMENTS
FREQUENCY	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**	Ø THROUGH 9
FM	**N** or ^	OFF Ø 100 kHz 1 10 MHz 2
RF	**O** or _	RF OFF Ø RF ON 1

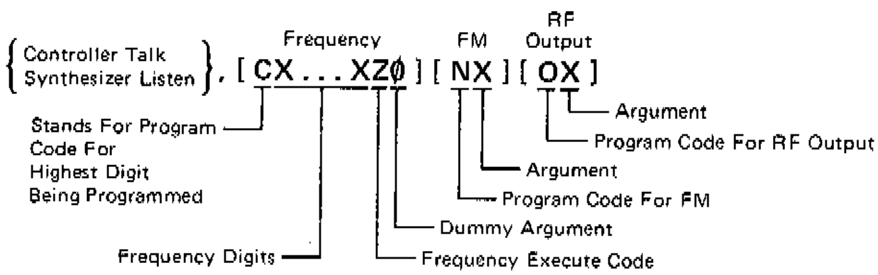
NOTE

The Synthesizer interprets any ASCII character in columns 4 and 5 of table 2-1 as a program code. The two columns are equivalent; for example, it will respond the same way to "Z" as it does to "J". The Synthesizer ignores all other characters. To avoid confusion, only the codes printed in bold type in the table are used in the examples in this book.

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	RSV REQUEST SERVICE	OUT OF RANGE (frequency)	RF OFF	NOT PHASE LOCKED	NOT USED	FM OVER-MOD	NOT USED

PROGRAM STRING SYNTAX



SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

NOTES

For ease of testing, the Frequency Switching Time tests may be performed with top covers removed.

If the performance tests are to be considered valid the following conditions must be met:

a. The Synthesizer must have a 1-hour warmup.

b. The line voltage must be within +5% and —10% of nominal.

c. The ambient temperature must be +15°C to +35°C for the RF Output Level and Flatness and the FM Accuracy tests.

Before aging rate tests are performed, the Synthesizer must 1) have a 30 day warmup if it has been disconnected from the Mains power for more than 24 hours or 2) the Synthesizer must have a 24 hr. warmup if it has been disconnected from the Mains power for less than 24 hours.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-5. TEST RECORD

4-6. Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

4-7. CALIBRATION CYCLE

4-8. This instrument requires periodic verification of performance. Depending on the use and environmental conditions, the instrument should be checked using the following performance tests at least every six months after the first year.

4-9. ABBREVIATED PERFORMANCE TESTING

4-10. Performing the Operational Verification checks is suggested as an alternative to a complete verification of the specifications listed in Table 1-1. These checks give reasonable assurance that the Synthesizer is performing properly.

PERFORMANCE TESTS

4-11. OPERATIONAL VERIFICATION CHECKS

DESCRIPTION: This procedure checks the Synthesizer to give reasonable assurance that it is working properly by performing selected tests of all major functions. If remote verification is required, the Remote Operator's Check in Section VIII is recommended.

EQUIPMENT:

Spectrum Analyzer . . . . HP 8565A
Power Meter . . . . HP 436A/8481A
Test Oscillator . . . . HP 651B
Digital Voltmeter . . . . HP 3455A
Frequency Counter . . . . HP 5340A

PERFORMANCE TESTS

4-11. OPERATIONAL VERIFICATION CHECKS (Cont'd)

PROCEDURE:

1. Connect the Synthesizer to the Mains power and allow sufficient warm-up time for the OVEN annunciator to go out.

2. Connect the power meter to the Synthesizer's RF OUTPUT and tune to 2000MHz.

3. Tune from 2 to 6100 MHz in 100 MHz steps. The power should remain above +8 dBm over the entire frequency range. Figure 4-1 shows a typical output level curve.

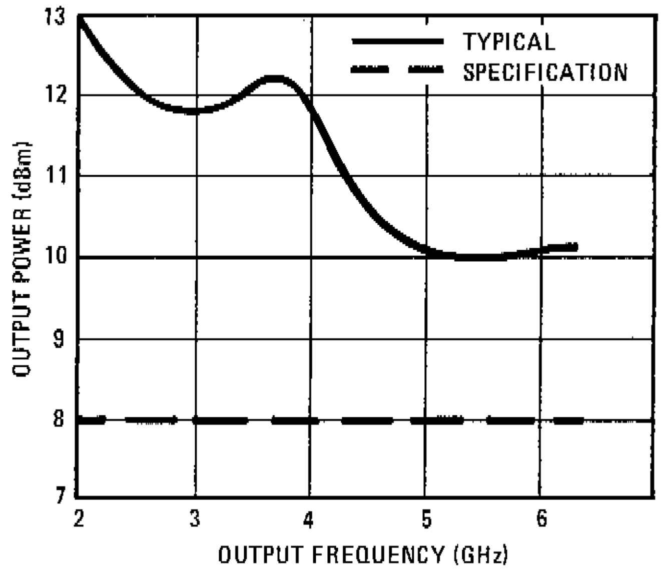


Figure 4-1. Typical Output Power from 8671A

4. Tune in 100 MHz steps from 2 to 6100 MHz. The total power variation should be less than 6 dB over the frequency range.

5. Connect a 41.58 kHz signal from a test oscillator's 50 ohm output to the FM INPUT connector. Set the DEVIATION switch to the 0.1 MHz range. Adjust the test oscillator's output level to obtain the first Bessel null of the carrier. This will usually occur between 1.241 Vrms and 1.603 Vrms. It should always occur between 1.045 Vrms and 1.905 Vrms.

NOTE

At the 100 kHz rate, the allowable voltage error is determined only by the FM Accuracy Relative to the External Input Level. (±7% of range from +15°C to 35°C). At rates other than 100 kHz the error due to FM Frequency Response must also be considered (±2.0 dB). Typically, however, this value is ±0.5 dB. The first test limits given in the previous step takes only the ±7% and ±0.5 dB error into account. The second set of limits expresses the "worst case" possible (±7% and ±2.0 dB).

6. Set the FM DEVIATION switch to OFF and disconnect the input signal.

PERFORMANCE TESTS

4-11. OPERATIONAL VERIFICATION CHECKS (Cont'd)

7. If any of the steps in this procedure seem to have failed, perform the related performance tests or refer to the service information in Section VIII as necessary.

Table 4-1. Record of Operational Verification Checks

Step	Description	Results
1	OVEN annunciator is not lighted.	________
3	Power Level is +8 dBm minimum The NOT PHASE-LOCKED annunciator is not lighted.	________ ________
4	Power variation is 6 dB maximum	________
5	Frequency Modulation drive voltage is within tolerance.	________

4-12. RF OUTPUT LEVEL AND FLATNESS

SPECIFICATION: Output Power (unleveled) >+8 dBm, +15° C to +35° C.
Flatness: < 6 dB total output power level variation with frequency across band.

NOTE

For Option 005 instruments, the unleveled Output Power is +7 dBm minimum.

DESCRIPTION: A power meter is used to measure the output power of the Synthesizer as the Frequency is tuned from 2 to 6.2 GHz. The minimum and maximum power points are checked for specification compliance.

EQUIPMENT: Power Meter/Sensor . . . . HP 436A/8481A

PROCEDURE:

1. Calibrate and zero the power meter.
2. Connect the power sensor to Synthesizer's RF OUTPUT connector.
3. Set the Synthesizer's RF switch to ON; set the FM DEVIATION switch OFF.
4. Tune the Synthesizer in 1 MHz steps from 2000 MHz to 6199 MHz. Note the minimum and maximum power output levels. The minimum should be at least +8 dBm and the maximum should be less than 6 dB greater than the measured minimum.

   maximum ________
   minimum + 8 dBm ________
   difference ______ 6dB

5. If the RF Output Level and Flatness is not within the required tolerance, check the YTO Loop output, A1AT1 Isolator and the output cable.

PERFORMANCE TESTS

4-13. HARMONICS

SPECIFICATION: All harmonics up to 18 GHz shall be less than −15 dB.

DESCRIPTION: A spectrum analyzer monitors the RF output of the Synthesizer. Various frequencies are tuned while the harmonics are observed to verify proper performance of the instrument.

EQUIPMENT: Spectrum Analyzer . . . . HP 8565A

PROCEDURE:

1. Tune the Synthesizer to 2000 MHz.

2. Connect the RF OUTPUT to the spectrum analyzer's RF input.

3. Set the spectrum analyzer controls to observe the fundamental signal on the display. Set the input attenuation to 40 dB. Set the peak of the fundamental signal to the reference level graticule using the reference level control.

4. Tune the spectrum analyzer to the second harmonic of the carrier.

5. Tune the Synthesizer in 100 MHz steps to 6200 MHz while observing the fundamental and second harmonic levels on the spectrum analyzer.

6. Verify that the harmonic level remains at least 15 dB below the carrier level. Record the minimum amplitude separation.

   15 dB ___________

7. If the harmonic signals are not within tolerance, perform the following adjustments in Section V: Digital-to-Analog Converter, YTO Driver, YTO Loop Preamp Driver and Sampler, YTO Loop Offset and FM Overmodulation, YTO Phase Detector and FM Driver.

4-14. SWR

SPECIFICATIONS: Impedance: 50 ohms
SWR: <1.7

DESCRIPTION: The insertion loss of the directional coupler is measured. From the insertion loss and the SWR specification, the maximum allowable power variation is calculated (assuming that the Synthesizer is operating into a short circuit). The Synthesizer is then operated into a short and the power variation is measured and compared with the calculated limits.

PERFORMANCE TESTS

4-14. SWR (Cont'd)

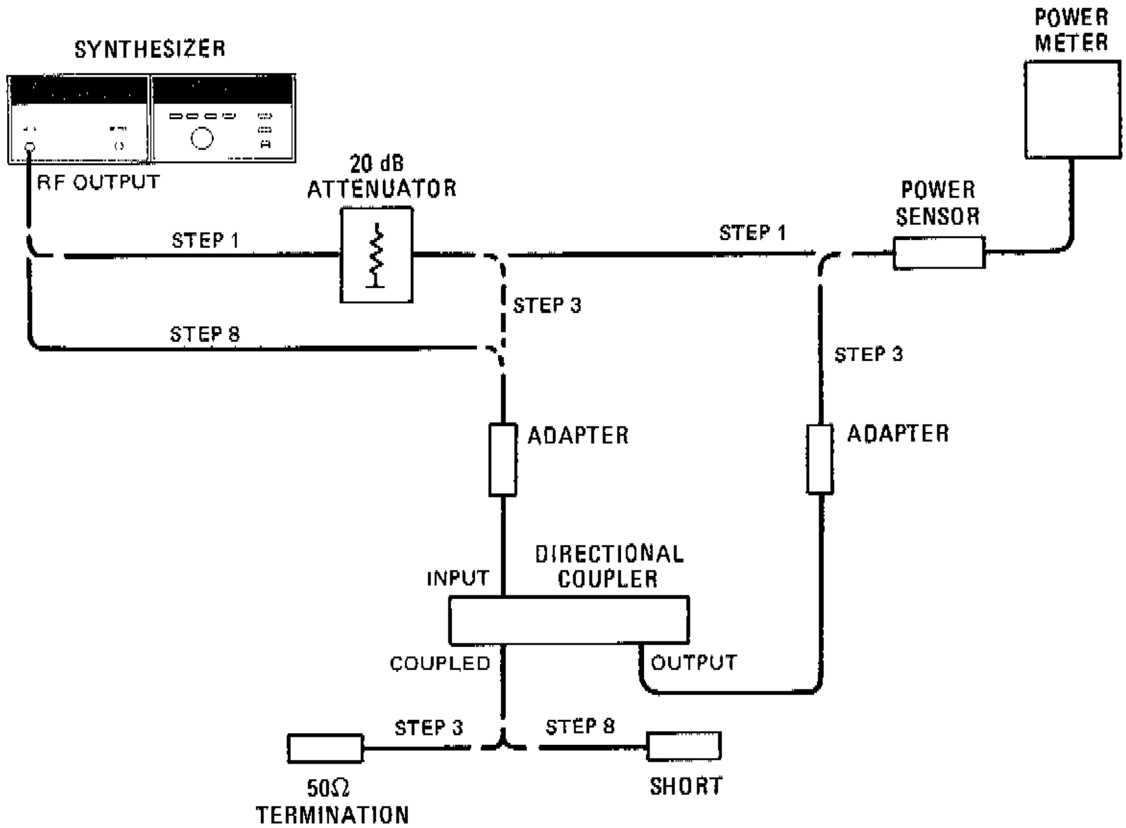


Figure 4-2. SWR Test Setup

EQUIPMENT:

20 dB Attenuator	HP 8491B Option 020
Adapter, APC-7 to Type-N Male (2 req'd) . .	HP 11525A
50 Ohm Termination, APC-7	HP 909A Option 12
Short, APC-7	HP 11565A
Directional Coupler	HP 11691D
Power Meter/Sensor	HP 436A/8481A

PROCEDURE:

1. Set Synthesizer's controls for an output of 2.1 GHz, connect the 20 dB attenuator to Synthesizer's RF OUTPUT connector and measure the power output with the power meter. (Refer to Figure 4-2, Step 1.)

   2.1 GHz __________ dBm

2. Repeat the measurement at 2 GHz intervals to 6.1 GHz.

   4.1 GHz __________ dBm

   6.1 GHz __________ dBm

3. Connect the equipment as shown in Figure 4-2 (Step 3).

PERFORMANCE TESTS

4-14. SWR (Cont'd)

4. Measure the power at the same frequencies as in Steps 1 and 2.

2.1 GHz	______	dBm
4.1 GHz	______	dBm
6.1 GHz	______	dBm

5. Compute the insertion loss (I) of the directional coupler and adapters for each frequency (Step 1 or 2 minus Step 4).

2.1 GHz	______	dB
4.1 GHz	______	dB
6.1 GHz	______	dB

6. Calculate the gain of the coupler and the ratio of maximum to minimum power for SWR of 1.7 at each listed frequency. Use the following formulas:

$$G = 10^{(-I/20)}$$

$$R = \frac{1 + G^2/3.86}{1 - G^2/3.86}$$

Where: G = gain of coupler

I = insertion loss (recorded in Step 5)

R = ratio of maximum to minimum power

2.1 GHz	G = ____	R = ____
4.1 GHz	G = ____	R = ____
6.1 GHz	G = ____	R = ____

7. Convert the ratio R to the maximum variation allowable (in dB) by using the formula:

$$S = 20 \log_{10} R$$

Where S = maximum variation (dB)

and R = ratio of maximum to minimum power

2.1 GHz	S = ____
4.1 GHz	S = ____
6.1 GHz	S = ____

8. Connect equipment as shown in Figure 4-2 (Step 8).

9. To verify the Synthesizer's SWR, slowly tune around 2.1 GHz to find the minimum and maximum power indications. Record the power indications and figure the variation.

	Maximum			Minimum			Variation
2.1 GHz	______	dBm	−	______	dBm	=	______ dB
4.1 GHz	______	dBm	−	______	dBm	=	______ dB
6.1 GHz	______	dBm	−	______	dBm	=	______ dB

PERFORMANCE TESTS

4-14. SWR (Cont'd)

Repeat the search for maxima and minima at the other frequencies. The variation at each frequency should be less than the value of S computed in Step 7.

10. If the SWR specification is not within tolerance, refer to the troubleshooting information in Section VIII, Service Sheet 4.

4-15. FM ACCURACY

SPECIFICATION: FM accuracy relative to external input level (at 100 kHz rate): ±7%, +15° C to +35° C
±10%, 0° to +55° C.

NOTE

For FM rates other than 100 kHz, add the FM frequency response specification.

DESCRIPTION: With the FM rate fixed, the FM peak deviation is varied to produce a carrier null. The relationship of FM rate and peak deviation at the null is expressed by the Bessel Function. The modulation drive level should be within the specified tolerance.

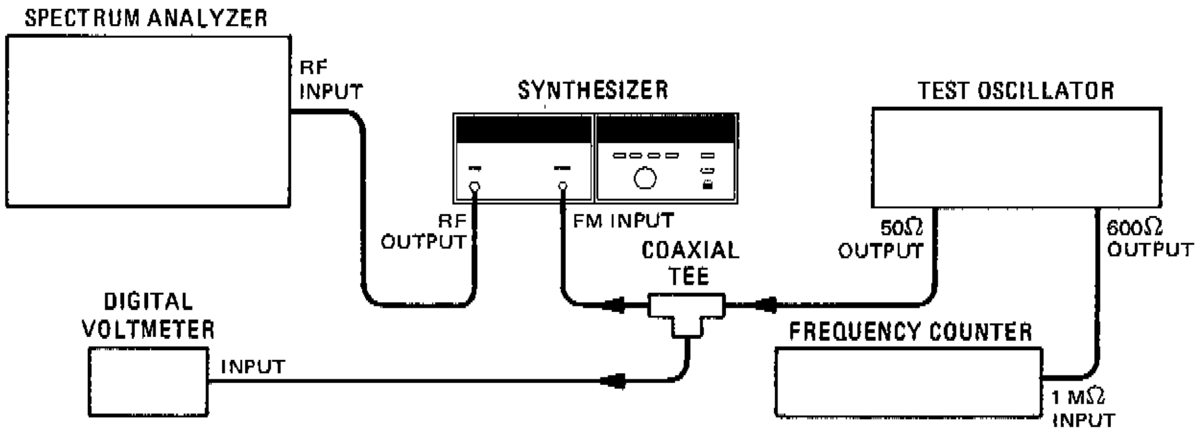


Figure 4-3. FM Accuracy Test Setup

EQUIPMENT:

Frequency Counter	HP 5340A
Test Oscillator	HP 651B
Digital Voltmeter	HP 3455A
Spectrum Analyzer	HP 8565A

PERFORMANCE TESTS

4-15. FM ACCURACY (Cont'd)

PROCEDURE:

1. Connect the equipment as shown in Figure 4-3.
2. Set the test oscillator's output to 100 kHz as accurately as possible.
3. Tune the Synthesizer to 3000 MHz. Adjust the spectrum analyzer controls for a clear display of the carrier using 100 kHz per division.
4. Set the Synthesizer's FM DEVIATION switch to the 10 MHz range.
5. Adjust the test oscillator's output level to obtain a carrier null. (This should occur near 34 m Vrms, 240 kHz.)
6. The DVM should read between 31.6 and 36.4 m Vrms. Record the level.
7. If the FM Accuracy is not within tolerance, perform the FM Driver and A1 RF Output Assembly FM Sensitivity Adjustment in Section V.

4-16. NON-HARMONICALLY RELATED SPURIOUS

SPECIFICATION: (CW and AM Modes): <−70 dB.

DESCRIPTION: The spectrum analyzer is calibrated by setting the carrier at the graticule line. The gain of the spectrum analyzer is increased. It is tuned to any frequency between 2 and 6.2 GHz in search of spurious signals.

EQUIPMENT:

Spectrum Analyzer . . . . HP 8565A
Attenuator, 10 dB Step . . . . HP 8495B Option 010

PROCEDURE:

1. Connect the Synthesizer's RF OUTPUT to the spectrum analyzer's input through the 10 dB step attenuator.
2. Set the attenuator to 60 dB, tune to 3000 MHz.
3. Tune the spectrum analyzer's center frequency to view the carrier. Set the frequency to 10 kHz per division, resolution bandwidth to 1 kHz and sweep time as needed to maintain spectrum analyzer calibration. Set the video filter to 100 Hz (0.1 times the resolution bandwidth).
4. Adjust the reference level control to place the carrier at top graticule line.
5. Connect the Synthesizer's output directly to the analyzer's RF input.
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 not generated by the spectrum analyzer. Verify that the spurious signals are below specified limits.
7. If the non-harmonically related spurious are not within tolerance, refer to the troubleshooting information on Section VIII, Service Sheet 1.

PERFORMANCE TESTS

4-17. POWER LINE RELATED SPURIOUS

SPECIFICATION: (CW Mode): Due to fan rotation with 5 Hz below line frequency and multiplies.

Except Option 003 instruments (400 Hz operation).

$f_o < 300$ Hz, −50 dB

$300 \text{ Hz} \leqslant f_o \leqslant 1$ kHz, −60 dB

$f_o > 1$ kHz, −65 dB

where f_o is frequency offset from carrier.

NOTE

For option 003 instruments (400 Hz operation) refer to Table 1-1.

DESCRIPTION: The Unit Under Test is isolated from vibration on a two-inch thick foam pad. The primary power source is separate from the power source for the reference unit and spectrum analyzer. The outputs of the Unit Under Test and reference unit are mixed together. The IF output is connected to the input of the low frequency spectrum analyzer. The line related sidebands are observed on the analyzer display.

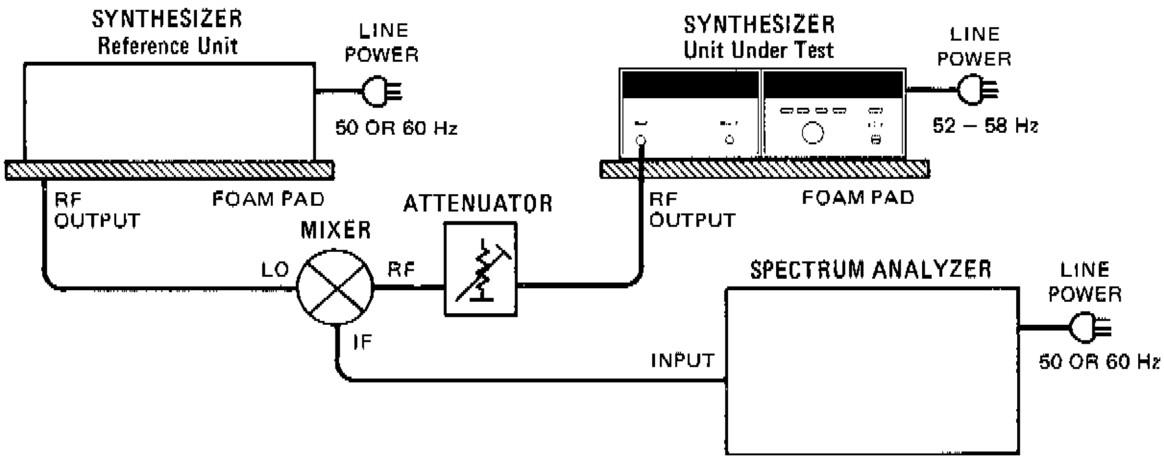


Figure 4-4. Power Line Related Spurious Test Setup

NOTE

The Unit Under Test must be operated at a line (Mains) power frequency different than that of the reference unit and spectrum analyzer. This avoids the summing of the power line spurious signals.

EQUIPMENT:

Synthesizer	HP 8671A
Mixer	RHG DM1-18
Spectrum Analyzer	HP 3580A
Attenuator (10 dB step)	HP 8495B Option 010
Foam Pads	

PERFORMANCE TESTS

4-17. POWER LINE RELATED SPURIOUS (Cont'd)

PROCEDURE:

1. Tune the Unit Under Test to 3000 MHz.
2. Tune the reference unit to 3000.020 MHz.
3. Set the attenuator to 30 dB.
4. Set the spectrum analyzer controls for a start frequency of 20 kHz, frequency span per division 50 Hz, and resolution bandwidth 3 Hz.
5. Connect the equipment as shown in Figure 4-4.
6. Adjust the spectrum analyzer to set the 20 kHz signal to the top graticule line on the display. Verify that the line related spurious of the Unit Under Test are below the values shown in the table. Record the highest spurious level in each offset band.

   $f_o < 300$ Hz 50 dB down ______
   $300 \text{ Hz} \leq f_o \leq 1$ kHz 60 dB down ______

7. Change the spectrum analyzer's frequency span per division to 500 Hz. Measure and record the spurious signal levels.

   $f_o > 1$ kHz 65 dB down ______

8. If the power supply related spurious are not within tolerance, refer to Section VIII, Service Sheet 12-A3, for troubleshooting information.

4-18. SINGLE-SIDEBAND PHASE NOISE RATIO

SPECIFICATION:

SSB Phase Noise Ratio (in 1 Hz BW and CW Mode) at Specified Offset Frequency				
10 Hz	100 Hz	1 kHz	10 kHz	100 kHz
~~−60~~ dB	~~−68~~ dB	−78 dB	~~−89~~ dB	~~−109~~ dB
−58	−70		−86	−110

DESCRIPTION: The RF outputs of two synthesizers are mixed together to obtain a 40 kHz or 200 kHz IF signal. The noise sidebands are observed on a spectrum analyzer. Correction factors are applied to compensate for the use of bandwidths wider than 1 Hz and for using a spectrum analyzer.

PERFORMANCE TESTS

4-18. SINGLE-SIDEBAND PHASE NOISE RATIO (Cont'd)

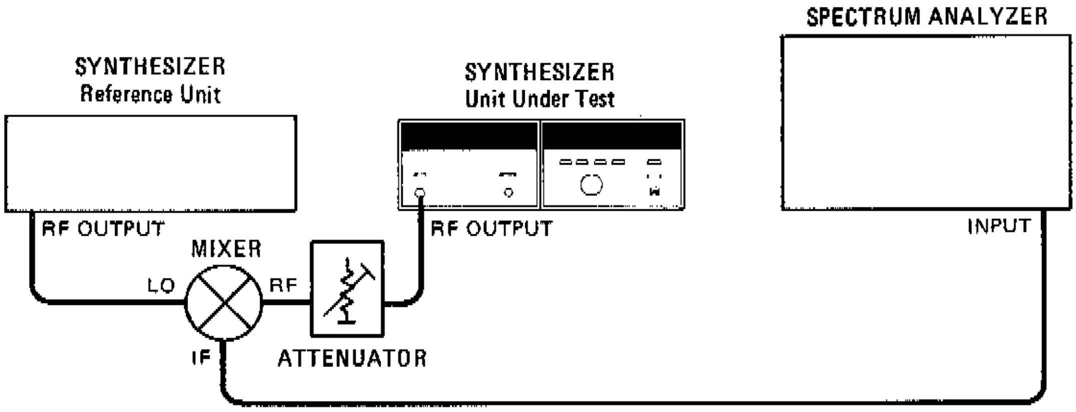


Figure 4-5. Signal-to-Phase Noise Ratio Test Setup

EQUIPMENT:

Synthesizer	HP 8671A
Spectrum Analyzer (5 Hz — 50 kHz)	HP 3580A
Spectrum Analyzer (20 Hz — 300 kHz) . . .	HP 8556A/8552B/141T
Mixer	RHG DM1-18
Attenuator (10 dB Step)	HP 8495B Option 010

NOTE

The signal-to-phase noise ratio as measured with the spectrum analyzer is reduced by the 2.4 dB noise correction factor. This correction is necessary due to the spectrum analyzer characteristics.

PROCEDURE:

1. Set the 5 Hz—50 kHz spectrum analyzer's start frequency to 40 kHz, bandwidth 1 Hz, frequency span per division to 5 Hz.

2. Set the attenuator to 30 dB.

3. Set the Unit Under Test to 6100 MHz.

4. Set the reference unit to 6100.040 MHz.

5. Connect the equipment as shown in Figure 4-5.

6. Set the spectrum analyzer controls so the peak of the 40 kHz signal is at the top graticule line.

7. Observe the noise level 10 Hz from the carrier. It should be greater than 60 dB below the carrier. Record the measured level.

~~57.6~~ dB down ____________
55.6

PERFORMANCE TESTS

4-18. SINGLE-SIDEBAND PHASE NOISE RATIO (Cont'd)

8. Set the spectrum analyzer controls for a bandwidth of 3 Hz and a frequency span per division of 20 Hz. (The use of a 3 Hz bandwidth requires a 4.77 dB correction in the measured noise level, that is, the actual noise level in a 1 Hz bandwidth is 4.77 dB lower than the noise measured in a 3 Hz bandwidth.) Set the peak of the 40 kHz signal to the top graticule line.

9. Observe the noise 100 Hz from the carrier and add the 4.77 dB correction factor. Record the measured level.

   62.8
   ~~60.8~~ dB down ____________

10. For the remainder of the procedure, use the 20 Hz — 300 kHz spectrum analyzer. Set the analyzer's bandwidth to 30 Hz, frequency span per division to 200 Hz, and sweep time as required. The 30 Hz bandwidth requires a 14.77 dB correction.

11. Change the reference oscillator frequency to 6100.200 MHz.

12. 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 200 kHz 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.

13. Observe the noise level 1 kHz from the carrier. The corrected level should be greater than 75 dB down. Record the measured level.

   60.8 dB down ____________

14. Set the spectrum analyzer controls for a bandwidth of 300 Hz, frequency span per division of 2 kHz, and sweep time as required. The correction for the 300 Hz bandwidth is 24.77 dB.

15. Repeat step 12, observe the noise 10 kHz from the carrier, and add the 24.77 dB correction factor. Record the measured level.

   ~~61.8~~ dB down ____________
   59.8

16. Set the spectrum analyzer controls for a bandwidth of 3 kHz, frequency span per division of 20 kHz, and sweep time as required. The correction factor is 34.77 dB.

17. Repeat step 12, observe the noise 100 kHz from the carrier and add the 34.77 dB correction factor. Record the measured level.

   ~~71.8~~ dB down ____________
   72.8

PERFORMANCE TESTS

4-18. SINGLE-SIDEBAND PHASE NOISE RATIO (Cont'd)

18. If the Single-Sideband Phase Noise Ratio is out of tolerance, perform the following adjustments: YTO Driver, VCXO, M/N Loop, 20/30 Loop VCO, 20/30 Loop Bias, YTO Sampler, YTO Phase Detector, YTO Offset and FM Overmodulation and FM Driver.

4-19. FM FREQUENCY RESPONSE

SPECIFICATION: (Relative to 100 kHz)

For 50 kHz/V range, ±2.0 dB from 100 kHz to 3 MHz.
For 5 MHz/V range, ±2.0 dB from 3 kHz to 3 MHz.

DESCRIPTION: The test oscillator is tuned to 100 kHz and the output level is adjusted to obtain the first carrier (Bessel) null (β = 2.404). The output level and the 100 kHz rate are the references for later calculations. At other modulation rates, the output level is set and measured for the first carrier null. The measured voltage and the rate are then compared to the established reference to determine frequency response.

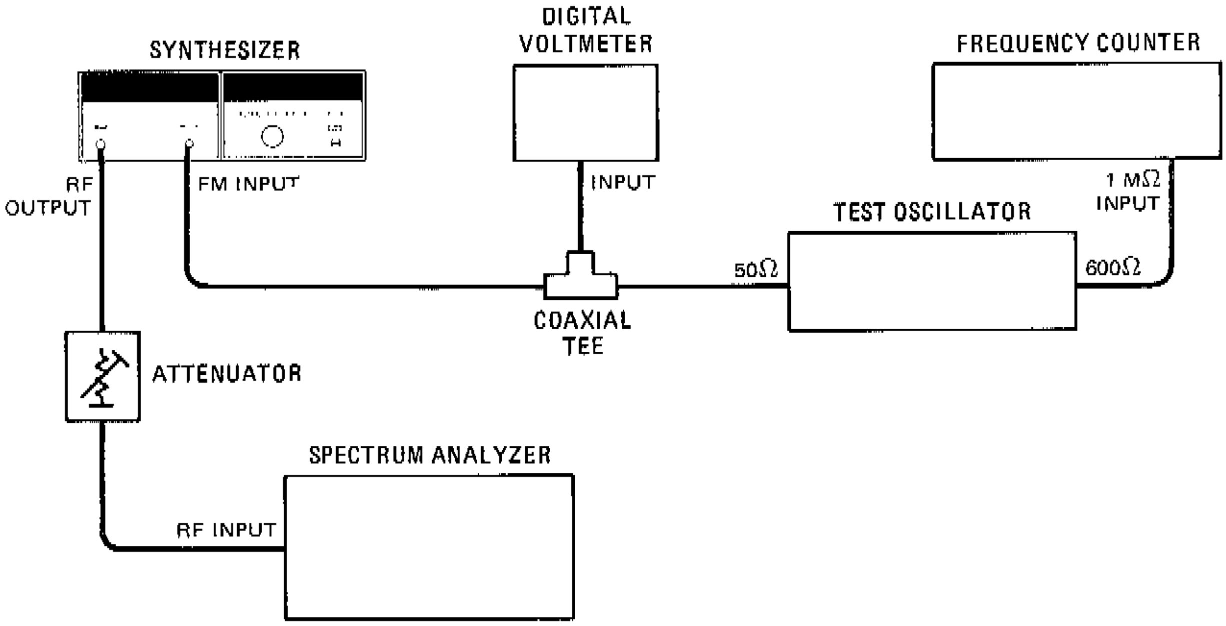


Figure 4-6. FM Frequency Response Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3455A
Frequency Counter	HP 5340A
Spectrum Analyzer	HP 8565A
Test Oscillator	HP 651B
Attenuator (10 dB steps)	HP 8495B Option 010

PERFORMANCE TESTS

4-19. FM FREQUENCY RESPONSE (Cont'd)

PROCEDURE:

1. Connect the equipment as shown in Figure 4-6; set the Attenuator to 10 dB.
2. Tune the Synthesizer to 3 GHz. Adjust the spectrum analyzer's controls to display the RF signal. Set the scan width to 100 kHz per division initially. Set the other controls as needed for a calibrated display. (It will be necessary to change the scan width for later measurements.)
3. Set the FM deviation switch to the 10 MHz range and tune the test oscillator as accurately as possible to 100 kHz.
4. Adjust the test oscillator output voltage to obtain the first carrier (Bessel) null (β = 2.404). Record in the table below the voltage indicated on the digital voltmeter. (The voltage should be approximately ~~0.17~~ 0.017 Vrms.)
5. Tune the test oscillator to 3 kHz (f_x) and adjust the output voltage (V_x) to obtain the first carrier null. Record the measured frequency and voltage in the table.
6. Repeat Step 5 for each of the remaining frequencies listed in the following table.

Frequency (in kHz)	Measured Frequency (f_x in kHz)	Measured Voltage V_x (mVrms)	Calibrated Response (in dB)
3	______	______	______
30	______	______	______
100	100.0	______	0
300	______	______	______
1000	______	______	______
3000	______	______	______

7. Use the following equation to calculate the flatness of the FM circuits.

$$dB = 20 \log \frac{V_x}{V_{100\ kHz}} - 20 \log \frac{f_x}{100\ kHz}$$

where dB = the calculated frequency response

V_x = the voltage measured at f_x

$V_{100\ kHz}$ = the reference voltage measured at 100 kHz

f_x = the measured frequency.

8. If the FM frequency response is not within the required tolerance, perform the FM Driver Adjustment and the FM Adjustment in Section V.

PERFORMANCE TESTS

4-20. FM HARMONIC AND NON-HARMONIC DISTORTION

SPECIFICATION: Less than 12% for rates less than 3 kHz decreasing linearly with frequency to 5% at 20 kHz. Less than 5% for 20 kHz to 100 kHz rates.

NOTE

For certain FM modulating frequencies, spurious FM signals (non-harmonic distortion) may occur. After demodulation in an external FM discriminator, the contribution to distortion of these spurious signals is typically less than 0.6%.

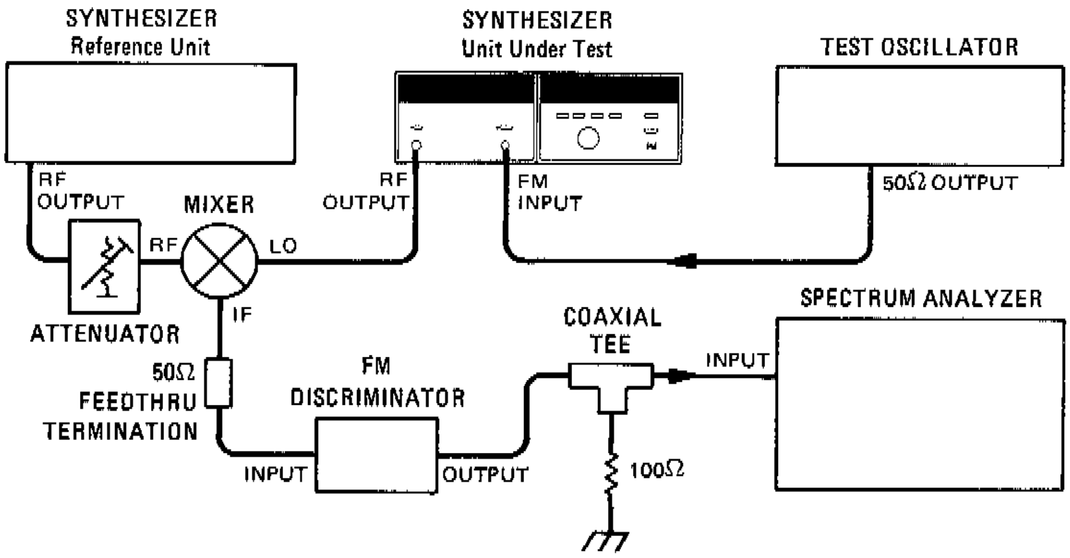


Figure 4-7. FM Distortion Test Setup

EQUIPMENT:

Synthesizer	HP 8671A
Test Oscillator	HP 651B
Mixer	RHG DM1-18
FM Discriminator	HP 5210A
1 MHz Low Pass Filter (for 5210A)	Refer to HP 5210A Operating and Service Manual
Spectrum Analyzer	HP 8556A/8552B/141T
Termination 50Ω Feedthru	HP 11048C
Resistor 100Ω	HP 0698-7212
Attenuator (10 dB Steps)	HP 8495B Option 010

PERFORMANCE TESTS

4-20. FM HARMONIC AND NON-HARMONIC DISTORTION (Cont'd)

PROCEDURE:

1. Tune the Unit Under Test to 3000 MHz.

2. Tune the reference unit to 3009 MHz.

3. Set the attenuator to 10 dB.

4. Set the test oscillator's controls to 100 kHz at 71 mVrms.

5. Connect the equipment as shown in Figure 4-7. Be sure that the Unit Under Test is connected to the mixer's LO port. Be sure that the 1 MHz Low Pass Filter is installed in the FM Discriminator.

6. Set the FM Deviation switch of the Unit Under Test to 10 MHz.

7. Set the FM discriminator's controls to the 10 MHz frequency range and 0.01 volt sensitivity range.

8. Adjust the spectrum analyzer's controls to view the recovered modulation and harmonics.

9. To determine the total distortion, first convert each significant harmonic or spurious level from dB below the fundamental to the power ratio using Table 4-2. Add the power ratios and convert the sum to percent distortion.

   Example:

2nd harmonic:	30 dB down	= .001
3rd harmonic:	45 dB down	= .0000316
4th harmonic:	39 dB down	= .0001259
5th harmonic:	60 dB down	= .0000010
Significant Spurious Level:	57 dB down	= .0000020
		.0011605 or 3.4%

   The total distortion should be less than 5%. Record the level.

   ________ 5%

10. If the FM distortion is not within the required tolerance, perform the FM Driver Adjustments in Section V. Then, if necessary, repair the FM Driver or FM Input Circuits.

PERFORMANCE TESTS

4-20. FM HARMONIC AND NON-HARMONIC DISTORTION (Cont'd)

Table 4-2. Harmonic Level versus Percentage Distortion

dB Down	Power Ratio	Percent Distortion	dB Down	Power Ratio	Percent Distortion
0dB	1.000000000	100.000%	−31dB	0.000794328	2.818%
−1dB	0.794328235	89.125%	−32dB	0.000630957	2.512%
−2dB	0.630957344	79.433%	−33dB	0.000501187	2.239%
−3dB	0.501187234	70.795%	−34dB	0.000398107	1.995%
−4dB	0.398107171	63.096%	−35dB	0.000316228	1.778%
−5dB	0.316227766	56.234%	−36dB	0.000251189	1.585%
−6dB	0.251188643	50.119%	−37dB	0.000199526	1.413%
−7dB	0.199526231	44.668%	−38dB	0.000158489	1.259%
−8dB	0.158489319	39.811%	−39dB	0.000125893	1.122%
−9dB	0.125892541	35.481%	−40dB	0.000100000	1.000%
−10dB	0.100000000	31.623%	−41dB	0.000079433	0.891%
−11dB	0.079432823	28.184%	−42dB	0.000063096	0.794%
−12dB	0.063095734	25.119%	−43dB	0.000050119	0.708%
−13dB	0.050118723	22.387%	−44dB	0.000039811	0.631%
−14dB	0.039810717	19.953%	−45dB	0.000031623	0.562%
−15dB	0.031622777	17.783%	−46dB	0.000025119	0.501%
−16dB	0.025118864	15.849%	−47dB	0.000019953	0.447%
−17dB	0.019952623	14.125%	−48dB	0.000015849	0.398%
−18dB	0.015848932	12.589%	−49dB	0.000012589	0.355%
−19dB	0.012589254	11.220%	−50dB	0.000010000	0.316%
−20dB	0.010000000	10.000%	−51dB	0.000007943	0.282%
−21dB	0.007943282	8.913%	−52dB	0.000006310	0.251%
−22dB	0.006309573	7.943%	−53dB	0.000005012	0.224%
−23dB	0.005011872	7.079%	−54dB	0.000003981	0.200%
−24dB	0.003981072	6.310%	−55dB	0.000003162	0.178%
−25dB	0.003162278	5.623%	−56dB	0.000002512	0.158%
−26dB	0.002511886	5.012%	−57dB	0.000001995	0.141%
−27dB	0.001995262	4.467%	−58dB	0.000001585	0.126%
−28dB	0.001584893	3.981%	−59dB	0.000001259	0.112%
−29dB	0.001258925	3.548%	−60dB	0.000001000	0.100%
−30dB	0.001000000	3.162%			

PERFORMANCE TESTS

4-21. RESIDUAL FM IN FM AND CW MODES

SPECIFICATION: Noise and power line related

In CW and 100 kHz range
6 Hz-rms in 20 Hz—1 kHz post detection bandwidth
12 Hz-rms in 20 Hz—3 kHz post detection bandwidth

In 10 MHz range
10 Hz-rms in 20 Hz—1 kHz post detection bandwidth
20 Hz-rms in 20 Hz—3 kHz post detection bandwidth

DESCRIPTION: The RF output of the Unit Under Test is mixed with the RF output of the reference unit. The IF signal is demodulated and filtered. The filtered output is measured in rms volts and is proportional to the residual FM.

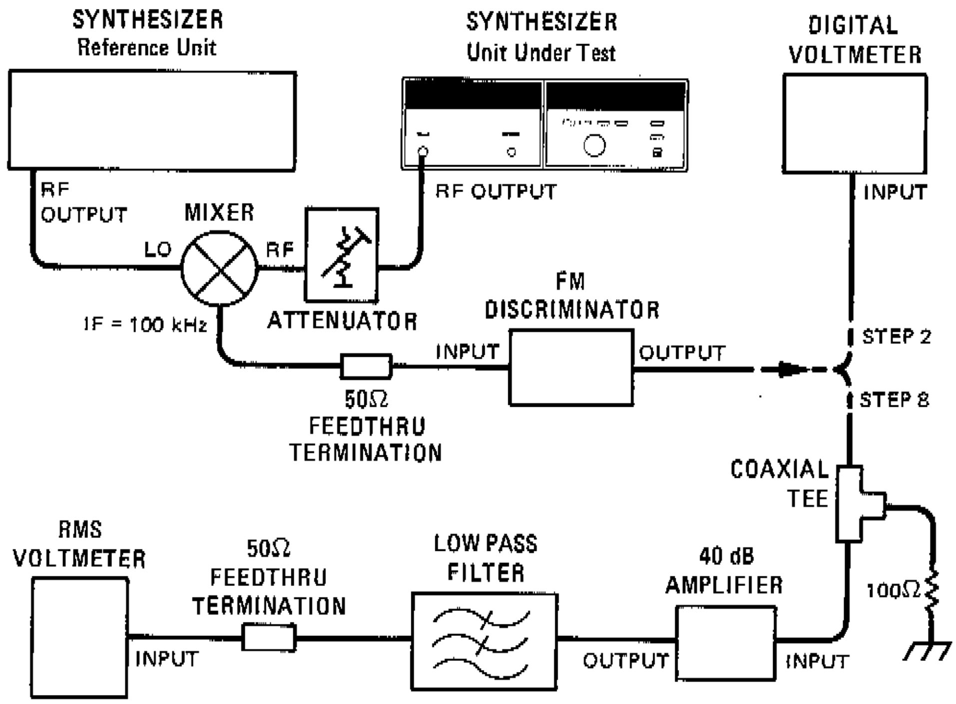


Figure 4-8. Residual FM in FM and CW Modes Test Setup

EQUIPMENT:

FM Discriminator	HP 5210A
40 dB Amplifier	HP 465A
Low Pass Filter (3 kHz)	CIR-Q-TEL FLT/21B-3K-5/50-3A/3B
Low Pass Filter (1 kHz)	CIR-Q-TEL FLT/21B-1K-5/50-3A/3B
Digital Voltmeter	HP 3455A
Synthesizer	HP 8671A
Mixer	RHG DM 1-18
50Ω Feedthru Termination	HP 11048C
RMS Voltmeter	HP 3400A
Attenuator (10 dB Step)	HP 8495B Option 010

4-21. RESIDUAL FM IN FM AND CW MODES (Cont'd)

NOTE

The shorting board and the 10 kHz filter are supplied with the FM discriminator.

PROCEDURE:

1. Install a shorting board in the FM discriminator. Set the sensitivity switch to calibrate position; set the range switch to 100 kHz.
2. Connect the digital voltmeter to the discriminator output.
3. Adjust the rear panel gain control for a discriminator output of 1.00 Vdc.
4. Set the controls of the Unit Under Test as follows:

   RF switch . . . . ON
   FM DEVIATION switch . . . . . OFF
   FREQUENCY . . . . 3000.000 MHz

5. Set the controls of the reference unit to 3000.1 MHz.
6. Install a 10 kHz Butterworth low pass filter in the FM discriminator. (Filter supplied with Discriminator.)
7. Set the attenuator to 10 dB.
8. Connect the equipment as shown in Figure 4-8.
9. Connect a 3 kHz low pass filter to the amplifier output.
10. Set the Synthesizer's FM DEVIATION switch to each range in turn. Allow time for the voltage reading to settle. Measure the voltage for each range and record it in the following table. Be sure each reading is within the required tolerance. The measurement sensitivity is 0.354 mVrms/Hz-rms.
11. Install a 1 kHz low pass filter and repeat step 10.

NOTES

This test may be performed at any desired frequency. The frequency of the reference unit must be 0.1 MHz greater than that of the Unit Under Test.

The test setup calibration can be checked by applying a 1 kHz signal to the FM input and adjusting the level to obtain 5 kHz peak deviation. The rms voltmeter should read 1.77 Vrms.

PERFORMANCE TESTS

4-21. RESIDUAL FM IN FM AND CW MODES (Cont'd)

FM Range	Residual FM in Post Detection Bandwidth			
	20 Hz–1 kHz		20 Hz–3 kHz	
	Actual	Max	Actual	Max
CW (OFF)	________	2.12 mVrms	________	4.24 mVrms
0.1 MHz	________	2.12 mVrms	________	4.24 mVrms
10 MHz	________	3.53 mVrms	________	7.06 mVrms

12. If the residual FM is not within the required tolerance, check the FM Driver for hum, noise or ground loops; check the YTO Loop for phase lock.

4-22. FREQUENCY SWITCHING TIME

SPECIFICATION: (CW mode): Less than 15 ms to be within 1 kHz.

DESCRIPTION: The measurement system is connected so the oscilloscope is triggered at the execute frequency change command. The mixer output is viewed on the oscilloscope display. Switching is completed when the displayed frequency settles to the minimum resolution (1 kHz), the difference between the Synthesizer's outputs.

PERFORMANCE TESTS

4-22. FREQUENCY SWITCHING TIME (Cont'd)

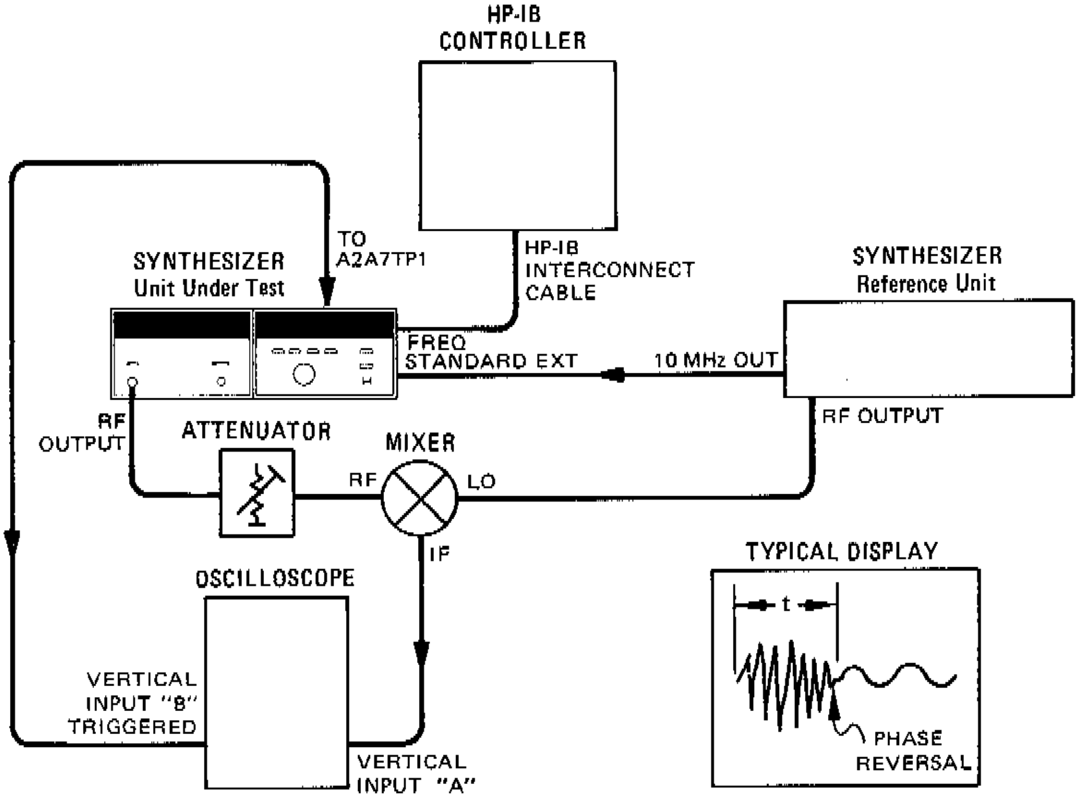


Figure 4-9. Frequency Switching Time Test Setup

EQUIPMENT:

HP-IB Controller	HP 9830A
Synthesizer	HP 8671A
HP-IB Interconnect Cable	HP 10631A
Mixer	RHG DM1-18
Oscilloscope	HP 180C/1801A/1821A
Attenuator (10 dB Step)	HP 8495B

WARNING

This test may be performed with power supplied and protective covers removed. If the covers are removed, this test should be performed by service trained personnel who are aware of the hazards involved (for example, electrical shock).

NOTE

The necessity of removing the Synthesizer's covers to perform this test is eliminated if the oscilloscope's trigger input is connected to pin 6 of the HP-IB Interconnect Cable. In this case, proceed immediately to Step 8.

PERFORMANCE TESTS

4-22. FREQUENCY SWITCHING TIME (Cont'd)

PROCEDURE:

1. Disconnect the line (Mains) power cable from the Synthesizer's rear panel.
2. Remove the two rear panel standoffs which are in contact with the top cover.
3. Loosen the screw at the center of the top cover's rear lip. Slide the cover toward the rear. Remove the cover.
4. Remove the screw which holds the A2 Assembly's protective cover in place. The screw is located near the right rear corner of the instrument.
5. Lift and remove the cover while sliding it toward the rear of the instrument.
6. Reconnect the line (Mains) power cable to the rear panel power module.
7. Connect the oscilloscope's triggered vertical input to A2A7TP1. (This test point pulses high when the frequency execute command is accepted by the Synthesizer.
8. Connect the Synthesizer and HP-IB controller together with an HP-IB Interconnect Cable.
9. Set the oscilloscope controls to alternate B display, sweep time per division 2 ms, sweep mode normal/internal, and positive slope.

NOTE

The following programs are for the HP 9830A Computing Controller. For use with any other HP-IB controller, the program may need to be modified.

10. Load and run the following HP-IB controller program. This program is used to set the oscilloscope for reliable triggering on the pulse at A2A7TP1.

```
10 OUTPUT (13,20)1280,768;
20 FORMAT 2B
30 CMD "?U3","Z1Z1Z1Z1Z1Z1Z1Z1Z1Z1"
40 GOTO 30
50 END
```

Frequency Execute

11. Set the attenuator to 10 dB.
12. Connect the remaining equipment as shown in Figure 4-9.
13. Set the frequency of the reference unit to 2100.001 MHz.

PERFORMANCE TESTS

4-22. FREQUENCY SWITCHING TIME (Cont'd)

14. Load and run the following program. The Synthesizer's initial conditions are set. Then this program will continue switching between output frequencies of 6.199 GHz and 2.1 GHz until the stop key is pressed.

```
10 OUTPUT (13,20)1280,768;
20 FORMAT 2B              ——— FM OFF, RF ON
30 CMD "?U3","N01"
40 CMD "","Q6199Z1"
50 WAIT 30                ——— 6199.000 MHz frequency execute
60 CMD "","Q2100Z1"
70 WAIT 10                ——— 2100.000 MHz, frequency execute
80 GOTO 40
90 END
```

NOTE

Lines 50 and 70 are included to stabilize the oscilloscope's display.

15. Measure the switching time by observing the signal on the oscilloscope display. The Frequency Execute program code triggers the oscilloscope's horizontal sweep. Therefore, the timing bagins at the display's left graticule line. The timing ends at the last phase reversal as the IF signal settles into a steady frequency. Refer to Figure 4-9. This should occur in less than 15 ms. Record the switching time.

    ________ 15 ms

16. Interchange lines 40 and 60 of the program.

17. Tune the reference unit to 6199.001 MHz.

18. Rerun the program. Record the switching time to the last phase reversal.

    ________ 15 ms

19. If the frequency switching time is not within tolerance, check the M/N Loop, 20/30 Loop, YTO Loop (specifically the A2A7 and A3A7 assemblies); also check the remote programming circuits on A2A7 and A2A9.

4-23. INTERNAL TIME BASE AGING RATE

SPECIFICATION: Less than 5×10^{-10} per day after 24-hour warmup.

DESCRIPTION: A reference signal from the Synthesizer (~~100~~ 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.

PERFORMANCE TESTS

4-23. INTERNAL TIME BASE AGING RATE (Cont'd)

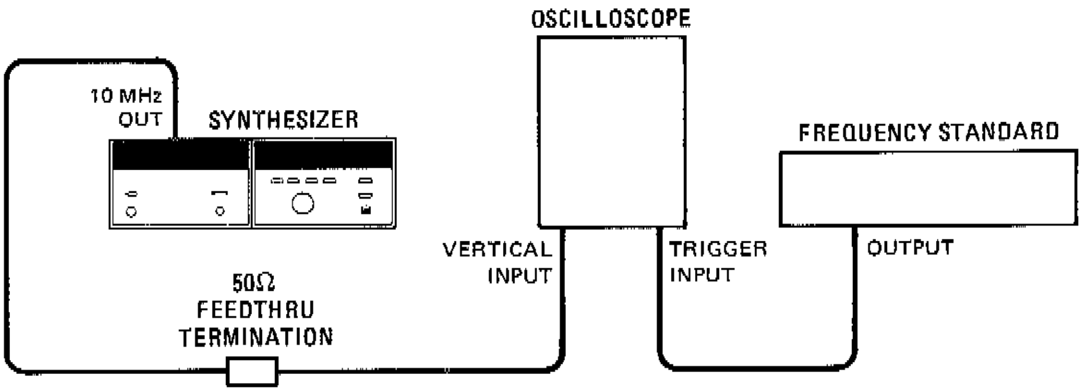


Figure 4-10. Internal Time Base Aging Rate Test Setup

EQUIPMENT:

Frequency Standard	HP 5065A
Oscilloscope	HP 180C/1801A/1821A
50Ω Feedthru Termination	HP 11048C

NOTE

Be sure the Synthesizer has had 30 days to warm up before beginning this test. If the synthesizer 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 4-10.

3. Adjust the oscilloscope controls for a stable display of the 10 MHz output.

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:

$$\text{Aging Rate} = \left|\left(\frac{1\ \text{cycle}}{f}\right)\left(\frac{1}{T_1}-\frac{1}{T_3}\right)\left(\frac{T}{T_2}\right)\right|$$

PERFORMANCE TESTS

4-23. INTERNAL TIME BASE AGING RATE (Cont'd)

where: 1 cycle = the phase change reference for the time measurement (in this case 360°)

f = Synthesizer'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. Record the aging rate. ________ 5×10^{-10}/day

NOTE

If the absolute frequencies of the frequency standard and the Synthesizer'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).

8. If the aging rate is not within the required tolerance, replace A3A8 or repair the power supply as necessary. Be sure sufficient warmup time has been allowed (may require up to 30 days).

Table 4-3. Performance Test Record (1 of 2)

Hewlett-Packard Company
Model 8671A
Synthesized Signal Generator

Serial Number ____________________

Tested by ____________________

Date ____________________

Para. No.	Test	Results		
		Min	Actual	Max
4-12	**RF OUTPUT LEVEL AND FLATNESS** Output Level $>+8$ dBm Flatness <6 dB	 +8 dBm	 ______ ______	 6 dB
4-13	**HARMONICS** Ratio of Harmonic Amplitudes to Carrier Amplitude Fundamental — Minimum Ratio 2.0–6.2 GHz — Harmonics to 18 GHz <15 dB	 15 dB	 ______	
4-14	**SWR** 2.1 GHz <1.7 4.1 GHz <1.7 6.1 GHz <1.7		______(√) ______(√) ______(√)	
4-15	**FM ACCURACY** At 100 kHz rate Accuracy relative to input level ±5%	 32.2	 ______	 35.6 mVrms
4-16	**NON-HARMONIC RELATED SPURIOUS SIGNALS** <-70 dB	 70 dB down	 ______√	
4-17	**POWER LINE RELATED SPURIOUS** $f_o < 300$ Hz −50 dB 300 Hz $\leqslant f_o \leqslant$ 1 kHz −60 dB $f_o > 1$ kHz −65 dB	 50 dB down 60 dB down 65 dB down	 ______ ______ ______	
4-18	**SINGLE-SIDEBAND PHASE NOISE RATIO** SSB level in 1 Hz BW and CW mode at specified offset frequencies 10 Hz −56 −60 dB 100 Hz −70 ~~−68~~ dB 1 kHz −78.dB 10 kHz −86 ~~−89~~ dB 100 kHz −110 ~~−109~~ dB	 ~~57.6~~ dB down ~~60.8~~ dB down 60.8 dB down ~~61.8~~ dB down ~~71.8~~ dB down	 55.6 62.8 ______ 58.8 72.8	

Table 4-3. Performance Test Record (2 of 2)

Para. No.	Test	Results		
		Min	Actual	Max
4-19	**FM FREQUENCY RESPONSE**			
	Relative to 100 kHz rate ±2.0 dB 3 kHz	-2.0 dB	________	+2.0 dB
	30 kHz	-2.0 dB	________	+2.0 dB
	100 kHz	-2.0 dB	0 dB	+2.0 dB
	300 kHz	-2.0 dB	________	+2.0 dB
	1000 kHz	-2.0 dB	________	+2.0 dB
	3000 kHz	-2.0 dB	________	+2.0 dB
4-20	**FM HARMONIC & NON-HARMONIC DISTORTION**			
	20 kHz to 100 kHz < 5%		________	5%
4-21	**RESIDUAL FM IN FM AND CW MODES**			
	20 Hz—1 kHz Post Detection Bandwidth			
	CW (OFF) 6 Hz-rms		________	2.12 mVrms
	0.1 MHz range 6 Hz-rms		________	2.12 mVrms
	10 MHz range 10 Hz-rms		________	3.53 mVrms
	20 Hz—3 kHz Post Detection Bandwidth			
	CW (OFF) 12 Hz-rms		________	4.24 mVrms
	0.1 MHz range 12 Hz-rms		________	4.24 mVrms
	10 MHz range 20 Hz-rms		________	7.06 mVrms
4-22	**FREQUENCY SWITCHING TIME**			
	Switching down < 15 ms		________	15 ms
	Switching up < 15 ms		________	15 ms
4-23	**INTERNAL TIME BASE AGING RATE**		________	5×10^{-10}/day

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section contains adjustments and checks that assure peak performance of the Synthesizer. This instrument should be readjusted after repair or failure to pass a performance test. Allow a 30-minute warmup prior to performing the adjustments.

5-3. The order in which the adjustments are made is critical. Prior to making any adjustments, refer to the paragraph entitled Related Adjustments.

5-4. 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 entitled Related Adjustments.

5-5. SAFETY CONSIDERATIONS

5-6. 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 protective covers removed.

Maintenance should be performed only by service trained personnel who are aware of the hazard involved (for example, electrical shock). Where maintenance can be performed without power applied, the power should be removed.

5-7. EQUIPMENT REQUIRED

5-8. 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.

5-9. If substitutions must be made for the specified test equipment, refer to Table 1-2 for the minimum specifications. It is important that the test equipment meet the ciritical specifications listed in the table if the Synthesizer is to meet the performance requirements.

5-10. The HP 11712A Support Kit is an accessory item available from Hewlett-Packard for use in maintaining the Synthesizer.

5-11. FACTORY SELECTED COMPONENTS

5-12. Factory selected components are identified on the schematics and parts list by an asterisk which follows the reference designator. The normal value or range of the components are shown. The manual change sheets will provide updated information pertaining to the selected components. Table 5-1 lists the reference designator, the criterion used for selecting a particular value, the normal value range, and the service sheet where the component part is shown.

5-13. RELATED ADJUSTMENTS

5-14. If all the adjustments are to be performed, they should be done in order with the exception of the A2 Assembly Adjustments. These adjustments should be performed after the M/N Loop Adjustments and before the YTO Sampler Adjustments.

5-15. In the event of a performance test or component failure, it must be determined if an 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.

5-16. After the instrument is repaired and/or adjusted, performance testing, a frequency check or verification of phase lock and possibly all of these things must be done to verify proper performance of the Synthesizer. Tables 5-2 and 5-3 contain the necessary information that provides assurance of proper performance.

5-17. Prior to performing the adjustment procedures, refer to the disassembly procedures in Section VIII. These procedures cover the removal of the top and bottom covers, the internal A2 assembly covers, and the A3A9 YTO Loop Assembly.

5-18. ADJUSTMENT LOCATIONS

5-19. The last foldouts in this manual contain figures that show the location of assemblies, adjustments, test points and chassis parts.

Table 5-1. Factory Selected Components

Reference Designation	Service Sheet	Range of Values	Basis of Selection
A3A1A2L4	2-A3	0.22 to 0.68 μH	Centers the adjustment range of A3A1A2C4 around 100 MHz. Refer to the VCXO Adjustment procedure.
A3A1A2R67, R68 and R69	2-A3	Refer to Table 5-4	Required change in attenuation necessary for a −10 dBm output level of the 400 MHz signal. Refer to the VCXO Adjustment procedure.
A3A7C19	10-A3	160 or 220 pF	Matched to the A3A9A3 2–6.2 GHz VTO Assembly. 160 pF with HP 5086–7131; 220 pF with HP 5086-7242.
A3A7C48	7-A3	3.9 to 5.6 pF	For the 0.1 MHz FM deviation range. Using FM Frequency Response Test Setup (test oscillator and spectrum analyzer only), set test oscillator's controls so the spectrum analyzer's display of the first FM sidebands are 30 dB down from carrier at 1 MHz. At 3.16 MHz, sidebands should be 40 dB down; at 10 MHz, 50 dB down. If response is peaking, insert a smaller value capacitor. If response is rolling off, insert a larger value capacitor.
A3A7R67	10-A3	75 or 178Ω	Matched to the A3A9A3 2–6.2 GHz YTO Assembly. 178Ω with HP 5086-7131; 75Ω with HP 5086-7242.
A3A9A4R20	9-A3	348 to 562Ω	YTO Loop gain crossover of 20 ±2 kHz. Refer to the YTO Loop Phase Detector Adjustment.

Table 5-2. Performance Test Failure and Required Action

Performance Test Failed[1]	Adjustment or Repair	Repeat Performance Test
RF Output Level and Flatness	Check YTO loop output, A1AT1 Isolator and the Output Cable.	RF Output Level and Flatness Harmonics.
SWR	Check the A1AT1 Isolator and the Output Cable.	SWR.
Harmonics	Digital-to-Analog Coverter, YTO Driver, YTO Loop Preamp Driver and Sampler, YTO Loop Offset and FM Overmodulation, YTO Loop Phase Detector and FM Driver Adjustments.	RF Output Level and Flatness Harmonics.
Non-Harmonically Related Spurious	This problem may occur anywhere in the instrument. Isolate the defective component and make adjustments as required (see Table 5-3).	Non-Harmonically Related Spurious. Other tests as required after repair.
Power Line Related Spurious	Refer to Section VIII, Service Sheet 12-A3 for troubleshooting information.	Power Line Related Spurious.
Single-Sideband Phase Noise Ratio	YTO Driver, VCXO, M/N Loop, 20/30 Loop VCO, 20/30 Loop Bias, YTO Sampler, YTO Phase Detector, YTO Offset and FM Overmodulation, and FM Driver Adjustments.	Check for phase lock. Signal-to-Phase Noise Ratio. All FM tests.
FM Accuracy or FM Frequency Response	FM Driver Adjustment. A1 RF Output Assembly FM Sensitivity Adjustment.	All FM tests.
FM Distortion	First perform FM Driver Adjustments; then, if necessary, repair FM Driver or FM Input Circuits (see Table 5-3).	All FM tests.
Residual FM in FM and CW modes	Check the FM Driver for hum, noise or ground loops. Check the YTO loop for phase lock.	Single-Sideband Phase Noise Ratio

Table 5-2. Performance Test Failure and Required Action (Cont'd)

Performance Test Failed[1]	Adjustment or Repair	Repeat Performance Test
Frequency Switching Time	Check the M/N Loop; 20/30 Loop; YTO Loop (specifically the A2A7 and A3A7 Assemblies). Check the remote programming circuits on A2A7 and A2A9.	Frequency Switching Time.
Internal Time Base Aging Rate	Replace A3A8 or repair power supply if necessary (see Table 5-3). Be sure sufficient warm-up time has been allowed (may require up to 30 days).	Internal Time Base Aging Rate.

[1] 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 lock loops are locked. Perform the single-sideband phase noise ratio test.

Table 5-3. Related Adjustments

Assembly Repaired	Adjustments	Performance Tests
A1A1 FM Input Circuit	FM Sensitivity Adjustment	All FM Tests
A2A3 VCO 160—240 MHz Assembly	20/30 Loop VCO Adjustment	Single-Sideband Phase Noise Ratio[1]. Power Line Related Spurious.
A2A4 20/30 Phase Detector Assembly	A2A4 Assembly Notch Filter Adjustments	Non-Harmonically Related Spurious
A2A5 20/30 Divider Assembly	20/30 Loop Divider Bias Adjustment	Single-Sideband Phase Noise Ratio[1]
Reference Loop Circuits A3A1A1, A2	VCXO Adjustments	Single-Sideband Phase Noise Ratio[1]. Power Line Related Spurious.
M/N Loop Circuits, A3A1A3, A4, A5	M/N Loop Adjustments	Single-Sideband Phase Noise Ratio[1]. Power Line Related Spurious.
Power Supplies A3A2, A3, A4	Power Supply Adjustments	None unless required by preceding problems
A3A5 DAC Assembly	Digital-to-Analog Converter Adjustments	Single-Sideband Phase Noise Ratio[1]
A3A6 YTO Driver Assembly	YTO Driver Adjustment	Single-Sideband Phase Noise Ratio[1]
A3A7 FM Driver Assembly	FM Driver Adjustments	Single-Sideband Phase Noise Ratio[1]. All FM Tests.
A3A8 10 MHz Reference Oscillator Assembly	10 MHz Reference Oscillator	Single-Sideband Phase Noise Ratio[1]. Power Line Related Spurious. Internal Time Base Aging Rate.
A3A9A3 2–6.2 GHz YTO Assembly	Power Supply, DAC, YTO Driver, YTO Loop, FM Driver, FM Mod Meter, Loop Offset and Overmodulation	Single-Sideband Phase Noise Ratio[1]. Power Line Related Spurious. Frequency Switching Time.
A3A9A4 YTO Phase Detector Assembly	YTO Loop Phase Detector Adjustments, YTO Loop Offset and FM Overmodulation Adjustments	Single-Sideband Phase Noise Ratio[1]
A3A9A5 YTO Sampler Assembly	YTO Loop Preamp, Driver and Sampler Adjustments	Single-Sideband Phase Noise Ratio[1]

[1] Check for correct frequency output, and verify the phase lock loops are locked before performing Single-Sideband Phase Noise Ratio Test.

ADJUSTMENTS

5-20. A3 RF SOURCE ASSEMBLY ADJUSTMENTS

5-21. Power Supply Adjustments

REFERENCE: Service Sheets 11-A3, 12-A3 and 13-A13.

DESCRIPTION: Adjust the +22 volt and +20 volt power supplies to their required tolerance. Check the remaining supply voltages for which the +20 volt supply is the reference (+11V, +5.2V, –5.2V, –10V and –40V).

EQUIPMENT: Digital Voltmeter . . . . HP 3455A

PROCEDURE:

1. Remove the Synthesizer's top cover.
2. Set the LINE switch to ON; set the rear panel FREQ STANDARD INT/EXT switch to INT.
3. Connect the DVM input to A3A2TP1.
4. Adjust +22 ADJ A3A2R2 for a DVM reading of +22.00 ± 0.02 Vdc.
5. Connect the DVM input to A3A3TP5.
6. Set +20 ADJ A3A3R50 for a DVM reading of +20.000 ± 0.001 Vdc.
7. Check the following power supplies as shown in the table. If any voltages are incorrect, try resetting A3A3R50 for the correct +20V, +5.2V, –5.2V, –10V, and –40 Vdc levels. All voltages should be within tolerance. If necessary refer to the troubleshooting information in Section VIII, repair the supply in question and recheck the voltages.

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	–39.0	–40.6

8. Repeat all performance test(s) as required by the performance test failure or repair which led to performing this adjustment procedure.

ADJUSTMENTS

5-22. 10 MHz REFERENCE OSCILLATOR ADJUSTMENT

REFERENCE: Service Sheet 1-A3

DESCRIPTION: A reference signal from the Synthesizer (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 Reference Oscillator's frequency is adjusted to match the standard frequency.

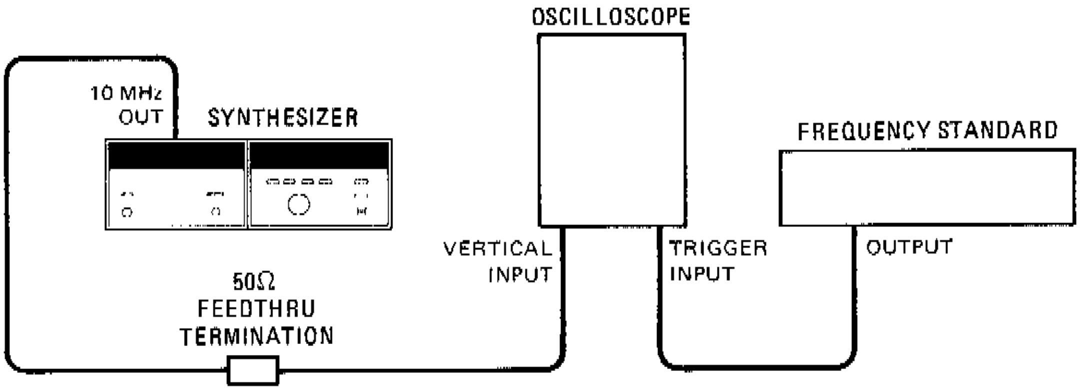


Figure 5-1. 10 MHz Reference Oscillator Adjustment Test Setup

EQUIPMENT:

Frequency Standard	HP 5065A
Oscilloscope	HP 180C/1801A/1821A
50Ω Feedthru Termination	HP 11048C

NOTE

Be sure the Synthesizer has had 30 minutes to warm up before performing the adjustment. Verify that the oven and phase lock status indicators are out. If necessary, refer to the troubleshooting information in Section VIII.

PROCEDURE:

1. Set the rear panel FREQ REFERENCE INT EXT switch to the INT position.
2. Set the FREQ adjustment (on the A3A8 Assembly) so the signal, as observed on the oscilloscope display, is not drifting.
3. Verify that in 10 seconds the display drifts less than 1 division. If necessary repeat Steps 2 and 3.

ADJUSTMENTS

5-23. Digital-to-Analog Converter Adjustment

REFERENCE: Service Sheet 6-A3.

DESCRIPTION: The adjustments set the analog output voltages with respect to the digital frequency inputs. Adjustments are made at certain selected frequencies of which some are below the low frequency limit of the Synthesizer (2000 MHz). These frequencies are selected by shorting together the test point pair A2A8TP1 and tuning to the specified frequencies.

EQUIPMENT: Digital Voltmeter . . . . HP 3490A

PROCEDURE:

1. Set the Synthesizer as follows:
   FM . . . . OFF
   RF switch . . . . ON
   FREQUENCY . . . . 4800.000 MHz
2. Press the HOLD pushbutton.
3. Connect the DVM ground lead to the reference ground, A3A6TP5. (The ground lead remains connected here for the remainder of this procedure.) Be sure the A3A6 assembly is properly installed in the instrument.
4. Attach the DVM test lead to A3A5TP4. Set Ref Adj (Reference Buffer Output) A3A5R13 for a DVM reading of –6.50 ± 0.07 Vdc.
5. 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.
6. Connect the DVM to the YTO Pretune Output, A3A5TP3.
7. Short the test point pair, A2A8TP, with an alligator clip. Adjust 1.6 GHz A3A5R4 (not 1.61) to obtain —4.800 ±0.001 Vdc. Obtain an accuracy of ±0.0001 Vdc if possible in this and succeeding steps.
8. Remove the clip from A2A8TP1. Adjust 4.8 GHz A3A5R3 to obtain a reading of –14.400 ± 0.001 Vdc.
9. Tune to 4900.000 MHz and short the test point pair A2A8TP1 with the clip. Adjust 1.7 GHz A3A5R29 to obtain –5.100 ± 0.001 Vdc.
10. Repeat steps 7, 8, and 9 until all voltages are within 0.001 Vdc of the specified value.
11. Tune the frequency to 4810.000 MHz. Verify that the clip is connected to A2A8TP1. Adjust 1.61 GHz A3A5R42 (not 1.6) to obtain a DVM reading of –4.830 ± 0.001 Vdc.
12. Tune to 5000.000 MHz. Adjust 1.8 GHz A3A5R24 to obtain —5.400 ± 0.001 Vdc.
13. Remove the alligator clip. Tune to 2000.000 MHz. Adjust 2.0 GHz A3A5R22 to obtain –6.000 ± 0.001 Vdc.

5-23. Digital-to-Analog Converter Adjustment (Cont'd)

14. Tune to 2400.000 MHz. Adjust 2.4 GHz A3A5R20 to obtain −7.200 ±0.001 Vdc.

15. Tune to 3200.000 MHz. Adjust 3.2 GHz A3A5R18 to obtain −9.600 ±0.001 Vdc.

16. At each frequency listed in the table, check the YTO Pretune voltage at A3A5TP3 with the clip attached to the test point pair A2A8TP1.

Synthesizer Frequency	YTO Pretune Voltage at A3A5TP3 (Vdc)
4.801 GHz	−4.803 ±0.001
4.802 GHz	−4.806 ±0.001
4.804 GHz	−4.812 ±0.001
4.808 GHz	−4.824 ±0.001
4.810 GHz	−4.830 ±0.001
4.820 GHz	−4.860 ±0.001
4.840 GHz	−4.920 ±0.001
4.880 GHz	−5.040 ±0.001

17. Tune to 4910.000 MHz. At A3A5TP3 the YTO Pretune voltage should be −5.130 ±0.002 Vdc with the clip in place and −14.730 ±0.002 Vdc with the clip removed. If necessary repeat the procedure. Then if the voltage tolerance cannot be met, refer to Section VIII for troubleshooting information.

18. Remove the DVM and clip lead.

5-24. YTO Driver Adjustment

REFERENCE: Service Sheet 7-A3.

DESCRIPTION: When the fundamental output of the Synthesizer is set to the maximum and minimum frequencies, the YTO Driver's gain and offset current are set to give specified YTO output frequencies.

EQUIPMENT: Frequency Counter . . . . HP 5340A

PROCEDURE: 1. Set the Synthesizer's RF switch to ON.

NOTE

All boards must be installed in the instrument before these adjustments are made.

ADJUSTMENTS

5-24. YTO Driver Adjustment (Cont'd)

2. Connect the frequency counter to the RF OUTPUT connector A1J1.
3. Connect the reference ground A3A6TP5 to A3A7TP2 (YTO Tune 1) with a jumper wire.
4. Tune the Synthesizer to 2000.000 MHz. Set 2 GHz Adj A3A6R34 to obtain 2000.0 ±0.1 MHz on the frequency counter.
5. Tune the Synthesizer to 6199.000 MHz. Set 6.199 GHz Adj A3A6R25 to obtain 6199.0 ±0.1 MHz on the frequency counter. (Note the frequency is 6199.000 MHz, not 6199.999 MHz.)
6. Repeat steps 4 and 5 as required to obtain the required tolerance at both frequencies.
7. Disconnect A3A6TP5 from A3A7TP2.
8. Verify that the frequency output is accurate and phase-locked before performing the Single-Sideband Phase Noise Ratio performance test in Section IV.

5-25. Voltage Controlled Crystal Oscillator (VCXO) Adjustment

REFERENCE: Service Sheet 2-A3.

DESCRIPTION: The open loop frequency and maximum power output of the 100 MHz VCXO is centered around 100 MHz. The output is set as close as practical to 100 MHz. The 400 MHz signal is adjusted for maximum 400 MHz output and minimum spurious output. The attenuator is selected to provide a 400 MHz output of −10 dBm.

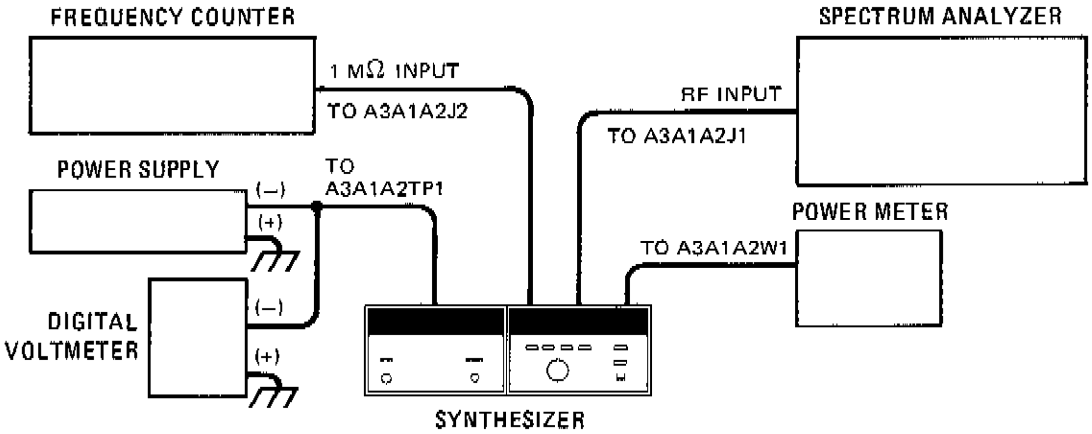


Figure 5-2. VCXO Adjustment Test Setup

ADJUSTMENTS

5-25. Voltage Controlled Crystal Oscillator (VCXO) Adjustment (Cont'd)

EQUIPMENT:

Frequency Counter	HP 5340A
Spectrum Analyzer	HP 8555A/8552B/141T
Power Supply	HP 6202B
Power Meter	HP 436A/8481A
Digital Voltmeter	HP 3455A

PROCEDURE:

1. Connect the frequency counter to A3A1A2J2 in place of the termination; connect the spectrum analyzer to A3A1A2J1 in place of the gray-orange-white cable.

2. Set the output of a low voltage power supply to −8.00 ±0.01 Vdc. Connect the positive lead to ground and the negative lead to A3A1A2TP1 TUNE.

3. Tune the 100 MHz Adj A3A1A2C4 for the maximum 100 MHz signal level as viewed on the spectrum analyzer display.

4. Tune the 100 MHz Adj to increase the frequency (and decrease the amplitude) until the oscillation stops on the high frequency side; then tune the 100 MHz Adj to decrease the frequency until the oscillation stops. If the VCXO does not stop oscillating at the high end, decrease the value of A3A1A3C8 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.

5. Adjust the 100 MHz Adj 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 1 dB point is above 100 MHz. Use the frequency counter to make the measurements to 10 Hz resolution.

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 1 dB point is below 100 MHz.

7. The VCXO centering about 100 MHz is correct if $0.5 \leqslant \frac{\Delta f_1}{\Delta f_2} \leqslant 2$.

   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 center frequency. Refer to the following table for the inductor values.

A3A1A2L4 Inductor Values	
Value	**HP Part Number**
.68 μH	9100-0141
.56 μH	9100-2256
.47 μH	9100-2255
.39 μH	9100-2254
.33 μH	9100-0368
.27 μH	9100-2252
.22 μH	9100-2251

8. If the inductor value is changed, repeat steps 3 through 7.

ADJUSTMENTS

5-25. Voltage Controlled Crystal Oscillator (VCXO) Adjustment (Cont'd)

9. Adjust the 100 MHz Adj to obtain a VCXO output of 100 MHz ±100 Hz.

10. Connect the spectrum analyzer to the 400 MHz output. 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.

11. Check the various harmonics of 100 MHz relative to the 400 MHz level. 200 and 800 MHz should be greater than 25 dB down; 100, 300, 500, 600, 700 and 900 MHz should be greater than 40 dB down. If necessary, repeat steps 10 and 11.

12. Connect the power meter to the 400 MHz output (the gray-red-white cable) after disconnecting it from A3A1A5J1. The power should be −10 to −11 dBm. If the power is incorrect, select the values of A3A1A2R67, R68 and R69 from the Table of Attenuator Resistor Values to obtain the proper power level. The attenuation should always be at least 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

13. If the amount of attenuation is changed, recheck the harmonic levels.

14. Verify that the frequency output is accurate and phase-locked before performing the Single-Sideband Phase Noise Ratio test.

5-26. M/N Loop Adjustments

REFERENCE: Service Sheet 4-A3.

DESCRIPTION: The M/N loop frequency is set to track tuning voltage across the frequency range. The output level is set and checked to ensure and adequate RF output level across the band.

ADJUSTMENTS

5-26. M/N Loop Adjustments (Cont'd)

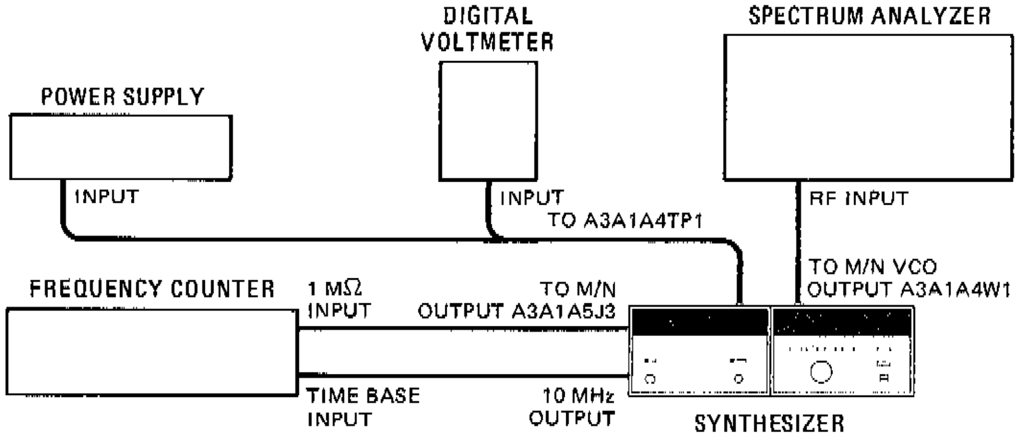


Figure 5-3. M/N Loop Adjustment Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3455A
Frequency Counter	HP 5340A
Spectrum Analyzer	HP 8555A/8552B/141T
Power Supply	HP 6202B

PROCEDURE:

1. Set the Synthesizer controls as follows:

RF Switch	ON
FREQUENCY	6090.000 MHz
FREQ REFERENCE INT-EXT switch	INT

2. Connect the equipment as shown in Figure 5-3.

3. Verify that the M/N output frequency is exactly 197.419 MHz ±1 count.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. Be careful while working on the circuit boards with power supplied. Work with one hand. Do not touch the extender board.

4. Remove the A3A1A4/A5 Assembly and place it on a 30 pin extender board.

5. Connect the spectrum analyzer input to the M/N VCO output A3A1A4W1 (white coax).

CAUTION

Do not apply a positive voltage to A3A1A4TP1. A positive voltage will forward bias the VCO tuning diodes and may destroy them.

ADJUSTMENTS

5-26. M/N Loop Adjustments (Cont'd)

6. Connect the negative output of a power supply to A3A1A4TP1; connect the positive output to chassis ground. Set the power supply for −35.0 ±0.5 Vdc.

NOTE

The adjustment screws for A3A1A4C1 and C5 are held in place by lock nuts. After making the adjustment, tighten the lock nuts and recheck the frequency and level.

7. Release the lock nut for the PWR adjustment A3A1A4C5. Adjust A3A1A4C5 for an output level of 0 ±2 dBm. Tighten the lock nut.

8. Slowly reduce the dc voltage at A3A1A4TP1 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).

9. Set 395 MHz TUNE A3A1A4C1 for a voltage level of −35.0 ±0.5 Vdc.

10. Tune the Synthesizer frequency to 2100.000 MHz. Verify that the M/N output frequency is 177.500 MHz and the tuning voltage is −2.3 ±0.5 Vdc.

11. Remove the power supply connection to A3A1A4TP1. Set the LINE switch to STANDBY; then install the A3A1A4/A5 Assembly.

NOTE

If required, proceed to the 20/30 MHz Loop VCO Pretune Adjustments.

12. Verify that the frequency output is accurate to 1 kHz and that the phase lock circuits are locked before performing the Single-Sideband Phase Noise Ratio performance test in Section IV.

5-27. YTO Loop Sampler Adjustments

REFERENCE: Service Sheet 8-A3.

DESCRIPTION: The sampler is driven by a sweep oscillator and the dc output is monitored with an 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 output level and the frequency response is checked.

ADJUSTMENTS

5-27. YTO Loop Sampler Adjustments (Cont'd)

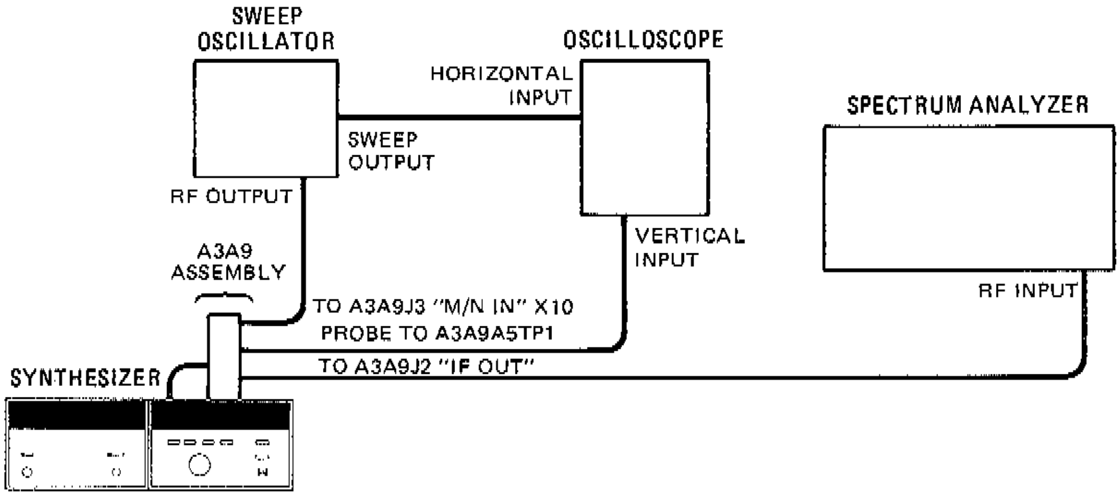


Figure 5-4. YTO Loop Sampler Adjustment Test Setup

EQUIPMENT:

Oscilloscope (with divide-by-10 probe) . .	HP 180C/1801A/1821A
Sweep Oscillator	HP 86220A/8620C
Spectrum Analyzer	HP 8553B/8552B/141T
Frequency Counter	HP 5340A

PROCEDURE:

1. Set the Synthesizer's RF switch to OFF and disconnect the power cord.
2. Remove the Synthesizer's top and bottom covers and place the A3A9 Assembly into the test position. See the disassembly procedures in Section VIII.
3. Remove the right side cover of A3A9.
4. Connect a 50 ohm termination to the A3A9A1 Directional Coupler.
5. Set the sweep oscillator's controls for a leveled output of 0 dBm, center frequency range of 187.5 ±1.0 MHz (measured by frequency counter) and a sweep range of 200 MHz (±100 MHz).
6. Connect the equipment as shown in Figure 5-4. The sweep oscillator's RF output is connected to the M/N LOOP SIGNAL connector, A3A9J3, in place of the white-orange cable.

ADJUSTMENTS

5-27. YTO Loop Sampler Adjustments (Cont'd)

7. Adjust A3A9A5C1 and C2 (with an insulated adjustment tool) to get an oscilloscope display similar to Figure 5-5. 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 0.4 volts.

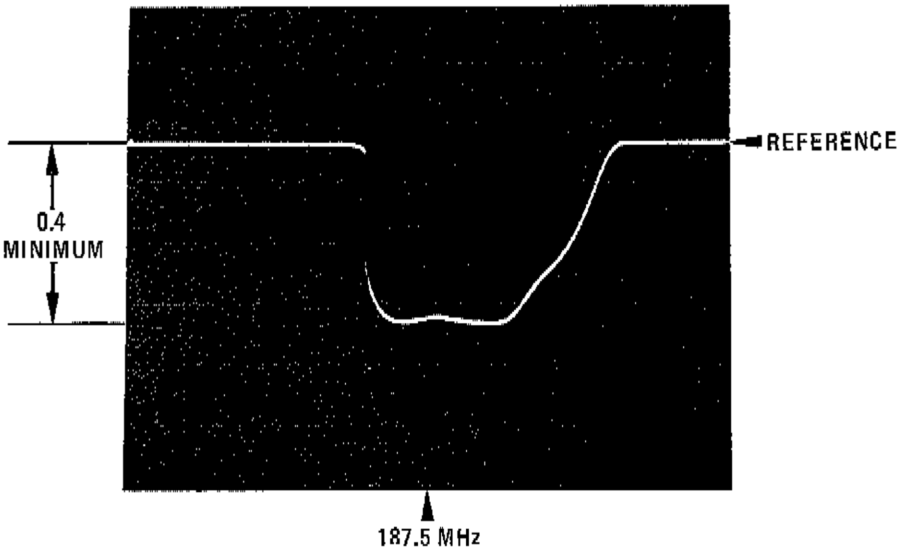


Figure 5-5. Typical Swept Frequency Response at A3A9A5TP1 (Frequency span per division 20 MHz)

8. Short A3A7TP2 to ground. Set the Synthesizer's RF switch to ON and tune to 2100 MHz. Disconnect the grey cable from the phase detector output A3A9J6. Remove the oscilloscope's probe from A3A9A5TP1.

9. Connect the spectrum analyzer's input directly to the IF OUT A3A9J2.

10. Set the sweep oscillator's controls for a center frequency of 177.5 ±1.0 MHz; set the sweep width to 10 MHz.

11. Connect the sweep oscillator's output to the M/N LOOP SIGNAL input A3A9J3.

12. Set the spectrum analyzer's controls for a 0 to 100 MHz frequency span. Set the other controls to display the swept 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.

13. Adjust the IF GAIN A3A9A5R1 so that the displayed IF signal at 30 MHz is +2 ±1 dBm.

ADJUSTMENTS

5-27. YTO Loop Sampler Adjustments (Cont'd)

14. 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 or that the power does not drop below the stated level over the frequency range.
    a. From 20 to 30 MHz, +2 to +6 dBm
    b. From 6 to 20 MHz, —3 dBm.
    c. From 30 to 70 MHz, —10 dBm.

15. Return the Synthesizer to normal operation.

16. Verify that the frequency output is accurate and phase locked before performing the Single-Sideband Phase Noise Ratio Performance test in Section IV.

5-28. YTO Loop Offset and FM Overmodulation Adjustments

REFERENCE: Service Sheet 9-A3.

DESCRIPTION: In order to operate the YTO loop phase detector in the linear region, the loop offset must be set 1 radian from the detector's zero crossover point. A drive signal of 1 radian-peak is connected at the FM INPUT connector while the phase detector output is monitored with an oscilloscope. The loop offset adjustment is set so that foldover at the peak of the phase detector output signal just begins. To set the FM overmodulation threshold, the FM input level is set for a modulation index of 6.5. The adjustment is set to a position that just lights the front panel OVERMOD annunciator.

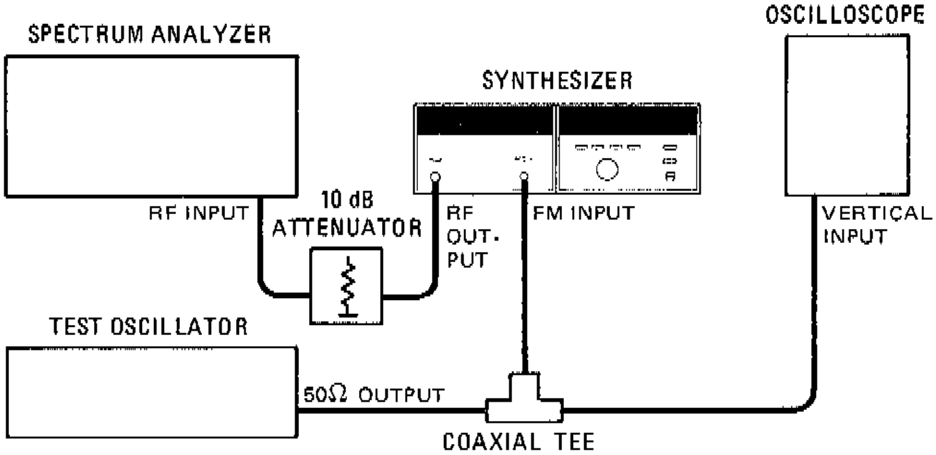


Figure 5-6. YTO Loop Offset and FM Overmodulation Adjustment Test Setup

EQUIPMENT:

Oscilloscope	HP 180C/1801A/1821A
Spectrum Analyzer	HP 8555A/8552A/141T
Test Oscillator	HP 651B
Attenuator (10 dB)	HP 8491B Option 010

ADJUSTMENTS

5-28. YTO Loop Offset and FM Overmodulation Adjustments (Cont'd)

PROCEDURE:

1. Set the Synthesizer's FM Deviation switch to 10 MHz and press the PRESET (3 GHz) pushbutton.
2. Tune the test oscillator to 100 kHz.
3. Connect the equipment as shown in Figure 5-6.
4. Adjust the spectrum analyzer's controls to display the carrier and the 100 kHz modulator sidebands.
5. Adjust the test oscillator's output level for the first carrier null as observed on the spectrum analyzer's display. Record the test oscillator's output level as measured with the oscilloscope.

   ______________ Vrms

6. Divide the measured value by 2.4. Readjust the test oscillator's output level to the computed level.
7. Connect the oscilloscope to A3A9A4TP1 through a divide-by-ten probe. Adjust the oscilloscope's controls to view the 100 kHz signal.
8. Set the YTO Loop Offset adjustment OFST A3A9A4R53 so the sinusoidal waveform just begins to fold over. Refer to Figure 5-7.

NOTE

There may be two settings of A3A9A4R53 which give the proper offset. Use the position closer to the center of the adjustment range.

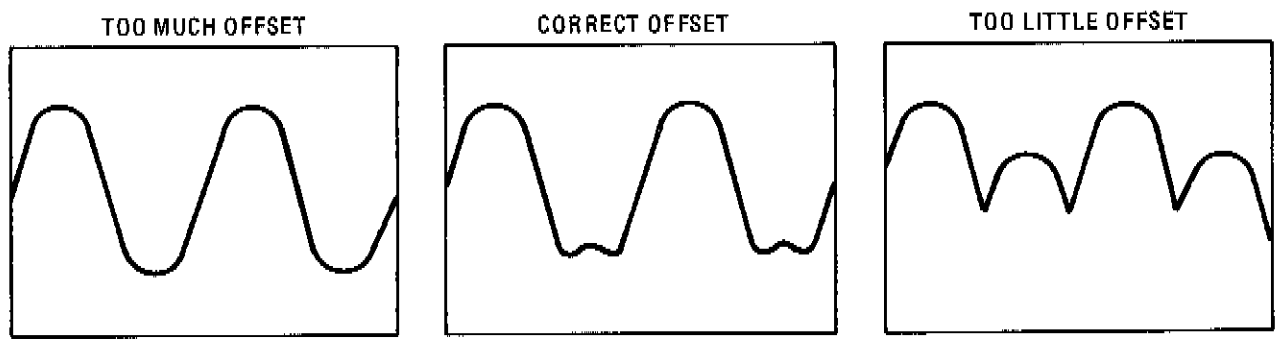


Figure 5-7. YTO Loop Offset Adjustment Waveforms

9. Disconnect the oscilloscope's probe.
10. Adjust the test oscillator's output level for the second carrier null as observed on the spectrum analyzer's display. Record the test oscillator's output level.

    ______________ Vrms

ADJUSTMENTS

5-28. YTO Loop Offset and FM Overmodulation Adjustments (Cont'd)

11. Multiply the measured value by 1.18. Readjust the test oscillator's output level to the computed level.

12. Set the FM overmodulation adjustment OMOD A3A9A4R30 to the full clockwise position. Slowly rotate the adjustment counterclockwise until the front panel OVERMOD annunciator is illuminated.

5-29. YTO Loop Phase Detector Adjustment

REFERENCE: Service Sheet 9-A3.

DESCRIPTION: The gain-crossover frequency of the YTO Phase-Locked loop is measured and adjusted using a low frequency spectrum analyzer and tracking generator. This procedure does not generally need to be done unless repairs were made in the YTO loop.

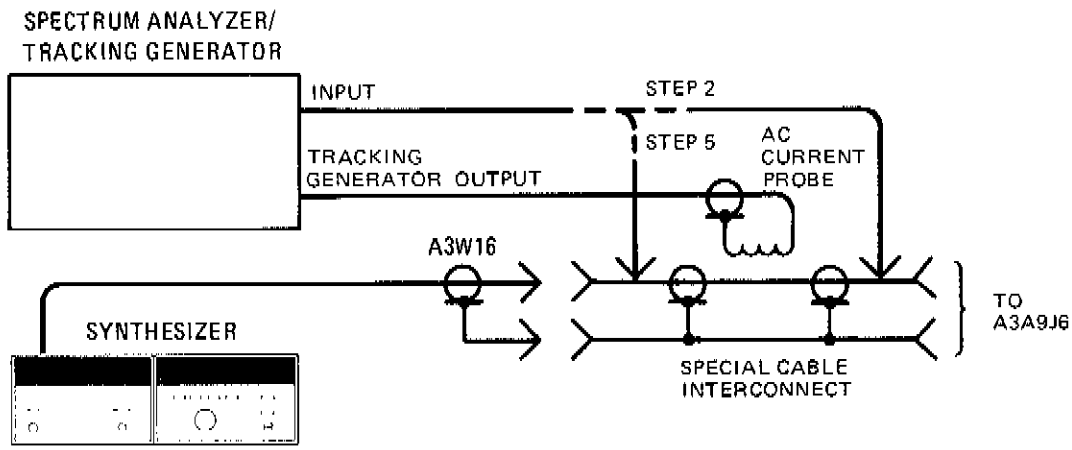


Figure 5-8. YTO Loop Phase Detector Adjustment Test Setup

EQUIPMENT:

Spectrum Analyzer (with tracking generator)	HP 8556A/8552B/141T
AC Current Probe	HP 1110A
Special Interconnect Cable	(See Figure 1-3.)

PROCEDURE:

1. Set the synthesizer RF switch to ON

2. Connect the equipment as shown in Figure 5-8. The special interconnect cable is inserted between A3W16 (grey 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.

ADJUSTMENTS

5-29. YTO Loop Phase Detector Adjustments (Cont'd)

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 pushbutton.

5. Move the spectrum analyzer's input to the cable side (A3W16) of the special cable.

6. Press the single sweep pushbutton. 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. Refer to Figure 5-9.

7. The required value of A3A9A4R20 must be changed to set the correct frequency.

$$R_2 = R_1 \frac{F_1}{F_2}$$

where R_2 = required value for R20
R_1 = present value of R20
F_1 = measured frequency
F_2 = required frequency (20 kHz)

for example
if $R_1 = 619\Omega$
and F_1 = 25 kHz
then

$$R_2 = 619 \left(\frac{25\text{ kHz}}{20\text{ kHz}}\right)$$

$R_2 = 773\Omega$ or 750Ω (closest value)

9. Install R20 and recheck the gain-crossover frequency.

18 ________ 22 kHz

NOTE

The other loop parameters, phase margin and open loop gain, may be checked if the loop does not operate correctly. Open 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 gain-crossover to the induced voltage. (Gain-crossover is the reference so the ratio is negative.)

ADJUSTMENTS

5-29. YTO Loop Phase Detector Adjustments (Cont'd)

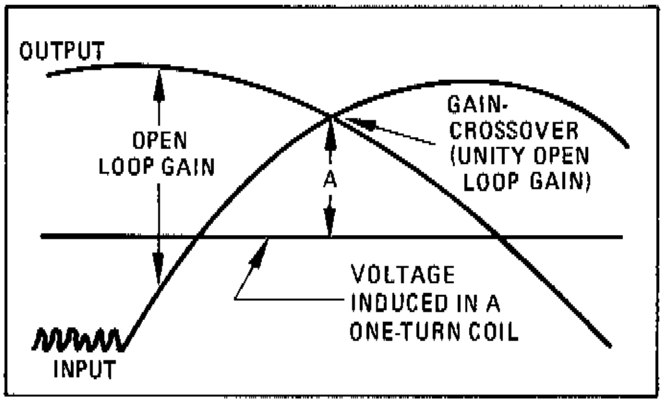


Figure 5-9. Spectrum Analyzer Display of Phase-Locked Loop Gain

10. Reinstall the A3A9 Assembly after replacing the covers. Refer to the appropriate procedures in Section VIII.

11. Verify that the output frequency is accurate to ±1 kHz and that the phase lock circuits are locked before performing the Single-Sideband Phase Noise Ratio performance test in Section IV.

5-30. FM Driver Adjustment

REFERENCE: Service Sheet 10-A3.

DESCRIPTION: The dc offset of the FM integrator amplifier is set as close to zero volts as possible. Any FM signal present on the error signal line of the YTO phase-locked loop is nulled at both high and low FM driver sensitivity.

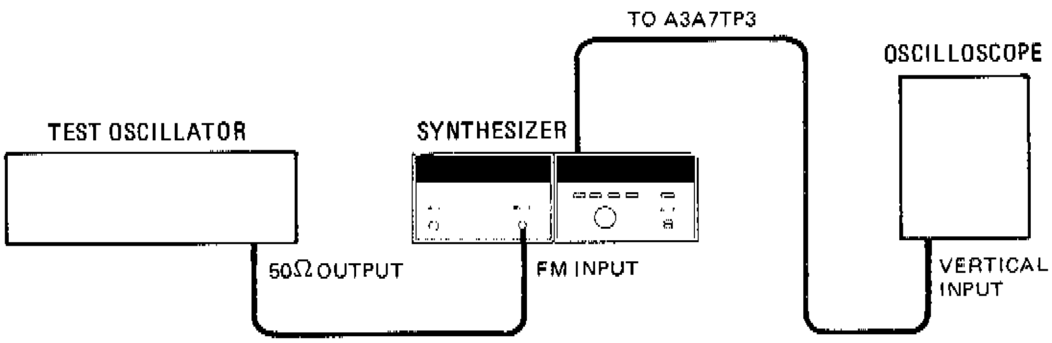


Figure 5-10. FM Driver Adjustment Test Setup

EQUIPMENT: Oscilloscope . . . . HP 180C/1801A/1821A
Test Oscillator . . . . HP 651B

ADJUSTMENTS

5-30. FM Driver Adjustment (Cont'd)

PROCEDURE:

1. Set the FM DEVIATION switch to 0.1 MHz.
2. Connect the oscilloscope to A3A7TP3.
3. Set OFST (offset adjust) A3A7R28 for 0.0 ±0.1 Vdc.
4. Set the FM DEVIATION switch to 10 MHz.
5. Verify a voltage level of 0 ±2 Vdc at A3A7TP3.
6. Set the RF switch to ON.
7. Set the test oscillator controls for an output of 3.0 mVrms at 5 kHz.
8. Connect the oscilloscope to A3A7TP2; connect the test oscillator output to the FM INPUT. The signal displayed by the oscilloscope will generally be less than 20 mV_{p-p}.
9. Set GAIN A3A7R40 to null any FM signal present at A3A7TP2.
10. Set the FM DEVIATION MHz switch to 0.1 MHz and set the test oscillator output level to 0.30 Vrms.
11. Set −40 GN (−40 Gain) A3A7R46 to null any FM signal present at A3A7TP2.

5-31. A2 CONTROLLER ASSEMBLY ADJUSTMENTS

5-32. 160–240 MHz (20/30 MHz or LFS Loop) VCO Pretune Adjustments

REFERENCE: Service Sheet 3-A2.

DESCRIPTION: If any oscillator components have been replaced, the low and high frequency limits of the oscillator must be checked to insure proper operation. The oscillator coil is moved closer to or away from the circuit board in order to set the low and high frequency limits.

EQUIPMENT: Frequency Counter . . . . HP 5340A

NOTE

This procedure need be performed only if major repair has been done to the oscillator.

PROCEDURE:

1. Set the LINE ON-STANDBY switch to ON.
2. Remove the screws which hold the A2A3 VCO assembly in place.

ADJUSTMENTS

5-32. 160–240 MHz (20/30 MHz or LFS Loop) VCO Pretune Adjustments (Cont'd)

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. Be careful while working on the circuit boards with power supplied. Work with one hand. Do not touch the extender board.

3. Remove the A2A3 Assembly, place it on an extender board, and reinstall the assembly.

4. Remove the green cable A3W14 which is connected to the 20/30 MHz OUTPUT A2A3J1. Connect the frequency counter output to A2A3J1.

5. Set the LINE ON-STANDBY 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, the oscillator coil must be moved closer to the circuit board. The oscillator cover must be removed before adjusting the coil.

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 and recheck the frequency.

9. Set A2A3S1 to the TEST LOW FREQ position. Verify a frequency reading of less than 19.5 MHz. If necessary, remove the cover, reset the coil, replace the cover and repeat steps 6 through 9.

10. Set A2A3S1 to the NORMAL position.

11. Reinstall A2A3 in its cavity and reconnect the green cable to A2A3J1.

5-33. 20/30 MHz (LFS) Loop Divider Bias Adjustments

REFERENCE: Service Sheet 1-A2.

DESCRIPTION: A clock 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.

ADJUSTMENTS

5-33. 20/30 MHz (LFS) Loop Divider Bias Adjustments

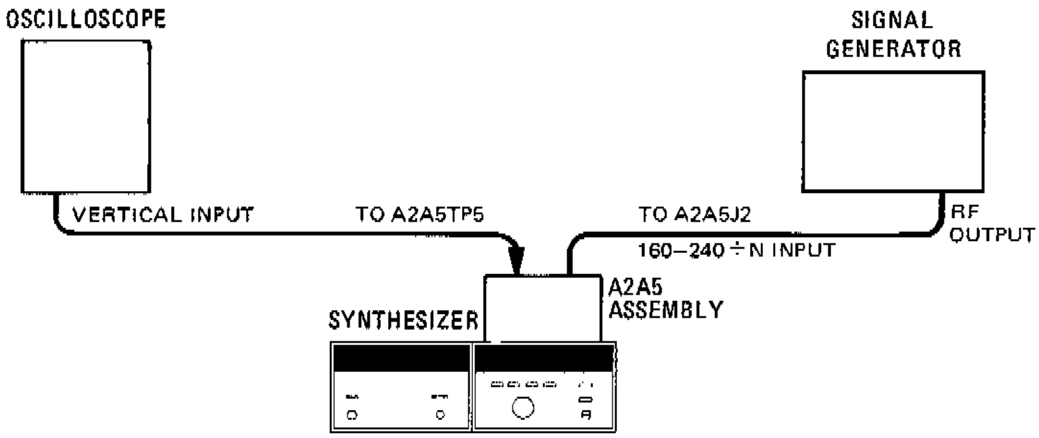


Figure 5-11. 20/30 MHz Loop Divider Bias Adjustment Test Setup

EQUIPMENT:

Oscilloscope . . . . HP 180C/1801A/1821A
Signal Generator . . . . HP 8654A

PROCEDURE:

1. Set the LINE ON-STANDBY switch to STANDBY.
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. Be careful while working on the circuit boards with power supplied. Work with one hand. Do not touch the extender board.

3. Remove the A2A5 Assembly, place it on an extender board, and reinstall the assembly.
4. Connect the power cable to the power module. Set the LINE ON-STANDBY switch to ON.
5. Set the signal generator controls for cw output of —5 dBm at 240 MHz.
6. Remove the read cable A2W2 from the 160—240 MHz INPUT A2A5J1.
7. Connect the equipment as shown in Figure 5-11.
8. Center A2A5R4 (CLK BIAS ADJ).
9. Observe the clock signal on the oscilloscope display.
10. Adjust A2A5R4 to obtain a stable clock frequency.
11. Reduce the signal generator output level while readjusting A2A5R4 to obtain a stable clock signal at the lowest possible signal.

5-33. 20/30 MHz (LFS) Loop Divider Bias Adjustments (Cont'd)

12. Verify that a stable clock signal is obtained with an input signal of −10 dBm or less.

13. Disconnect the test equipment and reinstall A2A5 in its cavity. Reconnect the cable to A2A5J1.

5-34. A2A4 Assembly Notch Filter Adjustment

REFERENCE: Service Sheet 2-A2.

DESCRIPTION: A 7985 Hz signal is passed through the 8 kHz notch filter. The adjustable components are set for minimum signal transfer.

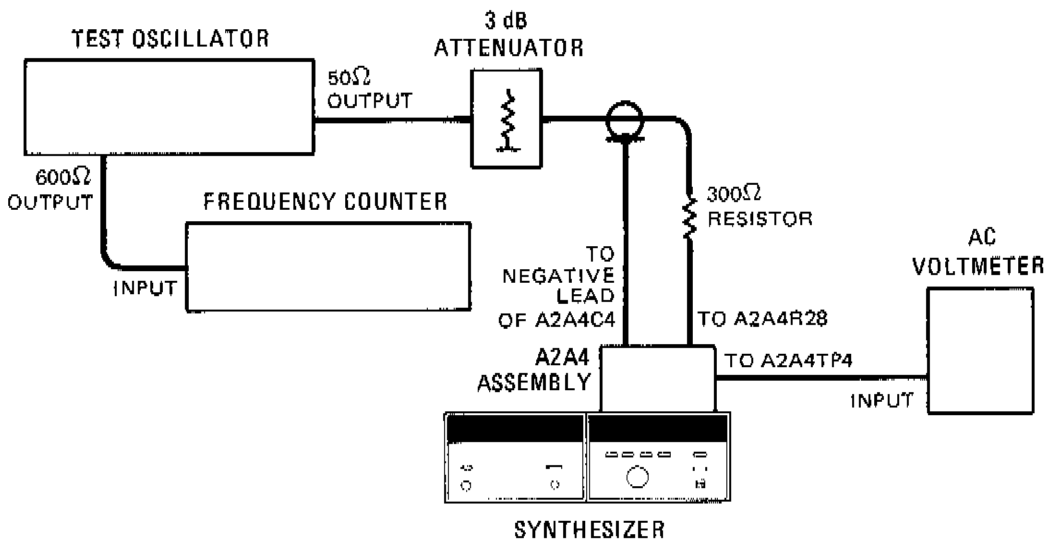


Figure 5-12. A2A4 Assembly Notch Filter Adjustment Test Setup

EQUIPMENT:

Test Oscillator	HP 651B
Frequency Counter	HP 5340A
AC Voltmeter	HP 400E
3 dB Attenuator	HP 8491A Option 003

PROCEDURE: 1. Set the LINE ON-STANDBY switch to STANDBY.

WARNING

Because this circuit board is being placed on en extender board, the possibility of coming in contact with 60 Vdc is greatly increased. Be careful while working on the circuit boards with power supplied. Work with one hand. Do not touch the extender board.

ADJUSTMENTS

5-34. A2A4 Assembly Notch Filter Adjustment (Cont'd)

2. Remove the A2A4 Assembly.
3. Unsolder the input end (top) of A2A4R28 (refer to the component location diagram).
4. Install the circuit board on an extender board.
5. Connect the equipment as shown in Figure 5-12. The leads from the 3 dB attenuator should be as short as possible. Clip the ground wire to the negative side of A2A4C4.
6. Set the test oscillator's controls for 1 kHz and an AC voltmeter indication of +10 dBm.
7. Set the test oscillator as close to 7985 Hz as possible.
8. Adjust A2A4L3 and L4 to minimize the meter reading. The indication must be less than −50 dBm.
9. Resolder A2A4R28, reinstall the A2A4 Assembly, and replace the top cover.

NOTE

If required, proceed to the YTO Loop, Preamp, Driver and Sampler Adjustments.

5-35. A1 RF OUTPUT ASSEMBLY FM SENSITIVITY ADJUSTMENT

REFERENCE: Service Sheet 1-A1.

DESCRIPTION: The FM drive signal is preset for a modulation index of 2.40 (first carrier null). The FM SENS ADJ is then set for the carrier null as observed on a spectrum analyzer's display.

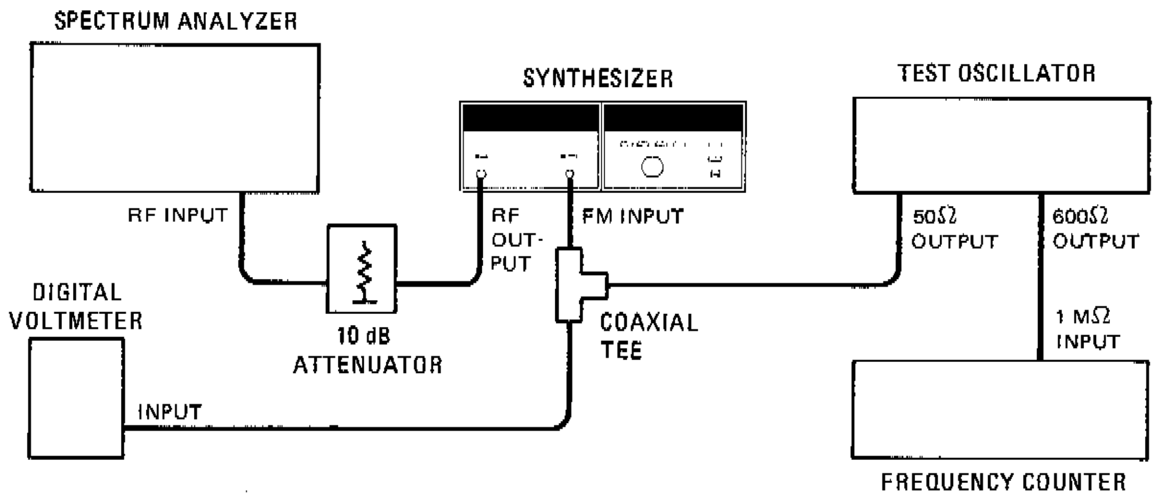


Figure 5-13. FM Sensitivity Adjustment Test Setup

ADJUSTMENTS

5-35. A1 RF OUTPUT ASSEMBLY FM SENSITIVITY ADJUSTMENT (Cont'd)

EQUIPMENT:

Spectrum Analyzer . . . . HP 8565A
Test Oscillator . . . . HP 651B
Frequency Counter . . . . HP 5340A
Digital Voltmeter . . . . HP 3455A
Attenuator, 10 dB . . . . HP 8491B Option 010

PROCEDURE:

1. Set the Synthesizer's controls as follows:

   RF switch . . . . ON
   FM DEVIATION switch . . . . . 10 MHz
   FREQUENCY . . . . 3 GHz

2. Connect the equipment as shown in Figure 5-13.

3. Tune the spectrum analyzer to obtain a display of the carrier.

4. Set the test oscillator's frequency to 100 kHz; set the output level as close as possible to 34.000 mVrms.

5. Set FM SENS ADJ A1A1R3 for the carrier null as observed on the spectrum analyzer's display.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-2 lists abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designator order. Table 6-4 contains the names and addresses that correspond to the manufacturer's code numbers.

6-3. EXCHANGE ASSEMBLIES

6-4. Table 6-1 lists assemblies within the instrument that may be replaced on an exchange basis, thus affording a considerable cost saving. Exchange, 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.

6-5. ABBREVIATIONS

6-6. Table 6-2 lists abbreviations used in the parts list, schematics and throughout the manual. In some cases, two forms of the abbreviation are used, one all in captial letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-7. REPLACEABLE PARTS LIST

6-8. Table 6-3 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numerical order by reference designation.

c. Miscellaneous parts.

6-9. The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. Part number check digit (CD).

c. The total quantity (Qty) in the major assembly (A1, A2, or A3).

d. The description of the part.

e. A typical manufacturer of the part in a five-digit code.

f. The manufacturer's number for the part.

6-10. The total quantity for each part is given only once — at the first appearance of the part number in the list for each major assembly.

NOTE

Total quantities for optional assemblies are totaled by assembly and not integrated into the standard list.

6-11. ORDERING INFORMATION

6-12. To order a part listed in the replaceable parts table, quote the Hewlett-Packard Part number (with the check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

6-13. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-14. SPARE PARTS KIT

6-15. Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has a "Spare Parts Kit" available for this purpose. The kit consists of selected repalceable assemblies and components for this instrument. The contents of the kit and the "Recommended Spares" list are base on failure reports and repair data, and provides parts support for one year. A complimentary "Recommended Spares" list for this instrument may be obtained on request and the "Spare Parts Kit" may be ordered through your nearest Hewlett-Packard office.

Table 6-1. Part Numbers for Exchange Assemblies

Reference Designation	Description	Part Number*	
		Exchange Assy	New Assy
A3A1A4	M/N VCO Assembly	86701-60071	86701-60065
A3A8	10 MHz Reference Oscillator Assembly	86701-60072	86701-60067
A3A9A3	2—6.2 GHz YTO Assembly	5086-6131	5086-7131

*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	double sideband
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	incandescent
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	milliampere
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_o	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	femto	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
A1				RF OUTPUT ASSEMBLY		
A1A1	08671-60002	1	1 1	BOARD ASSEMBLY, FRONT PANEL (A1A1S1 AND S2 MUST BE ORDERED SEPARATELY)	28480	08671-60002
A1A1C1	0180-0229	7	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A1C2	0180-2215	5	2	CAPACITOR-FXD 170UF+75-10% 15VDC AL	56289	30D177G015DD2
A1A1C3	0180-2215	5		CAPACITOR-FXD 170UF+75-10% 15VDC AL	56289	30D177G015DD2
A1A1CR1	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1DS1	2140-0427	5	5	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
A1A1J1	1250-1255	1	2	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1255
A1A1J2	1250-1255	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1255
A1A1K1	0490-1013	6	1	RELAY-REED 1C 250MA 28VDC 5VDC-COIL 3VA	28480	0490-1013
A1A1Q1	1854-0071	7	12	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q5	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q8	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q9	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q10	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q11	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q12	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1R1	0757-0442	9	11	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R2	0698-3400	9	1	RESISTOR 147 1% .5W F TC=0+-100	28480	0698-3400
A1A1R3	0757-0280	3	8	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R4	0757-0378	0	1	RESISTOR 11 1% .125W F TC=0+-100	19701	MF4C1/8-T0-11R0-F
A1A1R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R6	2100-1985	8	1	RESISTOR-TRMR 20 20% C TOP-ADJ 1-TRN	32997	3329H-1-20R
A1A1R7	0757-0795	5	1	RESISTOR 75 1% .5W F TC=0+-100	19701	MF-1/2-T0-75R0-F
A1A1R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R9	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A1A1R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R15	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R17	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R19	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A1A1R20	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R23	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1A1R24	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R25	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1S1	08672-60077	1	2	SWITCH RF ON-OFF	28480	08672-60077
A1A1S2	08672-60077	1		SWITCH, FM DEVIATION	28480	08672-60077
A1A1TP1	1251-0600	0	7	CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A1A1TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A1A1TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A1A1TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A1A1TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A1A1TP6	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A1A1TP7	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A1A1U1	1820-2085	6	1	IC GATE CMOS AND-OR QUAD	07263	F4019PC
A1A1U2	1820-1961	5	1	IC GATE CMOS NAND TPL 3-INP	04713	MC14023BCP
A1A1U3	1820-1962	6	1	IC DCDR CMOS BCD-TO-DEC	04713	MC14028BCP
				A1A1 MISCELLANEOUS		
	08672-20061	9	4	GUIDE, SLIDE SWITCH	28480	08672-20061

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				A1 CHASSIS PARTS		
A1AT1	0960-0362	3	1	ISOLATOR, 2-6.2 GHZ	28480	0960-0362
A1J1				CONNECTOR, RF OUTPUT (PART OF A1W3)		
A1J2				CONNECTOR, BNC (PART OF A1W3)		
	1250-0872	6	1	CONNECTOR-RF SMB FEM UNMTD 50-OHM	28480	1250-0872
	1250-0952	3	1	CONTACT-RF CONN BNC/TNC;FEM CTR	24931	C232-2
	1250-0958	9	1	BUSHING RF CONN BNC/TNC; FOR INTL	24931	CS 105-3
	1250-0960	3	1	SLEEVE-RF CONN SER BNC/TNC	28480	1250-0960
	1250-0964	7	1	NUT-RF CONN BNC/TNC; CLAMP NUT FOR	24931	N126-2
A1J13	1251-2245	3	1	CONNECTOR 50-PIN M D SERIES	28480	1251-2245
A1J14	1251-2204	4	1	CONNECTOR 24-PIN M D SERIES	28480	1251-2204
A1MP1	08731-210	2	1	NUT, LOCK	28480	08731-210
A1MP2	0590-1011	6	1	NUT-KNRLD-R 15/32-32-THD .12-IN-THK	28480	0590-1011
A1MP3	08671-20004	9	1	WINDOW, RF	28480	08671-20004
A1MP4	5040-6927	3	1	DIVIDER STRIP	28480	5040-6927
A1W1	08671-20005	0	1	CABLE ASSEMBLY, RF INPUT	28480	08671-20005
A1W2	08671-20006	1	1	CABLE ASSEMBLY, RF OUTPUT (EXCEPT OPT 005)	28480	08671-20006
A1W2	08671-20008	3	1	CABLE ASSEMBLY, RF OUTPUT (OPT 005 ONLY)	28480	08671-20008
A1W3	08671-60004	3	1	CABLE ASSEMBLY, FM INPUT (INCL A1J2)	28480	08671-60004
	1250-1091	3	1	CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM	28480	1250-1091
				A1 MISCELLANEOUS		
	1400-0510	8	4	CLAMP-CABLE .15-DIA .62-WD NYL	28480	1400-0510
	5020-3440	7	2	SPRING:DETENT	28480	5020-3440
	00310-48801	0	2	WASHER, SHOULDERED	28480	00310-48801
	08671-00001	4	1	DECK, MAIN	28480	08671-00001
	08671-00002	5	1	GUSSET, LEFT	28480	08671-00002
	08671-00003	6	1	GUSSET, RIGHT	28480	08671-00003
	08671-00004	7	1	PANEL, REAR	28480	08671-00004
	08671-00005	8	1	BAR TIE	28480	08671-00005
	08671-00006	9	1	PANEL, FRONT (EXCEPT OPT 005)	28480	08671-00006
	08671-00009	2	1	PANEL, FRONT (OPT 005 ONLY)	28480	08671-00009
	08671-00007	0	1	PANEL, SUB	28480	08671-00007
	08672-40006	4	1	LAMP, HOUSING, LONG	28480	08672-40006
	08672-40007	5	4	LAMP, HOUSING, SHORT	28480	08672-40007
	08672-40008	6	1	BAR LIGHT, LONG	28480	08672-40008
	08672-40009	7	4	BAR LIGHT, SHORT	28480	08672-40009
	08672-40010	0	5	PLUG, LIGHT	28480	08672-40010
	1400-0249	0	3	CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
	1400-0735	9	2	MOUNT-CA TIE .19-DIA .5-WD NYL	28480	1400-0735

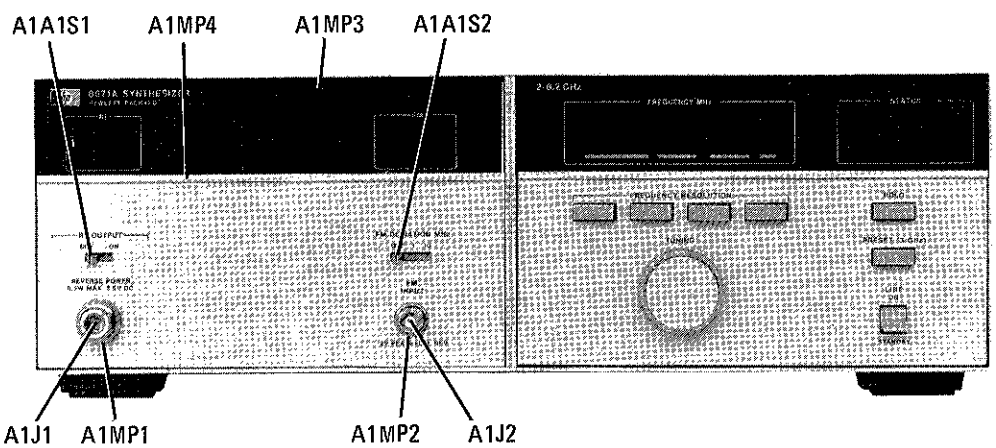


Figure 6-1. A1 Assembly, Front Panel Mechanical Parts

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2				CONTROLLER ASSEMBLY		
A2A1	08672-60100	1	1	ASSEMBLY, FRONT PANEL(THE FOLLOWING CHASSIS PARTS SUPPLIED SEPARATELY: 08672-20032,08672-20035,08672-20036, 08672-20037,08672-40001,08672-40002).	28480	08672-60100
A2A1C1†	0180-0229	7	6	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A1C2	0160-3878	6	9	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A1C3	0160-3878	6		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	23	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	20	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	28480	1901-0040
A2A1CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A1CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A1DS1	2140-0253	5	2	LAMP-INCAND 6839 28VDC 24MA T-1-BULB	71744	CM-6839
A2A1DS2	2140-0092	0	8	LAMP-INCAND 685 5VDC 60MA T-1-BULB	0000J	685 TIP END
A2A1DS3	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	0000J	685 TIP END
A2A1DS4	2140-0253	5		LAMP-INCAND 6839 28VDC 24MA T-1-BULB	71744	CM-6839
A2A1DS5	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	0000J	685 TIP END
A2A1DS6	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	0000J	685 TIP END
A2A1DS7	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	0000J	685 TIP END
A2A1DS8	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	0000J	685 TIP END
A2A1DS9	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	0000J	685 TIP END
A2A1DS10	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	0000J	685 TIP END
A2A1J1	1251-3024	8	2	CONNECTOR 26-PIN M RECTANGULAR	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 PD=300MW FT=200MHZ	28480	1854-0071
A2A1Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A1Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A1Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A1Q5	1853-0020	4	10	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A1Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A1Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A1Q8	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A1R1	0698-7253	8	11	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R2	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R3	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R4	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R5	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
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-G
A2A1R11	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R12	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A2A1R13	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A2A1R14	0698-7264	1	1	RESISTOR 14.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1472-G
A2A1R15	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R16	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R17	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R18	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R19	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A2A1R20	0698-7268	5	2	RESISTOR 21.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2152-G
A2A1R21	0698-7268	5		RESISTOR 21.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2152-G
A2A1R22	0698-7236	7	5	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A2A1R23	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A2A1R24	0698-7244	7	2	RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A2A1R25	0698-7261	8	1	RESISTOR 11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1102-G

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A2A1R26	0698-7260	7	3	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A2A1R27	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A2A1R28	0698-7269	6	1	RESISTOR 23.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2372-G
A2A1R29	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-G
A2A1R30	0698-7273	2	1	RESISTOR 34.8K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3482-G
A2A1R31	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A2A1R32	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A2A1R33	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A2A1R34	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A2A1R36	0698-7212	9	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
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	07263	F4019PC
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 T0-99	27014	LM311H
A2A1U8	1820-1199	1	5	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	CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A2	5060-0329	9	1	GENERATOR, ROTARY PULSE	28480	5060-0329
A2A3	08672-60006	6	1	ASSEMBLY, VCO, 160-240 MHZ	28480	08672-60006
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
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†	0160-2200	6	1	CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
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

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

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	28480	0122-0085
A2A3CR2	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	28480	0122-0085
A2A3CR3	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	28480	0122-0085
A2A3CR4	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	28480	0122-0085
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	COIL-MLD 2.7UH 10% Q=33 .155DX.375LG-NOM	28480	9140-0180
A2A3L2	9100-2583	1	2	COIL-MLD 6.8MH 10% Q=40 .156DX.375LG-NOM	28480	9100-2583
A2A3L3	9100-2583	1		COIL-MLD 6.8MH 10% Q=40 .156DX.375LG-NOM	28480	9100-2583
A2A3L4	9100-2249	6	1	COIL-MLD 150NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2249
A2A3L5	9100-0346	0	1	COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A2A3L6	9100-2248	5	2	COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
A2A3L7	9100-2254	3	1	COIL-MLD 390NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2254
A2A3L8	9100-2248	5		COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
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	C4-1/8-T0-2152-F
A2A3R2	0757-0442	9	14	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A3R3	0698-3156	2	2	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-3161-F
A2A3R6	0757-0280	3	27	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A3R7	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A3R8	0757-0278	9	4	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A2A3R9	0757-0346	2	4	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A3R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A3R11	0698-3444	1	12	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R12	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R13	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
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	C4-1/8-T0-316R-F
A2A3R16	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A2A3R17	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A3R18	0698-3440	7	2	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A2A3R19	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A2A3R20	0698-3160	8	4	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A3R21	0698-3452	1	2	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-511R-F
A2A3R24	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A2A3R25	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R26	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A3R27	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A2A3R28	0757-0418	9	4	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A2A3R29	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A3R30	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A2A3R31	0698-0083	8	24	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A3R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A3R33	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R34†	0757-0401	0	4	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A3S1	3101-1524	4	1	SWITCH-SL DP3T-NS SUBMIN .5A 125VAC/DC	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
	08672-20026	6	1	VCO COVER	28480	08672-20026

See introduction to this section for ordering information
† BACKDATING INFORMATION IN SECTION VII

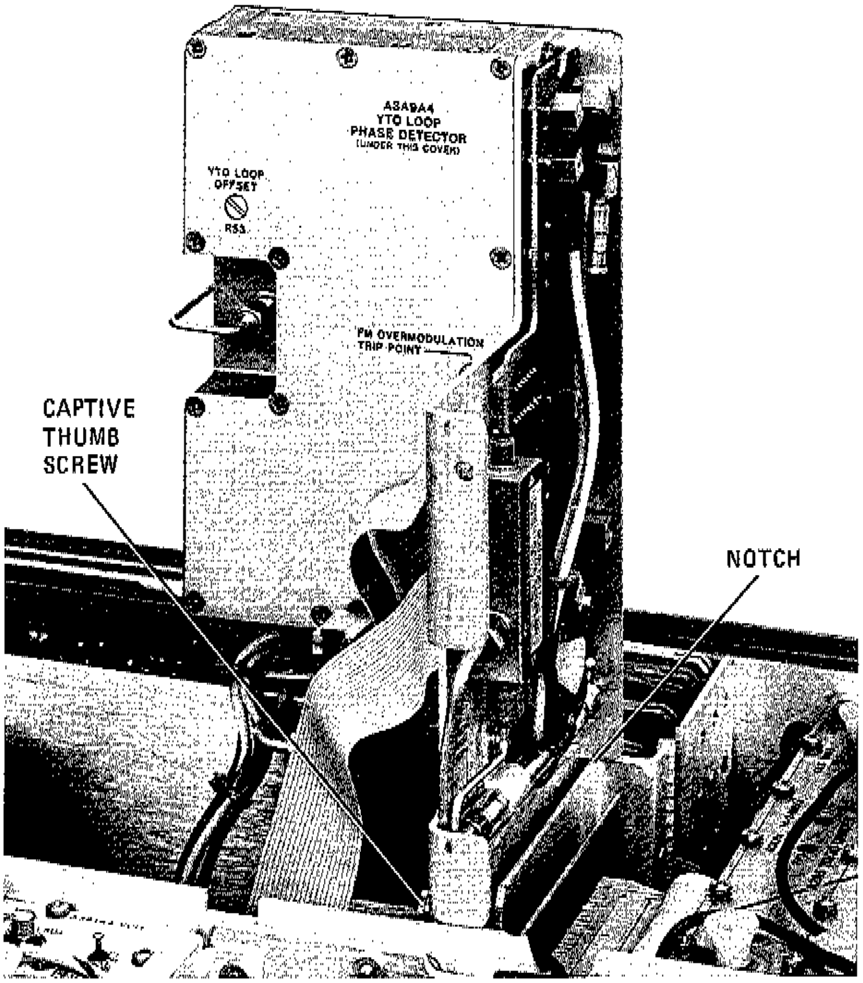


Figure 8-5. A3A9 Assembly in Service Position

Disassembly and Reassembly Procedures (Cont'd)

f. Secure the assembly into place by tightening the captive thumb screw into the pressed-in nut.

g. Connect a test cable from A3A9A1J1 to A1AT1J1 for troubleshooting and testing purposes.

CAUTION

When reinstalling the A3A9 Assembly, be careful ot to crush or pinch the coaxial or flat ribbon cables.

8-51. Battery Replacement. To replace the batteries, follow the steps listed below:

a. Remove the top cover as in paragraph 8-43.

b. Grasp the top of the battery holder's clip and pull forward until it slips off.

c. Grip the battery pack on both sides with your fingers and pull straight out.

d. Position the new battery pack so the metal strips press against the flexible contacts of the battery holder.

e. Slip the small end of the battery clip over the bottom end of the battery holder. Snap the top end of the clip into place.

8-52. LOGIC SYMBOLS

8-53. The logic symbols used in this manual are based on the American National Standard ANSI Y32.14-1973, "Graphic Symbols for Logic Dia-

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A2A4VR1	1902-3234	3	1	DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	28480	1902-3234
				A2A4 MISCELLANEOUS		
	1205-0250	9	2	THERMAL LINK SGL TO-5/TO-39-PKG	28480	1205-0250
	08672-20027	7	1	COVER, PHASE DETECTOR	28480	08672-20027
	86701-40001	9		EXTRACTOR	28480	86701-40001
A2A5	08672-60008	8	1	ASSEMBLY, 20/30 DIVIDER	28480	08672-60008
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
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	28480	1901-0040
A2A5J1	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A5L1	08672-80001	3	7	INDUCTOR, TOROID	28480	08672-80001
A2A5L2	9100-1618	1	1	COIL-MLD 5.6UH 10% Q=45 .155DX.375LG-NOM	28480	9100-1618
A2A5L3	08672-80001	3		INDUCTOR, TOROID	28480	08672-80001
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	C4-1/8-T0-68R1-F
A2A5R3	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A5R4	2100-2413	9	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	30983	ET50X201
A2A5R5	0698-7216	3	16	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R6	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R7	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R8	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A5R12	0698-3150	6	2	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A2A5R13	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A5R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A5R16	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R17	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R18	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R19	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R20	0698-3157	3	1	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A2A5R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R23	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R24	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R25	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R26	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R27	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R29	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A2A5R30	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A2A5R31	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A2A5R32	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R34	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R35	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A5R36	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5R37	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A2A5TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A5TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A5TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A5TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A5TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A5TP6	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	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
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	52648	SP8641B
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 ASYNCHRO NEG-EDGE-TRIG	01295	SN74196N
A2A5U14	1820-0751	9		IC CNTR TTL DECD ASYNCHRO NEG-EDGE-TRIG	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-PKG	28480	1205-0250
	08672-20028	8	1	COVER, DIVIDER	28480	08672-20028
	86701-40001	9		EXTRACTOR, P.C. BOARD	28480	86701-40001
A2A6	08672-60014	6	1	ASSEMBLY, INTERCONNECT	28480	08672-60014
A2A6J1	1251-3495	7	1	CONNECTOR 50-PIN M D SERIES	28480	1251-3495
A2A6J2	1251-3025	9	2	CONNECTOR 34-PIN M RECTANGULAR	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	1	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	28480	1901-0040
A2A7CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A7CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A7CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A7CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A7CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A7CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A7DS1	1990-0404	8	4	LED-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A2A7DS2	1990-0404	8		LED-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A2A7DS3	1990-0404	8		LED-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A2A7DS4	1990-0404	8		LED-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A2A7J1	1251-3025	9		CONNECTOR 34-PIN M RECTANGULAR	28480	1251-3025
A2A7L1	08672-80001	3		INDUCTOR, TOROID	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 PD=300MW FT=200MHZ	28480	1854-0071
A2A7Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
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	C4-1/8-T0-2152-F
A2A7R2	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R3	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R4	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R5	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A7R6	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R7	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R9	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R10	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R11	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R12	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R13	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R14	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R15	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R16	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R17	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R18	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R19	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R20	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R21	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R22	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R23	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R24	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R25	0757-0465	6	7	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A7R26	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A7R27	0698-3450	9	1	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A2A7R28	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A2A7R29	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R30	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R31	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A7R33	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R34	0698-3442	9	5	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A7R35	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A7R36	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A7R37	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A7R38	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R39	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R40	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A7R41	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R42	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A2A7R43	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A7R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7R45	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R46	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A7R47	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A7R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A7U1	1826-0502	0	5	IC SWITCH 16-DIP-P	04713	MC14066BCP
A2A7U2	1826-0502	0		IC SWITCH 16-DIP-P	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	07263	F4029PC
A2A7U5	1820-1962	6		IC DCDR CMOS BCD-TO-DEC	04713	MC14028BCP
A2A7U6	1820-1746	4	12	IC BFR CMOS INV HEX	04713	MC14049BCP
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 16-DIP-P	04713	MC14066BCP
A2A7U10	1826-0502	0		IC SWITCH 16-DIP-P	04713	MC14066BCP
A2A7U11	1826-0502	0		IC SWITCH 16-DIP-P	04713	MC14066BCP
A2A7U12	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
A2A7U13	1820-1745	3	8	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	01928	CD4013BAE
A2A7U18	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
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	6	IC BFR CMOS NON-INV HEX	01928	CD4050BE
A2A7U25	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A7U26	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
				A2A7 MISCELLANEOUS		
	1480-0073	6	8	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3	5	EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0750	7	1	EXTRACTOR-PC BOARD RED POLYC	28480	4040-0750

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A8	08672-60011	3	1	ASSEMBLY, OUTPUT REGISTER	28480	08672-60011
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
A2A8DS1	2140-0016	8	1	LAMP-INCAND 683 5VDC 60MA T-1-BULB	08806	683
A2A8L1	08672-80001	3		INDUCTOR, TOROID	28480	08672-80001
A2A8Q1	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A8Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A8Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A8Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A8R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A8R2	0683-1055	5	1	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A2A8R3	0757-0461	2	2	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A2A8R4	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R5	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R6	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R7	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R9	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A2A8R10	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R11	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A2A8R12	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A8R13	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R14	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R15	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A8R17	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R18	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R19	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R20	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R21	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R22	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A8R23	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A8R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A8R25	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A2A8R26	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A2A8TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A8TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A2A8TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	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
A2A8U4	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
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	01928	CD4008BE
A2A8U11	1820-2080	1		IC SHF-RGTR CMOS SYNCHRO PRL-IN PRL-OUT	04713	MC14035BCP
A2A8U12	1820-0497	0	4	IC SHF-RGTR TTL L R-S PRL-IN PRL-OUT	01295	SN74L95N
A2A8U13	1820-0497	0		IC SHF-RGTR TTL L R-S PRL-IN PRL-OUT	01295	SN74L95N
A2A8U14	1820-0497	0		IC SHF-RGTR TTL L R-S PRL-IN PRL-OUT	01295	SN74L95N
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	01928	CD4008BE
A2A8U18	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	01928	CD4008BE
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	01928	CD4008BE
A2A8U21	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A8U22	1820-0497	0		IC SHF-RGTR TTL L R-S PRL-IN PRL-OUT	01295	SN74L95N
A2A8U23	1820-0656	3	2	IC MUXR/DATA-SEL TTL L 2-TO-1-LINE QUAD	01295	SN74L98N
A2A8U24	08672-80007	9	2	IC, ROM	28480	08672-80007
A2A8U25	08672-80007	9		IC, ROM	28480	08672-80007
A2A8U26	1820-1976	2		IC BFR CMOS NON-INV HEX	01928	CD4050BE
A2A8U27	1820-1976	2		IC BFR CMOS NON-INV HEX	01928	CD4050BE
A2A8U28	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
A2A8U29	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	01928	CD4008BE

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				A2A8 MISCELLANEOUS		
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0753	0	1	EXTRACTOR-PC BOARD GRN POLYC	28480	4040-0753
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% 25VDC CER	28480	0160-0174
A2A9CR1	1901-0518	8	13	DIODE-SCHOTTKY	28480	1901-0518
A2A9CR2	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A9CR3	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A9CR4	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A9CR5	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A9J1	1251-3283	1	1	CONNECTOR 24-PIN F MICRORIBBON	28480	1251-3283
A2A9L1	08672-80001	3		INDUCTOR, TOROID	28480	08672-80001
A2A9Q1	1854-0039	7	1	TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	04713	2N3053
A2A9R1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R2	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R3	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A9R4	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A9R5	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R6	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A9R7	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A9R8	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A9R9	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A9R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A9R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A9R13	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A9R14	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A9R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A9R16	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A9R17	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R18	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A9R19	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A9R20	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A9R21	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A9R22	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R23	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A9R24	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A9R25	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R26	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R27	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R28	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R29	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R30	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A9R31	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-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-INPT	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	SN74LS74N
A2A9U6	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A9U7	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
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 MISC TTL* QUAD	04713	MC3440P
A2A9U13	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A9U14	1820-1522	4		IC MISC TTL* QUAD	04713	MC3440P
A2A9U15	1820-1961	5		IC GATE CMOS NAND TPL 3-INP	04713	MC14023BCP

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	01928	CD4027BE
A2A9U18	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
A2A9U19	1820-1964	8		IC FF CMOS J-K POS-EDGE-TRIG DUAL	01928	CD4027BE
A2A9U20	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A2A9U21	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
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	01928	CD4013BAE
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	01928	CD4050BE
A2A9U29	1820-1558	6	2	IC MISC TTL* QUAD	04713	MC3441P
A2A9U30	1820-1558	6		IC MISC TTL* QUAD	04713	MC3441P
				A2A9 MISCELLANEOUS		
	0380-0643	3	2	STANDOFF-METRIC LONG STUD MOUNT FOR CONN	28480	0380-0643
	1200-0173	5	1	INSULATOR-XSTR DAP-GL	28480	1200-0173
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	1530-1098	4	2	CLEVIS 0.070-IN W SLT; 0.454-IN PIN CTR	00000	ORDER BY DESCRIPTION
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0755	2	2	EXTRACTOR-PC BOARD VIO POLYC	28480	4040-0755
A2A10	08672-60010	2	1	ASSEMBLY, REGISTER I	28480	08672-60010
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
A2A10CR1	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A10CR2	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A10L1	08672-80001	3		INDUCTOR, TOROID	28480	08672-80001
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	C4-1/8-T0-2152-F
A2A10R2	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R3	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R4	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R5	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R6	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R7	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A10R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A10R9	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A2A10R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A10R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R13	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R14	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R15	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R17	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R18	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A10R20	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-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	08672-80005	7	1	IC, ROM	28480	08672-80005
A2A10U4	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
A2A10U5	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A10U6	1820-1976	2		IC BFR CMOS NON-INV HEX	01928	CD4050BE
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	01928	CD4050BE
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	08672-80006	8	1	IC, ROM	28480	08672-80006
A2A10U15	1820-0910	2	4	IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS83N
A2A10U16	1820-0961	3	1	IC SHF-RGTR CMOS D-TYPE PRL-IN	01928	CD4021AF
A2A10U17	1820-1976	2		IC BFR CMOS NON-INV HEX	01928	CD4050BE
A2A10U18	1820-1976	2		IC BFR CMOS NON-INV HEX	01928	CD4050BE
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

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	1820-1745	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A2A10U25	1820-0656	3		IC MUXR/DATA-SEL TTL L 2-TO-1-LINE QUAD	01295	SN74L98N
				A2A10 MISCELLANEOUS		
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0755	2		EXTRACTOR-PC BOARD VIO POLYC	28480	4040-0755
A2A11	08672-60012	4	1	ASSEMBLY, TIMING AND CONTROL	28480	08672-60012
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% 25VDC 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	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A11C19	0160-2208	4	1	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A2A11C20†	0160-3877	5	1	CAPACITOR-FXD 100PF+-20% 200VDC CER	28480	0160-3877
A2A11CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR4	1901-0376	6	2	DIODE-GEN PRP 35V 50MA DO-7	28480	1901-0376
A2A11CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR7	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-7	28480	1901-0376
A2A11CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR9	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A11CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR12	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A11CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR14	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A11CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR16				NOT ASSIGNED		
A2A11CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A11CR19				NOT ASSIGNED		
A2A11CR20	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A11CR21	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A11L1	08672-80001	3		TOROID FILTER	28480	08672-80001
A2A11Q1	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A11Q2	1853-0015	7	1	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A2A11Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A11Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
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	C4-1/8-T0-316R-F
A2A11R2	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A11R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A11R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A11R5	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A11R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A11R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A11R10	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R11	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A11R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A11R13	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A11R14	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R15	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F

See introduction to this section for ordering information

† 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	C4-1/8-T0-8252-F
A2A11R17	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A11R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A11R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A11R20	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R21	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R22	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A11R23	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R24	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A11R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A11R26	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A11R27	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A2A11R28	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A11R29	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A11R30	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A11R31	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A11R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A11R33	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R34	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R35	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R36	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A11R37	0757-0463	4		RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A2A11R38	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A11R39	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A11R40	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A2A11R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A11R42	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A11R43	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A11R44	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A11R45	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A2A11R46	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A11R47	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A11S1	3101-1277	4	1	SWITCH-TGL SUBMIN SPDT NS .5A 120VAC PC	28480	3101-1277
A2A11U1	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049BCP
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	01928	CD4013BAE
A2A11U4	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	01928	CD4013BAE
A2A11U5	1820-1144	6	2	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A2A11U6	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A2A11U7	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A2A11U8	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A11U9	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
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	MC14049BCP
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	SN74LS86N
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	1850-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A11U20	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	01928	CD4013BAE
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	08672-80004	6	1	PROM PROGRAMMED	28480	08672-80004
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	01928	CD4013BAE
A2A11U28	1820-1963	7		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	01928	CD4013BAE
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	SN74LS83N
A2A11U31	1820-0910	2		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS83N
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	SN74LS83N
				A2A11 MISCELLANEOUS		
	0340-0060	4	1	TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	28480	0340-0060
	0360-1730	9	12	CONNECTOR-SGL CONT PIN .058-IN-BSC-SZ	28480	0360-1730
	4040-0747	2	1	EXTRACTOR-PC BOARD GRA POLYC	28480	4040-0747
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A12	08672-60015	7	1	BOARD ASSEMBLY, MOTHER (A2A12W1 SUPPLIED SEPARATELY)	28480	08672-60015
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	28480	1901-0040
A2A12CR2	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A2A12CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A12J1	1251-3024	8		CONNECTOR 26-PIN M RECTANGULAR	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	C4-1/8-T0-101-F
A2A12R2	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A12VR1	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
A2A12W1	8120-2117	8	1	CABLE ASSY-COAX 11.94-IN-LG BLK	28480	8120-2117
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	12,1-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
				A2A12 MISCELLANEOUS		
	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
				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, SOLID STATE	28480	1990-0651
A2DS2	1990-0651	7		DISPLAY, SOLID STATE	28480	1990-0651
A2DS3	1990-0651	7		DISPLAY, SOLID STATE	28480	1990-0651
A2DS4	1990-0651	7		DISPLAY, SOLID STATE	28480	1990-0651
A2DS5	1990-0506	1	4	DISPLAY-NUM DOT MAT 1-CHAR .29-H	28480	5082-7300, CAT E
A2DS6	1990-0506	1		DISPLAY-NUM DOT MAT 1-CHAR .29-H	28480	5082-7300, CAT E
A2DS7	1990-0506	1		DISPLAY-NUM DOT MAT 1-CHAR .29-H	28480	5082-7300, CAT E
A2DS8	1990-0506	1		DISPLAY-NUM DOT MAT 1-CHAR .29-H	28480	5082-7300, CAT E
A2MP1	08672-40005	3	6	PUSHBUTTON	28480	08672-40005
A2MP2	0370-2389	7	1	KNOB-BASE 1-1/2 JGK .25" ID	28480	0370-2389
A2MP3	5040-6927	3	1	DIVIDER STRIP	28480	5040-6927
A2MP4	08671-20003	8	1	WINDOW, CONTROLLER (8671A ONLY)	28480	08671-20003
	08672-20033	5	1	WINDOW, CONTROLLER (8672A ONLY)	28480	08672-20033
A2S1	3101-0613	0	1	SWITCH-TGL SUBMIN SPDT NS 5A 120VAC PC	28480	3101-0613
A2W1	08672-60026	0	1	CABLE,RIBBON,26-CONDUCTOR(A2A1 TO A2A12)	28480	08672-60026
	1251-3880	4	2	CONNECTOR 26-PIN F RECTANGULAR	28480	1251-3880
A2W2	08672-60030	6	1	CABLE ASSEMBLY, VCO OUTPUT,RED	28480	08672-60030
	1250-0872	6	2	CONNECTOR-RF SMB FEM UNMTD 50-OHM	28480	1250-0872
A2W3	08672-60058	8	1	CABLE ASSEMBLY,34-CONDUCTOR(A2A6 TO A2A7	28480	08672-60058
	1251-3511	8	2	CONNECTOR 34-PIN F RECTANGULAR	28480	1251-3511

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2XBT1	08672-60029	3	1	BATTERY HOLDER ASSEMBLY	28480	08672-60029
				INCLUDES:		
	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
	0400-0082	8	1	GROMMET-CHAN NCH .09-IN-GRV-WD	28480	0400-0082
	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
				A2 MISCELLANEOUS		
	0510-1148	2	4	RETAINER-PUSH ON KB-TO-SHFT EXT .156-DIA	28480	0510-1148
	7100-0647	2	1	CAN/COVER .531"DP-OUT,.969"WD-OUT	28480	7100-0647
	08672-00001	5	1	PANEL, SUB-FRONT	28480	08672-00001
	08672-00002	6	1	PANEL, RIGHT-FRONT	28480	08672-00002
	08672-20032	4	1	HEAT SINK, L.E.D.	28480	08672-20032
	08672-20035	7	1	LIGHT PIPE, LONG	28480	08672-20035
	08672-20036	8	3	LIGHT PIPE, MEDIUM	28480	08672-20036
	08672-40001	9	2	HOUSING, LAMP	28480	08672-40001
	08672-40002	0	6	BAR, LIGHT	28480	08672-40002
	08672-00003	7	1	GUSSET, CENTER	28480	08672-00003
	08672-00004	8	1	GUSSET, RIGHT	28480	08672-00004
	08672-00005	9	1	GUSSET, ADAPTER BOARD	28480	08672-00005
	08672-00006	0	1	BAR, TIE RIGHT	28480	08672-00006
	08672-00008	2	1	SUPPORT, FRONT PANEL, RIGHT	28480	08672-00008
	08672-00012	8	1	COVER, DIGITAL BOARDS	28480	08672-00012
	08672-00013	9	1	PANEL, REAR-SUB	28480	08672-00013
	08672-00015	1	1	SUPPORT, BOTTOM	28480	08672-00015
	08672-00018	4	1	PLATE, REAR GUIDE	28480	08672-00018
	08672-00020	8	1	PANEL, REAR, HP-IB	28480	08672-00020
	08672-20031	3	1	HOUSING, AMPLIFIER	28480	08672-20031
	08672-20037	9	2	SUPPORT, FRONT PANEL	28480	08672-20037

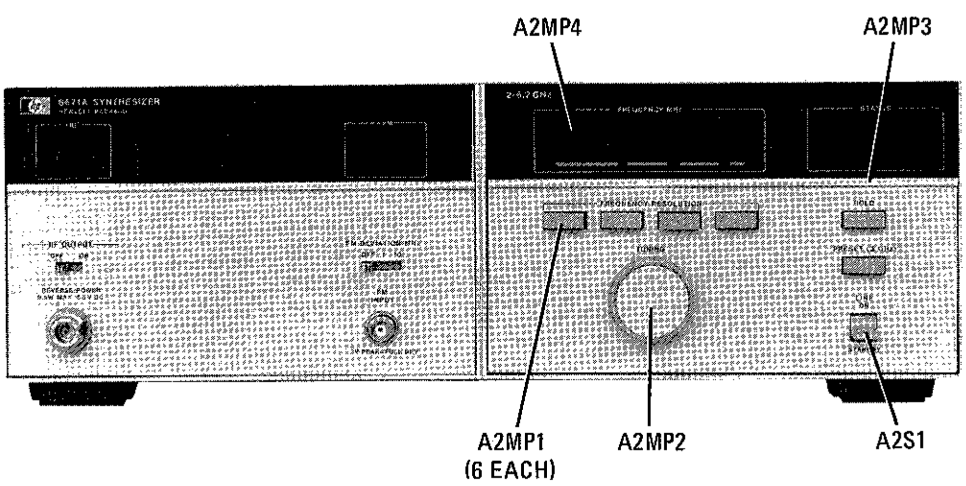


Figure 6-2. A2 Assembly, Front Panel Mechanical Parts

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3				RF SOURCE ASSEMBLY		
A3A1				M/N REFERENCE ASSEMBLY		
A3A1A1	86701-60021	5	1	REFERENCE PHASE DETECTOR ASSEMBLY	28480	86701-60021
A3A1A1C1	0180-0197	8	19	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				NOT ASSIGNED		
A3A1A1C5	0140-0190	7	2	CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3A1A1C6	0160-3879	7	30	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C7	0160-2055	9	52	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
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	00908	T368-B-106-M-025-AS
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	0160-3446	4	1	CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3446
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		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	4	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	35	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A1C60	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C61	0160-3454	4	24	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-SCHOTTKY	28480	1901-0518
A3A1A1CR2	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A3A1A1CR3	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A3A1A1CR4	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A3A1A1CR5	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1CR6	1901-0518	8		DIODE-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	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	COIL-MLD 82UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0238
A3A1A1L2	9140-0238	3		COIL-MLD 82UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0238
A3A1A1L3	9140-0143	9	3	COIL-MLD 3.3UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0143
A3A1A1L4	9140-0143	9		COIL-MLD 3.3UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0143
A3A1A1L5	9100-2261	2	1	COIL-MLD 2.7UH 10% Q=40 .095DX.25LG-NOM	28480	9100-2261
A3A1A1L6	9140-0114	4	1	COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A3A1A1L7	9100-2255	4	4	COIL-MLD 470NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2255
A3A1A1L8	9100-0368	6	4	COIL-MLD 330NH 10% Q=28 .095DX.25LG-NOM	28480	9100-0368
A3A1A1L9	9100-2257	6	3	COIL-MLD 820NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2257
A3A1A1L10	9100-2255	4		COIL-MLD 470NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2255
A3A1A1L11	9100-2257	6		COIL-MLD 820NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2257
A3A1A1L12	9100-2255	4		COIL-MLD 470NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2255
A3A1A1L13	9100-2257	6		COIL-MLD 820NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2257
A3A1A1L14	9100-2255	4		COIL-MLD 470NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2255
A3A1A1L15	9100-2256	5	1	COIL-MLD 560NH 10% Q=34 .095DX.25LG-NOM	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	17	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	C4-1/8-T0-82R5-F
A3A1A1R2	0757-0417	8	1	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A3A1A1R3	0757-0416	7	18	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A1R4	0757-0401	0	25	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A1R5	0698-3156	2	3	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3A1A1R6	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A1R7	0757-0420	3	4	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A1A1R8	0757-0438	3	20	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A1R9	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1A1R10	0698-7222	1	2	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A3A1A1R11	0698-7219	6	7	RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A3A1A1R12	0757-0442	9	20	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R13	0698-3453	2	3	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A3A1A1R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R15	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A3A1A1R16	0757-0441	8	6	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A1A1R17	0698-3438	3	3	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A3A1A1R18	0757-0346	2	32	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R19	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R20	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A1A1R21	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A3A1A1R22	0698-3136	8	1	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A3A1A1R23	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R24	0698-3154	0	12	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R25	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R26	0757-0280	3	23	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R27	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R28	0698-3450	9	3	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A3A1A1R29	0698-3449	6	2	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A3A1A1R30	0757-0444	1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A3A1A1R31	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R32	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R33	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R34	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R36	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A3A1A1R37	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A3A1A1R38	0757-0421	4	9	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A1A1R39	0757-0440	7	5	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A1A1R40	0757-0394	0	16	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A1R41	0698-3446	3	2	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A3A1A1R42	0698-0085	0	7	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A1A1R43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R45	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1R46	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R47	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A3A1A1R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R49	0698-7285	6	1	RESISTOR 110K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1103-G
A3A1A1R50	0698-3157	3	6	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A1A1R51	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A1A1R52	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A1R53	0698-3440	7	8	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A1A1R54	0698-7234	5	1	RESISTOR 825 1% .05W F TC=0+-100	24546	C3-1/8-T0-825R-G
A3A1A1R55	0698-7257	2	1	RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-G
A3A1A1R56	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A1R57	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A3A1A1R58	0698-7246	9	1	RESISTOR 2.61K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2611-G
A3A1A1R59	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A1A1R60	0757-0276	7	3	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A3A1A1R61	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R62	0757-1094	9	3	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3A1A1R63	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A1A1R64	0698-3132	4	4	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A3A1A1R65	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A1A1R66	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A1A1R67	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R68	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A1R69	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A1R70	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A1R71	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3A1A1R72	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A3A1A1R73	0757-0317	7	3	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A3A1A1R74	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A3A1A1R75†	0698-7236	7	4	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A3A1A1T1	08552-6044	1	2	TRANSFORMER, RF, 5-PIN	28480	08552-6044
A3A1A1T2	08552-6044	1		TRANSFORMER, RF, 5-PIN	28480	08552-6044
A3A1A1TP1	1251-0600	0	48	CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A1U1	1821-0001	4	1	TRANSISTOR ARRAY	01928	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 301 OP AMP TO-99	18324	LM301A
A3A1A1U6	1820-0429	8	1	IC V RGLTR TO-39	18324	LM309H
A3A1A1VR1	1902-3082	9	3	DIODE-ZNR 4.64V 5% DO-7 PD=.4W TC=-.023%	28480	1902-3082
A3A1A1VR2†	1902-3256	9	1	DIODE-ZNR 23.7V 5% DO-7 PD=.4W TC=+.076%	28480	1902-3256
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-PKG	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	6	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	10	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 250V	28480	0121-0495
A3A1A2C2	0121-0495	5		CAPACITOR-V TRMR-AIR 1.9-15.7PF 250V	28480	0121-0495
A3A1A2C3	0121-0495	5		CAPACITOR-V TRMR-AIR 1.9-15.7PF 250V	28480	0121-0495
A3A1A2C4	0121-0453	5	1	CAPACITOR-V TRMR-AIR 1.3-5.4PF 250V	74970	187-0103-195
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	0160-2256	2	1	CAPACITOR-FXD 9.1PF +-.25PF 500VDC CER	28480	0160-2256
A3A1A2C9	0160-4084	8	10	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

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
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	C067F251F222M822-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
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-SCHOTTKY	28480	1901-0539
A3A1A2CR4	1901-0539	3		DIODE-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	COIL-MLD 150NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2249
A3A1A2L3	9140-0158	6	2	COIL-MLD 1UH 10% Q=32 .095DX.25LG-NOM	28480	9140-0158
A3A1A2L4*	9100-2252	1	1	COIL-MLD 270NH 10% Q=30 .095DX.25LG-NOM	28480	9100-2252
A3A1A2L5	9100-2538	6	1	COIL-MLD 1UH 10% Q=44 .156DX.375LG-NOM *FACTORY SELECTED PART	28480	9100-2538
A3A1A2L6	9100-2251	0	5	COIL-MLD 220NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2251
A3A1A2L7	9100-2251	0		COIL-MLD 220NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2251
A3A1A2L8	9100-2251	0		COIL-MLD 220NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2251
A3A1A2L9	9100-2251	0		COIL-MLD 220NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2251
A3A1A2L10				PART OF CIRCUIT BOARD		
A3A1A2L11				PART OF CIRCUIT BOARD		
A3A1A2L12				PART OF CIRCUIT BOARD		
A3A1A2L14	9100-2247	4	2	COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A3A1A2L15	9100-2247	4		COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A3A1A2Q1	1854-0345	8	21	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	17	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	5	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A1A2R2	0757-0419	0	2	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A3A1A2R3	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A1A2R4	0757-0422	5	9	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R5	0698-3155	1	11	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A2R6	0698-7224	3	6	RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A3A1A2R7	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A2R8	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A2R10	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R11	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R12	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R13	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R15	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R16	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R17	0698-3150	6	19	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R18	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R19	0698-7198	0	2	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A3A1A2R20	0698-3443	0	7	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-287R-F
A3A1A2R23	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R24	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R25	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R26	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R27	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A2R28	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R29	0698-7198	0		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A3A1A2R30	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
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	C4-1/8-T0-287R-F
A3A1A2R33	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-287R-F
A3A1A2R36	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R37	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R38	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R39	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R40	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R41	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R42	0698-0084	9	7	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A1A2R43	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A1A2R44	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A1A2R45	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A1A2R46	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A1A2R47	0757-0439	4	3	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A3A1A2R48	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R49	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A1A2R50	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A3A1A2R51	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R52	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A2R53	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R54	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R55	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R57	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R58	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R59	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A2R61	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A3A1A2R62	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R63				NOT ASSIGNED		
A3A1A2R64				NOT ASSIGNED		
A3A1A2R65				NOT ASSIGNED		
A3A1A2R66				NOT ASSIGNED		
A3A1A2R67*	0698-3441	8	4	RESISTOR 215 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-215R-F
A3A1A2R68*	0698-3431	6	1	RESISTOR 23.7 1% .125W F TC=0+-100 *FACTORY SELECTED PART	03888	PME55-1/8-T0-23R7-F
A3A1A2R69*	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-215R-F
A3A1A2T1	08553-6012	5	3	TRANSFORMER, RF, BLUE	28480	08553-6012
A3A1A2T2	08553-6012	5		TRANSFORMER, RF, BLUE	28480	08553-6012
A3A1A2T3	08553-6012	5		TRANSFORMER, RF, BLUE	28480	08553-6012
A3A1A2TP1				PART OF A3A1A2C56		
A3A1A2TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A2TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A2TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A2W1	86701-60031	7	1	CABLE ASSEMBLY, GRAY/RED/WHITE	28480	86701-60031
A3A1A2Y1†	0410-1086	5	1	CRYSTAL, 3.5714 MHZ +-0.001%	28480	0410-1086
				A3A1A2 MISCELLANEOUS		
	2190-0009	4	14	WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2200-0101	0		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2580-0002	4	22	NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	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	86701-60019	1	1	M/N PHASE DETECTOR ASSEMBLY	28480	86701-60019
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
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	1	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	COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A3A1A3L2	9100-2259	8	2	COIL-MLD 1.5UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2259
A3A1A3L3	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A3A1A3L4	9100-2562	6	2	COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A3A1A3L5	9100-2562	6		COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	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	C4-1/8-T0-4221-F
A3A1A3R2	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A3R3				NOT ASSIGNED		
A3A1A3R4	0698-7212	9	12	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A1A3R5	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A3A1A3R6				NOT ASSIGNED		
A3A1A3R7	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A3A1A3R8	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A1A3R9	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A3A1A3R10	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A3A1A3R11	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A3R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-511R-F
A3A1A3R15	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A3R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A3R17	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A3R18	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A3R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A3R20	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A1A3R21	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A3R22	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A3R23	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A3A1A3R24	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A3A1A3R25	0698-0083	8	13	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A1A3R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A3R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A3R28	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A3TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP6	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP7	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP8	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP9	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP10	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3TP11	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A1A3U1	1820-1344	8	2	IC PL LOOP 14-DIP-C	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-PIN-SIP .1-PIN-SPCG	28480	1810-0251
A3A1A3U6	1810-0204	6	7	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A3A1A3U7	1826-0092	3	4	IC OP AMP TO-99	28480	1826-0092
A3A1A3U8	1820-0821	4	2	IC CNTR ECL BIN UP/DOWN SYNCHRO	04713	MC10136L
A3A1A3U9	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A3A1A3U10	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	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-PIN-SIP .1-PIN-SPCG	28480	1810-0251
A3A1A3U15	1856-0059	2	1	IC 201A OP AMP TO-99	07263	LM201AH
A3A1A3U16	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	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	1820-0821	4		IC CNTR ECL BIN UP/DOWN SYNCHRO	04713	MC10136L
A3A1A3U20	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A3A1A3U21	1810-0204	6		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R1K
A3A1A3U22	1810-0251	3		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	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-7 PD=.4W TC=-.023%	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-LG SST	28480	0590-0533
	1205-0285	0		HEAT SINK SGL DIP-PKG	28480	1205-0285
	2190-0014	1	5	WASHER-LK INTL T NO. 2 .089-IN-ID	28480	2190-0014
	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
	2200-0103	2	67	SCREW-MACH 4-40 .25-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	86701-60065	7	1	M/N VCO ASSEMBLY	28480	86701-60065
A3A1A4A1	86701-60029	3	1	VCO RESONATOR ASSEMBLY	28480	86701-60029
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
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	9100-0346	0	7	COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A3A1A4A2L2	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A3A1A4A2L3	86701-20051	7	1	INDUCTOR	28480	86701-20051

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A4A2L4	9140-0158	6		COIL-MLD 1UH 10% Q=32 .095DX.25LG-NOM	28480	9140-0158
A3A1A4A2Q1	1854-0610	0	1	TRANSISTOR NPN SI TO-46 FT=.8HZ	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	C4-1/8-T0-1001-F
A3A1A4A2R2	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A3A1A4A2R3	0698-7193	5	1	RESISTOR 16.2 1% .05W F TC=0+-100	24546	C3-1/8-T00-16R2-G
A3A1A4A2R4†	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A4A2R5	0757-0428	1	6	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A1A4A2R6	0698-7262	9	1	RESISTOR 12.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1212-G
A3A1A4A2R7	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A1A4A2R8	0698-7254	9	1	RESISTOR 5.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5621-G
A3A1A4A2R9	0698-7205	0	4	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A3A1A4A2R10	0698-7265	2	1	RESISTOR 16.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1622-G
A3A1A4A2R11	0698-7250	5	1	RESISTOR 3.83K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3831-G
A3A1A4A2R12	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A4A2R13	0757-0400	9	1	RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A3A1A4A2TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	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-LG SST	28480	0590-0526
	0380-0020	0	1	SPACER-RND .25-IN-LG .128-IN-ID	00000	ORDER BY DESCRIPTION
	86701-20052	8	2	SPACER, INSULATOR	28480	86701-20052
	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
	0610-0002	7	1	NUT-HEX-DBL-CHAM 0-80-THD .049-IN-THK	28480	0610-0002
	2190-0045	8	4	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045
	3050-0672	2	1	WASHER-SHLDR NM NO. 4 .118-IN-ID	28480	3050-0672
	86701-20046	0	1	PROBE	28480	86701-20046
	86701-20047	1	1	SUPPORT, RESONATOR	28480	86701-20047
A3A1A5	86701-60018	0	1	M/N OUTPUT ASSEMBLY	28480	86701-60018
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				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	1	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
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
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

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A5L1	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A3A1A5L2	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A3A1A5L3				NOT ASSIGNED		
A3A1A5L3	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A3A1A5L4	9100-2248	5	2	COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
A3A1A5L5	9100-2250	9	2	COIL-MLD 180NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2250
A3A1A5L6	9100-1635	2	1	COIL-MLD 91UH 5% Q=50 .155DX.375LG-NOM	28480	9100-1635
A3A1A5L7	9100-1634	1	1	COIL-MLD 75UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1634
A3A1A5L8	9100-1620	5	4	COIL-MLD 15UH 10% Q=65 .155DX.375LG-NOM	28480	9100-1620
A3A1A5L9	9140-0210	1	1	COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A3A1A5L10	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A3A1A5L11	9100-2248	5		COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
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	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q6	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q7	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q8	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q9	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5R1	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A1A5R2	0698-7248	1	5	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A3A1A5R3	0698-7243	6	5	RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A3A1A5R4	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A3A1A5R5	0698-7223	2	3	RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A3A1A5R6	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A3A1A5R7	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A3A1A5R8	0698-7203	8	1	RESISTOR 42.2 1% .05W F TC=0+-100	24546	C3-1/8-T00-42R2-G
A3A1A5R9	0698-7218	5	1	RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A3A1A5R10	0698-7188	8	5	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A3A1A5R11	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A3A1A5R12	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A3A1A5R13	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A3A1A5R14	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A3A1A5R15	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A3A1A5R16	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A3A1A5R17	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A1A5R18	0698-7208	3	1	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-68R1-G
A3A1A5R19	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A1A5R20	0698-7222	1		RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A3A1A5R21	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A3A1A5R22	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A3A1A5R23	0698-7229	8	3	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A3A1A5R24	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A1A5R25	0698-7247	0	1	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-G
A3A1A5R26	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A3A1A5R27	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A3A1A5R28	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A3A1A5R29	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A3A1A5R30	0698-7200	5	1	RESISTOR 31.6 1% .05W F TC=0+-100	24546	C3-1/8-T00-31R6-G
A3A1A5R31	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A3A1A5R32	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A3A1A5R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A5R34	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A1A5R35				NOT ASSIGNED		
A3A1A5R36	0698-7210	7	1	RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-G
A3A1A5R37	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A3A1A5R38				NOT ASSIGNED		
A3A1A5R39	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A3A1A5R40	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A3A1A5R41	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A1A5U1	0955-0063	0	1	MIXER, DOUBLE BALANCED	28480	0955-0063
A3A1A5U2	1820-0736	0	1	IC CNTR ECL BIN DUAL	28480	1820-0736
A3A1A5VR1	1902-3070	5	2	DIODE-ZNR 4.22V 5% DO-7 PD=.4W TC=-.038%	28480	1902-3070
A3A1A5VR2	1902-3070	5		DIODE-ZNR 4.22V 5% DO-7 PD=.4W TC=-.038%	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
	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	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	00000	ORDER BY DESCRIPTION
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	86701-40001	9		EXTRACTOR, P.C.	28480	86701-40001
	86701-00041	3	1	COVER, TOP	28480	86701-00041
	86701-20037	9	1	COVER, P.C. M/N OUT	28480	86701-20037
	86701-20056	2	1	COVER, BOTTOM	28480	86701-20056
	86701-20057	3	1	SHIELD, HOUSING	28480	86701-20057
A3A1A6	86701-60022	6	1	M/N REFERENCE MOTHER 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
A3A1A6XA3A1A1	1251-4423	3	1	CONNECTOR-PC 15-CONTACT, TOP	28480	1251-4423
A3A1A6XA3A1A2	1251-4174	1	2	CONNECTOR-PC 15-CONTACT,TOP & BOTTOM TERM	28480	1251-4174
A3A1A6XA3A1A3	1251-2035	9	3	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A3A1A6XA3A1A4	1251-4174	1		CONNECTOR-PC 15-CONTACT,TOP & BOTTOM TERM	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	00000	ORDER BY DESCRIPTION
	86701-00031	1	2	INSULATOR	28480	86701-00031
	86701-00046	8	1	INSULATOR	28480	86701-00046
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
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-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
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 FAST-BLO 1.25X.25 UL IEC	75915	312001
A3A2R1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A2R2	2100-3123	0	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A3A2R3	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A2R4	0698-3444	1	9	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A2R5	0698-3447	4	5	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A2R6				NOT ASSIGNED		
A3A2R7	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A2R8	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A2TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A2U1	1826-0126	4	1	IC 7818 V RGLTR TO-3	04713	MC7818CK
A3A2VR1	1902-3263	8	1	DIODE-ZNR 24.9V 2% DO-7 PD=.4W TC=+.081%	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-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
	5040-6850	1	6	BOARD EXTRACTOR	28480	5040-6850
	86701-00018	4	1	HEAT SINK	28480	86701-00018
	86701-00025	3	1	INSULATOR	28480	86701-00025
A3A3	86701-60013	5	1	POSITIVE REGULATOR ASSEMBLY	28480	86701-60013
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	12	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	6	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A3C14	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A3C15†	0160-4298	6	2	CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
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-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A3A3CR4	1901-0033	2	21	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR9	1990-0404	8		LED-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A3CR10	1990-0404	8		LED-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A3CR11	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR12	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3F1	2110-0056	3	1	FUSE 6A 250V FAST-BLO 1.25X.25 UL IEC	75915	312006
A3A3F2	2110-0003	0	2	FUSE 3A 250V FAST-BLO 1.25X.25 UL IEC	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	28480	1854-0005
A3A3Q10	1854-0039	7	1	TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	04713	2N3053
A3A3R1	0757-0443	0	3	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3A3R2	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-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	3	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3A3R5	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3A3R6	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A3R7	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R8	0698-3442	9	2	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-1001-F
A3A3R12	0757-0278	9	4	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A3R13	0683-0275	9	5	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3A3R14	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A3R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A3R16	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A3R17	0698-3162	0	1	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A3A3R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A3R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A3R20	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A3R21	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A3A3R22	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A3R23	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-2151-F
A3A3R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-681R-F
A3A3R31	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A3R32	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A3R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-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 FC TC=-400/+500	01121	CB27G5
A3A3R38	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A3R39	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A3R40	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A3R41	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R42	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3A3R43	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3A3R44	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A3A3R45	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R46	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R47	0757-0290	5	4	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3A3R48	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-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	02111	43P201
A3A3R51	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A3R52	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A3R53	0698-4405	6	1	RESISTOR 107 1% .125W F TC=0+-100	24546	C4-1/8-T0-107R-F
A3A3R54	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A3R55	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A3R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R57	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A3R58	0698-3634	1	1	RESISTOR 470 5% 2W MO TC=0+-200	28480	0698-3634
A3A3R59	0757-0447	4	4	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3A3RT1	0837-0126	6	1	THERMISTOR DISC 1K-OHM TC=-4.4%/C-DEG	28480	0837-0126
A3A3TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A3TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A3TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A3TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A3TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A3TP6	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A3U1	1826-0161	7	1	IC 324 OP AMP 14-DIP-P	18324	LM324-A
A3A3U2	1820-0223	0		IC 301 OP AMP TO-99	18324	LM301A
A3A3U3	1820-0223	0		IC 301 OP AMP TO-99	18324	LM301A
A3A3VR1	1902-3171	7	2	DIODE-ZNR 11V 5% DO-7 PD=.4W TC=+.062%	28480	1902-3171
A3A3VR2	1902-0686	3	2	DIODE-ZNR 1N825 6.2V 2% DO-7 PD=.4W	04713	1N825
A3A3VR3	1902-3252	5	1	DIODE-ZNR 22.6V 2% DO-7 PD=.4W TC=+.073%	28480	1902-3252
A3A3VR4	1902-0049	2	2	DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
A3A3VR5	1902-0686	3		DIODE-ZNR 1N825 6.2V 2% DO-7 PD=.4W	04713	1N825
A3A3VR6	1902-3082	9		DIODE-ZNR 4.64V 5% DO-7 PD=.4W TC=-.023%	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	28480	2190-0014
	2190-0027	6	1	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0027
	2950-0051	8	3	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
	5040-6850	1		BOARD EXTRACTOR	28480	5040-6850
	86701-20036	8	1	MOUNTING BLOCK, DIODE	28480	86701-20036

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A4	86701-60014	6	1	NEGATIVE REGULATOR ASSEMBLY	28480	86701-60014
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
A3A4C11	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC 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% 25VDC CER	28480	0160-0127
A3A4C14	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A4C15	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A4CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
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-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A4CR11	1990-0404	8		LED-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A4CR12	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A4CR13	1990-0404	8		LED-VISIBLE LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A4CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
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 FAST-BLO 1.25X.25 UL IEC	28480	2110-0083
A3A4F2	2110-0043	8	2	FUSE 1.5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0043
A3A4F3	2110-0010	9	1	FUSE 5A 250V FAST-BLO 1.25X.25 UL IEC	75915	312005
A3A4K1	0490-0916	6	1	RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	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	0811-1552	0	2	RESISTOR .56 5% 2W PW TC=0+-800	75042	BWH2-9/16-J
A3A4R2	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A4R3	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A4R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-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 FC TC=-400/+500	01121	CB27G5
A3A4R9	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A4R10	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A4R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R12	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A4R13	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A4R14	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A4R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A4R16	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-1001-F
A3A4R19	0698-3449	6		RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A3A4R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A4R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A4R23	0811-1552	0		RESISTOR .56 5% 2W PW TC=0+-800	75042	BWH2-9/16-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

† BACKDATING INFORMATION IN SECTION VII

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 FC TC=-400/+500	01121	CB27G5
A3A4R28	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A4R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A4R30	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A4R31	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-1001-F
A3A4R36	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-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 FC TC=-400/+500	01121	CB27G5
A3A4R41	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A4R42	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3A4R43	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A4R44	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A4R45	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A4R46	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R47	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A4TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A4TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A4TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A4TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A4TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A4U1	1820-0223	0		IC 301 OP AMP TO-99	18324	LM301A
A3A4U2	1820-0223	0		IC 301 OP AMP TO-99	18324	LM301A
A3A4U3	1820-0223	0		IC 301 OP AMP TO-99	18324	LM301A
A3A4VR1	1902-0025	4	2	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A3A4VR2	1902-3171	7		DIODE-ZNR 11V 5% DO-7 PD=.4W TC=+.062%	28480	1902-3171
A3A4VR3	1902-3330	0	1	DIODE-ZNR 44.2V 2% DO-7 PD=.4W TC=+.081%	28480	1902-3330
A3A4VR4	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	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
	5040-6850	1		BOARD EXTRACTOR	28480	5040-6850
A3A5	86701-60015	7	1	DAC ASSEMBLY(DIGITAL-TO-ANALOG CONVERTER	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		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A3A5L2	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A3A5L3	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	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	1854-0475	5	3	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
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	28480	1854-0474
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% .025W PWW TC=0+-5	28480	0811-3404
A3A5R2	0811-3358	8	1	RESISTOR 7.2K .1% .025W 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	C4-1/8-T0-422R-F

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A5R6	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A5R7	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3A5R8	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3A5R9	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A5R10	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R11	0811-3357	7	2	RESISTOR 6.25K .1% .025W PWW TC=0+-5	28480	0811-3357
A3A5R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R13	2100-1662	8	1	RESISTOR-TRMR 50K 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-503
A3A5R14	0811-3359	9	5	RESISTOR 12.5K .1% .025W PWW TC=0+-5	28480	0811-3359
A3A5R15	0811-3357	7		RESISTOR 6.25K .1% .025W PWW TC=0+-5	28480	0811-3357
A3A5R16	0698-7879	4	1	RESISTOR 14.3K 1% .125W F TC=0+-25	19701	MF4C1/8-T9-1435-F
A3A5R17	0811-3359	9		RESISTOR 12.5K .1% .025W 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% .025W 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% .025W 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% .025W 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	BP70-1/16-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	2	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% .0125W PWW TC=0+-10	20940	140-1/20-1002-T
A3A5R31	0811-3359	9		RESISTOR 12.5K .1% .025W PWW TC=0+-5	28480	0811-3359
A3A5R32	0811-3138	2	1	RESISTOR 25K .1% .062W PWW TC=0+-10	20940	114-1/16-2502-B
A3A5R33	0811-0647	2	1	RESISTOR 50K .1% .062W 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% .025K 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% .025W 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% .062W 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	C4-1/8-T0-3831-F
A3A5R45	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A5R46	0757-0458	7	9	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A5R47	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R48	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R49	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R50	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A5R51	0811-3356	6	1	RESISTOR 5.9K .1% .062W PWW TC=0+-5	28480	0811-3356
A3A5R52	0698-6358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A3A5R53	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A5R54	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A5R55	0811-3325	9	1	RESISTOR 312 .1% .062W PWW TC=0+-10	28480	0811-3325
A3A5R56	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A5R57	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A5R58	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3A5R59	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2873-F
A3A5R60	0698-3454	3	1	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A3A5R61	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3A5TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A5TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A5TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A5TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A5TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A5U1	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A3A5U2	1826-0261	8	4	IC 741 OP AMP TO-99	28480	1826-0261
A3A5U3	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A3A5U4	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A3A5U5	1901-1011	8	3	DIODE-ARRAY VF DIFF=5MV	28480	1901-1011
A3A5U6	1901-1011	8		DIODE-ARRAY VF DIFF=5MV	28480	1901-1011
A3A5U7	1901-1011	8		DIODE-ARRAY 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	1902-0625	0	1	DIODE-ZNR 1N829 6.2V 5% DO-7 PD=.25W	04713	1N829
A3A5VR2	1902-0244	9	1	DIODE-ZNR 30.1V 5% DO-15 PD=1W TC=+.075%	28480	1902-0244

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				A3A5 MISCELLANEOUS		
	5000-9043	6		PIN;P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6850	1		BOARD EXTRACTOR	28480	5040-6850
A3A6	86701-60016	8	1	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	06001	69F177G7
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-7	28480	1901-0033
A3A6CR2	1901-0040	1	19	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A6CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A6CR4				NOT ASSIGNED		
A3A6CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A6CR9	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
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	1854-0475	5		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A3A6Q10	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A6Q11†	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A6Q12	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A6Q13†	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A6R1				NOT ASSIGNED		
A3A6R2				NOT ASSIGNED		
A3A6R3	0757-0456	5	1	RESISTOR 43.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4322-F
A3A6R4	0698-4492	1	1	RESISTOR 32.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3242-F
A3A6R5	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A6R6	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A6R7	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A6R8	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A6R9	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A6R10	0757-0465	6	4	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3A6R11	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A6R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A6R13	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A6R14	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A6R15	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-1003-F
A3A6R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A6R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A6R20	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A6R21	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A6R22	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3A6R23	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
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

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A6R26	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A6R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A6R28	0757-0467	8	2	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3A6R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A6R30	0698-8025	4	1	RESISTOR 1.91K .25% .125W F TC=0+-50	19701	MF4C1/8-T2-1911-C
A3A6R31	0757-0402	1	1	RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3A6R32	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A6R33	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-3831-F
A3A6R36	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A6R37	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-4641-F
A3A6R40	0698-8420	3	1	RESISTOR 4.22K 1% .125W F TC=0+-25	19701	MF4C1/8-T9-4221-F
A3A6R41	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A6R42	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A6TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A6TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A6TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A6TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A6TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A6U1	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A3A6VR1	1902-0680	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.25W	24046	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-7 PD=.4W TC=+.08%	28480	1902-3323
A3A6VR4	1902-0025	4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
				A3A6 MISCELLANEOUS		
	1205-0085	8	1	HEAT SINK TO-66-PKG	28480	1205-0085
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6850	1		BOARD EXTRACTOR	28480	5040-6850
	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
	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	86701-60017	9	1	FM DRIVER ASSEMBLY	28480	86701-60017
A3A7C1	0160-0578	7	4	CAPACITOR-FXD .047UF +-1% 50VDC	28480	0160-0578
A3A7C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C3	0160-0578	7		CAPACITOR-FXD .047UF +-1% 50VDC	28480	0160-0578
A3A7C4	0160-0573	2	1	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A3A7C5	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A7C6	0160-3874	2	4	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A7C7	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A7C8	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472M822-CDH
A3A7C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A7C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C11	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A7C12	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3A7C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C14	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	00908	T368-B-106-M-025-AS
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	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A7C19*	0160-2206	2	2	CAPACITOR-FXD 160PF +-5% 300VDC MICA *FACTORY SELECTED PART	28480	0160-2206
A3A7C20	0140-0210	2		CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A3A7C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A7C22	0160-0158	9	1	CAPACITOR-FXD 5600PF +-10% 200VDC POLYE	28480	0160-0158
A3A7C23	0180-1719	2		CAPACITOR-FXD 22UF+-10% 25VDC TA	56289	150D226X9025B2
A3A7C24	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C25	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C26	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A7C27	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C28	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A7C29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A7C30	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A7C31	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C32	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C33	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A7C34	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A3A7C35	0180-0234	4	1	CAPACITOR-FXD 33UF+-20% 75VDC TA	06001	69F286G7
A3A7C36	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A7C37	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C38	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C39	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	00908	T368-B-106-M-025-AS
A3A7C40	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C41	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C42	0160-2202	8	1	CAPACITOR-FXD 75PF +-5% 300VDC MICA	28480	0160-2202
A3A7C43	0140-0194	1	2	CAPACITOR-FXD 110PF +-5% 300VDC MICA	72136	DM15F111J0300WV1CR
A3A7C44	0160-3872	0	1	CAPACITOR-FXD 2.2PF +-.25PF 200VDC CER	28480	0160-3872
A3A7C45	0160-0578	7		CAPACITOR-FXD .047UF +-1% 50VDC	28480	0160-0578
A3A7C46	0160-0578	7		CAPACITOR-FXD .047UF +-1% 50VDC	28480	0160-0578
A3A7C47	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A7C48*	0160-2248	2	1	CAPACITOR-FXD 4.3PF +-.25PF 500VDC CER *FACTORY SELECTED PART	28480	0160-2248
A3A7C49	0160-3491	9	1	CAPACITOR-FXD .47UF +-20% 50VDC CER	28480	0160-3491
A3A7C50	0160-3874	2		CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A7CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7K1	0490-0564	0	2	RELAY-REED 1C 250MA 115VAC 5VDC-COIL 6VA	28480	0490-0564
A3A7K2	0490-0564	0		RELAY-REED 1C 250MA 115VAC 5VDC-COIL 6VA	28480	0490-0564
A3A7L1	9100-2259	8		COIL-MLD 1.5UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2259
A3A7Q1	1854-0013	7	1	TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	04713	2N2218A
A3A7Q2	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A7Q3	1854-0238	8	1	TRANSISTOR NPN 2N3933 SI TO-72 PD=200MW	28480	1854-0238
A3A7Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A7Q5	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A7Q6	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A7Q7	1854-0023	9	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A3A7Q8†	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A7Q9†	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A7Q10†	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A7Q11	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A7Q12	1855-0020	8	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A3A7Q13	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A3A7Q14†	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A7Q15	1855-0417	7	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0417
A3A7R1	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3A7R2	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A7R3	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3A7R4	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3A7R5	0698-7277	6	1	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-G
A3A7R6	0698-7258	3	1	RESISTOR 8.25K 1% .05W F TC=0+-100	24546	C3-1/8-T0-8251-G
A3A7R7	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A7R8	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3A7R9	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A3A7R10	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A7R11	0698-3432	7	1	RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
A3A7R12				NOT ASSIGNED		
A3A7R13	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A7R14				NOT ASSIGNED		
A3A7R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R16	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R17	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R18	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R19	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R20	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R21	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A7R22	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A7R23	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A7R24	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A3A7R25				NOT ASSIGNED		
A3A7R26	0698-7276	5	2	RESISTOR 46.4K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4642-G
A3A7R27	0698-7276	5		RESISTOR 46.4K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4642-G
A3A7R28	2100-3353	8	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-Y46-203
A3A7R29	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A7R30	0683-1555	0	2	RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01121	CB1555

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A7R31	0698-4414	7	2	RESISTOR 158 1% .125W F TC=0+-100	24546	C4-1/8-T0-158R-F
A3A7R32	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A7R33	0698-7271	0	1	RESISTOR 28.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2872-G
A3A7R34	0698-7283	4	1	RESISTOR 90.9K 1% .05W F TC=0+-100	24546	C3-1/8-T0-9092-G
A3A7R35	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A7R36	0698-7272	1	1	RESISTOR 31.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3162-G
A3A7R37	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A7R38	0757-0316	6	2	RESISTOR 42.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A3A7R39	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A7R40	2100-3354	9	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
A3A7R41	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A7R42	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3A7R43	0698-3152	8	2	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A3A7R44	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A3A7R45	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A7R46	2100-3350	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A3A7R47	0757-0440	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-TO-751-F
A3A7R48	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R49	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A7R50	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R51	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R52	0757-0440	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A7R53	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A7R54	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A7R55	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3A7R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A7R57	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A7R58	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A7R59	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A7R60	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3A7R61*	0698-6113	7	1	RESISTOR 1.82K .25% .125W F TC=0+-100 *FACTORY SELECTED PART	28480	0698-6113
A3A7R62	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A7R63	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A3A7R64				NOT ASSIGNED		
A3A7R65*	0757-0200	7	2	RESISTOR 5.62K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-5621-F
A3A7R66	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A3A7R67*	0698-3439	4	3	RESISTOR 178 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-178R-F
A3A7R68	0757-0424	7	3	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3A7R69	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A7R70	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3A7R71	0686-1525	0	1	RESISTOR 1.5K 5% .5W CC TC=0+647	01121	EB1525
A3A7R72	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R73	0757-0802	5	2	RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A3A7R74	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A7R75*	0698-4429	4	1	RESISTOR 1.87K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1871-F
A3A7R76				NOT ASSIGNED		
A3A7R77	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A7R78	0757-0802	5		RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A3A7R79	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A3A7R80	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A7R81	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A3A7R82	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A3A7R83	0683-1555	0		RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01121	CB1555
A3A7R84	0698-4414	7		RESISTOR 158 1% .125W F TC=0+-100	24546	C4-1/8-T0-158R-F
A3A7R85	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A7R86	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A7TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A7TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A7TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A7TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A7TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A7U1	1826-0261	8		IC 741 OP AMP TO-99	28480	1826-0261
A3A7U2	1826-0081	0	1	IC 318 OP AMP TO-99	27014	LM318H
A3A7U3	1826-0044	5	2	IC OP AMP 14-DIP-C	07263	739DC
				A3A7 MISCELLANEOUS		
	1205-0011	0	4	HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
	1205-0037	0	2	HEAT SINK TO-18-PKG	28480	1205-0037
	1200-0173	5	6	INSULATOR-XSTR DAP-GL	28480	1200-0173
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6850	1		BOARD EXTRACTOR	28480	5040-6850

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A8	86701-60074	8	1	10 MHZ REFERENCE OSCILLATOR ASSEMBLY (EXCEPT OPTION 002)	28480	86701-60074
A3A8P1				NSR, P/O A3A8		
A3A8W1				NSR, P/O A3A8		
A3A9	86701-60026	0	1	YTO LOOP ASSEMBLY	28480	86701-60026
				A3A9 CHASSIS PARTS		
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	0160-4082	6	3	CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
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	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A3A9C7	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C8	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A3A9C9	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9J1	1250-0901	2	6	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0901
A3A9J2	1250-0901	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0901
A3A9J3	1250-0901	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0901
A3A9J4	1250-0901	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0901
A3A9J5	1250-0901	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0901
A3A9J6	1250-0901	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0901
A3A9U1	5086-7097	6	1	SAMPLER, 2-6.5 GHZ		
A3A9W1	86701-20032	4	1	CABLE ASSEMBLY, YTO OUTPUT	28480	86701-20032
A3A9W2	86701-20031	3	1	CABLE ASSEMBLY, ATTENUATOR OUTPUT	28480	86701-20031
A3A9W3	86701-20062	0	1	CABLE ASSEMBLY, FILTER INPUT	28480	86701-20062
A3A9W4	86701-60052	2	1	CABLE ASSEMBLY, COAX, BLACK	28480	86701-60052
				A3A9 MISCELLANEOUS		
	1250-1142	5	1	WASHER-RF,CONN,SERIES SMA,.0250 ID	16179	4151
	1250-1143	6	1	NUT-RF CONN,SERIES SMA,HEX,1/4-36 THRD	16179	1707
	1400-0024	9	1	CLAMP-CABLE .25-DIA .5-WD NYL	28480	1400-0024
	2360-0331	6		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	28480	2360-0331
	2360-0332	7		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2360-0332
	3050-0227	3		WASHER-FL MTLC NO. 6 .149-IN-ID	28480	3050-0227
	6960-0016	0	1	PLUG-HOLE TR-HD FOR .125-D-HOLE NYL	28480	6960-0016
	86701-00009	3	1	DECK	28480	86701-00009
	86701-00010	6	1	COVER, SAMPLER	28480	86701-00010
	86701-00011	7	1	COVER, PHASE LOCK	28480	86701-00011
	86701-20009	5	1	HOUSING, CASTING	28480	86701-20009
	86701-00054	8	1	SPACER, SAMPLER	28480	86701-00054
	86701-40001	9	1	EXTRACTOR, P.C. BOARD	28480	86701-40001
A3A9A1	5086-7237	6	1	DIRECTIONAL COUPLER ASSEMBLY	28480	5086-7237
A3A9A2	86701-20025	5	1	ASSEMBLY, YTO INTERCONNECT	28480	86701-20025
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
	5086-6131	7		2-6.2 GHZ YTO ASSEMBLY (RESTORED 5086-7131)	28480	5086-6131
A3A9A4	86701-60024	8	1	ASSEMBLY, YTO PHASE DETECTOR	28480	86701-60024

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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		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	2	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	28480	1901-0040
A3A9A4CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR3	1901-0539	3		DIODE-SCHOTTKY	28480	1901-0539
A3A9A4CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR5	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3A9A4CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR8				NOT ASSIGNED		
A3A9A4CR9				NOT ASSIGNED		
A3A9A4CR10				NOT ASSIGNED		
A3A9A4CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3A9A4CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4L1	9100-2254	3	2	COIL-MLD 390NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2254
A3A9A4L2	9100-1620	5		COIL-MLD 15UH 10% Q=65 .155DX.375LG-NOM	28480	9100-1620
A3A9A4L3	9100-1620	5		COIL-MLD 15UH 10% Q=65 .155DX.375LG-NOM	28480	9100-1620
A3A9A4L4	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A3A9A4L5	9100-1620	5		COIL-MLD 15UH 10% Q=65 .155DX.375LG-NOM	28480	9100-1620
A3A9A4L6	9100-1641	0		COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
A3A9A4L7	9100-0368	6		COIL-MLD 330NH 10% Q=28 .095DX.25LG-NOM	28480	9100-0368
A3A9A4L8	9140-0179	1	2	COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A3A9A4L9	9100-2254	3		COIL-MLD 390NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2254
A3A9A4L10	9100-0368	6		COIL-MLD 330NH 10% Q=28 .095DX.25LG-NOM	28480	9100-0368
A3A9A4L11	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	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 SI	17856	FN2645
A3A9A4Q4	1854-0475	5		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
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-G
A3A9A4R2	0757-0464	5	1	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A3A9A4R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A4R4	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A9A4R5	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A9A4R6	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A9A4R7	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A3A9A4R8	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A9A4R9	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-G
A3A9A4R10	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	C4-1/8-T0-196R-F
A3A9A4R13	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A9A4R14	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A9A4R15	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A9A4R16	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A4R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A4R18	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A9A4R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A9A4R20	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A9A4R21	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3A9A4R22	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A3A9A4R23				NOT ASSIGNED		
A3A9A4R24	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A9A4R25	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A9A4R26	0698-4020	1	1	RESISTOR 9.53K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9531-F
A3A9A4R27	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A9A4R28	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A9A4R29	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-511R-F
A3A9A4R32	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A9A4R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A4R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A4R35	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A9A4R36	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A9A4R37	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A9A4R38	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A9A4R39	0757-0467	8		RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-T0-5112-F
A3A9A4R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A4R45	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A3A9A4R46	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A3A9A4R47	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A9A4R48	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A3A9A4R49	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A3A9A4R50	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A9A4R51	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A9A4R52	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-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-G
A3A9A4R55	0698-7242	5	1	RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-G
A3A9A4R56	0698-7253	8	1	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-G
A3A9A4R57	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3A9A4R58	0698-3451	0	1	RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A3A9A4TP1	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A9A4TP2	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A9A4TP3	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A9A4TP4	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A9A4TP5	1251-0600	0		CONTACT-CONN U/W-POST-TYPE MALE DPSLDR	28480	1251-0600
A3A9A4U1	1826-0092	3		IC OP AMP TO-99	28480	1826-0092
A3A9A4U2	1826-0026	3	1	IC COMPARATOR TO-99	27014	LM311H
A3A9A4U3	1826-0044	5		IC OP AMP 14-DIP-C	07263	739DC
A3A9A4U4	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A3A9A4U5	1820-1344	8		IC PL LOOP 14-DIP-C	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-PIN-SIP .1-PIN-SPCG	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-7 PD=.4W TC=-.009%	28480	1902-0041
A3A9A4VR4	1902-3104	6	1	DIODE-ZNR 5.62V 5% DO-7 PD=.4W TC=+.016%	28480	1902-3104
A3A9A5	86701-60023	7	1	ASSEMBLY, SAMPLER	28480	86701-60023
A3A9A5C1	0121-0046	2	2	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304322 9/35PF N650
A3A9A5C2	0121-0046	2		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304322 9/35PF N650
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	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	150D226X901582
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	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
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	0160-2205	1	1	CAPACITOR-FXD 120PF +-5% 300VDC MICA	28480	0160-2205
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
A3A9A5L1				NSR, PART OF CIRCUIT BOARD		
A3A9A5L2	9140-0144	0	1	COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A3A9A5L3	9100-1623	8	1	COIL-MLD 27UH 5% Q=60 .155DX.375LG-NOM	28480	9100-1623
A3A9A5L4	9100-2251	0		COIL-MLD 220NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2251
A3A9A5L5	9100-2258	7	2	COIL-MLD 1.2UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2258
A3A9A5L6	9100-2258	7		COIL-MLD 1.2UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2258
A3A9A5L7	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A3A9A5L8				NSR, PART OF CIRCUIT BOARD		
A3A9A5L9				NSR, PART OF CIRCUIT BOARD		
A3A9A5L10	9140-0143	9		COIL-MLD 3.3UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0143
A3A9A5L11	9100-0368	6		COIL-MLD 330NH 10% Q=28 .095DX.25LG-NOM	28480	9100-0368
A3A9A5L12	9100-2249	6		COIL-MLD 150NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2249
A3A9A5L13	9100-2250	9		COIL-MLD 180NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2250
A3A9A5L14	9100-2249	6		COIL-MLD 150NH 10% Q=34 .095DX.25LG-NOM	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†	1854-0254	8	1	TRANSISTOR NPN SI TO-5 PD=800MW	28480	1854-0254
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	C4-1/8-T0-51R1-F
A3A9A5R3	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A9A5R4	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A9A5R5	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3A9A5R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A5R7	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-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	C4-1/8-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	C4-1/8-T0-1623-F
A3A9A5R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A5R13	0698-7216	3	1	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A3A9A5R14	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3A9A5R15	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A3A9A5R16	0757-0398	4	1	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3A9A5R17	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A9A5R18	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A9A5R19	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A9A5R20	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-G
A3A9A5R21	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A9A5R22	0698-7197	9	1	RESISTOR 23.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-23R7-G
A3A9A5R23	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A9A5R24	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A9A5R25	0698-0082	7	2	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A3A9A5R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A5R27	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A5R28	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A3A9A5R29	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A3A9A5R30	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9A5R31	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A9A5R32	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3A9A5R33	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A9A5R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A5R35	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3A9A5R36	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A5R37	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A5R38	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A3A9A5R39	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A3A9A5R40	0757-0394	0		RESISTOR 51.1 1% .125W FTC=0+-100	24546	C3-1/8-T0-51R1-F
A3A9A5R41	0698-7196	8	1	RESISTOR 21.5 1% .05W F TC=0+-100	24546	C4-1/8-T00-21R5-G
				A3A9A5 MISCELLANEOUS		
	1205-0011	0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
	1205-0037	0		HEAT SINK TO-18-PKG	28480	1205-0037
	1251-3172	7	1	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	86701-60011	3	1	MOTHER BOARD ASSEMBLY	28480	86701-60011
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	28480	1901-0050
A3A10CR3	1990-0517	4	1	LED-VISIBLE LUM-INT=3MCD IF=20MA-MAX	28480	5082-4655
A3A10J1				NSR, PART OF A3W11		
A3A10J2	1251-3905	4	1	CONNECTOR 20-PIN M RECTANGULAR	28480	1251-3905
A3A10J3	86701-60069	1	1	CONNECTOR ASSEMBLY, 5-PIN	28480	86701-60069
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	C4-1/8-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 FC TC=-400/+600	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 FC TC=-400/+700	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		
	0380-0076	6	4	STANDOFF-RVT-ON .5-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
	0380-0659	1	2	SPACER-RVT-ON .375-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
	0380-0677	3	2	SPACER-RVT-ON .156-IN-LG .188-IN-ID	00000	ORDER BY DESCRIPTION
	0380-0884	4	5	STANDOFF-RVT-ON .156-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
	0590-0526	6		THREADED INSERT-NUT 4-40 .065-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(PRIMARY POWER, FUSE LISTED AS A3F1)	28480	86701-60070
A3A11TB1	5020-8122	2	1	LINE VOLTAGE SELECTION CARD	28480	5020-8122

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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 (EXCEPT OPTION 003)	28480	3160-0296
A3B1	3160-0298	1	1	FAN (OPTION 003 ONLY)	28480	3160-0298
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
A3C5	0170-0073	8	1	CAPACITOR-FXD 1UF +-10% 600VDC POLYE (OPTION 003 ONLY)	28480	0170-0073
A3C6	0160-4065	5	1	CAPACITOR-FXD .1UF +-20% 250VAC(RMS)	28480	0160-4065
A3F1	2110-0003	0		FUSE 3A 250V FAST-BLO 1.25X.25 UL IEC (100/120 VAC)	75915	312003
A3F1	2110-0043	8		FUSE 1.5A 250V FAST-BLO 1.25X.25 UL IEC (220/240 VAC)	28480	2110-0043
A3J1				NSR (P/O A3W11)		
A3J2				NSR (P/O A3W10)		
A3J3				NSR (P/O A3W10)		
A3J4				NOT ASSIGNED		
A3J5				NOT ASSIGNED		
A3J6				NSR, RF OUTPUT CONNECTOR, P/O A1W7 (OPT 005 ONLY) OR A1W8 (OPT 004 ONLY)		
A3J7	1250-0870	4	4	CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM (10 MHZ OUT)	28480	1250-0870
A3J8	1250-0870	4		CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM (100 MHZ OUT)	28480	1250-0870
A3J9	1250-0870	4		CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM (FREQ. STD. INT)	28480	1250-0870
A3J10	1250-0870	4		CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM (FREQ. STD. EXT)	28480	1250-0870
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	28480	1854-0679
A3S1	3101-0070	3	1	SWITCH-SL DPDT-NS 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	68701-60053	5	1	CABLE ASSEMBLY,M/N OUTPUT(WHT/ORG)	28480	68701-60053
A3W9				NOT ASSIGNED		
A3W10	86701-60064	6	1	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		CABLE ASSEMBLY,FM COIL DRIVE (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
				A3 MISCELLANEOUS PARTS		
	0360-0268	6	1	TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	28480	0360-0268
	0400-0001	1	1	GROMMET-RND .562-IN-ID .75-IN-GRV-OD	28480	0400-0001
	0400-0082	8	1	GROMMET-CHAN NCH .09-IN-GRV-WD	28480	0400-0082
	0510-0198	0	2	NUT-HEX-DBL-CHAM 0-80-THD .047-IN-THK	00000	ORDER BY DESCRIPTION
	0515-0095	6	1	THUMB SCREW	00000	ORDER BY DESCRIPTION
	0520-0166	3	10	SCREW-MACH 2-56 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
	0590-0012	5	4	NUT-KNRLD-R 15/32-32-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
	0590-0106	8	10	NUT-HEX-PLSTC LKG 2-56-THD .143-IN-THK	00000	ORDER BY DESCRIPTION
	0890-0092	7	6	TUBING-FLEX .102-ID TFE .016-WALL	00000	ORDER BY DESCRIPTION
	1200-0043	8	4	INSULATOR-XSTR ALUMINUM	28480	1200-0043
	1200-0147	3	8	INSULATOR-FLG-BSHG NYLON	28480	1200-0147
	1400-0618	7	1	CABLE CLAMP-HFCL .125-DIA .5-WD	28480	1400-0618
	1400-0619	8	3	CABLE CLAMP-HFCL .312-DIA .5-WD	28480	1400-0619
	1400-0510	8	1	CLAMP-CABLE .15-DIA .62-WD NYL	28480	1400-0510
	1400-0673	4	1	CLAMP-CABLE 2-DIA .5-WD SST	28480	1400-0673

See introduction to this section for ordering information

† BACKDATING INFORMATION IN SECTION VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	1520-0065	2	4	SHOCK MOUNT .5-EFF-HGT 6-LB-LOAD-CAP	28480	1520-0065
	1520-0094	7	3	ISOLATION MOUNT (EXCEPT OPTION 002)	28480	1520-0094
	2190-0004	9	6	WASHER-LK INTL T NO. 6 .115-IN-ID	28480	2190-0004
	2190-0007	2	2	WASHER-LK INTL T NO. 6 .141-IN-ID	28480	2190-0007
	2190-0011	8	8	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
	2190-0017	4	8	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
	2190-0018	5	2	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
	2190-0019	6	4	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
	2190-0049	2	2	WASHER-LK HLCL NO. 0 .065-IN-ID	28480	2190-0049
	2190-0102	8	5	WASHER-LK INTL T 15/32 IN .472-IN-ID	28480	2190-0102
	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0105	4	1	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0111	2	8	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0141	8	4	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0151	0	2	SCREW-MACH 4-40 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0153	2	4	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0115	4	25	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0117	6	2	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0119	8	8	SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0197	2	2	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0219	9	2	SCREW-MACH 6-32 1.375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0333	8	14	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
	2510-0192	6	8	SCREW-MACH 8-32 .25-IN-LG 100 DEG	28480	2510-0192
	2510-0195	9	8	SCREW-MACH 8-32 .375-IN-LG 100 DEG	28480	2510-0195
	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	00000	ORDER BY DESCRIPTION
	2680-0129	8	8	SCREW-MACH 10-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2950-0035	8	5	NUT-HEX-DBL-CHAM 15/32-32-THD	00000	ORDER BY DESCRIPTION
	2950-0051	8		NUT-HEX-DBL-CHAM 1/4-28-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	3030-0422	8	2	SCREW-SKT HD CAP 0-80 .188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
	3050-0105	6	4	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
	3050-0227	3		WASHER-FL MTLC NO. 6 .149-IN-ID	28480	3050-0227
	6960-0010	4	1	PLUG-HOLE DOME-HD FOR .625-D-HOLE STL	28480	6960-0010
	7120-4296	7	1	LABEL-WARNING .688-IN-WD 1.5-IN-LG AL	28480	7120-4296
	7120-4477	6	1	LABEL-WARNING .45-IN-WD 7.5-IN-LG AL	28480	7120-4477
	7120-4439	0	1	LABEL, POWER LINE MODULE	28480	7120-4439
	5040-0170	6	1	GUIDE:PLUG-IN PC BOARD	28480	5040-0170
	86701-00002	6	1	CHASSIS CONTROL	28480	86701-00002
	86701-00003	7	1	CHASSIS, RF MOD	28480	86701-00003
	86701-00004	8	1	SUPPORT, P.C. GUIDE	28480	86701-00004
	86701-00007	1	1	AIR FILTER	28480	86701-00007
	86701-00016	2	1	SUPPORT, CAPACITOR	28480	86701-00016
	86701-00017	3	1	DISK, FAN SHIELD	28480	86701-00017
	86701-00019	5	1	INSULATOR	28480	86701-00019
	86701-00020	8	1	DIVIDER CENTER, 21"	28480	86701-00020
	86701-00022	0	1	COVER, GUARD	28480	86701-00022
	86701-00024	2	1	SCOOP, AIR	28480	86701-00024
	86701-00027	5	1	PANEL, REAR	28480	86701-00027
	86701-00028	6	1	SPRING, FLAT	28480	86701-00028
	86701-00029	7	1	BAFFLE-AIR, TOP	28480	86701-00029
	86701-00030	0	1	BAFFLE-AIR, BOTTOM	28480	86701-00030
	86701-00038	8	1	STRUT ASSEMBLY, LEFT	28480	86701-00038
	86701-00039	9	1	STRUT ASSEMBLY, RIGHT	28480	86701-00039
	86701-00042	4	1	SUPPORT, MOUNT, BOTTOM	28480	86701-00042
	86701-00043	5	1	SUPPORT, MOUNT, TOP	28480	86701-00043
	86701-00044	6	4	SNUBBER	28480	86701-00044
	86701-20002	8	2	COWLING FAN	28480	86701-20002
	86701-20003	9	4	GUIDE PIN	28480	86701-20003
	86701-40004	2	1	HEAT SINK	28480	86701-40004
	86701-20005	1	1	GUIDE, REAR P.C.	28480	86701-20005
	86701-20006	2	1	GUIDE, FRONT P.C.	28480	86701-20006
	86701-20007	3	1	FRAME, REAR MOD	28480	86701-20007
	86701-20010	8	1	HOUSING, REFERENCE BLOCK	28480	86701-20010

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				8671A CHASSIS PARTS		
1	5001-0439	8	2	SIDE TRIM, FRONT FRAME W/O FRONT HANDLE	28480	5001-0439
2	5040-7220	1	2	STRAP, HANDLE, CAP-REAR	28480	5040-7220
3	0570-1170	6	4	RETAINER, SCREW FOR STRAP HANDLE	28480	0570-1170
4	5060-9938	4	2	COVER, SIDE, PERFORATED	28480	5060-9938
5	5020-8883	2	4	STRUT, CORNER 21"	28480	5020-8883
6	86701-20007	3	1	FRAME, READ MOD	28480	86701-20007
7	5040-7221	2	4	STANDOFF, REAR PANEL	28480	5040-7221
8	0570-1171	7	2	CAPTIVE SCREW(USE WITH TOP & BOTTOM COVERS; SEE ALSO ITEM 9)	28480	0570-1176
9	0510-0043	4	2	CLIP (USE WITH TOP & BOTTOM COVERS; SEE ALSO ITEM 8)	28480	0510-0043
10	5060-9836	1	1	COVER, TOP	28480	5060-9836
11	5040-7202	9	1	TRIM, TOP	28480	5040-7202
12	5001-0432	1	1	GUSSET, SIDE	28480	5001-0432
13	5060-9805	4	2	STRAP, HANDLE	28480	5060-9805
14	5020-8803	6	1	FRONT FRAME	28480	5020-8803
15	86701-20001	7	1	DIVIDER FRAME, FRONT	28480	86701-20001
16	5040-7201	8	4	FOOT(STANDARD)	28480	5040-7201
17	5060-9848	5	1	COVER, BOTTOM	28480	5060-9848
18	1460-1345	5	2	TILT, STAND	28480	1460-1345
19	5040-7219	8	2	STRAP, HANDLE, CAP-FRONT	28480	5040-7219
				8671A MISCELLANEOUS PARTS		
	1460-0553	5	4	STAMPING-BE-CU CLIP-WINDOW	28480	1460-0553
	7120-5911	5	1	LABEL, WARNING 1" WD LG PPR	28480	7120-5911
	7120-0049	0	1	LABEL, SERIAL	28480	7120-0049
	08640-60036	4	1	BOARD ASSEMBLY, EXTENDER	28480	08640-60036
	08672-60016	8	1	BOARD ASSEMBLY, EXTENDER	28480	08672-60016
	0515-0095	6	1	THUMB SCREW	00000	ORDER BY DESCRIPTION
	8120-1374	7	1	CABLE RIBBON, 8-SHIELDED & JKTED COND	28480	8120-1374

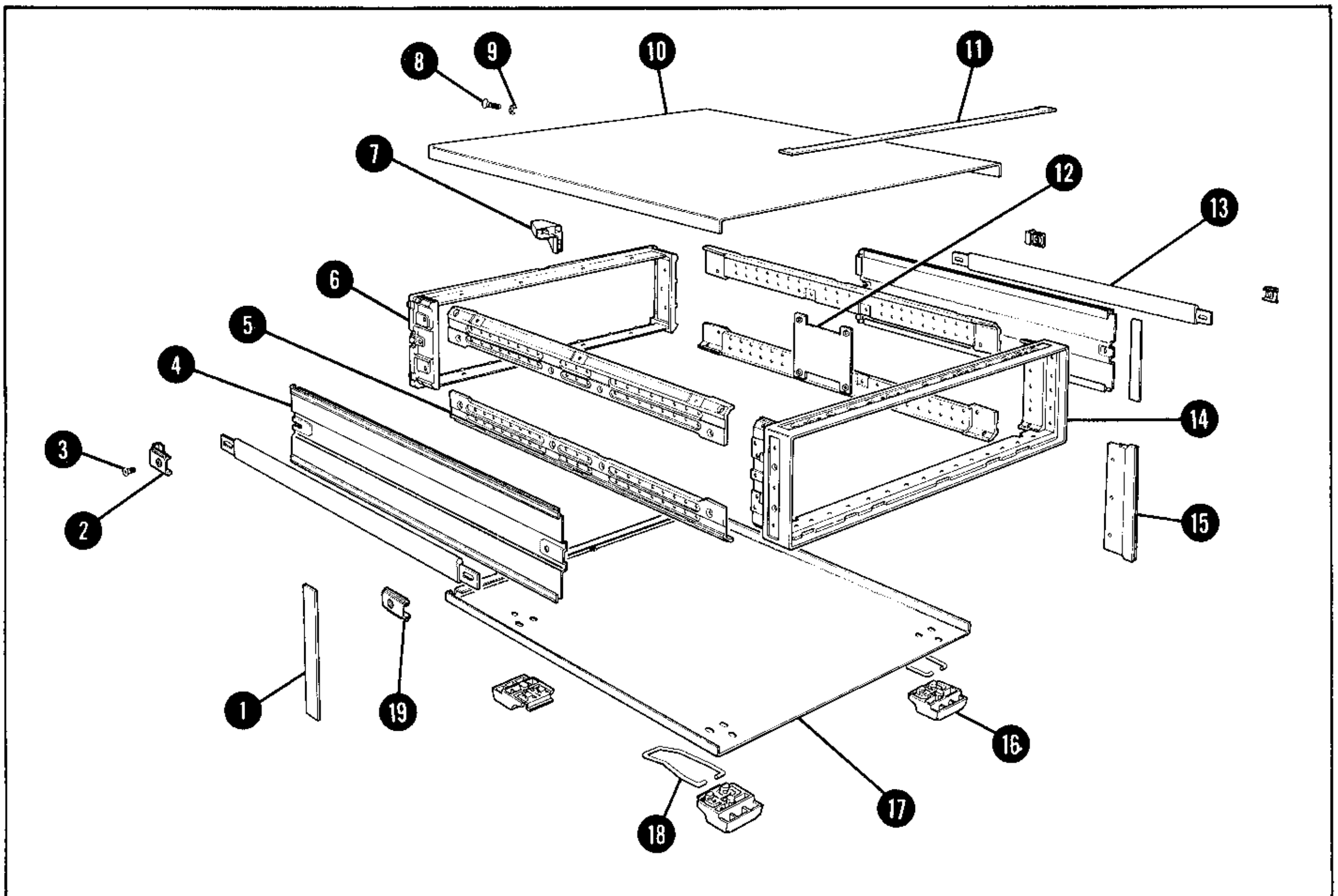


Figure 6-3. Synthesizer Chassis Parts

See introduction to this section for ordering information

Table 6-4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
0000J	GTE SYLVANIA MINIATURE LT PROD	HILLSBORO NH	03244
00000	ANY SATISFACTORY SUPPLIER		
00908	KEMET		
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53204
0129F	AMERICAN CHEM PAINT CO		
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75222
01928	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	08876
02111	SPECTROL ELECTRONICS CORP	CITY OF IND CA	91745
03508	GE CO SEMICONDUCTOR PROD DEPT	SYRACUSE NY	13201
03888	KDI PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85062
05820	WAKEFIELD ENGINEERING INC	WAKEFIELD MA	01880
06001	GE CO ELEK CAP & BAT PROD DEPT	IRMO SC	29063
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94042
07707	USM CORP USM FASTENER DIV	SHELTON CT	06484
08806	GE CO MINIATURE LAMP PROD DEPT	CLEVELAND OH	44112
11236	CTS OF BERNE INC	BERNE IN	46711
14140	EDISON ELEK DIV MCGRAW-EDISON	MANCHESTER NH	03130
16179	OMNI SPECTRA INC	FARMINGTON MI	03054
17856	SILICONIX INC	SANTA CLARA CA	95054
18324	SIGNETICS CORP	SUNNYVALE CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
20940	MICRO-OHM CORP	EL MONTE CA	91731
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD MA	01880
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
24931	SPECIALTY CONNECTOR CO INC	INDIANAPOLIS IN	46227
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
30983	MEPCO/ELECTRA CORP	SAN DIEGO CA	92121
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
52648	PLESSEY SEMICONDUCTORS	SANTA ANA CA	92705
52763	STETTNER-TRUSH INC	CAZENOVIA NY	13035
54294	CUTLER-HAMMER-INC SHALLCROSS MFG CO	SELMA NC	27576
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71744	CHICAGO MINIATURE/DRAKE	CHICAGO IL	60640
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
74970	JOHNSON E F CO	WASECA MN	56093
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA PA	19108
75915	LITTELFUSE INC	DES PLAINES IL	60016

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information for adapting this manual to instruments for which the content does not apply directly. In addition, information about recommended modifications for improvements to the instruments is provided.

7-3. MANUAL CHANGES

7-4. To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument serial number. Perform these changes in the sequence listed.

7-5. If your instrument serial number is not listed on the title page of this manual or in Table 7-1 below, it may be documented in a yellow MANUAL CHANGES supplement. For additional important information about serial number coverage refer to INSTRUMENTS COVERED BY MANUAL in Section I.

Table 7-1. Manual Changes

Serial Prefix or Number	Make Changes
1701A	D through A
1702A	D through B
1703A00103	D, C
1703A00104	D

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Table 1-1:

Change the FREQUENCY MODULATION CHARACTERISTICS, Frequency Response (relative to 100 kHz rate) to "±1.5 dB, 100 Hz —3 MHz, 100 kHz range; ±1.5 dB, 3 kHz —3 MHz, 10 MHz range."

Section IV, FM Frequency Response performance test:

Change the FM Frequency Response specification to "for 100 kHz range, ±1.5 dB from 100 Hz to 3 MHz and for 10 MHz range, ±1.5 dB from 3 kHz to 3 MHz."

In the table following step 6, change the Calculated Response Minimum to —1.5 dB and maximum to +1.5 dB.

Table 4-3:

Change the specification for frequency response to "±1.5 dB from 100 Hz to 3 MHz."

Table 6-3:

Change A3A9A5Q4 to 1855-0218 TRANSISTOR-MOSFET DUAL-GATE N-CHAN E-MODE.

Service Sheet 8-A3:

Change the part number of A3A9A5Q4 to 1855-0218.

CHANGE B

Section V, Voltage Controlled Crystal Oscillator (VCXO) adjustment procedure:

Change step 2 to "Connect —10 Vdc from A3A4TP4 to the TUNE test point A3A1A2TP1."

Change the second sentence of step 5 to "Disconnect —10 Vdc from the TUNE test point."

CHANGE B (Cont'd)

Table 6-3:
Change A3A1A1R51 to 0698-3136, RESISTOR 17.8K 1% 0.125W F TC=0±100.
Change A3A1A1R75 to 0698-7247, RESISTOR 2.87K 1% 0.05W F TC=0±100.
Change A3A1A1VR2 to 1902-0184, DIODE-ZNR 16.2V 5%, DO-7 PD=0.4W TC=0.066%.
Change A3A1A2Y1 to 0410-0482, 100 MHz ±10 ppm SERIES MODE HC-18/U HOLDER.
Change A3A1A4A2R4 to 0698-3150, RESISTOR 2.37K 1% 0.125W F TC=0±100.
Delete A3A3C15.

Service Sheet 2 Schematic:
Change the A3A1A1 TUNE VOLTAGE to "—5 to —40 Vdc, —10 Vdc nominal."

Service Sheet 1-A3 Schematic:
Change the TUNE VOLTAGE to "—10 Vdc nominal."
Change the value of A3A1A1R51 to 17.8K and A3A1A1R75 to 2870 ohms.
Change the rated value of A3A1A1VR2 to 16.2V.

Service Sheet 2-A3 Schematic:
Change the TUNE VOLTAGE to "—5 to —40 Vdc, —10 Vdc nominal."

Service Sheet 4-A3 Schematic:
Change the value of A3A1A4A2R4 to 2370 ohms.

Service Sheet 12-A3 Schematic:
Delete A3A3C15.

CHANGE C

Table 6-3:
Change A2A1C1 to 0180-0197, CAPACITOR-FXD 2.2UF ±10% 20 VDC TA.
Change A2A3C12 to 0160-2200, CAPACITOR-FXD 43PF ±5% 300WVDC MICA.
Delete A2A3R34.

Service Sheet 3-A2 Schematic:
Delete A2A3R34.
Change A2A3C12 to 43pF.

Service Sheet 12-A2 Schematic:
Change A2A1C1 to 2.2UF.

CHANGE D

Table 6-3:
Change A3A4C12 to 0160-3460, CAPACITOR-FXD 0.05 UF +80 —20% 100WVDC CER.
Change A3C4 to 0180-0455, CAPACITOR-FXD 0.0425F +100 —10% 15VDC AL.
Delete A3A6TP1—5.

Service Sheet 11-A3 Schematic:
Change A3C4 to 42 500UF

Service Sheet 13-A3 Schematic:
Change A3A4C12 to 0.05 UF.

7-7. INSTRUMENT IMPROVEMENTS

7-8. Hewlett-Packard recommends that the certain modifications be done to the Synthesizer or that certain parts be replaced with preferred parts in the event of a failure. These modifications and new parts are intended to increase reliability and improve the instruments performance.

7-9. The modifications are not the same as manual changes or preferred replacement parts and should not be confused with them. If the instruments are modified or the preferred replacement parts are installed, the manual should be updated to reflect the differences. Table 7-2 indicates which parts have been changed over the life of the instrument, the recommended modifications and the preferred replacements.

7-10. Perform the modifications as indicated in the following paragraphs if your instrument's serial number or prefix is among those listed.

7-11. INSTRUMENT IMPROVEMENT MODIFICATION INSTRUCTIONS

7-12. For instruments with Serial Prefixes 1702A or below:

a. Change A3A1A1R51 to 0698-3157, RESISTOR 19.6K 1% 0.125W F TC=0±100.

b. Change A3A1A1R75 to 0698-7236, RESISTOR 1K 2% 0.05W F TC=0±100.

c. Change A3A1A1VR2 to 1902-3256, DIODE-ZNR 23.7V 5% DO—7 PD=0.4W TC=.075%.

d. Use the Voltage Controlled Crystal Oscillator (VCXO) adjustment procedure in Section V as stated (without the changes indicated by Change B in Section VII).

e. All references to the TUNE VOLTAGE (Service Sheets 2, 1-A3, and 2-A3) are shown in Section VIII. For example, the TUNE VOLTAGE "—5 to —20 Vdc, —8 Vdc nominal."

f. Add A3A3C15 (0160-4298, CAPACITOR-FXD 4700 pF ±20% 250WVDC CER) between the base and collector of A3A3Q2.

7-13. For all instruments:

On Table 6-3 and Service Sheet 9-A2:
Change A2A11C20 to 0160-3877, CAPACITOR-FXD 100 pF.

This will permit A2A11U9D (2 "D-type" Flip-Flops) to function properly. If U9 is replaced, C20 should be changed to assure proper instrument performance.

Table 7-2. Summary of Changes by Component

Change	Assemblies														
	A2A1	A2A3	A2A11	A3A1A1	A3A1A2	A3A1A3	A3A1A4A2	A3A3	A3A4	A3A5	A3A6	A3A7	A3A9A4	A3A9A5	A3
A														Q4[1]	
B				R51[2] R75[2] VR2[2]	Y1[1]		R4[1]	C15[1]							
C	C1[1]	C12[1] R34[1]													
D									C12[1]						C4[1]
NONE		Q6[1]	C20[2]	Q5[1] Q6[1]		Q1[1] Q2[1]		Q2[1]		Q2[1] Q3[1] Q6[1] Q9[1] Q10[1] Q12[1]	Q11[1] Q13[1]	Q9[1] Q10[1] Q14[1]	Q2[1]		

[1]New part (as shown in Table 6-3) is the preferred replacement.

[2]Modification to new part is recommended.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section provides information on service related subjects. Safety considerations include warnings and cautions to be observed while servicing the instrument. The arrangement of the principles of operation and troubleshooting is explained. Repair information such as non-repairable items, module exchange and disassembly and reassembly procedure is included.

8-3. The service sheets are in the foldout section. Each service sheet includes a block or schematic diagram, with accompanying principles of operation and troubleshooting information. Usually a component location diagram is also included. Figure 8-1 Schematic Diagram Notes provides general information which relates to block and schematic diagram symbols.

8-4. Other pertinent service information is included throughout the section.

8-5. SAFETY CONSIDERATIONS

8-6. This section contains warnings and cautions which must be followed for your protection and to avoid damage to the equipment.

WARNING

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. Where maintenance can be performed without power supplied, the power should be removed.

8-7. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

8-8. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

8-9. Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

8-10. Whenever it is likely that this protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

8-11. PRINCIPLES OF OPERATION

8-12. The operation of the Synthesizer is explained on each service sheet. Overall operation, in terms of interaction of the major assemblies, is found on Service Sheet 1. Each major assembly is broken down into sections (groups of assemblies) on Service Sheets 2 and 3. Remaining service sheets review the section operating information and explain the assembly operation to the stage (group of components) level.

8-13. TROUBLESHOOTING

NOTE

If the Synthesizer malfunctions, begin troubleshooting on Service Sheet 1.

8-14. Arrangement in Manual

8-15. The troubleshooting information for the Synthesizer is found on each service sheet. If the Synthesizer malfunctions, begin troubleshooting with Service Sheet 1 to isolate the defect to a major assembly. On service sheets 2 and 3, troubleshoot to the section level (a logic group of assemblies). Next, isolate the defective assembly by following the information on the key Service Sheet for the section. With the remaining information on the key service sheet (which applies to the assembly) on the remaining service sheets, isolate the defective stage. Continue troubleshooting to defective component.

8-16. Supplemental Troubleshooting Aids

8-17. The HP-IB Diagnostic Program may verify that the HP-IB input to the Synthesizer is operat-

SCHEMATIC DIAGRAM NOTES

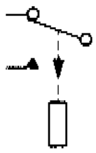
Resistance in ohms, capacitance in microfarads, inductance in millihenries unless otherwide noted.

*	Asterisk denotes a factory-selected value. Value shown is typical. Part may be omitted.
	Tool-aided adjustment. ○ Manual control.
	Encloses front-panel designation.
	Encloses rear-panel designation.
	Circuit assembly borderline.
	Other assembly borderline. Also used to indicate mechanical interconnection (ganging).
	Heavy line with arrows indicates path and direction of main signal.
	Heavy dashed line with arrows indicates path and direction of main feedback.
CW	Wiper moves toward CW with clockwise rotation of control (as viewed from shaft or knob).
1	Numbered Test Point. Measurement aid provided.
A	Lettered Test Point. No measurement aid provided.
	Encloses wire 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., (947) denotes white base, yellow wide stripe, violet narrow stripe.
	A direct conducting connection to the 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-designated points are connected.
AA 3-A3	Letters – off page connection, e.g., AA Number – Service Sheet number for off-page connection, e.g., 3 Letter number – Service Sheet Assembly Number. A3
1 THIS PAGE	Number (only) – on page connection.
A B C A 3 2	Indicates multiple paths represented by only one line. Letters or names identify individual paths. Numbers indicate number of paths represented by the line.

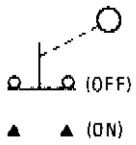
Figure 8-1. Schematic Diagram Notes (1 of 3)

SCHEMATIC DIAGRAM NOTES

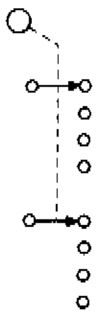
Coaxial or shielded cable.



Relay contact moves in direction of arrow when energized.

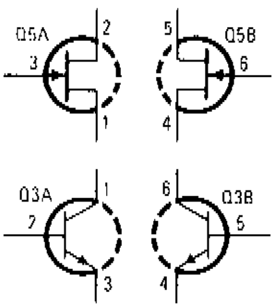


Indicates a pushbutton switch with a momentary (ON) position.

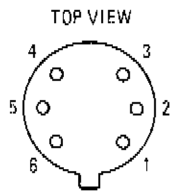


Indicates a ganged 2-section 4-position rotary switch.

Indicates a Schottky (hot-carrier) diode.



Dual Transistors — Physical location of the pins is as shown.



NSTOR Signals that are active-low, are identified by the letter N followed by a signal mnemonic (such as NSTOR).

STOR Signals that are active-high are identified by a signal mnemonic (such as STOR).

Identification of logic families is as shown (in this case, ECL). For more information on logic symbols, refer to the paragraph entitled Logic Symbols in Section VIII.

Figure 8-1. Schematic Diagram Notes (2 of 3)

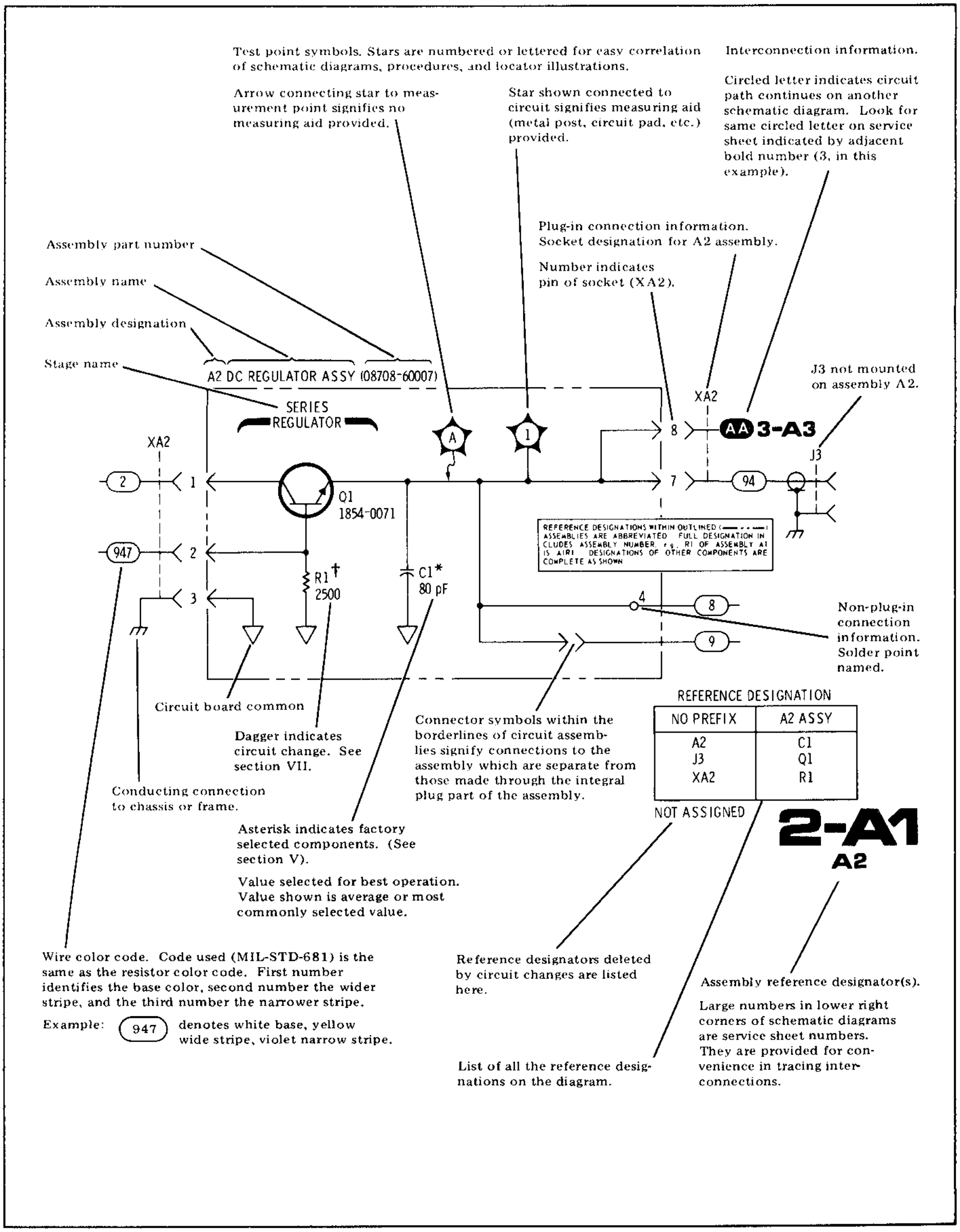


Figure 8-1. Schemaic Diagram Notes (3 of 3)

Arrangement in Manual (Cont'd)

ing properly. The program will not isolate a remote problem but it may give some indication of what the actual problem is. A remote operator's check, found near the last page of this manual, checks the various functions of the Synthesizer when the HP-IB controller and bus are operating correctly.

8-18. An Operational Verification Check, located before the performance tests in Section IV, may be used to check the performance of the instrument without an excessive outlay of time.

8-19. Table 5-2 (in Section V) may aid in isolating a circuit defect in the event of a performance test failure.

8-20. RECOMMENDED TEST EQUIPMENT

8-21. Test equipment and test equipment accessories required to maintain the Synthesizer are listed in Table 1-2. Equipment other than that listed may be used if it meets the listed critical specifications.

8-22. SERVICE AIDS

8-23. Pozidriv Screwdrivers. Many screws in the instrument appear to be Phillips, but are not. To avoid damage to the screw slots, Pozidriv screwdrivers should be used.

8-24. Blade Tuning Tools. For adjustments requiring a non-metallic tuning tool, use the J.F.D. Model No. 5284 (HP 8710-1010). In situations not requiring non-metallic tuning tools, an ordinary small screwdriver or other suitable tool is sufficient. No matter what tool is used, never try to force any adjustment control in this instrument. This is especially critical when adjusting variable inductors or capacitors.

8-25. Part Location Aids. The locations of some chassis-mounted parts and the major assemblies are shown on/or near the last foldout of this manual. The locations of individual components mounted on printed circuit boards or other assemblies are shown on the service sheet.

8-26. Servicing Aids on Printed Circuit Boards. The servicing aids include test points, transistor and integrated circuit designations, adjustment callouts, and assembly stock numbers.

8-27. REPAIR

8-28. After a circuit board is repaired, it is recommended that the area sorrounding the new component be sprayed with a protective coating.*

8-29. Factory Selected Components

8-30. Some component values are selected at the time of final checkout at the factory (see Table 5-1). Usually these values are not extremely critical; they are selected to provide optimum compatibility with associated components. These components are identified on individual schematics by an asterisk (*). The recommended procedure for replacing a factory-selected part is as follows:

a. Try the original value, then perform the calibration test specified for the circuit in the performance and adjustment sections of this manual.

b. If calibration cannot be accomplished, try the typical value shown in the parts list and repeat the test.

c. If the test results are still not satisfactory, substitute various values within the tolerance specified in Table 5-1 until the desired result is obtained.

8-31. Non-Field Repairable Assemblies

8-32. A few of the Synthesizer's assemblies must be replaced if they malfunction. If they are repairable, they may be returned to the factory under the Module Exchange Program (refer to the next paragraph). The following assemblies are not repairable:

A2A2	Rotary Pulse Generator
A3A9U1	Sampler 2–6.5 GHz
A3A9A1	Directional Coupler Assembly
A3A9A2	YTO Interconnect Assembly
A3A9A6	Attenuator Assembly, 15 dB
A3A9A7	6.3 GHz Low Pass Filter Assembly
A3A11	Power Line Module

8-33. Module Exchange Program

8-34. The restored assemblies listed below may be ordered as replacements under the Module Exchange Program.

A3A1A4 M/N VCO Assembly (if A3A1A4A1 is defective, replace the entire assembly.)

*Such as "Krylon" No. 1301 by Borden Inc., Department CP Columbus, Ohio 43215.

Module Exchange Program (Cont'd)

A3A8 10 MHz Reference Oscillator Assembly
A3A9A3 2–6.2 GHz YTO Assembly

Refer to Section VI for ordering information.

8-35. After Service Product Safety Checks

8-36. 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 cause of any such condition.

8-37. Using a suitable ohmmeter, check resistance from instrument enclosure to ground pin on power cable plug. The reading must be less than one-half ohm. Flex the power cable while making this measurement to determine whether intermittent discontinuities exist.

8-38. Check any indicated front or rear panel ground terminals marked, using the above procedure.

8-39. Check resistance from instrument enclosure to the 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 which results in a failure.

8-40. Check line fuse (A3F1) to verify that a correctly rated fuse is installed. (Refer to Section II).

8-41. Disassembly and Reassembly Procedures

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. Where maintenance can be performed without power supplied, the power should be removed.

A pin-to-pin voltage difference of 60 Vdc may be found on many of the Synthesizer's circuit board connectors. This voltage could cause personal injury if contacted. Be careful while working on the circuit boards with power supplied to the instrument.

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. Be careful while working on the circuit boards with power supplied. Work with one hand. Do not touch the extender board.

8-42. Before performing any of the following disassembly or reassembly procedures, the following steps must pe performed.

a. Set the LINE switch to STANDBY.

b. Remove the Line Power Cable from the Line Module (A3A11).

8-43. Top Cover Removal. To remove the top cover from the Synthesizer follow the steps as listed below:

a. Remove the two plastic feet from the rear of the top cover by removing the Pozidriv screw from each foot (see Figure 8-2).

b. Unscrew the Pozidriv screw at the middle of the rear edge of the top cover (see Figure 8-2). This is a captive screw and will cause the top cover to pull away from the front frame. Captive screw part number HP 0570-1171; clip part number HP 0510-0043.

c. Lift the top cover off the Synthesizer.

8-44. A2 Assembly Protective Cover Removal. To remove the protective cover follow the steps as listed below:

a. Remove the Pozidriv screw at the rear of the protective cover.

b. Lift up the rear portion of the protective cover and slide towards the rear of the Synthesizer to allow the front edge pins to disengage from the guide slots.

8-45. Bottom Cover Removal. To remove the bottom cover from the Synthesizer follow the steps as listed below.

a. Place the Synthesizer upside down.

b. Remove the two plastic feet from the rear of the bottom cover by removing the Pozidriv screw from each foot (see Figure 8-2).

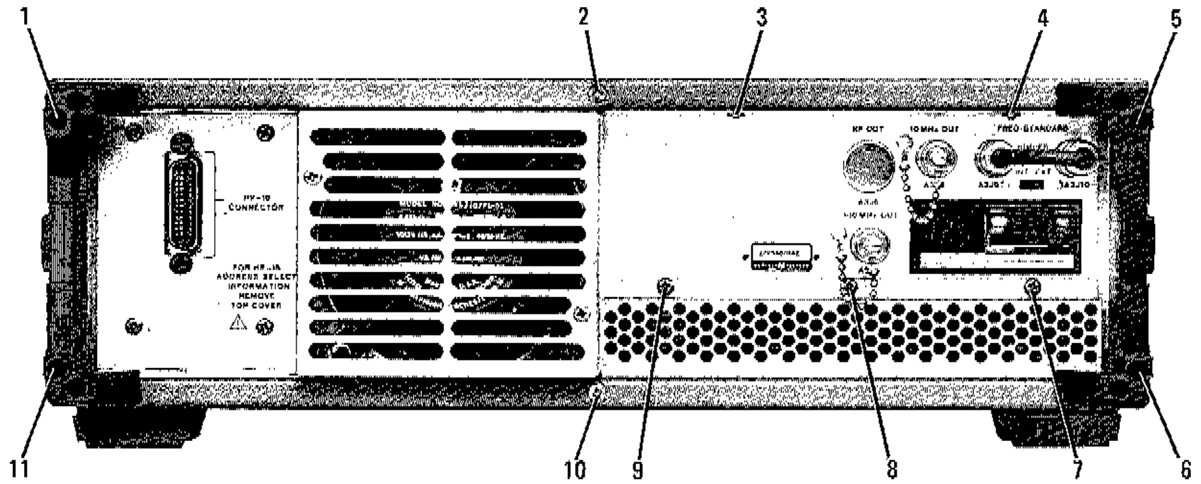


Figure 8-2. Rear Panel of the Synthesizer

Disassembly and Reassembly Procedures (Cont'd)

c. Unscrew the Pozidriv screw at the middle of the rear edge of the bottom cover (See Figure 8-2). This is a captive screw and will cause the front edge of the bottom cover to pull away from the front frame. Captive screw part number HP 0570-1171; clip part number HP 0510-0043.

d. Lift the bottom cover off the Synthesizer.

8-46. Front Panel Removal. To remove the A2 Assembly Front Panel follow the steps as listed below:

a. Place the Synthesizer upside down.

b. Remove the plastic trim strip from the bottom of the front frame.

c. Remove the plastic foot on the A2 assembly side of the instrument.

d. Remove the two Pozidriv screws from the bottom edge of the front frame over the front panel

e. Place the Synthesizer with top side up.

f. Remove the top plastic trim strip from the front frame.

g. Remove the two Pozidriv screws from the top edge of the front frame over the front panel.

h. Carefully, pull the front panel outward to clear the front frame (see Figure 8-3).

i. Disconnect the cables and the wiring as necessary to free the front panel.

j. Remove the two Pozidriv screws from the hinge and remove the front panel.

8-47. Fan Removal and Replacement. To remove the fan from the Synthesizer follow the steps as listed below:

a. Remove the bottom cover from the Synthesizer as in paragraph 8-45.

b. Remove two Pozidriv screws from the fan cowl and remove the cowl.

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.

c. Remove the clear plastic protective cover from the bottom of the Synthesizer by removing the five white circled screws (see Figure 8-4).

d. Remove the plastic clamp holding the three wires going to the fan from the Mother Board.

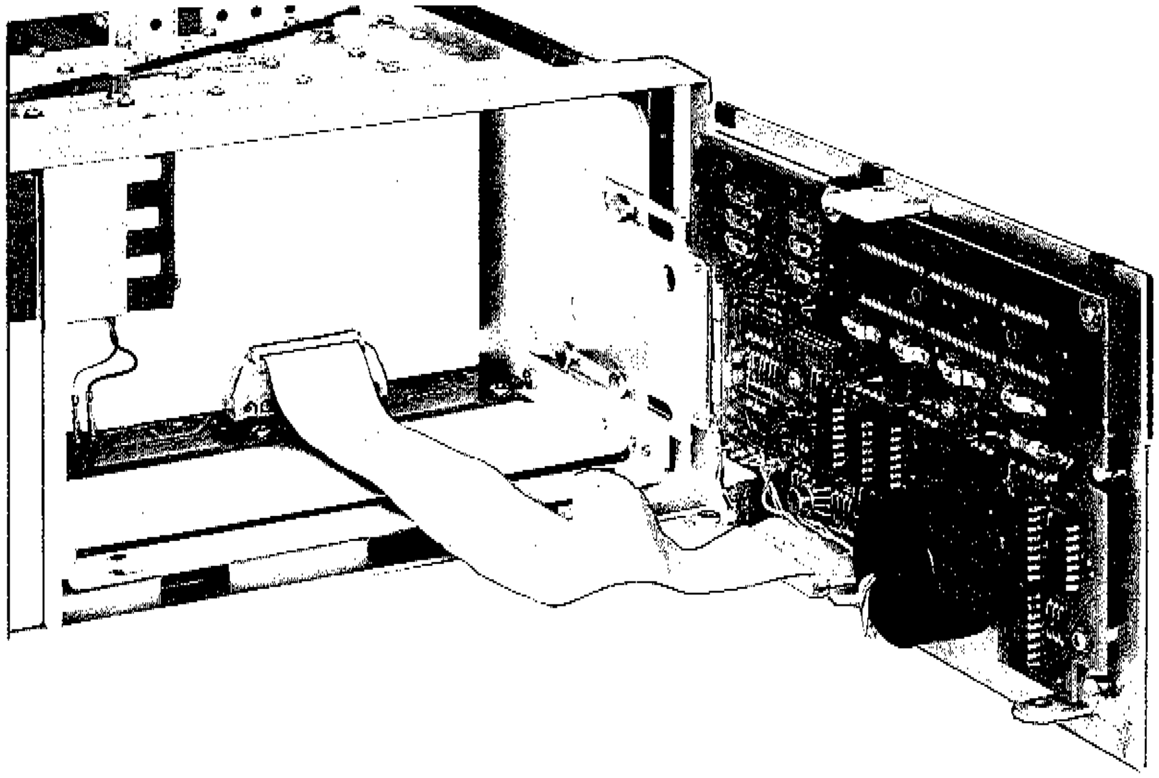


Figure 8-3. A2 Assembly Front Panel Fully Extended

Disassembly and Reassembly Procedures (Cont'd)

e. Unsolder the two black (06 and 09) wires from the Mother Board. Remove the screw from the ground wire.

f. Pull the three wires out of the rear frame going to the fan.

g. Remove the four nuts and lockwashers from the fan mounting brackets.

h. Carefully remove the fan from the mounting bracket. Do not lose any of the hardware.

i. Before replacing the fan, check to see that the magnetic shield is securely in place on the blade side of the fan motor.

j. 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 protective plastic cover before replacing the bottom cover. This cover is intended to provide protection from electrical shock when the bottom cover is removed.

k. Replace the cable camp and MAKE SURE that the plastic protective cover is replaced before replacing the bottom cover.

8-48. Rear Panel Removal. To remove the rear panel for access to the Line Module (A3A11), fan relay (A3K1), transistors (A3Q1-Q4), and the rear panel coax connectors, follow the steps listed below:

a. Remove the top cover as in paragraph 8-43.

b. 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).

c. Push the top of the panel outward. The transistors (A3Q1-Q4) can be replaced by removing the two Pozidriv screws holding them in place.

8-49. A3A1 M/N Loop Assembly Removal. To remove the A3A1 Assembly from the Synthesizer follow the steps as listed below:

a. Remove the top and bottom covers as in paragraphs 8-43 and 8-45.

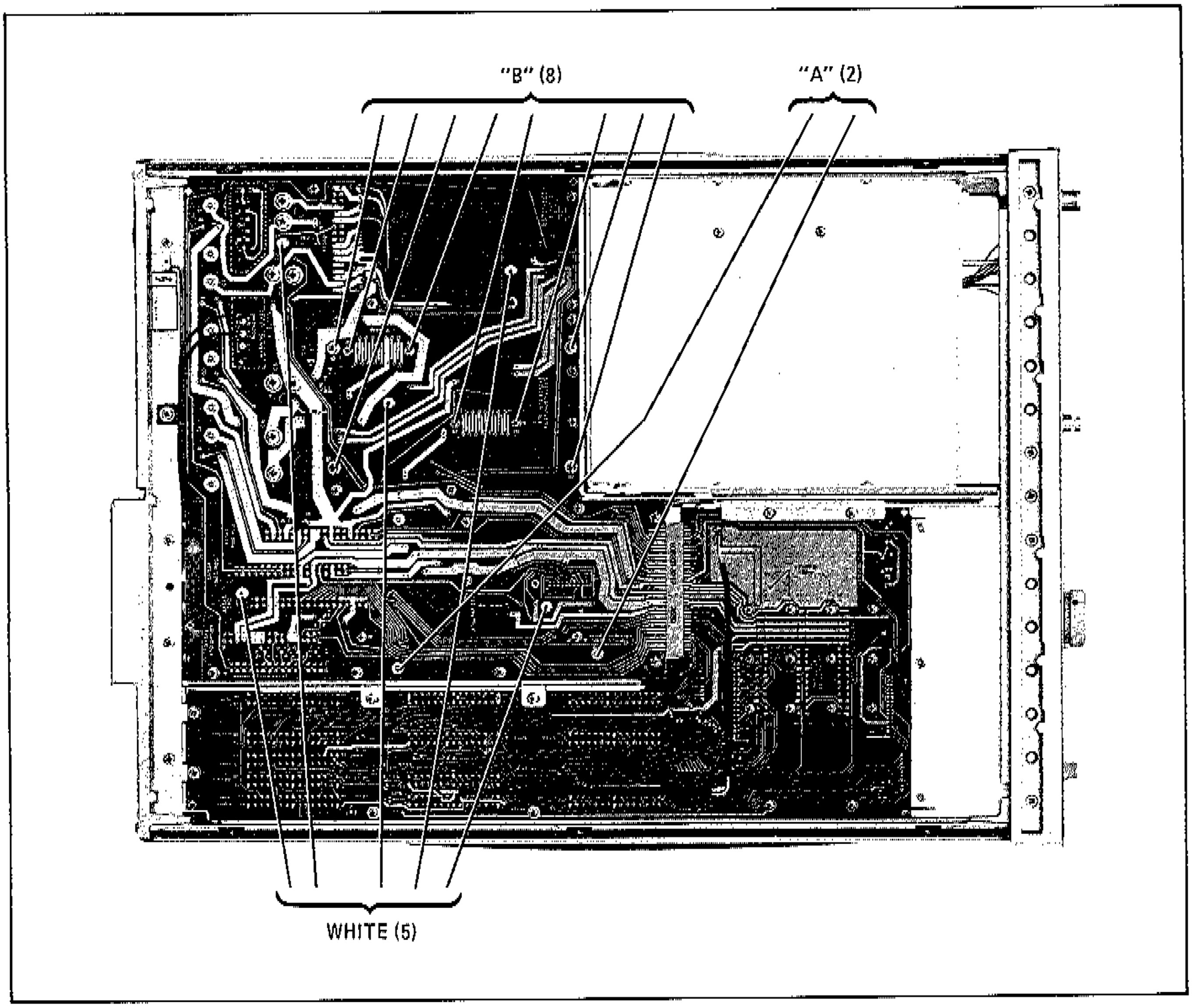


Figure 8-4. Bottom of the Synthesizer

Disassembly and Reassembly Procedures (Cont'd)

b. Set the Synthesizer on its right side.

c. Remove the fire coaxial cables from the A3A1 Assembly to free it from the other assemblies.

d. Remove the eight Pozidriv screws labeled B from the Mother Board, noting the sizes of each. These screws can be removed without removing the protective cover from the bottom of the Synthesizer.

e. Hold the A3A1 Assemlby while removing the last screw. Then lift the assembly away from the Mother Board.

8-50. A3A9 YTO Loop Assembly Removal. To remove the A3A9 YTO Loop Assembly from the Synthesizer, follow the steps as listed below:

a. Remove the top and bottom covers as in paragraphs 8-43 and 8-45.

b. Remove the Pozidriv screw labeled "A" from the top of the A3A9 Assembly.

c. Disconnect the semi-rigid coax (A1W1) from A3A9A1J1. Loosen the cable at A1A13A1J1 and rotate it up and away from A3A9.

d. Remove the two Pozidriv screws labeled A from the bottom of the A3A9 Assembly through the Mother Board (see Figure 8-4).

e. Lift the assembly out until it clears the surrounding assemblies. Hook the front edge of the assembly over the front edge of the A3 Assembly as shown in Figure 8-5.

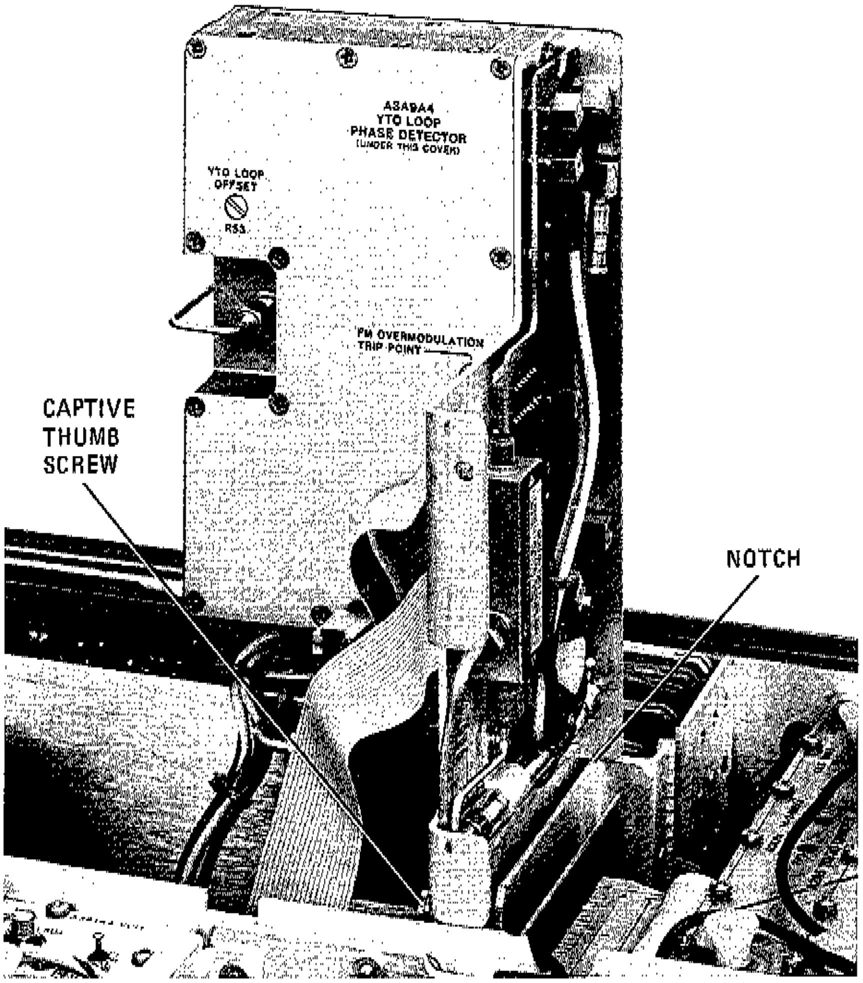


Figure 8-5. A3A9 Assembly in Service Position

Disassembly and Reassembly Procedures (Cont'd)

f. Secure the assembly into place by tightening the captive thumb screw into the pressed-in nut.

g. Connect a test cable from A3A9A1J1 to A1AT1J1 for troubleshooting and testing purposes.

CAUTION

When reinstalling the A3A9 Assembly, be careful ot to crush or pinch the coaxial or flat ribbon cables.

8-51. Battery Replacement. To replace the batteries, follow the steps listed below:

a. Remove the top cover as in paragraph 8-43.

b. Grasp the top of the battery holder's clip and pull forward until it slips off.

c. Grip the battery pack on both sides with your fingers and pull straight out.

d. Position the new battery pack so the metal strips press against the flexible contacts of the battery holder.

e. Slip the small end of the battery clip over the bottom end of the battery holder. Snap the top end of the clip into place.

8-52. LOGIC SYMBOLS

8-53. The logic symbols used in this manual are based on the American National Standard ANSI Y32.14-1973, "Graphic Symbols for Logic Dia-

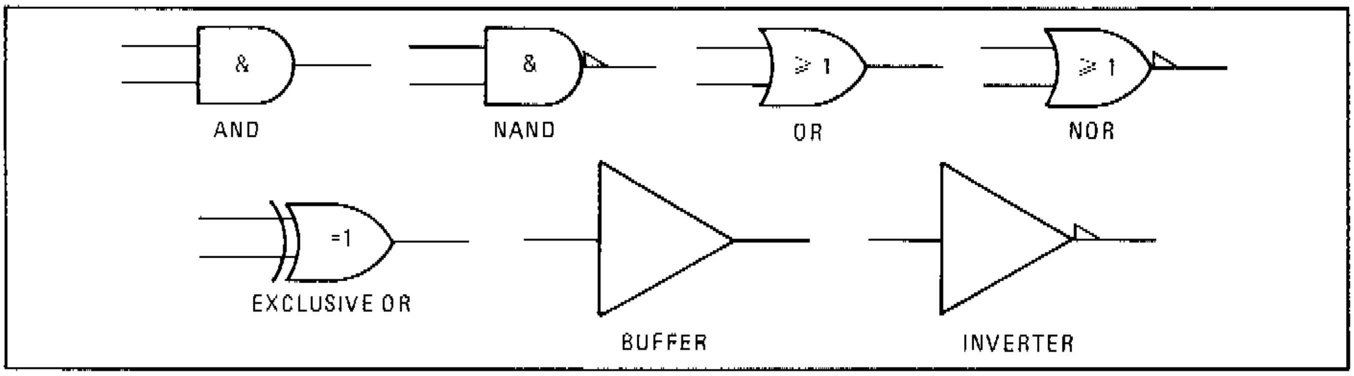


Figure 8-6. Qualifiers

LOGIC SYMBOLS (Cont'd)

grams (Two-State Devices)." The following summary should settle most questions of interpretation.

8-54. Qualifiers

8-55. Qualifiers are that portion of the symbol (either rectangular or distinctive shaped) that denotes the logic function. Refer to Figure 8-6.

8-56. Indicator Symbols

8-57. Indicator symbols identify the active state or level of a symbol's input or output. The more positive level is the high state; the less positive is the low state. Refer to Figure 8-8.

8-58. Contiguous Blocks

8-59. Two symbols may share a common boundary parallel or perpendicular to the direction of signal flow. Note that in the examples shown in Figure 8-7, there is generally no logic connection across a horizontal line; however, there is always a logic connection across a vertical line. An exception to this is the Common Control Block (Figure 8-12) where there is a logic connection across a horizontal line.

8-60. Dependency Notation

8-61. Dependency Notation is a way to simplify symbols for complex IC elements by defining the existence of an AND relationship between inputs, or by the AND, OR, control, or free (switch) conditioning of an output by an input without actually showing all the elements and interconnections involved. The examples of Figure 8-9 and 8-10 use the letter "C" for control, "G" for gate (AND), "V" for OR and "F" for free. 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; as for example, a coder. In this case, the controlling or gating input will be labeled with a letter. See Figure 8-11.

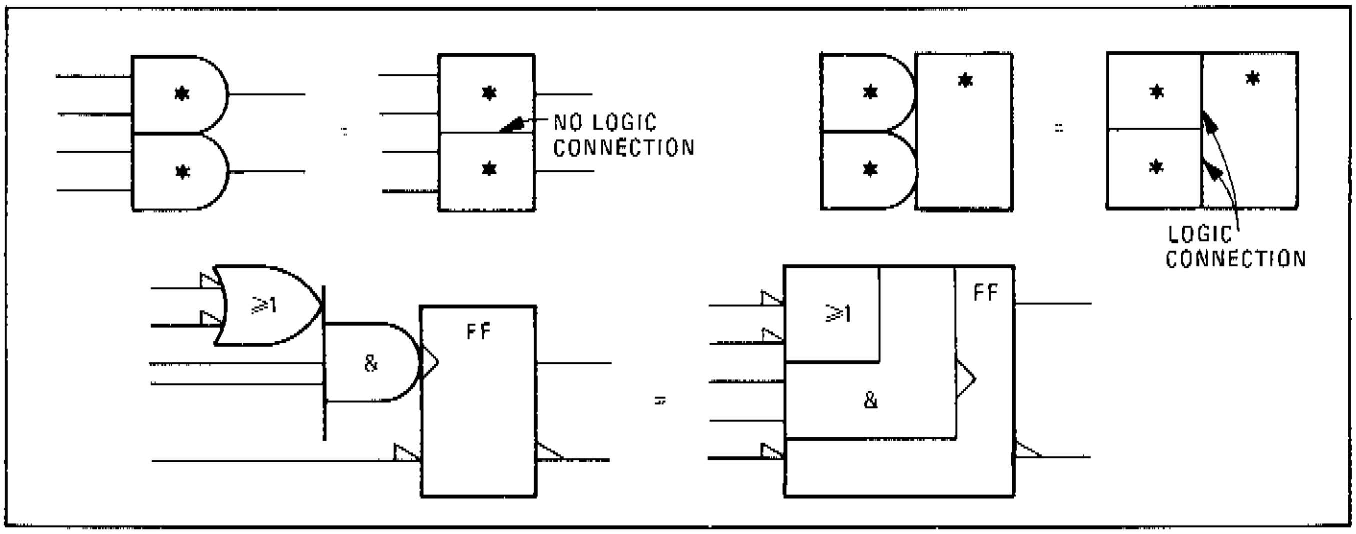
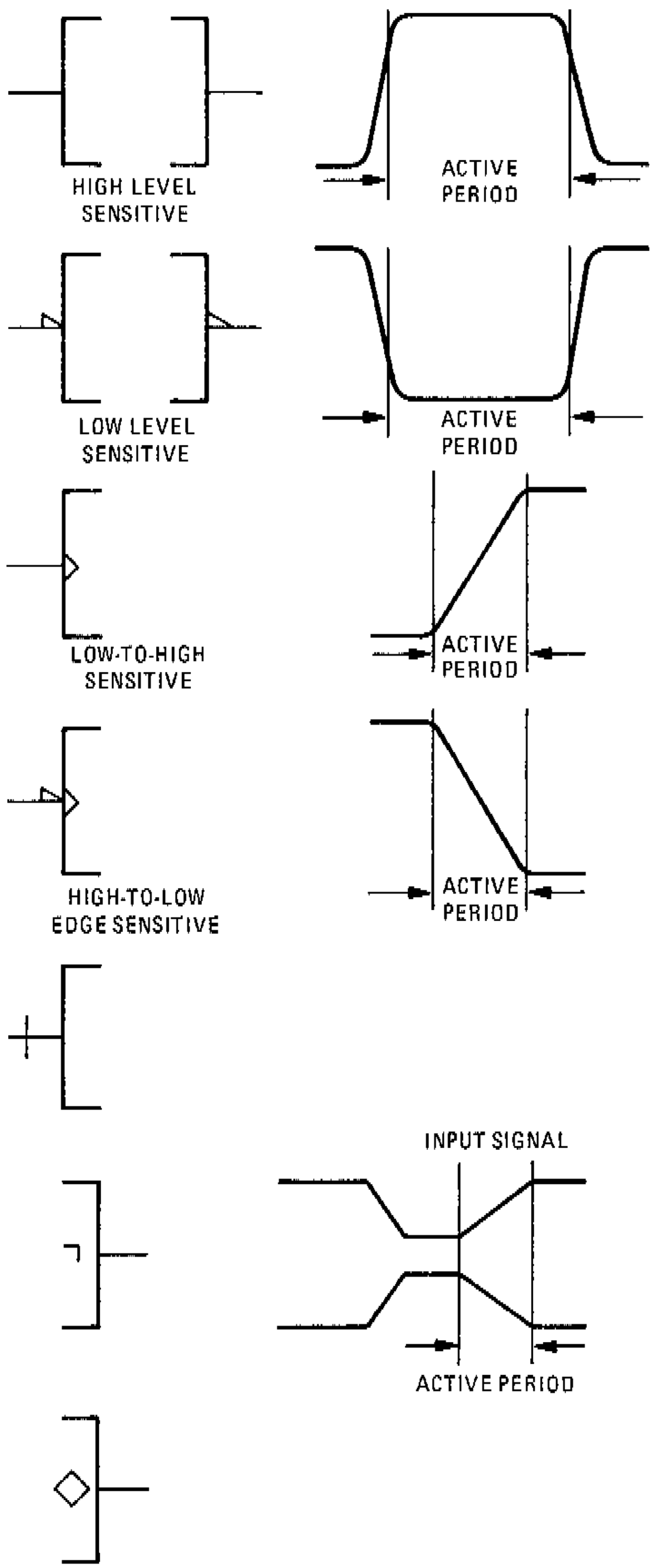


Figure 8-7. Contiguous Blocks



ACTIVE HIGH inputs and outputs are indicated by the absence of the polarity indicator symbol ( ).

ACTIVE LOW inputs and outputs are indicated by the presence of the polarity indicator symbol ( ).

EDGE SENSITIVE (Dynamic) inputs are indicated by the presence of the dynamic indicator symbol ( ).

INHIBIT input ( ) used when active input inhibits (blocks) the active state outputs of the logic function.

OUTPUT DELAY indicator symbol ( ) shows that an output becomes effective when the signal that initiated that change returns to its opposite state.

OPEN COLLECTOR OUTPUT. Output that forms part of a distributed connection.

Figure 8-8. Indicator Symbols

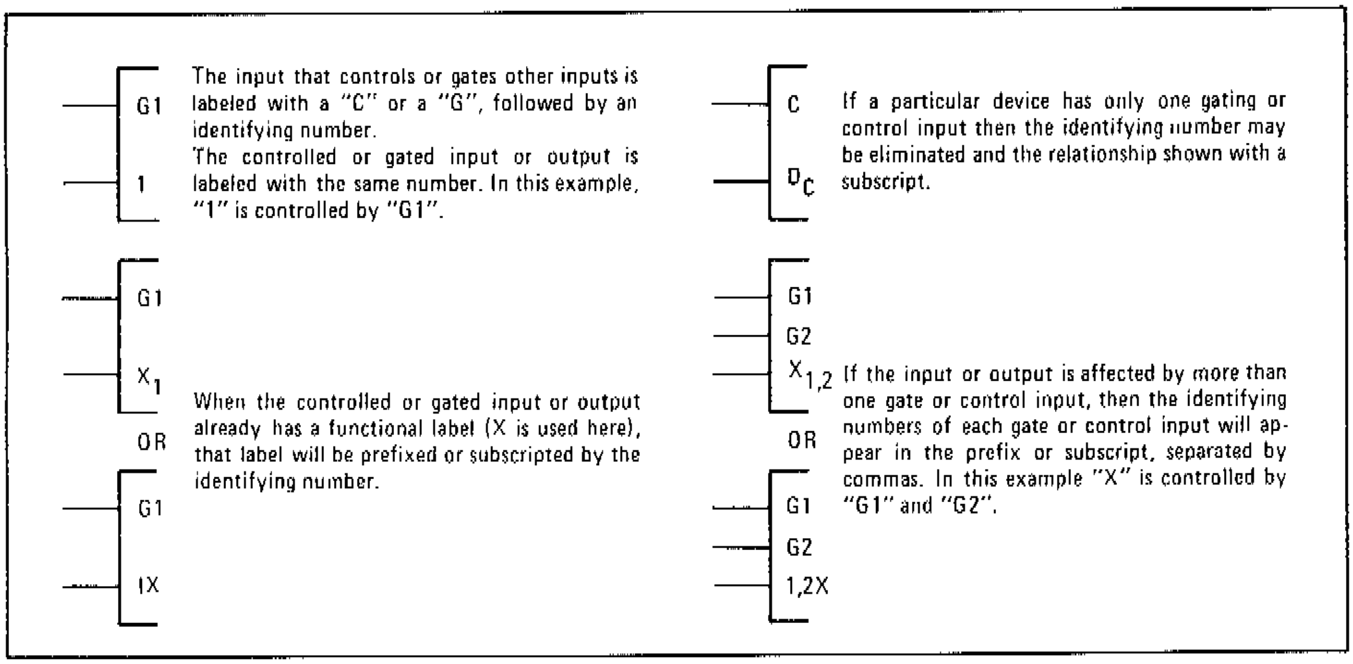


Figure 8-9. AND Dependency Notation

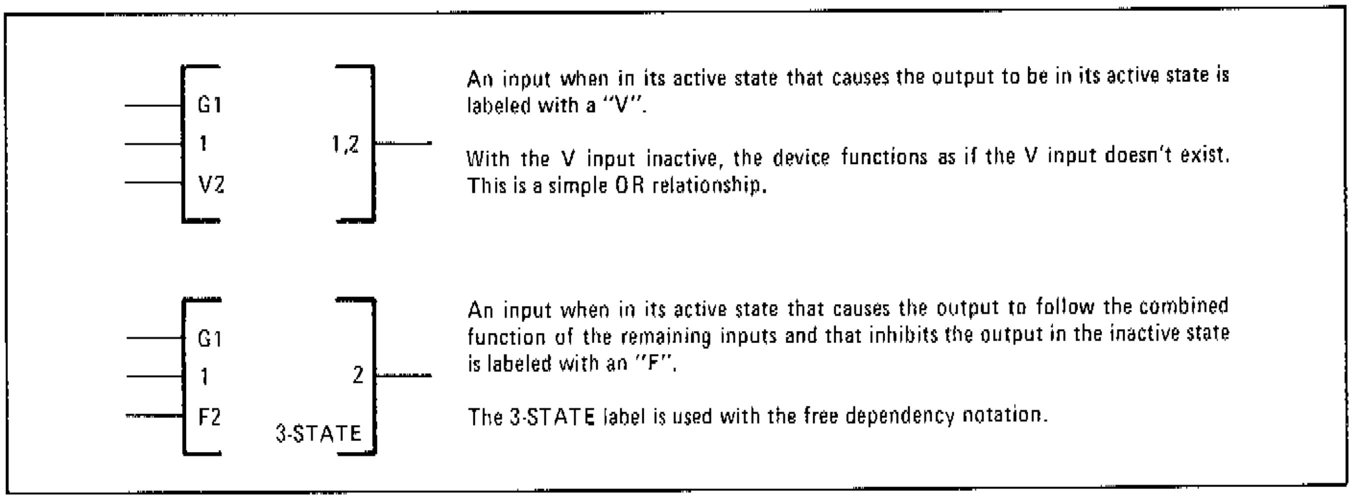


Figure 8-10. OR and Free Dependency Notation

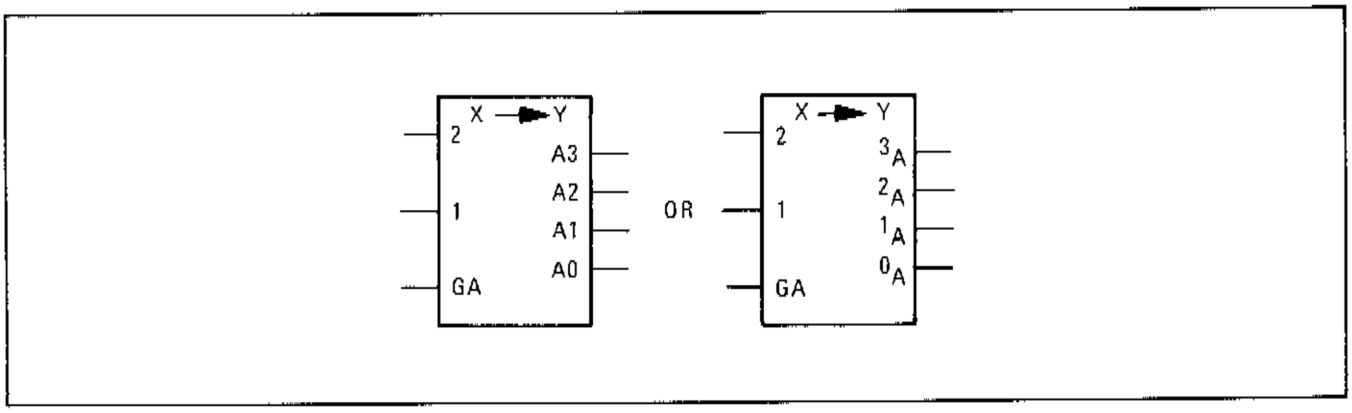


Figure 8-11. AND Dependency Notation, Coder Example Using Letters

8-62. Common Control Block

8-63. The Control Block is used in conjunction with an array of related symbols in order to group common logic lines. Figure 8-12 shows how the Control Block is usually represented. Figure 8-13 shows a quad D-Type flip-flop with reset. This can be redrawn by combining what is shown in Figures 8-12 and 8-13 about Contiguous Blocks and Common Control Blocks. The result is shown in Figure 8-14. Note that the more complex representation shown in Figure 8-13 might be used when the flip-flops are functionally scattered around the schematic (not used as a quad unit).

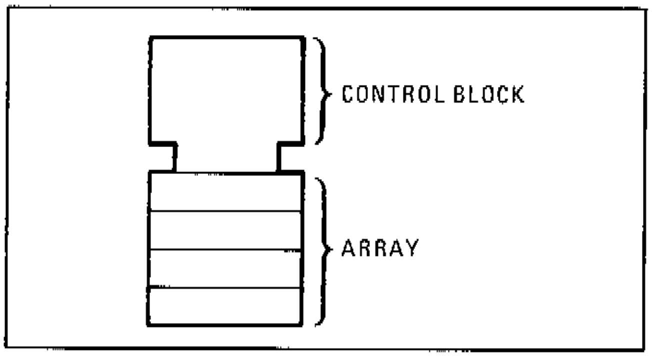


Figure 8-12. Common Control Block

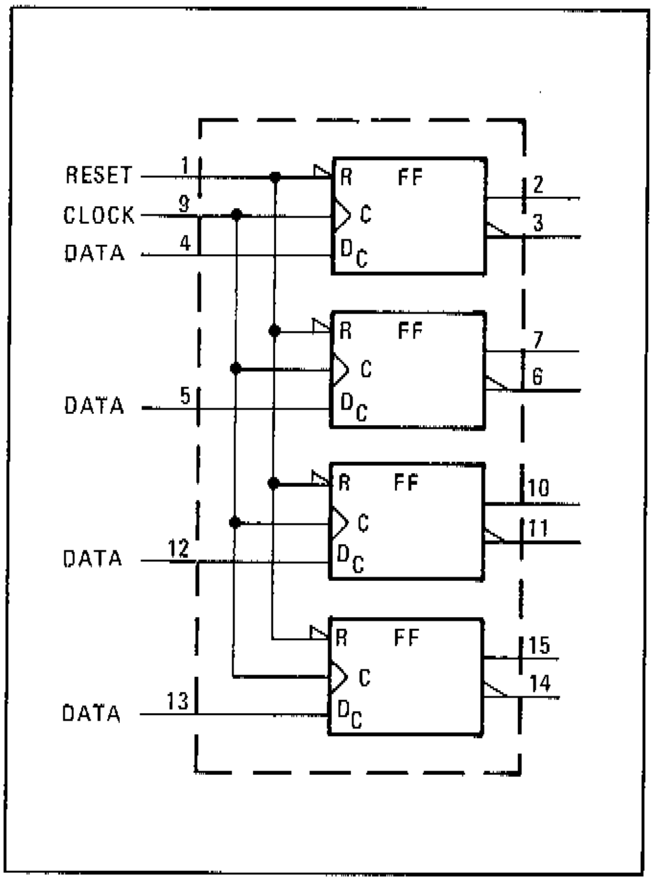


Figure 8-13. Quad D-Type Latch (Individual)

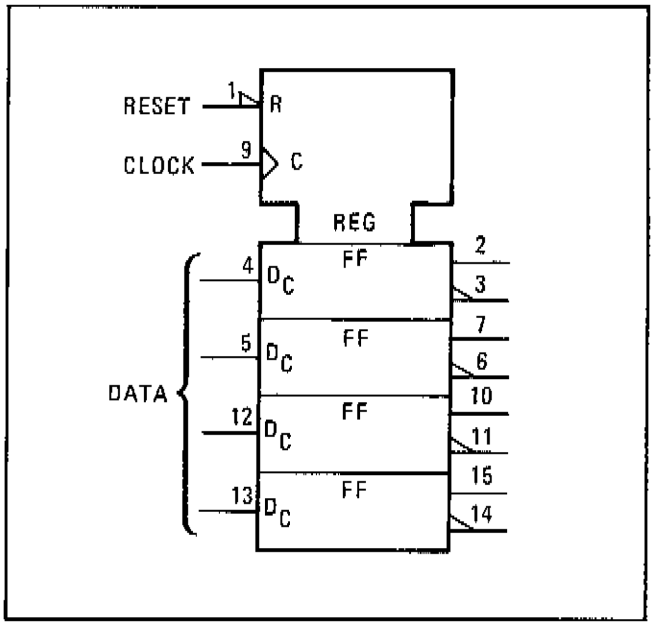


Figure 8-14. Quad D-Type Latch (Combined)

8-64. Complex Devices

8-65. Figures 8-15 through 8-17 show how the basic symbols can be combined in various ways to illustrate the behavior of fairly complex devices.

8-66. Quad D-Type Latch. Refer to Figure 8-15. The register control block is used to illustrate a quad D-type latch. 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 function (D) are subscripted with a C.

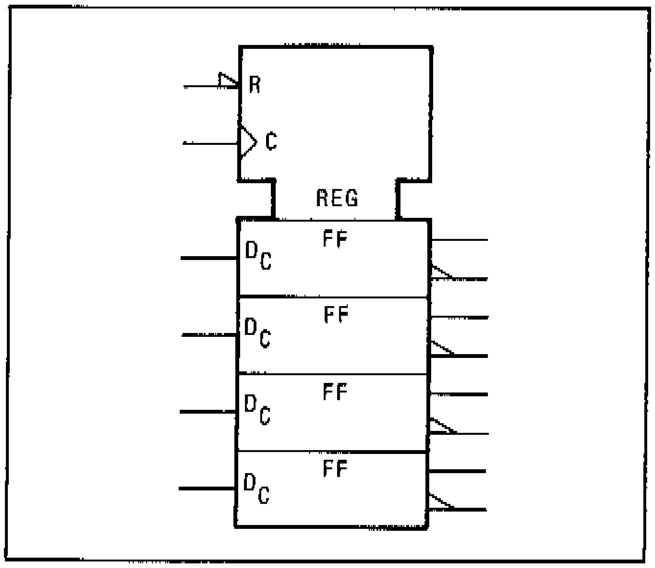


Figure 8-15. Quad D-Type Latch Example

Complex Devices (Cont'd)

8-67. Multiplexer. The multiplexer block is used to simplify the AND portion of a quad AND-OR select gate. When G1 is high, the data presented at the "1" inputs are gated through. When G2 is high, the data presented at the "2" inputs are gated through.

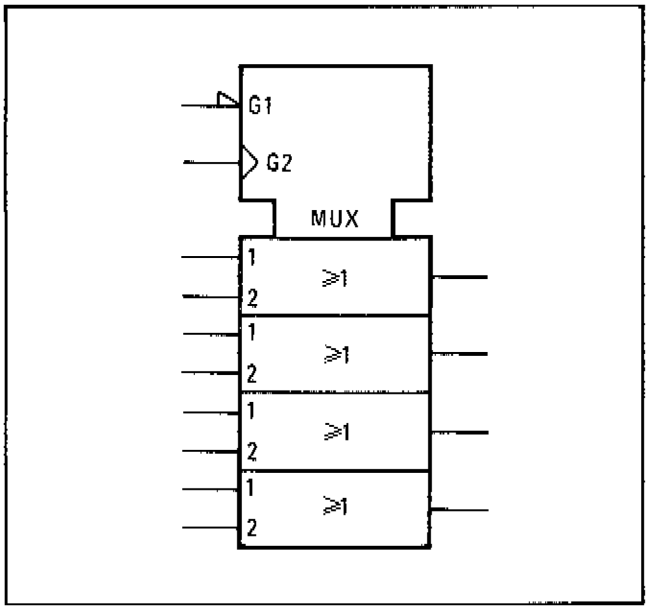


Figure 8-16. Multiplexer (AND-OR Selected) Example

8-68. Shift Register Control Block. The shift register control block is used to show 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, "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 one unit. Input "b" enables one of the inputs to the bottom flip-flop (2D), and also shifts the register contents up one unit. Input "c" loads all four flip-flops in parallel (3D). Input "d" is a common reset. The output delay indicator is used because the outputs change state when the control input returns to its inactive state.

8-69. Up-Down Counter Control Block. The counter control block (Figure 8-18) is used to show the common inputs to a Presettable Decade Up/Down Counter. Notice that "+m" means count up (increment the count) by "m"; "−m" means count down by "m". Note that if m=1, "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 barrow outputs are generated. They also define it as a decade counter; a binary counter would have carry indicated with "=15, +1". Flip-flop weighting is indicated in parenthesis.

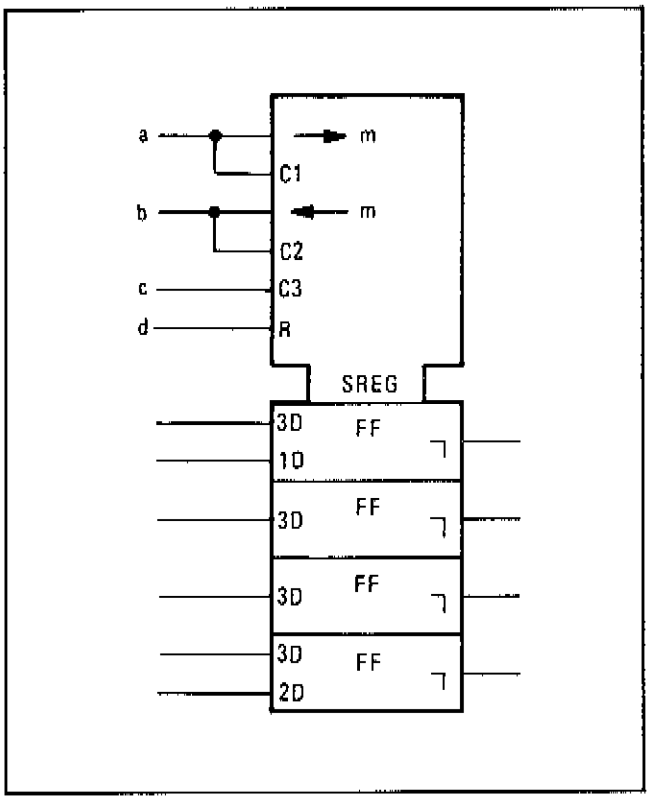


Figure 8-17. Shift Register Example

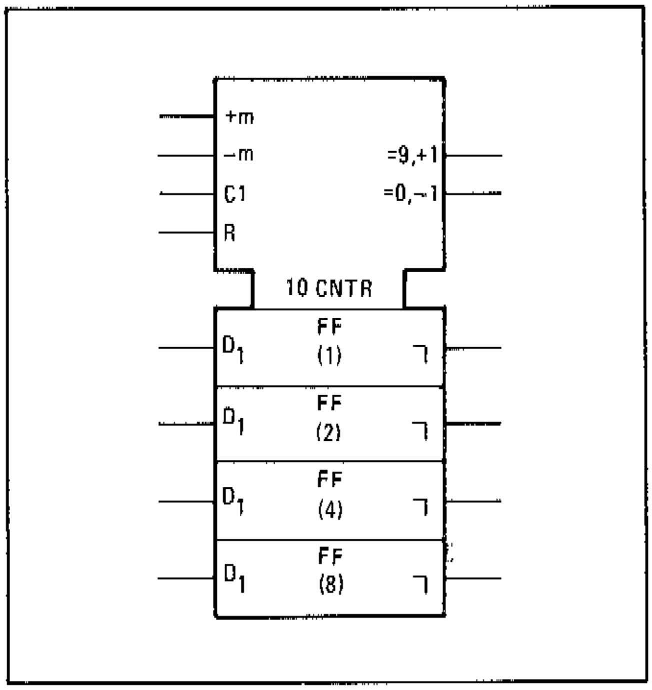


Figure 8-18. Up-Down Counter Example

Table 8-1. HP-IB Diagnostic Program (1 of 8)

```
10 REM 8671A HP-IB DIAGNOSTIC PROGRAM HEWLETT PACKARD 31 JAN 1977
20 REM NO EXTERNAL TEST EQUIPMENT REQUIRED.
30 FORMAT 6B
40 FORMAT F1000.0
50 REM SEARCH FOR 8671 TALK ADDRESS
60 OUTPUT (13,30)1024;
70 T=64
80 OUTPUT (13,30)256,T,53,512;
90 IF (STAT13=1) OR (STAT13=3) THEN 160
100 T=T+1
110 IF T=85 THEN 100
120 IF T >= 95 THEN 140
130 GOTO 80
140 PRINT "TALK ADDRESS INOPERATIVE.  PROGRAM SUSPENDED"
150 GOTO 4050
160 OUTPUT (15,30)"TALK ADDRESS=",T
170 REM CHECK UNTALK FOR OTA
180 FOR T1=64 TO 95
190 IF T1=85 THEN 290
200 IF T1=T THEN 290
210 OUTPUT (13,30)256,T,53,512;
220 IF (STAT13=1) OR (STAT13=3) THEN 250
230 E=1
240 GOSUB 3790
250 OUTPUT (13,30)256,T1,512;
260 IF (STAT13=0) OR (STAT13=2) THEN 290
270 E=2
280 GOSUB 3790
290 NEXT T1
300 REM FIND LISTEN ADDRESS AND VERIFY UNTALK FOR LISTEN
310 L=T-32
320 OUTPUT (13,30)256,T,L,512;
330 IF (STAT13=0) OR (STAT13=2) THEN 360
340 PRINT " FAILURE TO LISTEN"
350 GOTO 4050
360 OUTPUT (15,30)"LISTEN ADDRESS="L
370 OUTPUT (13,30)256,T,512;
380 IF (STAT13=1) OR (STAT13=3) THEN 410
390 E=1
400 GOSUB 3790
410 FOR L1=32 TO 62
420 IF L1=L THEN 440
430 OUTPUT (13,30)256,T,L1,512;
440 IF (STAT13=1) OR (STAT13=3) THEN 470
450 E=1
460 GOSUB 3790
470 NEXT L1
480 PRINT "8671A RESPONDS OK TO TALK AND LISTEN ADDRESSES"LIN1
490 REM CHECK INITIAL CONDITION OF SRQ
500 IF (STAT13=2) OR (STAT13=3) THEN 530
510 E=5
```

Table 8-1. HP-IB Diagnostic Program (2 of 8)

```
520 GOSUB 3790
530 GOSUB 3990
540 IF S=0 THEN 570
550 GOSUB 3460
560 GOSUB 3760
570 OUTPUT (13,30)768;
580 GOSUB 3960
590 DISP "FREQUENCY DISPLAY SCAN"
600 WAIT 1300
610 GOSUB 3960
620 CMD "","@0D0Z0"
630 DISP "     0000"
640 WAIT 700
650 CMD "","G1248"
660 DISP "     0001"
670 WAIT 700
680 CMD "","F12Z2"
690 DISP "     0012"
700 WAIT 700
710 CMD "","E124J1"
720 DISP "     0124"
730 WAIT 700
740 CMD "","D1248Z4"
750 DISP "    1248"
760 WAIT 700
770 CMD "","C1248Z6"
780 DISP "    12480"
790 WAIT 700
800 CMD "","B1248Z1"
810 DISP "  124800"
820 WAIT 700
830 CMD "","A1248Z1"
840 DISP " 1248000"
850 WAIT 700
860 CMD "","@12480Z0"
870 DISP "12480000"
880 WAIT 700
890 CMD "","@248Z1"
900 DISP "24800000"
910 WAIT 700
920 CMD "","@48Z1"
930 DISP "48000000"
940 WAIT 700
950 CMD "","P8Z8"
960 DISP "80000000"
970 WAIT 700
980 PRINT "FREQUENCY SCAN COMPLETE"
990 DISP "REPEAT? 1 OR 0";
1000 INPUT A
1010 IF A#0 THEN 590
1020 CMD "","A4Z1"
```

Table 8-1. HP-IB Diagnostic Program (3 of 8)

```
1030 REM RF UNIT SCAN
1040 GOSUB 3960
1050 CMD "","A2000Z1"
1060 DISP "RF SECTION TESTS"
1070 WAIT 2000
1080 CMD "","O0"
1090 DISP "RF OFF"
1100 WAIT 1500
1110 IF STAT13=2 THEN 1140
1120 E=5
1130 GOSUB 3790
1140 GOSUB 3990
1150 IF S=28 THEN 1180
1160 GOSUB 3460
1170 GOSUB 3760
1180 GOSUB 3960
1190 CMD "","O1"
1200 DISP "RF ON"
1210 WAIT 1500
1220 IF STAT13=2 THEN 1250
1230 E=5
1240 GOSUB 3790
1250 GOSUB 3990
1260 IF S=0 THEN 1290
1270 GOSUB 3460
1280 GOSUB 3760
1290 GOSUB 3960
1300 CMD "","N1"
1310 DISP "FM 100KHZ RANGE"
1320 WAIT 1200
1330 CMD "","N2"
1340 DISP "FM 10MHZ RANGE"
1350 WAIT 1500
1360 CMD "","N0"
1370 DISP "FM OFF"
1380 PRINT "RF CONTROL TESTS COMPLETE"LIN1
1390 DISP "REPEAT RF SECTION TESTS? 1 OR 0";
1400 INPUT A
1410 IF A=0 THEN 1430
1420 GOTO 1030
1430 REM BUS COMMAND TESTS
1440 REM CHECK SRQ FALSE BEFORE PROCEEDING
1450 OUTPUT (13,30)256,63,95,512;
1460 IF STAT13=2 THEN 1490
1470 E=5
1480 GOSUB 3790
1490 REM CHECK RESPONSE TO BAD FREQUENCY
1500 GOSUB 3960
1510 CMD "","@8671Z1"
1520 GOSUB 3990
1530 IF BIAND(S,32)=32 THEN 1560
```

Table 8-1. HP-IB Diagnostic Program (4 of 8)

```
1540 E=6
1550 GOSUB 3790
1560 GOSUB 3960
1570 WAIT 100
1580 IF STAT13=0 THEN 1660
1590 IF STAT13=1 THEN 1630
1600 E=4
1610 GOSUB 3790
1620 GOTO 1660
1630 E=2
1640 GOSUB 3790
1650 REM CHECK SPE
1660 OUTPUT (13,30)256,24,512;
1670 IF STAT13=0 THEN 1750
1680 REM AND CHECK FOR NO RESPONSE
1690 IF STAT13=1 THEN 1730
1700 E=4
1710 GOSUB 3790
1720 GOTO 1750
1730 E=2
1740 GOSUB 3790
1750 GOSUB 3990
1760 GOSUB 3460
1770 IF S6=1 THEN 1800
1780 E=6
1790 GOSUB 3790
1800 IF S7=1 THEN 1840
1810 E=7
1820 GOSUB 3790
1830 REM SRQ SHOULD=0 AFTER SERIAL POLL
1840 IF STAT13=3 THEN 1920
1850 IF STAT13<2 THEN 1890
1860 E=2
1870 GOSUB 3790
1880 GOTO 1920
1890 E=5
1900 GOSUB 3790
1910 REM CHECK SPD
1920 OUTPUT (13,30)256,25,512;
1930 IF STAT13=3 THEN 2000
1940 IF STAT13<2 THEN 1980
1950 E=1
1960 GOSUB 3790
1970 GOTO 2000
1980 E=5
1990 GOSUB 3790
2000 S=RBYTE13
2010 DISP "8671 SHOULD STILL HAVE BAD FREQ."
2020 IF S>95 THEN 2070
2030 E=7
2040 GOSUB 3790
```

Table 8-1. HP-IB Diagnostic Program (5 of 8)

```
2050 GOSUB 3460
2060 GOSUB 3760
2070 GOSUB 3960
2080 REM SEND GOOD THEN BAD FREQUENCY - SRQ SHOULD RETURN
2090 CMD "","A4Z1","","@8761Z1"
2100 WAIT 100
2110 IF STAT13=0 THEN 2150
2120 E=4
2130 GOSUB 3790
2140 REM CHECK SDC
2150 OUTPUT (13,30)256,4,512;
2160 PRINT "SELECTED DEVICE CLEAR (SDC) TESTED"
2170 IF STAT13=2 THEN 2200
2180 E=5
2190 GOSUB 3790
2200 GOSUB 3990
2210 IF S=28 THEN 2240
2220 GOSUB 3460
2230 GOSUB 3760
2240 GOSUB 3960
2250 CMD "","@8671Z1","?U","A4Z1"
2260 REM CHECK NO RESPONSE AFTER UNLISTEN
2270 WAIT 100
2280 IF STAT13=0 THEN 2310
2290 PRINT "RESPONSE WHEN NOT ADDRESSED"
2300 GOSUB 3920
2310 OUTPUT (13,30)256,4,512;
2320 WAIT 100
2330 IF STAT13=0 THEN 2370
2340 PRINT "RESPONSE TO SDC WHEN NOT ADDRESSED"
2350 GOSUB 3920
2360 REM CHECK DCL
2370 OUTPUT (13,30)256,20,512;
2380 PRINT "DEVICE CLEAR (DCL) TESTED"
2390 IF STAT13=2 THEN 2430
2400 GOSUB 3990
2410 GOSUB 3460
2420 GOSUB 3760
2430 GOSUB 3960
2440 REM CHECK GTL
2450 OUTPUT (13,30)256,1,512;
2460 CMD "","@8671Z1"
2470 WAIT 100
2480 IF STAT13=2 THEN 2510
2490 PRINT "PROGRAMMED FREQUENCY IN LOCAL"
2500 GOSUB 3920
2510 GOSUB 3960
2520 CMD "","@8671Z1"
2530 WAIT 100
2540 IF STAT13=0 THEN 2570
2550 E=6
```

Table 8-1. HP-IB Diagnostic Program (6 of 8)

```
2560 GOSUB 3790
2570 OUTPUT (13,30)256,4,512;
2580 REM CHECK REN
2590 OUTPUT (13,30)1024;
2600 GOSUB 3960
2610 CMD "","@8671Z1"
2620 WAIT 100
2630 IF STAT13=2 THEN 2660
2640 PRINT "PROGRAMMED FREQUENCY WITH REN FALSE"
2650 GOSUB 3920
2660 OUTPUT (13,30)768;
2670 GOSUB 3960
2680 CMD "","@8671Z1"
2690 WAIT 100
2700 IF STAT13=0 THEN 2730
2710 E=6
2720 GOSUB 3790
2730 OUTPUT (13,30)256,20,512;
2740 GOSUB 3960
2750 REM CHECK FOR NO RESPONSE TO UNDEFINED CHARACTERS"
2760 CMD "","@8671Z"
2770 FOR X=0 TO 47
2780 GOSUB 2870
2790 NEXT X
2800 GOSUB 3430
2810 FOR X=96 TO 127
2820 GOSUB 2870
2830 NEXT X
2840 GOSUB 3430
2850 GOTO 2990
2860 REM ROUTINE TO OUTPUT UNDEFINED CHARACTERS
2870 OUTPUT (13,30)X
2880 WAIT 100
2890 IF STAT13=2 THEN 2970
2900 PRINT "RESPONSE TO CHARACTER ",X
2910 GOSUB 3920
2920 GOSUB 3990
2930 GOSUB 3460
2940 GOSUB 3760
2950 GOSUB 3960
2960 CMD "","@8671Z"
2970 RETURN
2980 REM FINISH TEST FOR UNDEFINED CHARACTERS
2990 CMD "","0"
3000 WAIT 100
3010 IF STAT13=0 THEN 3040
3020 PRINT "INVALID CHARACTER UPSET I/A REGISTER"LIN1
3030 GOSUB 3920
3040 OUTPUT (13,30)256,4,512;
3050 PRINT "INSTRUMENT DID NOT RESPOND TO INVALID INPUTS"
3060 REM CHECK FREQUENCY LIMITS
```

Table 8-1. HP-IB Diagnostic Program (7 of 8)

```
3070 PRINT "FREQUENCY LIMITS CHECKED NOW"LIN1
3080 A=1
3090 GOSUB 3960
3100 FOR F=0 TO 999 STEP 2
3110 GOSUB 3310
3120 IF (STAT13=2) OR (STAT13=3) THEN 3160
3130 GOSUB 3990
3140 GOSUB 3960
3150 IF S >= 96 THEN 3180
3160 S6=0
3170 GOTO 3190
3180 S6=1
3190 IF A=S6 THEN 3270
3200 A=S6
3210 IF S6=1 THEN 3250
3220 F1=F
3230 PRINT "LOWER LIMIT = ";F1/10;"GHZ"LIN1
3240 GOTO 3270
3250 F9=F
3260 PRINT "UPPER LIMIT = ";F9/10;"GHZ"LIN1
3270 NEXT F
3280 F=F1
3290 GOSUB 3310
3300 GOTO 3390
3310 OUTPUT (13,30)64
3320 IF F>99 THEN 3360
3330 OUTPUT (13,30)48
3340 IF F>9 THEN 3360
3350 OUTPUT (13,30)48
3360 OUTPUT (13,40)F,"Z1"
3370 WAIT 100
3380 RETURN
3390 CMD "","D0Z0"
3400 OUTPUT (13,30)256,L,1,63,512;
3410 PRINT "DONE"LIN2
3420 GOTO 4050
3430 REM SUBROUTINES********
3440 DISP "CHECKING INVALID CHARACTERS"
3450 RETURN
3460 REM STATUS BYTE DECODING SUBROUTINE
3470 S2=S3=S4=S5=S6=S7=S8=0
3480 S1=S
3490 IF S1<128 THEN 3520
3500 S8=1
3510 S1=S1-128
3520 IF S1<64 THEN 3550
3530 S7=1
3540 S1=S1-64
3550 IF S1<32 THEN 3580
3560 S6=1
3570 S1=S1-32
```

Table 8-1. HP-IB Diagnostic Program (8 of 8)

```
3580 IF S1<16 THEN 3610
3590 S5=1
3600 S1=S1-16
3610 IF S1<8 THEN 3640
3620 S4=1
3630 S1=S1-8
3640 IF S1<4 THEN 3670
3650 S3=1
3660 S1=S1-4
3670 IF S1<2 THEN 3700
3680 S2=1
3690 S1=S1-2
3700 IF  NOT (S6 OR ( NOT S5 AND (S1 OR S3 OR S4))) THEN 3750
3710 IF S7=1 THEN 3750
3720 GOSUB 3760
3730 E=7
3740 GOSUB 3790
3750 RETURN
3760 PRINT " S     OVN   RSV  ERRS  RFOFF  UNLK UNUSED FMOM  UNUSED"
3770 PRINT S;S8;S7;S6;S5;S4;S3;S2;S1
3780 RETURN
3790 REM SUBROUTINE TO PRINT ERROR MESSAGES
3800 GOTO E OF 3810,3830,3920,3850,3870,3890,3910
3810 PRINT "8671 FAILED TO TALK WHEN ADDRESSED"
3820 GOTO 3920
3830 PRINT "8671 TALKED WHEN NOT ADDRESSED"
3840 GOTO 3920
3850 PRINT "DID NOT GET EXPECTED SRQ"
3860 GOTO 3920
3870 PRINT "UNEXPECTED  SRQ"
3880 GOTO 3920
3890 PRINT "ERROR IN FREQUENCY PROGRAMMING OR FREQ STATUS BIT"
3900 GOTO 3920
3910 PRINT "ERROR IN ENCODING RSV"
3920 DISP "PRESS -CONT EXECUTE- TO CONTINUE"
3930 STOP
3940 RETURN
3950 REM SUBROUTINE TO ADDRESS 8671 AS LISTENER
3960 OUTPUT (13,30)256,63,85,L,512;
3970 RETURN
3980 REM ROUTINE TO ADR. 8671 TO TALK AND CHECK BYTE RECEIVED
3990 OUTPUT (13,30)256,53,T,512;
4000 IF (STAT13=1) OR (STAT13=3) THEN 4030
4010 E=1
4020 GOSUB 3790
4030 S=RBYTE13
4040 RETURN
4050 END
```

SERVICE SHEET 1

PRINCIPLES OF OPERATION

The HP Model 8671A Synthesizer consists of the A3 RF Source Assembly, A2 Controller Assembly and the A1 RF Output Assembly. Figure 8-19 is a simplified block diagram. The overall Troubleshooting Block Diagram shows the interconnections between the major assemblies. Figure 8-20 shows the physical location of these assemblies in the Synthesizer.

The Synthesizer's RF output signal is generated in the YTO Loop of the A3 RF Source Assembly. Through the interconnection of the phase lock loops, the output signal is phase locked to the time base. The power supplies are also part of the A3 Assembly.

Digital signals from the A2 Controller Assembly are input to the loop circuits to control the RF output frequency. The frequency may be tuned from the front panel or programmed through the HP-IB Interface. The RF signal from the YTO Loop is passed through an isolator in the A1 RF Output Assembly. The isolator's output is connected to the front panel RF Output jack. The frequency modulation mode is selected by circuits within the A1 Assembly. The FM is added to the carrier in the A3 Assembly's YTO Loop.

In the local mode, the control signals are input from the front panel. Programmed inputs come through the HP-IB Interface to control frequency and RF level functions.

The front panel annunciators indicate the Synthesizer's operating mode and status. The following table lists the status and explains the function monitored.

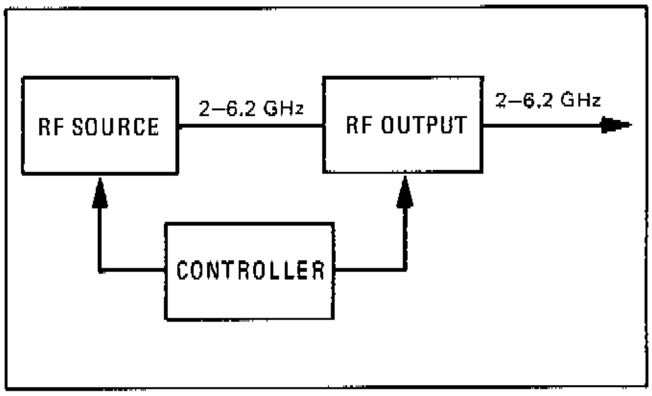


Figure 8-19. Synthesizer's Simplified Block Diagram

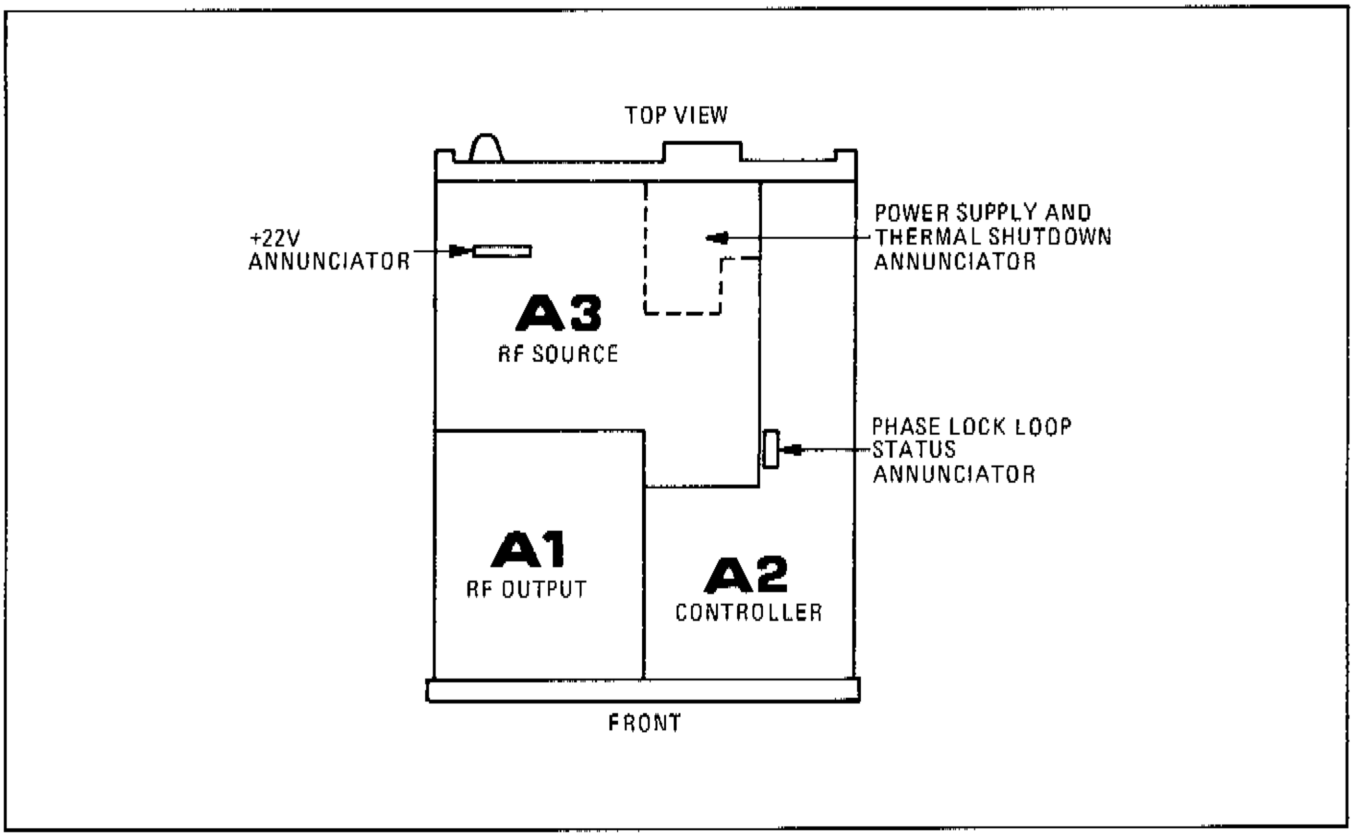


Figure 8-20. Major Assembly Locations

Table 8-2. Front Panel Status Annunciators

Annunciator		Purpose
Name	Location	
OVEN	A2	Monitors the time base oven (A3 Assembly) Indicates oven temperature is not stabilized.
OUT OF RANGE	A2	Indicates that an incorrect frequency has been programmed.
REMOTE	A2	Indicates that the Synthesizer is in the remote mode.
STANDBY	A2	Indicates that the LINE switch is set to STANDBY.
NOT PHASE-LOCKED	A2	Indicates that one or more of the loops are not phase-locked. Refer to the Phase Lock Loop Status Annunciators.
INT REFERENCE OFF	A2	Indicates that the rear panel FREQ REF switch is set to EXT.
FM OVER MOD	A1	Indicates that the maximum FM deviation (A3) or maximum input drive (A1) has been exceeded.

TROUBLESHOOTING

Begin troubleshooting by following Table 8-3, Overall Troubleshooting. The table is designed to isolate a malfunction to one of the three major assemblies. Begin troubleshooting with step 1. This is important since the table assumes that all measurements and indications are normal. When a malfunction is isolated by using the table, turn to the service sheet indicated for further troubleshooting information.

The following information can also be used to isolate a malfunction to the major assembly level or it can be used as supplemental information to the table.

Refer to Overall Troubleshooting Block Diagram. Examine the front and rear panel switches and annunciator or program specific functions and examine their annunciators. A switch or programmed function normally will effect only one annunciator. Some will also change the status annunciators listed in the Front Panel Status Annunciators' table. Check to see that those related to the malfunction respond properly to the switch setting or programmed function. For detailed information on the annunciator response to switch settings, refer to the figures showing the front and rear panel controls, connectors and indicators in Section III.

Problems indicated by the NOT PHASE-LOCKED annunciator can be further isolated by removing the instrument's top cover. (Refer to the Disassembly and Reassembly procedures in this section.) View the phase-locked loop annunciators which are located on the A2 assembly (refer to Figure 8-20). If the entire instrument seems to be off or if the STANDBY annunciator does not change with the LINE switch being set to ON, check the rear panel fuse and the power supply and thermal shutdown annunciators. Also check the +22V annunciator.

The next step is to measure main signal paths that lead to a malfunction in one of the major assemblies. Refer to the Overall Troubleshooting Block Diagram. When a problem is isolated to a major assembly, refer to the troubleshooting information on the appropriate service sheet.

The following table is designed to isolate a malfunction to one of three major assemblies. Begin troubleshooting with step 1. This is important, since the table is set up assuming that all previous steps are normal. When a malfunction is located in the table, turn to the service sheet indicated for further troubleshooting information.

Table 8-3. Overall Troubleshooting (1 of 2)

INITIAL CONDITIONS

1. Check that the LINE switch is in STANDBY and remove the Power Cable from the Line Module (A3A11).
2. Set the voltage selection card in the Line Module (A3A11) for the nominal line voltage to be used.
3. Check that the Line Fuse (A3F1) is the correct value and type.

NOTE

Remove the HP-IB Connector Plug, if connected.

4. Check that the LINE switch is in STANDBY and insert the Power Cable into the Line Module.
5. Set the rear panel controls and cables as follows:
   a. FREQ STANDARD INT/EXT switch to INT.
   b. Jumper (A3W3) connecting A3J9 to A3J10.
6. Set the front panel controls and switches as follows:
   a. RF switch to ON.
   b. FM DEVIATION switch to OFF.

Test	Results	If Faulty, Go To
1. Set LINE switch to STANDBY position	OVEN and STANDBY annunciators light.	Continue to step 2.
2. Set LINE switch to ON position.	RF annunciator ON lights.	1-A1
	NOT PHASE-LOCKED annunciator may light momentarily and then extinguish	SS3
	Frequency within specified range.[1]	SS3
3. Press PRESET pushbutton.	Frequency goes to 3000.000 MHz	SS3
4. Press FREQUENCY RESOLUTION pushbutton on the left to produce 100 MHz resolution.	Light Bar for 100 MHz resolution lights.	SS3
5. Turn TUNING control first clockwise, then counterclockwise	Frequency increases and then decreases in 100 MHz steps.	SS3
6. Press FREQUENCY RESOLUTION pushbutton next to the left to produce 1 MHz resolution and turn the TUNING control clockwise and then counterclockwise.	Light Bars for 100 and 1 MHz resolution light and frequency increases and decreases in 1 MHz steps.	SS3
7. Press the next FREQUENCY RESOLUTION pushbutton to produce 10 kHz resolution and turn the TUNING control clockwise and then counterclockwise.	Light Bars for 100 and 1 MHz and 10 kHz light and frequency increases and decreases in 10 kHz steps.	SS3

[1] The Synthesizer will produce the last frequency entered. If the Synthesizer was remotely programmed to an out-of-range frequency, when power is applied and the Syntehsizer is in local, it will count up or down until a legal frequency is reached. This action can be terminated by pressing the PRESET pushbutton. A dead battery can produce similar results when first applying power.

Table 8-3. Overall Troubleshooting (2 of 2)

Test	Results	If Faulty, Go To
8. Press the last FREQUENCY RESOLUTION pushbutton to produce 1 kHz resolution and turn the TUNING control clockwise and then counterclockwise.	Light Bars for 100 and 1 MHz, 10 and 1 kHz resolution light; the frequency increases and decreases in 1 kHz steps.	SS3
9. Press the HOLD pushbutton	All Light Bars extinguish.	SS3
10. Turn the TUNING control clockwise and then counterclockwise.	Frequency does not change.	SS3
11. Press the PRESET pushbutton	Frequency goes to 3000.000 MHz.	SS3
SETUP Connect spectrum analyzer to RF OUTPUT connector and adjust to observe a 3 GHz signal. Use 50 dB input attenuation, 2 kHz scan width, 0.3 kHz bandwidth, 50 milliseconds scan time, and +10 dBm log reference level.		
12. Set RF switch to ON position.	Signal displayed on Spectrum Analyzer approaches top graticule line.	Continue to step 13.
13. Set RF switch to OFF position	Power level drops to zero.	1-A1
14. Set RF switch to ON position.	Power returns.	1-A1
15. Apply modulating signal at 50 ohms impedance to FM INPUT connector and adjust input level to null the carrier for the following deviation ranges. Measure modulating signal with DVM.		SS2
16. Set FM DEVIATION selector to OFF.	FM display disappears but carrier remains on.	1-A1
17. On the rear panel, set FREQ STANDARD INT/EXT switch to EXT position.	INTERNAL REF OFF and NOT PHASE-LOCKED annunciators light.	SS2
18. On the rear panel, disconnect Jumper (A3W3) from A3J9 and A3J10. Connect a 10 MHz signal at 0 dBm to (A3J10) FREQ STANDARD External Input connector.	INTERNAL REF OFF annunciator remains lighted and NOT PHASE-LOCKED annunciator extinguishes. Synthesizer is phase-locked.	SS2
19. To thoroughly check remote operation load and run the HP-IB Diagnostic Program listed in Table 8-1. For a quicker but less complete check, load and run the Remote Operator's Checks (in Section VIII).		

Step 15 deviation ranges:

FM Deviation Selector	Modulation Frequency	Signal Level
0.1 MHz	37.5 kHz	1.275 ± 0.089 Vrms
10 MHz	3 MHz	1.020 ± 0.071 Vrms

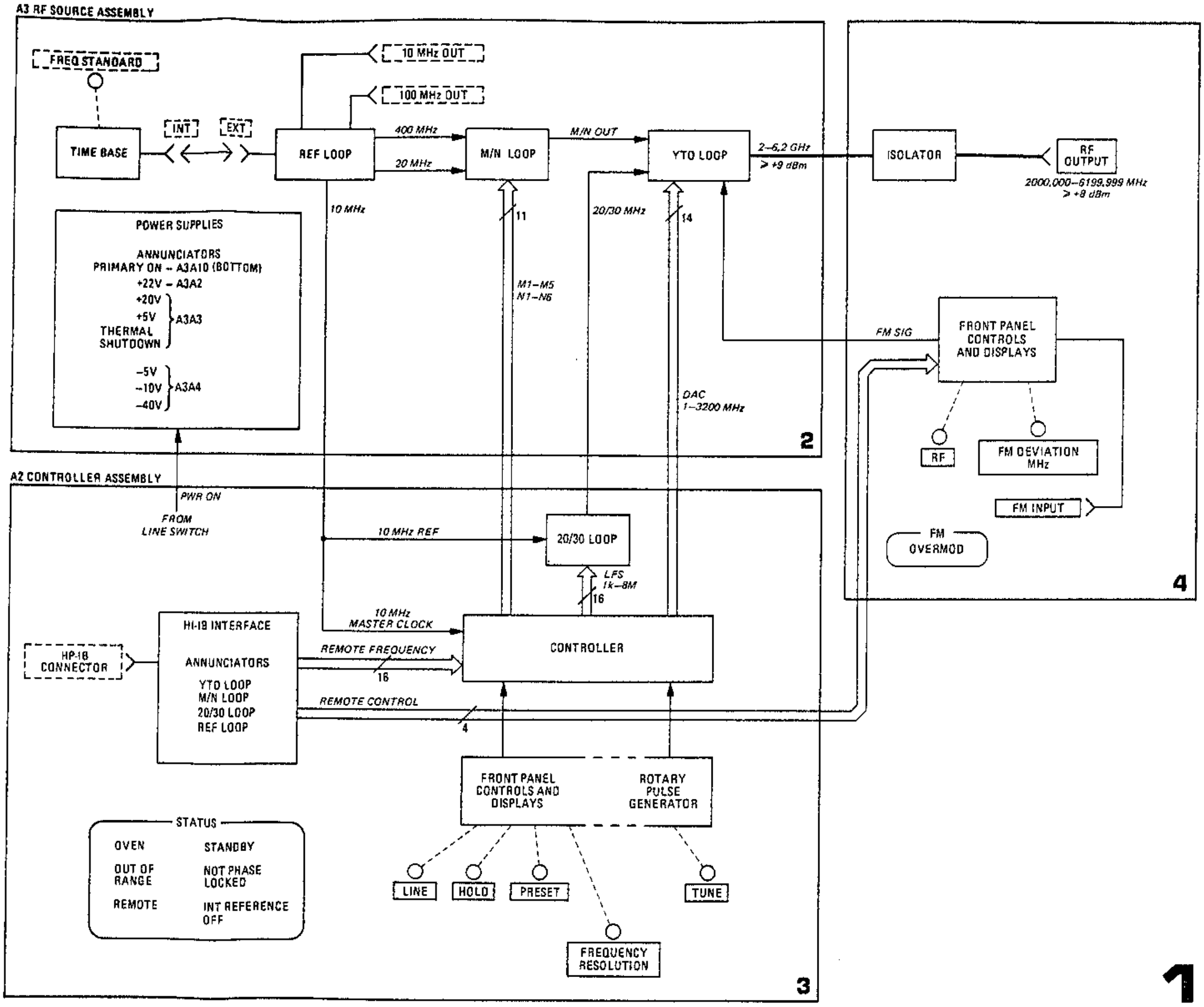


Figure 8-21. Overall Troubleshooting Block Diagram

SERVICE SHEET 2

A3 RF Source Assembly

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-29
- Motherboard wiring — Last 3 foldout sheets
- Parts list — Page 6-1
- Performance tests — Page 4-1
- Adjustment procedures — Page 5-1

PRINCIPLES OF OPERATION

General

The Synthesizer's fundamental RF output signal is generated by the YTO (YIG Tuned Oscillator). This signal is phase-locked through the other loops to the Synthesizer's time base—an internal crystal oscillator. The YTO Loop pretunes and locks the YTO signal to the output of the M/N Loop and the 20/30 MHz (LFS) Loop (part of the A2 assembly). The M/N and 20/30 MHz Loops serve two basic functions. First, they are phase-locked to the reference crystal oscillator through the Reference Loop. They also provide the stepped tuning of the YTO output signal. The M/N Loop provides the larger steps (2000 to 6199 MHz in 10 MHz steps) while the 20/30 loop provides the smaller (1 MHz, 100, 10 and 1 kHz) steps.

Power is supplied to the Synthesizer by the power supply circuits, the Rectifier Assembly and the Positive and Negative Regulator Assemblies. Some functions are controlled by switching power supply outputs on and off.

Reference Loop

The Reference Loop is phase-locked to the A3A8 10 MHz Reference Oscillator Assembly. The Reference Loop's phase-locked outputs (10, 20 and 400 MHz) are used as references for the 20/30 MHz (LFS) Loop (part of A2 assembly) and the M/N Loop. The 10 MHz signal is also used as the master clock for digital circuits in the Synthesizer. The loop can also be locked to an external 5 or 10 MHz reference.

The 100 MHz VCXO (Voltage Controlled Crystal Oscillator) is the heart of this loop. The 100 MHz output signal is 1) multiplied by four to generate the 400 MHz reference for the M/N Loop and 2) divided by five to generate a 20 MHz reference signal that is also used in the M/N Loop. The 20 MHz signal is divided by two to produce a 10 MHz that is used as a reference and the master clock for the Synthesizer's digital circuits. The 10 MHz signal also is phase compared to the 10 MHz Reference Oscillator output. The resulting error signal is passed through the integrating amplifier and tunes the VCXO to phase lock the Reference Loop.

M/N Loop

The frequency output of the M/N loop 1) is dependent on the front panel frequency and 2) in part, controls the YTO output frequency. An encoded equivalent of the front panel frequency's most significant digits (10 MHz to 10 GHz) are input to the M/N Loop as M and N numbers. The ratio of the M and N numbers 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 for each valid M/N OUT frequency (M/N ratio) and Nth harmonic (N number). This 10 MHz step complements the 20/30 MHz loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N Loop, YTO pretuning and 20/30 MHz Loop are able to tune the YTO from 2000.000 to 6199.999 MHz in 1 kHz steps.

The M/N Loop VCO generates an output signal ($f_{M/N\ VCO}$) that varies between 355 and 395 MHz. The VCO signal is 1) divided by two ($f_{M/N}$) and is output to the YTO Loop and 2) mixed with the 400 MHz reference to produce an IF signal (f_{IF}) that varies between 5 and 45 MHz. The IF signal is divided by the M number and is phase compared to the quotient of the 20 MHz reference signal divided by the N number. The error voltage from the detector is integrated and tunes the M/N VCO to achieve phase lock.

The frequency output from the M/N Loop is dependent on the ratio of the M and N numbers. These numbers are input in the form of digital tuning information to the M/N Loop Phase Detector. The following equation shows the relationship between the output frequency and the M and N numbers.

$$f_{M/N} = \left[200 - 10\left(\frac{M}{N}\right)\right] \text{ MHz}$$

where $f_{M/N}$ = M/N out frequency

M = M number

N = N number

For a listing of the M and N numbers, M/N output frequencies ($f_{M/N}$) and the YTO frequencies (f_o), refer to Table 8-4 of M and N Numbers and Resulting Frequencies.

The M and N numbers and $f_{M/N}$ may also be calculated by the following formulas:

$$M = 27 - \left(\frac{1}{10}\right)\ [f_{o(A)} - f_{o(B)}]$$

$$N = \text{INT}\left[\frac{(f_o + 300)}{200}\right]$$

$$\text{and } f_{M/N} = \frac{1}{N}\left[(f_{o(A)} + 30)\right]$$

where $f_{M/N}$ = M/N Out frequency

f_o = YTO frequency

$f_{o(A)}$ = YTO frequency rounded off to lower 10 MHz.

$f_{o(B)}$ = YTO frequency rounded off to lower odd 100 MHz.

M = M number

N = N number

SERVICE SHEET 2 (Cont'd)

YTO Loop

Phase Lock System. When a frequency change occurs, the YTO is pretuned near the new desired frequency. This places the YTO frequency 20 to 30 MHz below the Nth harmonic of the M/N Loop output. (The Nth harmonic is the same as the M/N Loop's N number.) The YTO frequency and M/N Loop harmonic are mixed in the Sampler (Harmonic Mixer). The YTO IF (20—30 MHz) is phase compared with the 20/30 Loop output. (Note that the YTO IF and 20/30 Loop output are equal if the YTO Loop is locked.) The YTO Phase Detector's error voltage is integrated and ultimately is used to tune the YTO to achieve phase lock. The following formula expresses the relationship between the frequencies found in the YTO Loop:

$$f_{20/30} = f_{YTO\ IF} = N(f_{M/N} - f_o)$$

where $f_{20/30}$ = 20/30 Loop frequency

$f_{YTO\ IF}$ = YTO IF frequency

$f_{M/N}$ = M/N Loop frequency

f_o = YTO frequency

N = N number (same as in the M/N Loop)

The various frequencies in the YTO Loop can also be determined by using the front panel frequency reading as long as it is from 2000.000 to 6199.999 MHz. In this case

$$f_{20/30} = (30.000 - D_4 . D_3 D_2 D_1)\ \text{MHz}$$

and $f_o = (D_7 D_6 D_5 D_4 D_3 D_2 D_1)$ MHz

where D_1 to D_7 is the front panel frequency reading with D_1 being the least significant digit (1 kHz).

FM System. During the CW mode, the YTO Phase Detector output voltage may be expressed as follows:

$$V_e = \int f_o$$

where V_e = the error voltage

f_o = the YTO frequency

The error voltage is fully dependent on the YTO carrier frequency. During the FM mode, however, the error voltage is also dependent on the instantaneous frequency deviation. Because the frequency deviation is dependent on the modulation drive voltage, then:

$$V_e = \int f_o + \int V_{FM}(t)\,dt$$

where $V_{FM}(t)$ = the instantaneous drive voltage.

SERVICE SHEET 2 (Cont'd)

The effect of the phase detector reacting in this way to FM is a cancellation of FM within the loop bandwidth (<20 kHz). Outside the bandwidth (>20 kHz), the cancellation effect is reduced as the FM drive rate is increased.

To compensate for the FM cancellation, the FM drive input is integrated and summed with (subtracted from) the phase detector's error output. Note that the FM drive is input to the YTO's FM coil just after the Loop Integrator and the integrated FM drive signal is summed with the phase detector's error signal output just before the Loop Integrator. The result is that only the phase lock voltage is integrated and passed on to phase lock the YTO Loop; therefore the YTO Loop does not affect the frequency response of the FM system.

Power Supplies

The Synthesizer's power supply section is made up of three assemblies and their associated assemblies and components. These are the Positive and Negative Regulators, and the Rectifier Assembly.

The Mains (line) voltage is input to the Synthesizer through the Line Power Module. The primary ac voltage is always connected to the Fan Relay and, with the LINE SWITCH in the ON position, to the Fan. Also, the Transformer, Rectifier Assembly, and Positive and Negative Regulators all receive power inputs if the Mains voltage is connected. The +22V output is regulated and is independent of the LINE switch. Its primary purpose is to supply the heater voltage for the 10 MHz Reference Oscillator and to supply power to the A2 Assembly frequency retention circuit.

The Positive Regulator, in conjunction with the LINE switch, controls the power supply voltage to the Synthesizer (with the exception of +22V). The front panel LINE switch, through the Front Panel Shutdown (PWR ON), turns the +20V supply on or off. The +20V supply is the reference for all other supplies that come from the Positive and Negative Regulators. The +11V switch (that turns the 10 MHz Reference Oscillator ON or OFF) is controlled by the rear panel FREQ STND INT/EXT switch. The Thermal Shutdown circuit turns off the +20V supply (thus turning the Synthesizer off) if the internal temperature exceeds +85°C. The fan will continue to run (if the LINE switch is ON) and will cool the instrument. At +55°C the Synthesizer will return to normal operation.

The Negative Regulator is controlled by the +20V supply. The −5.2 and −10V supplies are both taken from the −10V regulated input. The −10V switch is controlled by the front panel RF switch.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate an A3 Assembly malfunction. The following troubleshooting information may be used to further isolate the problem to one of the four RF Source Assembly sections.

a. The Power Supply Section

SERVICE SHEET 2 (Cont'd)

b. The YTO Phase-Locked Loop section

c. The M/N Phase-Locked Loop section

d. The Reference Phase-Locked Loop section

Test Equipment

Frequency Counter .... HP 5340A
Spectrum Analyzer .... HP 8565A
Test Oscillator .... HP 651A
Digital Voltmeter .... HP 3455A

Procedure

1. Remove the Synthesizer's top cover. Connect the Synthesizer to the Mains (line) power. Set the RF switch to ON. Be sure the rear panel FREQ STANDARD switch is set to INT and the reference jumper is in place.

2. Observe the phase lock Status indicator's on A2A7. If the instrument has been disconnected from the Mains for more than a few minutes, the REF indicator may be off and the front panel OVEN light will be on. If that is the case, allow 10 minutes warm-up before continuing (or until the OVEN light goes off).

3. The phase lock Status indicators can help to quickly isolate a malfunction. In normal operation they all should be on. If the Reference Loop indicator is off go to Step 8. If the LFS Loop indicator is off, go to Service Sheet 3. If the M/N Loop indicator is off, go to Step 9. If the YTO Loop indicator is off, make sure the RF switch is ON. If the switch is ON, go to Step 11.

4. Connect the frequency counter to A3W9, the semirigid coaxial cable that connects A3 to A1. Tune to 2 GHz; then tune each frequency digit from zero to 9. The counter readout should be the same as the front panel frequency from 2 to 6.199 GHz, half the frequency from 6.2 to 12.399 GHz and one-third the frequency above 12.4 GHz. If the frequency is incorrect but the lock indicators are all on, one of the loops is probably locked at the wrong frequency due to incorrect data from the A2 Controller or a loop divider malfunction. Use the following table to determine which loop is probably the cause of a malfunction of a particular digit.

Loop Name	Digits Controlled	If Wrong
LFS loop	1 kHz to 1 MHz	Go to Service Sheet 3
M/N loop	10 MHz to 1 GHz	Go to Step 10
YTO loop	Controls all digits and pretunes 1 MHz – 1 GHz	Go to Step 12

SERVICE SHEET 2 (Cont'd)

5. The FM function is checked next. Connect the spectrum analyzer to A3W9 in place of the frequency counter. Set the front panel FM Deviation switch to the 300 kHz range. Apply a modulation signal of 100 kHz at 0.5668 Vrms to the FM input connector. This should yield a modulation index of 2.404 (first carrier null). Adjust the voltage slightly to obtain the deepest carrier null; it should occur between 0.5271 Vrms and 0.6065 Vrms. If the voltage is incorrect, go to Step 7.

NOTE

If this test is done at any frequency other than 100 kHz, the FM flatness specification must be added to the input accuracy specification to obtain an overall accuracy number (±32.89% at +15 to +35°C).

6. Set the Meter Mode switch to FM. Set the FM Deviation switch to 100 kHz and input 100 kHz at 0.707 Vrms. The first sidebands should average 4.8 ±0.8 dB below the carrier and the meter should indicate full scale ±10%. If the results of both steps 5 and 6 are correct, the FM circuits are operating properly. If only step 6 results are incorrect, go to Service Sheet 10-A3 to troubleshoot the A3A7 FM Driver Assembly. Do not overlook the possibility that only an adjustment may be required.

7. In this step an FM malfunction is isolated to either the A1 or A3 Assemblies. Tune to 3000 MHz. Locate A3A7TP5 and attach the digital voltmeter. Apply 100 kHz at 0.707 Vrms to FM input connector. The voltage at TP5 should be 1 Vrms. If the voltage is correct, measure the voltage at A3A7TP1; it should be 3.4 Vrms. If the voltage at TP5 is incorrect go to Service Sheet 8-A1. Otherwise, go to Service Sheet 10-A3.

8. The following steps check the Reference Loop. Connect the frequency counter to the 100 MHz output on the rear panel. For this measurement, the time base of the counter *must not be* connected to the Synthesizer. The signal should be stable and within ±100 Hz of 100 MHz. If the frequency is correct and the lock indicator indicates the loop is unlocked, go to Service Sheet 1-A3 to troubleshoot the lock indicator. If the frequency is incorrect, go to Service Sheet 1-A3 and begin troubleshooting.

9. The following steps check the M/N Loop. Use a common time base between the frequency counter and Synthesizer. Connect the frequency counter to M/N output connector on A3A1A5. Tune the Synthesizer's frequency to 2100 MHz. The counter should indicate 177.500 000 MHz. If the frequency is correct go to Service Sheet 3-A3 to troubleshoot the phase lock comparator.

10. Connect the digital voltmeter to A3A1A4 TUNE test point. Disconnect the IF OUT (red/white) coax. The voltage should go to about −0.5 Vdc. Connect the IF cable previously disconnected to the 20 MHz reference in place of the gray/white coax. The phase detector should swing the tune voltage to the opposite limit, about −38 Vdc. If the voltages are correct, go to Service Sheet 4-A3 to troubleshoot the M/N VCO. If the voltages are incorrect, go to Service Sheet 3-A3 to troubleshoot the dividers or phase detector.

11. The following steps check the YTO loop. Make sure the front panel RF switch is on. Connect the frequency counter to the semirigid coaxial cable A3W9 (the YTO loop output). Ground A3A6TP1 to open the loop. The YTO should be pretuned within ±20 MHz of the selected frequency from 2 to 6.199 GHz. Tune the 1 MHz and 10 MHz digits from zero to 9 and tune the 1 GHz and 100 MHz digits from 20 to 61 while observing the pretune frequency to assure it stays within ±20 MHz of the selected frequency. If the frequency does not tune properly, continue with the next step. Otherwise go to Service Sheet 10-A3 to troubleshoot the YTO Loop.

12. Connect the digital voltmeter to A3A5TP3. The voltage should be −3.000 V/GHz at this point at any frequency from 2 to 6.199 GHz. The voltage should remain within ±0.005V of the correct voltage over the entire range. Slowly tune the frequency and observe the voltage. If the voltage is incorrect perform the DAC adjustment procedure. If necessary, go to Service Sheet 6-A3 to troubleshoot the DAC Assembly. If the voltage is correct go to Service Sheet 7-A3 to troubleshoot the main coil driver.

Table 8-4. M and N Numbers and Resulting Frequencies (1 of 4)

RF Output (MHz)	M	N	M/N Out (MHz)	RF Output (MHz)	M	N	M/N Out (MHz)
2000	17	11	184.545455	2530	24	14	182.857143
2010	16	11	185.454545	2540	23	14	183.571429
2020	15	11	186.363636	2550	22	14	184.285714
2030	14	11	187.272727	2560	21	14	185.000000
2040	13	11	188.181818	2570	20	14	185.714286
2050	12	11	189.090909	2580	19	14	186.428571
2060	11	11	190.000000	2590	18	14	187.142857
2070	10	11	190.909091	2600	17	14	187.857143
2080	9	11	191.818182	2610	16	14	188.571429
2090	8	11	192.727273	2620	15	14	189.285714
2100	27	12	177.500000	2630	14	14	190.000000
2110	26	12	178.333333	2640	13	14	190.714286
2120	25	12	179.166667	2650	12	14	191.428571
2130	24	12	180.000000	2660	11	14	192.142857
2140	23	12	180.833333	2670	10	14	192.857143
2150	22	12	181.666667	2680	9	14	193.571429
2160	21	12	182.500000	2690	8	14	194.285714
2170	20	12	183.333333	2700	27	15	182.000000
2180	19	12	184.166667	2710	26	15	182.666667
2190	18	12	185.000000	2720	25	15	183.333333
2200	17	12	185.833333	2730	24	15	184.000000
2210	16	12	186.666667	2740	23	15	184.666667
2220	15	12	187.500000	2750	22	15	185.333333
2230	14	12	188.333333	2760	21	15	186.000000
2240	13	12	189.166667	2770	20	15	186.666667
2250	12	12	190.000000	2780	19	15	187.333333
2260	11	12	190.833333	2790	18	15	188.000000
2270	10	12	191.666667	2800	17	15	188.666667
2280	9	12	192.500000	2810	16	15	189.333333
2290	8	12	193.333333	2820	15	15	190.000000
2300	27	13	179.230769	2830	14	15	190.666667
2310	26	13	180.000000	2840	13	15	191.333333
2320	25	13	180.769231	2850	12	15	192.000000
2330	24	13	181.538462	2860	11	15	192.666667
2340	23	13	182.307692	2870	10	15	193.333333
2350	22	13	183.076923	2880	9	15	194.000000
2360	21	13	183.846154	2890	8	15	194.666667
2370	20	13	184.615385	2900	27	16	183.125000
2380	19	13	185.384615	2910	26	16	183.750000
2390	18	13	186.153846	2920	25	16	184.375000
2400	17	13	186.923077	2930	24	16	185.000000
2410	16	13	187.692308	2940	23	16	185.625000
2420	15	13	188.461538	2950	22	16	186.250000
2430	14	13	189.230769	2960	21	16	186.875000
2440	13	13	190.000000	2970	20	16	187.500000
2450	12	13	190.769231	2980	19	16	188.125000
2460	11	13	191.538462	2990	18	16	188.750000
2470	10	13	192.307692	3000	17	16	189.375000
2480	9	13	193.076923	3010	16	16	190.000000
2490	8	13	193.846154	3020	15	16	190.625000
2500	27	14	180.714286	3030	14	16	191.250000
2510	26	14	181.428571	3040	13	16	191.875000
2520	25	14	182.142857	3050	12	16	192.500000

Table 8-4. M and N Numbers and Resulting Frequencies (2 of 4)

RF Output (MHz)	M	N	M/N Out (MHz)	RF Output (MHz)	M	N	M/N Out (MHz)
3060	11	16	193.125000	3590	18	19	190.526316
3070	10	16	193.750000	3600	17	19	191.052632
3080	9	16	194.375000	3610	16	19	191.578947
3090	8	16	195.000000	3620	15	19	192.105263
3100	27	17	184.117647	3630	14	19	192.631579
3110	26	17	184.705882	3640	13	19	193.157895
3120	25	17	185.294118	3650	12	19	193.684211
3130	24	17	185.882353	3660	11	19	194.210526
3140	23	17	186.470588	3670	10	19	194.736842
3150	22	17	187.058824	3680	9	19	195.263158
3160	21	17	187.647059	3690	8	19	195.789474
3170	20	17	188.235294	3700	27	20	186.500000
3180	19	17	188.823529	3710	26	20	187.000000
3190	18	17	189.411765	3720	25	20	187.500000
3200	17	17	190.000000	3730	24	20	188.000000
3210	16	17	190.588235	3740	23	20	188.500000
3220	15	17	191.176471	3750	22	20	189.000000
3230	14	17	191.764706	3760	21	20	189.500000
3240	13	17	192.352941	3770	20	20	190.000000
3250	12	17	192.941176	3780	19	20	190.500000
3260	11	17	193.529412	3790	18	20	191.000000
3270	10	17	194.117647	3800	17	20	191.500000
3280	9	17	194.705882	3810	16	20	192.000000
3290	8	17	195.294118	3820	15	20	192.500000
3300	27	18	185.000000	3830	14	20	193.000000
3310	26	18	185.555556	3840	13	20	193.500000
3320	25	18	186.111111	3850	12	20	194.000000
3330	24	18	186.666667	3860	11	20	194.500000
3340	23	18	187.222222	3870	10	20	195.000000
3350	22	18	187.777778	3880	9	20	195.500000
3360	21	18	188.333333	3890	8	20	196.000000
3370	20	18	188.888889	3900	27	21	187.142857
3380	19	18	189.444444	3910	26	21	187.619048
3390	18	18	190.000000	3920	25	21	188.095238
3400	17	18	190.555556	3930	24	21	188.571429
3410	16	18	191.111111	3940	23	21	189.047619
3420	15	18	191.666667	3950	22	21	189.523810
3430	14	18	192.222222	3960	21	21	190.000000
3440	13	18	192.777778	3970	20	21	190.476190
3450	12	18	193.333333	3980	19	21	190.952381
3460	11	18	193.888889	3990	18	21	191.428571
3470	10	18	194.444444	4000	17	21	191.904762
3480	9	18	195.000000	4010	16	21	192.380952
3490	8	18	195.555556	4020	15	21	192.857143
3500	27	19	185.789474	4030	14	21	193.333333
3510	26	19	186.315789	4040	13	21	193.809524
3520	25	19	186.842105	4050	12	21	194.285714
3530	24	19	187.368421	4060	11	21	194.761905
3540	23	19	187.894737	4070	10	21	195.238095
3550	22	19	188.421053	4080	9	21	195.714286
3560	21	19	188.947368	4090	8	21	196.190476
3570	20	19	189.473684	4100	27	22	187.727273
3580	19	19	190.000000	4110	26	22	188.181818

Table 8-4. M and N Numbers and Resulting Frequencies (3 of 4)

RF Output (MHz)	M	N	M/N Out (MHz)	RF Output (MHz)	M	N	M/N Out (MHz)
4120	25	22	188.636364	4650	12	24	195.000000
4130	24	22	189.090909	4660	11	24	195.416667
4140	23	22	189.545455	4670	10	24	195.833333
4150	22	22	190.000000	4680	9	24	196.250000
4160	21	22	190.454545	4690	8	24	196.666667
4170	20	22	190.909091	4700	27	25	189.200000
4180	19	22	191.363636	4710	26	25	189.600000
4190	18	22	191.818182	4720	25	25	190.000000
4200	17	22	192.272727	4730	24	25	190.400000
4210	16	22	192.727273	4740	23	25	190.800000
4220	15	22	193.181818	4750	22	25	191.200000
4230	14	22	193.636364	4760	21	25	191.600000
4240	13	22	194.090909	4770	20	25	192.000000
4250	12	22	194.545455	4780	19	25	192.400000
4260	11	22	195.000000	4790	18	25	192.800000
4270	10	22	195.454545	4800	17	25	193.200000
4280	9	22	195.909091	4810	16	25	193.600000
4290	8	22	196.363636	4820	15	25	194.000000
4300	27	23	188.260870	4830	14	25	194.400000
4310	26	23	188.695652	4840	13	25	194.800000
4320	25	23	189.130435	4850	12	25	195.200000
4330	24	23	189.565217	4860	11	25	195.600000
4340	23	23	190.000000	4870	10	25	196.000000
4350	22	23	190.434783	4880	9	25	196.400000
4360	21	23	190.869565	4890	8	25	196.800000
4370	20	23	191.304348	4900	27	26	189.615385
4380	19	23	191.739130	4910	26	26	190.000000
4390	18	23	192.173913	4920	25	26	190.384615
4400	17	23	192.608696	4930	24	26	190.769231
4410	16	23	193.043478	4940	23	26	191.153846
4420	15	23	193.478261	4950	22	26	191.538462
4430	14	23	193.913043	4960	21	26	191.923077
4440	13	23	194.347826	4970	20	26	192.307692
4450	12	23	194.782609	4980	19	26	192.692308
4460	11	23	195.217391	4990	18	26	193.076923
4470	10	23	195.652174	5000	17	26	193.461538
4480	9	23	196.086957	5010	16	26	193.846154
4490	8	23	196.521739	5020	15	26	194.230769
4500	27	24	188.750000	5030	14	26	194.615385
4510	26	24	189.166667	5040	13	26	195.000000
4520	25	24	189.583333	5050	12	26	195.384615
4530	24	24	190.000000	5060	11	26	195.769231
4540	23	24	190.416667	5070	10	26	196.153846
4550	22	24	190.833333	5080	9	26	196.538462
4560	21	24	191.250000	5090	8	26	196.923077
4570	20	24	191.666667	5100	27	27	190.000000
4580	19	24	192.083333	5110	26	27	190.370370
4590	18	24	192.500000	5120	25	27	190.740741
4600	17	24	192.916667	5130	24	27	191.111111
4610	16	24	193.333333	5140	23	27	191.481481
4620	15	24	193.750000	5150	22	27	191.851852
4630	14	24	194.166667	5160	21	27	192.222222
4640	13	24	194.583333	5170	20	27	192.592593

Table 8-4. M and N Numbers and Resulting Frequencies (4 of 4)

RF Output (MHz)	M	N	M/N Out (MHz)	RF Output (MHz)	M	N	M/N Out (MHz)
5180	19	27	192.962963	5710	26	30	191.333333
5190	18	27	193.333333	5720	25	30	191.666667
5200	17	27	193.703704	5730	24	30	192.000000
5210	16	27	194.074074	5740	23	30	192.333333
5220	15	27	194.444444	5750	22	30	192.666667
5230	14	27	194.814815	5760	21	30	193.000000
5240	13	27	195.185185	5770	20	30	193.333333
5250	12	27	195.555556	5780	19	30	193.666667
5260	11	27	195.925926	5790	18	30	194.000000
5270	10	27	196.296296	5800	17	30	194.333333
5280	9	27	196.666667	5810	16	30	194.666667
5290	8	27	197.037037	5820	15	30	195.000000
5300	27	28	190.357143	5830	14	30	195.333333
5310	26	28	190.714286	5840	13	30	195.666667
5320	25	28	191.071429	5850	12	30	196.000000
5330	24	28	191.428571	5860	11	30	196.333333
5340	23	28	191.785714	5870	10	30	196.666667
5350	22	28	192.142857	5880	9	30	197.000000
5360	21	28	192.500000	5890	8	30	197.333333
5370	20	28	192.857143	5900	27	31	191.290323
5380	19	28	193.214286	5910	26	31	191.612903
5390	18	28	193.571429	5920	25	31	191.935484
5400	17	28	193.928571	5930	24	31	192.258065
5410	16	28	194.285714	5940	23	31	192.580645
5420	15	28	194.642857	5950	22	31	192.903226
5430	14	28	195.000000	5960	21	31	193.225806
5440	13	28	195.357143	5970	20	31	193.548387
5450	12	28	195.714286	5980	19	31	193.870968
5460	11	28	196.071429	5990	18	31	194.193548
5470	10	28	196.428571	6000	17	31	194.516129
5480	9	28	196.785714	6010	16	31	194.838710
5490	8	28	197.142857	6020	15	31	195.161290
5500	27	29	190.689655	6030	14	31	195.483871
5510	26	29	191.034483	6040	13	31	195.806452
5520	25	29	191.379310	6050	12	31	196.129032
5530	24	29	191.724138	6060	11	31	196.451613
5540	23	29	192.068966	6070	10	31	196.774194
5550	22	29	192.413793	6080	9	31	197.096774
5560	21	29	192.758621	6090	8	31	197.419355
5570	20	29	193.103448	6100	27	32	191.562500
5580	19	29	193.448276	6110	26	32	191.875000
5590	18	29	193.793103	6120	25	32	192.187500
5600	17	29	194.137931	6130	24	32	192.500000
5610	16	29	194.482759	6140	23	32	192.812500
5620	15	29	194.827586	6150	22	32	193.125000
5630	14	29	195.172414	6160	21	32	193.437500
5640	13	29	195.517241	6170	20	32	193.750000
5650	12	29	195.862069	6180	19	32	194.062500
5660	11	29	196.206897	6190	18	32	194.375000
5670	10	29	196.551724				
5680	9	29	196.896552				
5690	8	29	197.241379				
5700	27	30	191.000000				

FIG. 8-22
Sht 1 of 4

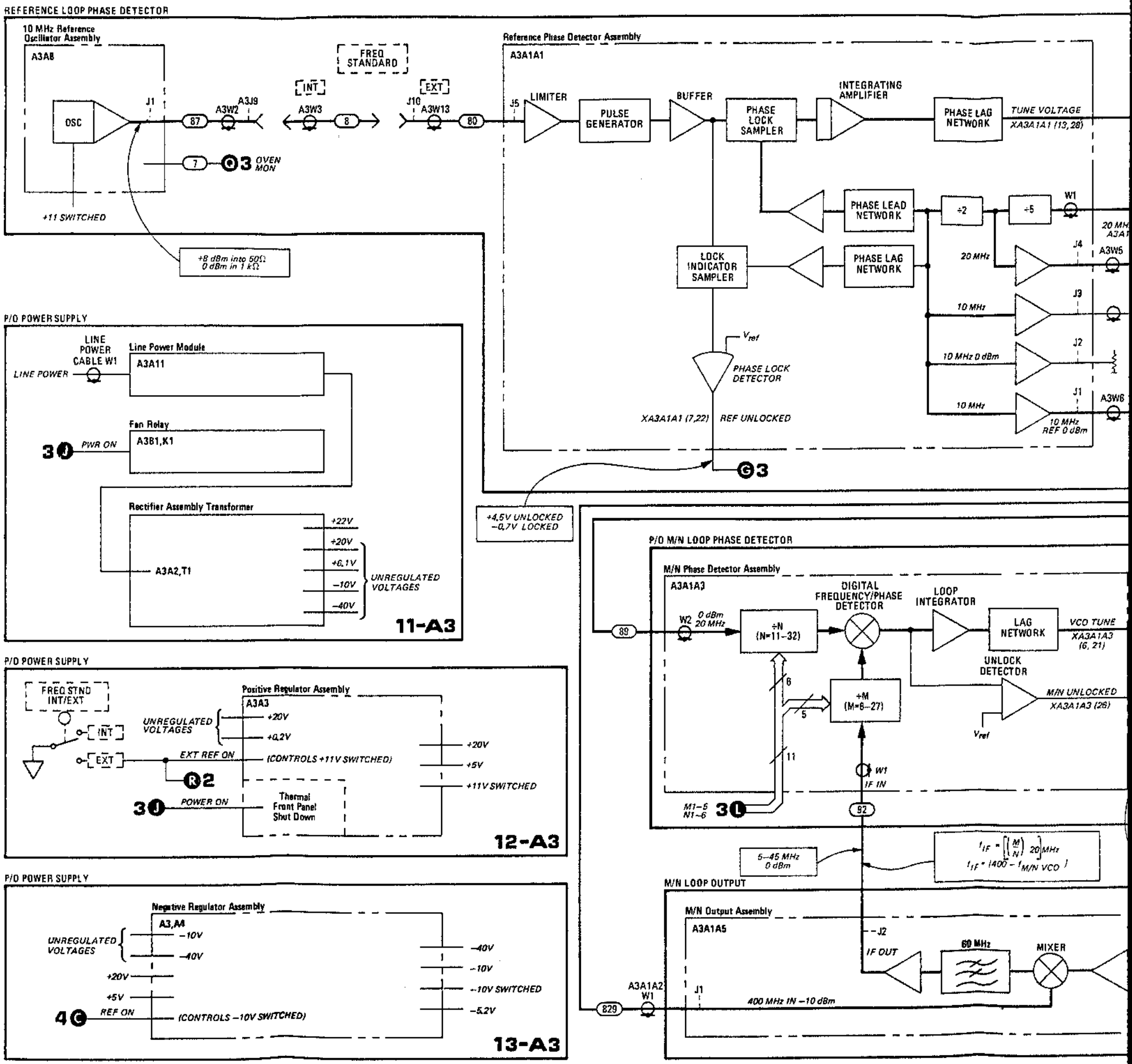


FIG. 8-22
Sht 2 of 4

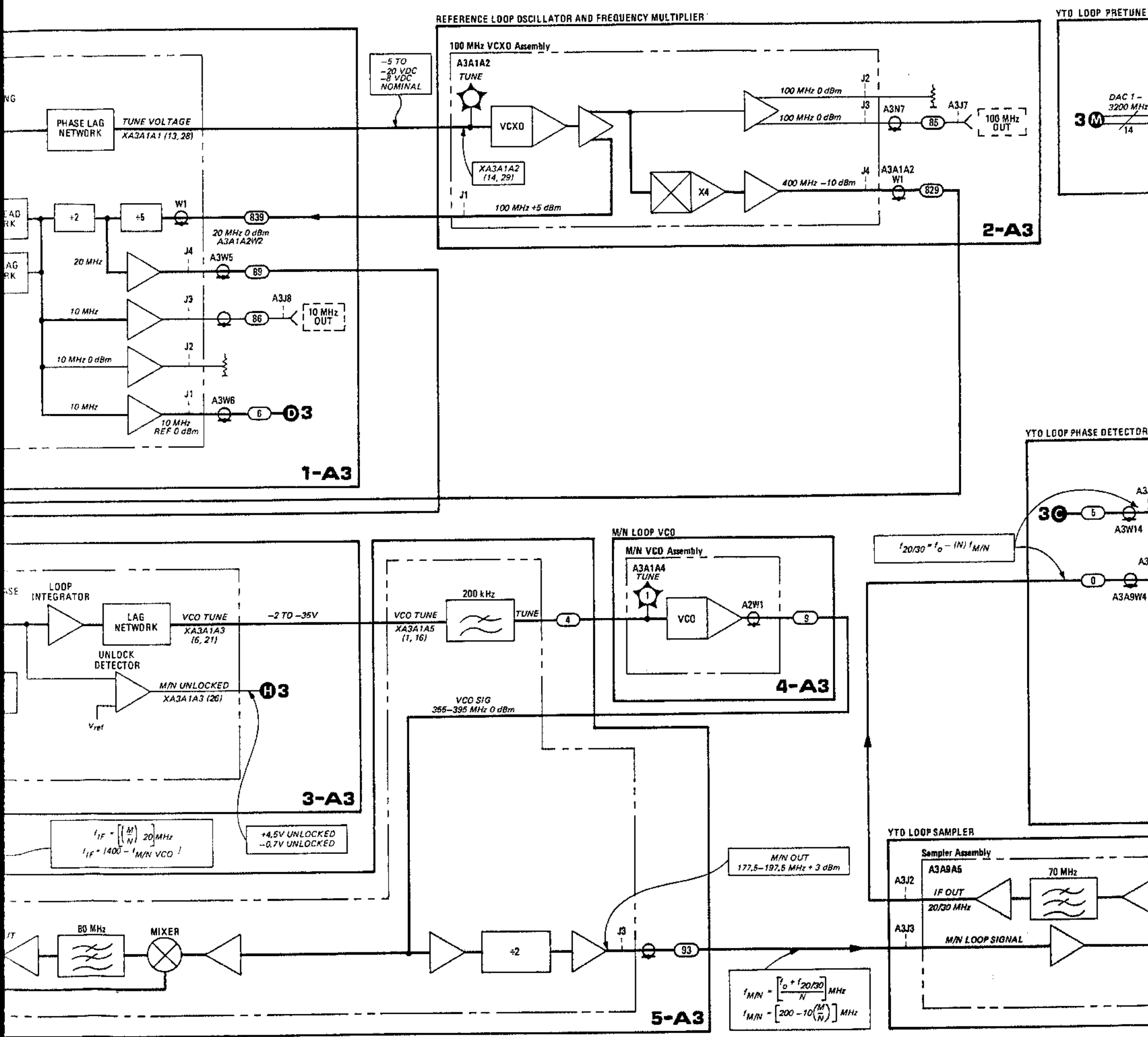


FIG. 8-22
Sht 3 of 4

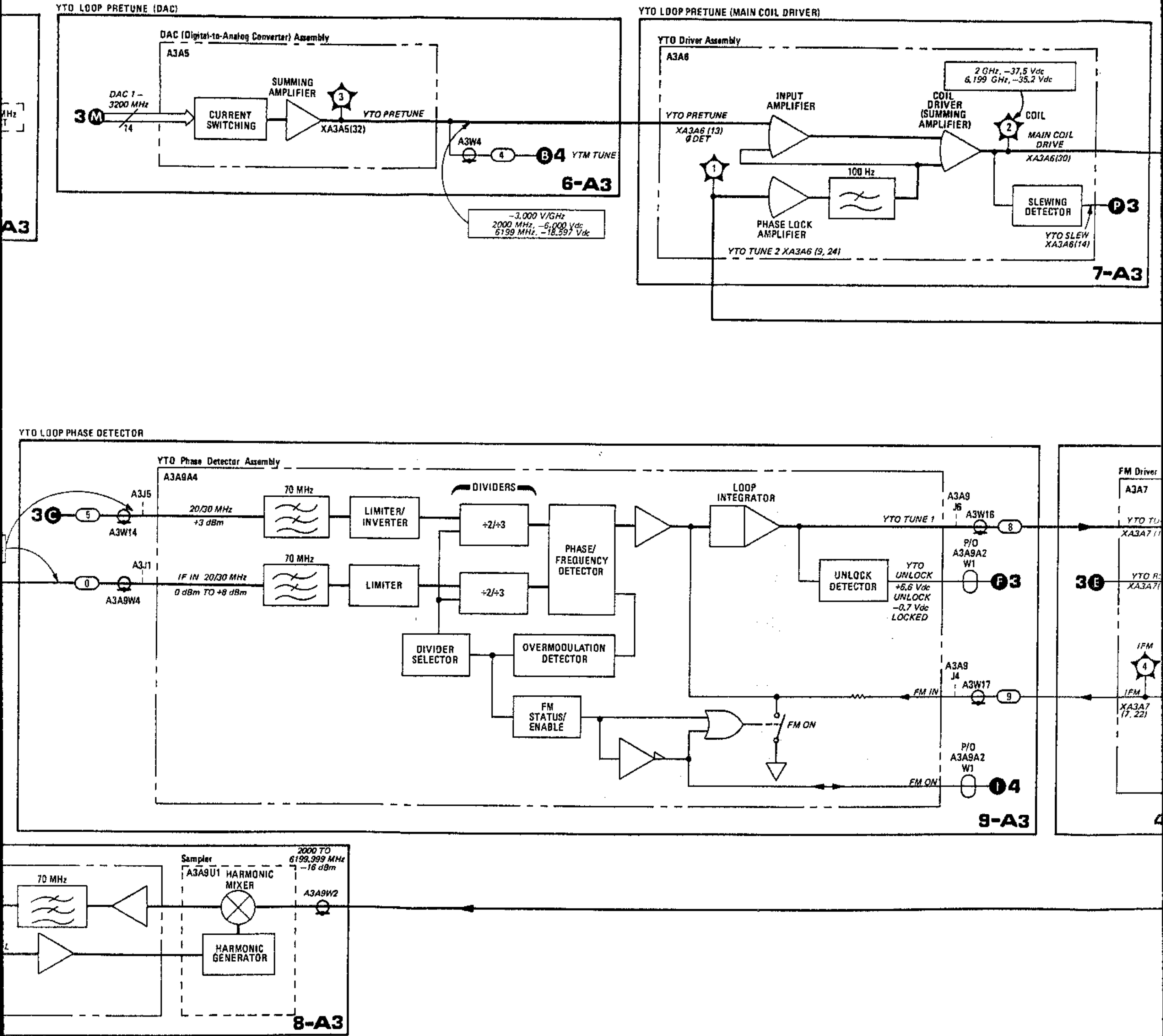


FIG. 8-22
Sht 4 of 4

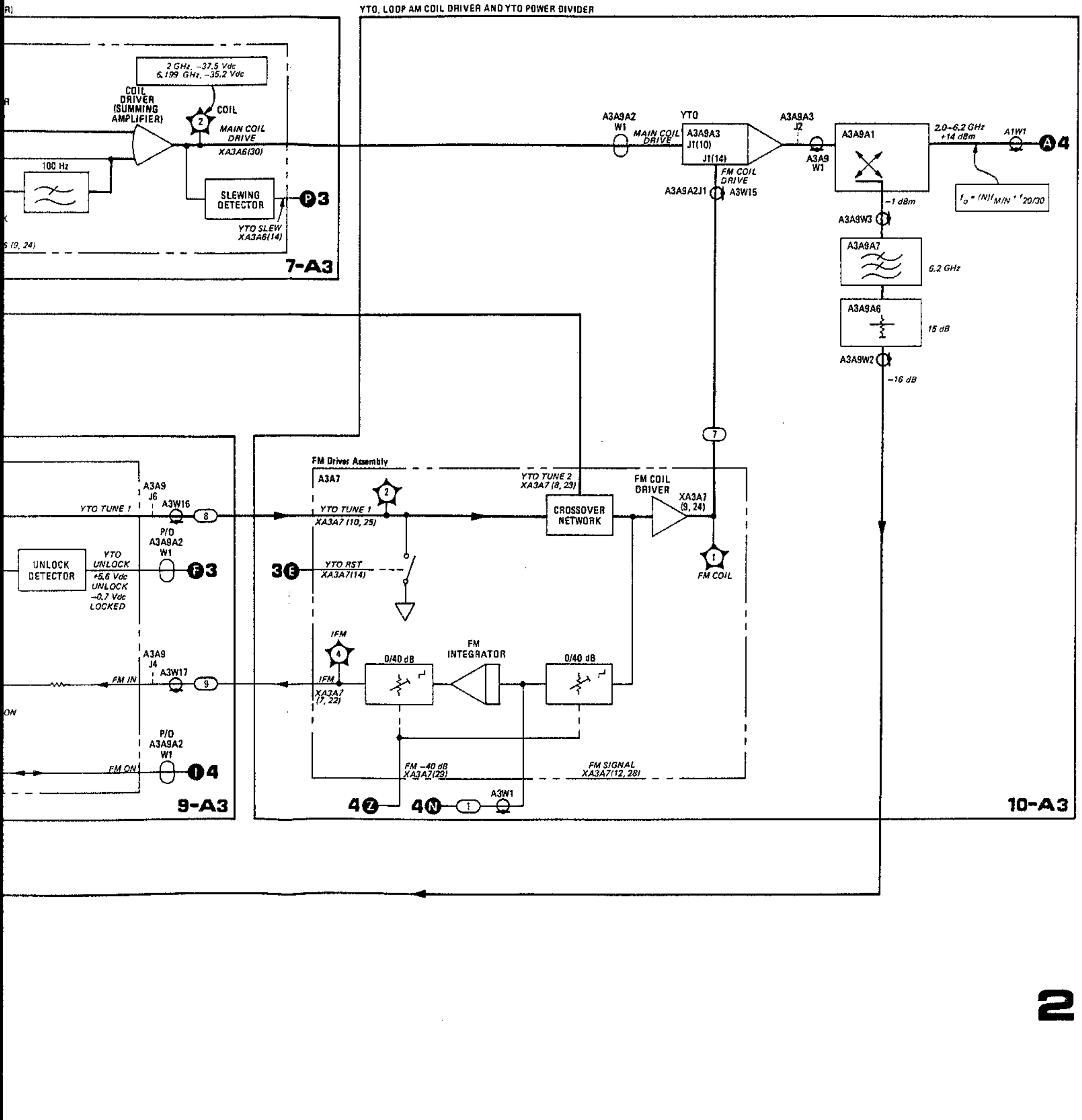


Figure 8-22. A3 RF Source Assembly Troubleshooting Block Diagram

SERVICE SHEET 3

A2 Controller Assembly

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-29
• Motherboard wiring	Last 3 foldout sheets
• Parts list	Page 6-1
• Performance tests	Page 4-1
• Adjustment procedures	Page 5-1

PRINCIPLES OF OPERATION

General

The Synthesizer's fundamental RF output signal is generated by the YTO (YIG Tuned Oscillator). This signal is phase-locked through other loops to the Synthesizer's reference oscillator. The Controller Assembly consists of the LFS (Low Frequency Synthesizer) or 20/30 MHz loop, a Digital controller, which generates tuning information, and a Remote Control section.

LFS Loop (A2A3, A2A4 and A2A5). The low frequency phase lock loop translates tuning data for the four least significant digits into frequencies from 30 MHz to 20.001 MHz. This translation is straightforward. The loop output frequency is calculated by the following equation:

$$f = 30 - x.xxx \text{ MHz}$$

where x.xxx signifies the four least significant digits of the YTO frequency.

The VCO in the low frequency section of this loop operates from 160 to 240 MHz. The output from this VCO is divided into two paths; one path is filtered and the other path is divided by eight and then filtered. In the output loop path, the signal is divided by eight and filtered to obtain a relatively clean sine wave between 20.001 MHz and 30.000 MHz. In the feedback path the signal is filtered and prescaled by a divider which can divide by either 10 or 11. The output of the prescaler is applied to the programmable divider which produces an 80 kHz output if the loop is locked. This signal is phase compared to an 80 kHz reference signal (10 MHz divided by 125) to generate a pulse whose width is determined by the phase difference between the two 80 kHz signals. The pulse is integrated to obtain a dc tuning voltage which can be either negative or positive. When the loop is properly locked, the phase detector's output pulse is approximately 30 nanoseconds wide. If the loop becomes unlocked, a one-shot is triggered to generate a 140 μs wide out-of-lock signal. If the loop remains unlocked, the one-shot is retriggered and the NOT PHASE-LOCKED annunciator will light.

Digital Controller (A2A1, A2A2, A2A8, A2A10, and A2A11). The digital controller generates frequency data for use by the phase lock loops. The frequency stored in the digital controller can be changed in various resolutions by the FREQUENCY RESOLUTION push-buttons and the TUNING control on the front panel or by remote programming. A battery supply provides a protected supply to allow the digital controller to retain the stored frequency data in the event of a power failure.

The Register 1 Assembly (A2A10) is a CMOS register that can be powered by either the Synthesizer's power supply or a rechargeable NICAD battery (A2BT1) if the line power is interrupted. This register stores the center frequency data in a BCD format. When the front panel TUNING control is turned, pulses are generated on two lines RPG 1 and RPG 2 from the Rotary Pulse Generator (A2A2). When the control is turned clockwise, RPG1 occurs before RPG2 and when turned counterclockwise, RPG2 occurs before RPG1. The Sign Decode circuit (A2A11) determines which pulse occurred first. When RPG1 occurs first, the ±1 Adder circuit (A2A11) is set to add one to the appropriate frequency digit as the data from Register 1 is clocked through the ±1 Adder by CLK1 (a train of 9 pulses). The three clock lines in the digital controller are triggered when the TUNING control is turned. As the data leaves the ±1 Adder it is routed to the Front Panel Display (A2A1), to Register 2 (A2A8), and back into Register 1 (A2A10).

In the standard Synthesizer, the Offset Adder circuit (A2A11) passes data without change. The data is clocked into Register 2 by the first nine pulses of CLK2. The LEFT line then goes high and sets Register 2 into the left shift mode. The next nine pulses of CLK2 shifts the data through a divider circuit that can divide by 1, 2, or 3. At the end of the division, the remainder must be zero. If the remainder is not zero, a one will be added or subtracted from the least significant digit of the data in Register 1, and the result will be clocked into Register 2 where the division will again occur. This process will continue until the remainder is reduced to zero. When the remainder is zero, a single clock pulse, CLK3, causes the data in Register 2 to be dumped in parallel into Register 3. The outputs of Register 3 are decoded to generate tuning data for the phase lock loops.

Remote Control Section (A2A7 and A2A9). Remote programming of the Synthesizer is accomplished via the Hewlett-Packard Interface Bus (HP-IB). The Synthesizer accepts most bus commands as well as data to set frequency, power output, modulation, and leveling. When addressed to talk, the Synthesizer transmits an 8-bit byte which indicates the status of certain portions of the Synthesizer. (Section III of this manual contain programming information under Remote Programming.) The remote interface circuits are contained on two boards. The HP-IB Address Assembly (A2A9), handles the actual communications while the Interface Assembly (A2A7) distributes data to the appropriate locations within the Synthesizer. Data is received from the bus by the transceivers on A2A9. The transceivers convert the low true bus signals to high true signals for use within the Synthesizer. The same transceivers convert the high true signals from the Synthesizer into low true signals for the bus.

The HP-IB handshake sequence is handled by two circuits, one for talking (source handshake) and one for listening (acceptor handshake). The handshake sequence monitors the DCU BZY (Busy) line and will not allow the handshake to continue until the digital controller has finished processing the previous data.

Circuits on A2A9 determine if the information on the eight bus data lines (DI01-8) is to be interpreted as data, addresses, or totally ignored. Service requests are generated on A2A9 by examining the status signals generated by the rest of the Synthesizer. For instance, if the Synthesizer is unlocked or if the FM is overmodulated and the RF is on, then a service request (SRQ) will be generated. If there is a frequency error, an SRQ will be generated whether or not the RF is on or off. A short delay is included at the clock input to the service request flip-flop to avoid generating a service request every time the frequency is changed. The delay is approximately 50 ms, long enough to allow the Synthesizer to settle at any new frequency except when FM is on.

After the Synthesizer is addressed to listen and with the bus in the data mode, data is routed to the A2A7 board where it is first interpreted as either an internal address (alpha) or as data (numeric) to be stored. Internal address data, also called program codes, causes the address counter flip-flops to be preset. This counter controls the distribution of data to the output registers. When data is received without internal address information, the address counter will be incremented one count for each character received. When the "Frequency Execute" command is received, A2A7 generates two clock signals to trigger the digital controller to process the remote frequency data.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate an A2 Assembly malfunction. The following troubleshooting information may be used to further isolate the problem to one of the three controller sections.

a. The LFS Loop

b. The Digital Controller

c. The Remote Control Section

Test Equipment:

Digital Voltmeter .... HP 3455A
or
Logic Probe .... HP 545A
Oscilloscope .... HP 180C/1801A/1821A

NOTE

If there is an obvious front panel fault (i.e., dead annunciator) go directly to troubleshoot A2A1.

1. Set RF switch ON.

SERVICE SHEET 3 (Cont'd)

2. Observe LED lock indicators on A2A7. All indicators should be on.
   REF — Fixed Reference Loop (A3A1A1, A3A1A2, A3A8)
   M/N — M/N Loop (A3A1A3, A3A1A4, A3A1A5)
   YTO – YIG Tuned Upper Loop (A3A5, A3A6, A3A7, A3A9)
   LFS — Low Frequency Loop (A2A3, A2A4, A2A5)

   If the REF, M/N or YTO Loops are unlocked go to Service Sheet 2. If the LFS Loop is unlocked, go to Service Sheet 1-A2.

3. If the malfunction involves incorrect frequency output continue with this procedure. Otherwise go to step 9.

4. Install A2A8 (Register board) on extender.

5. Set center frequency to 6169.696 MHz. If you cannot tune to this frequency skip to step 9. Measure logic state at the edge connector pins indicated by arrows pointing to them. All such pins on the front of connector A should be "0", all on the rear of A should be "1". All such pins on the front of B should be "1" and on the rear of B should be "0".

6. Set frequency to 3,696.969 MHz.

   Front of A should be "1".
   Back of A should be "0".
   Front of B should be "0".
   Back of B should be "1".

7. Set frequency to 5,990.000 MHz.

   Front of C should be "1".
   Rear of C should be "0".

8. Set frequency to 3640 MHz.

   Front of C should be "0".
   Rear of C should be "1".

   If there is a frequency data malfunction in A2, it should show up as a pattern of incorrect logic states on the output pins. Check the logic states at all 4 frequency settings as this will help to isolate the defect. If steps 5 through 8 all measure OK, determine which phase lock loop is mistuning by measuring their output frequencies with a counter. The equation needed to determine the *correct* frequencies are shown on the Service Sheet 2 block diagram.

9. If the frequency cannot be changed (but is a legal frequency), continue with this step. Otherwise, go to step 11. Check RPG1 and RPG2 signals at pins 3B and 16B of A2A11 with a dual channel oscilloscope. The normal output is two pulses of about 2.5V in phase quadrature as the TUNING knob is turned. The leading pulse is determined by the direction the knob is turned. If the RPG signals are bad, troubleshoot RPG and interconnections.

10. If the RPG signals are normal, check the ±1 bit line at pin 22A. This signal is a string of pulses as the TUNING knob is turned. Check the ±1 bit line at all tuning resolution settings. If ±1 bit is OK, troubleshoot A2A11, otherwise troubleshoot A2A1.

11. If the instrument does not turn on properly, check the following items.

    (a) Battery charge

    (b) Clock signal from mainframe

    (c) CLK1, CLK2 and CLK3 signals on A2A11

    (d) PWRUP line to A2A11

12. If frequency limits are improper, check frequency decoder circuit on A2A10.

FIG. 8-23
Sht 1 of 2

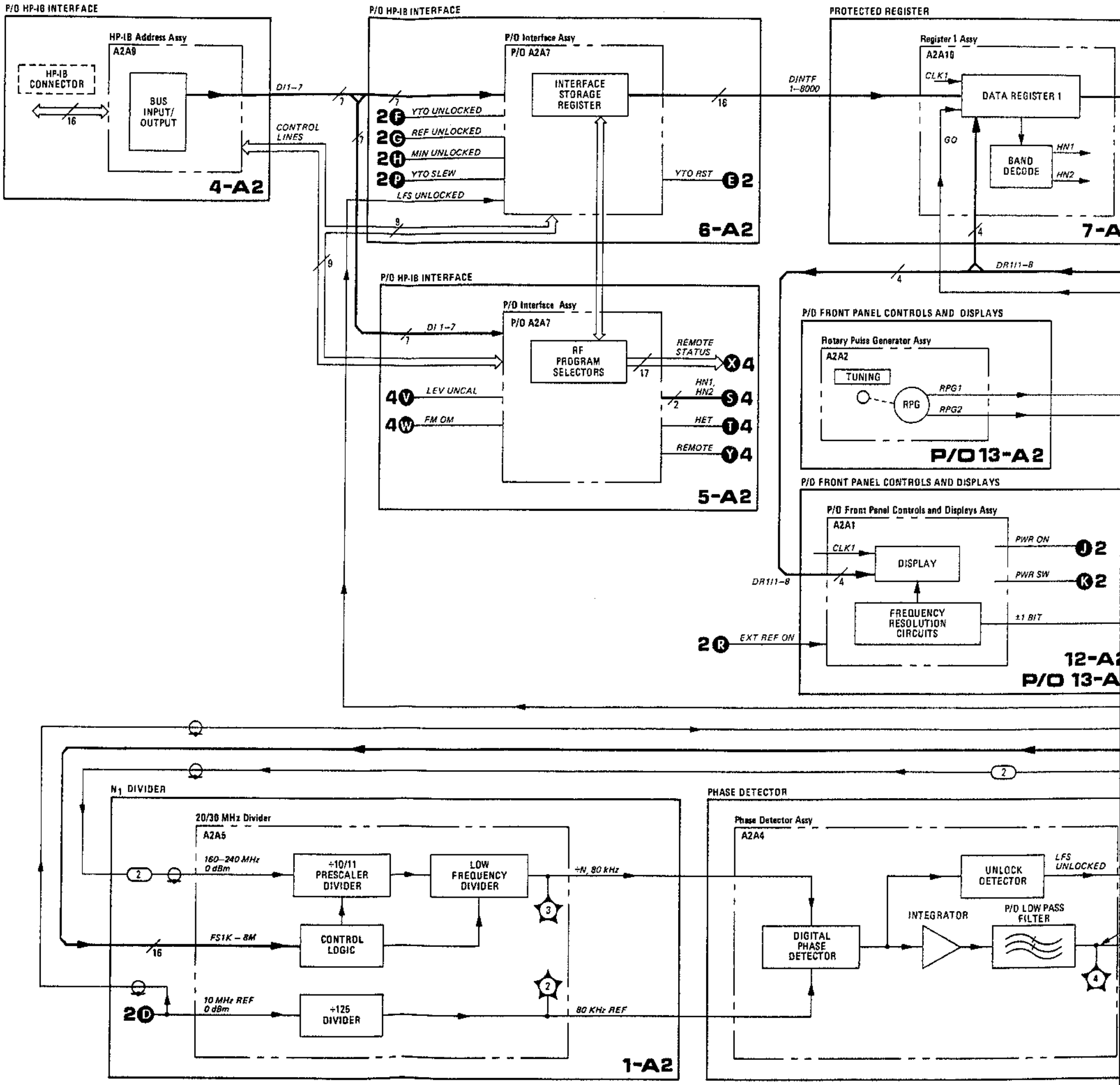


FIG. 8-23
Sht 2 of 2

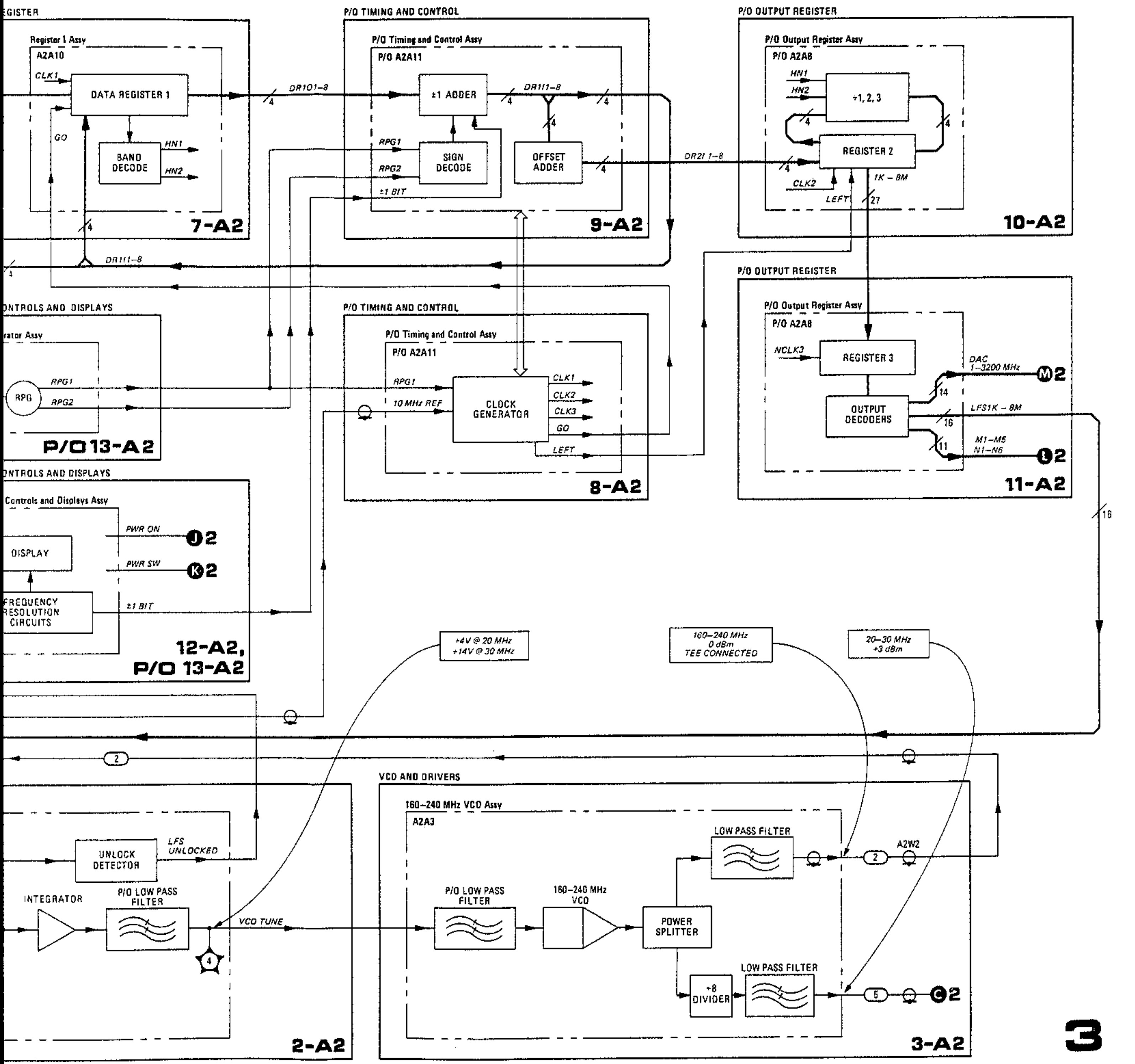


Figure 8-23. A2 Controller Assembly Troubleshooting Block Diagram

SERVICE SHEET 1-A1

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram Page 8-29
- Parts list Page 6-5
- Performance tests Page 4-1
- Adjustment procedures Page 5-24

A1 RF OUTPUT ASSEMBLY

General

The A1 Assembly performs two basic functions. The RF signal from the A3 Assembly's YTO Loop is isolated from the RF Output by the A1AT1 Isolator. Also, the A1A1 Front Panel Assembly makes it possible to control the frequency modulation and RF switching functions.

A1A1 Panel Assembly

The RF switching and FM mode functions may be front panel controlled or externally programmed via HP-IB. The RF output may be switched on or off and full scale FM ranges of 10 MHz or 0.1 MHz may be selected.

The front panel annunciators display the mode status. In the FM mode, the OVERMOD annunciator indicates when the modulation level (deviation) is too high for existing RF output frequency and modulation rate.

The Local/Remote Data Selector passes local or remote control information depending on the status of the REMOTE input. In the FM mode, selecting either range causes an active output from the FM Decoder that lights the appropriate FM range annunciator. An output on either range also activates the FM Relay Driver circuit. This closes the relay and allows the front panel FM INPUT signal to pass through to the A3 Assembly FM circuits (YTO Loop). The FM signal, that is output to the A3 Assembly's YTO Loop, is adjusted for the correct FM deviation to input level sensitivity by the FM SENS ADJ control.

The active high on the emitter of Q10 is connected through R19 to activate the FM circuits in the A3 Assembly (FM ON). If the FM overmodulation condition exists, the same control line is pulled low (NFM ON). The FM OVERMOD status indicator lights and FM OM output goes high.

SERVICE SHEET 1-A1 (Cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a reference loop malfunction.

Test Equipment

Power Meter	HP 436A/8481A
Digital Voltmeter	HP 3455A
Frequency Counter	HP 5340A
Spectrum Analyzer	HP 8565A

1. Connect the power meter to RF OUTPUT connector. The output should be > +8 dBm across the entire frequency range of Synthesizer; the total power variation across the band should be <6 dB. If the power level is adequate, proceed to Step 3.

2. If power level is low, measure the RF signal feeding the isolator. The insertion loss of the isolator should be <1 dB.

3. Set the FM Deviation switch to the 0.1 MHz position. The FM 0.1 lamp should light.

4. Set the FM Deviation switch to the 10 MHz position. The FM 10 lamp should light. If either FM light doesn't function, check the lamp and if it is good, troubleshoot the local/remote data selector, FM decoder and display drivers.

5. Set the RF switch OFF. The RF ON lamp should extinguish and the RF OFF lamp should light. When the RF is off, the NOT PHASE-LOCKED lamp should light. If the lock indicator functions properly but the RF ON or RF OFF lamps don't work properly, check the lamps and if necessary troubleshoot the display drivers. Set the RF switch ON before continuing.

6. Apply 1.8 Vrms to FM input at 10 MHz rate (FM switch should still be in 10 MHz position) the FM OVERMOD indicator should light. If the indicator does not light, check the lamp and if necessary troubleshoot the overmodulation circuit and display driver.

7. Set the FM switch to the 0.1 MHz range. The OVERMOD lamp should remain on. If the lamp does not remain on, troubleshoot the overmodulation circuit. (A1A1TP6 should be low if the modulation voltage is excessive.)

8. Set modulating signal to 10 kHz at 1.0 Vrms. the OVERMOD lamp should light. If the lamp doesn't light under these conditions but worked properly in Steps 6 and 7, go to Service Sheet 10-A3 to troubleshoot the overmodulation circuitry in the YTO Loop.

9. Connect 100 kHz at 1.414 Vrms to the FM input. Set FM Switch to 0.1 MHz deviation range. Connect spectrum analyzer to RF OUTPUT and tune to view signal and sidebands. The first sideband pair should be 4.8 dB below the carrier. Adjust the voltage slightly to obtain the correct sideband level. The voltage should be between 1.315V and 1.513V. If the voltage is within tolerance, the A1 Assembly is working properly. If the voltage is incorrect, perform the FM adjustments procedures if the voltage is close to correct. If the voltage is way off, troubleshoot the FM sensitivity circuit and if it is working properly, go to Service Sheet 10-A3 to troubleshoot the FM driver.

NOTE

After repairing the A1A1 Assembly, if necessary, perform the FM Sensitivity Adjustment in Section V.

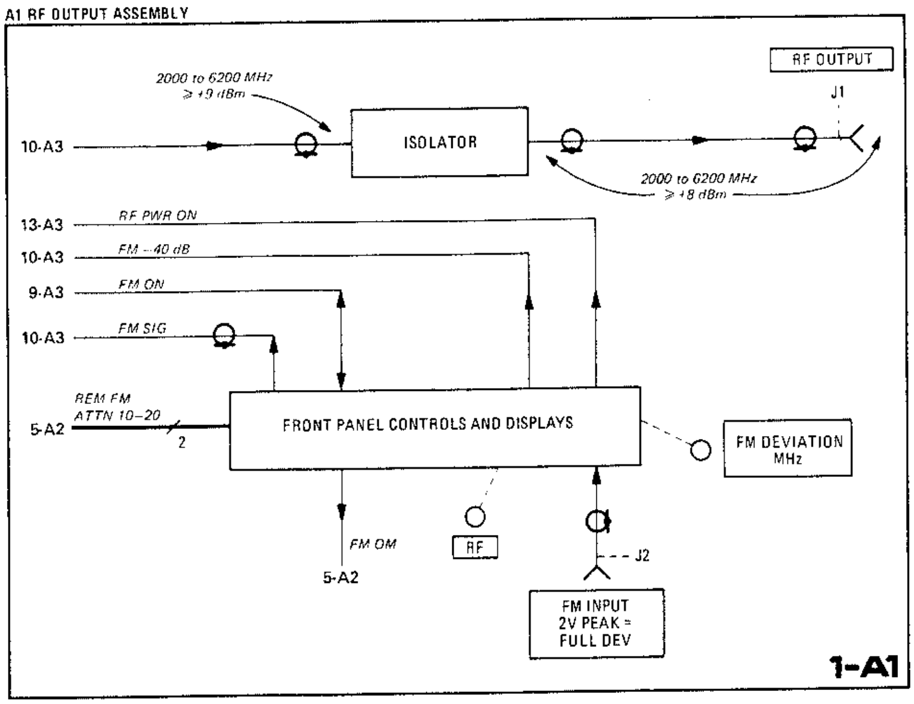


Figure 8-24. A1 RF Output Assembly Block Diagram

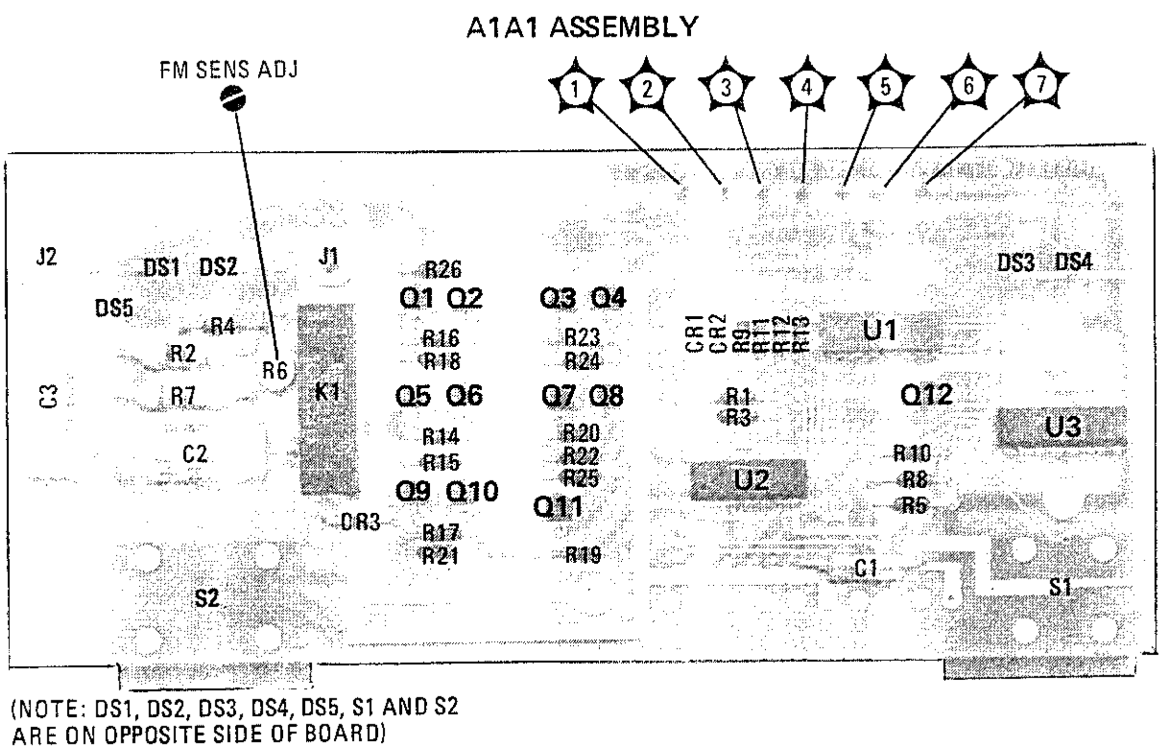


Figure 8-25. A1A1 Front Panel Assembly Component, Adjustment, and Test Point Locations

FIG. 8-26
Sht 1 of 3

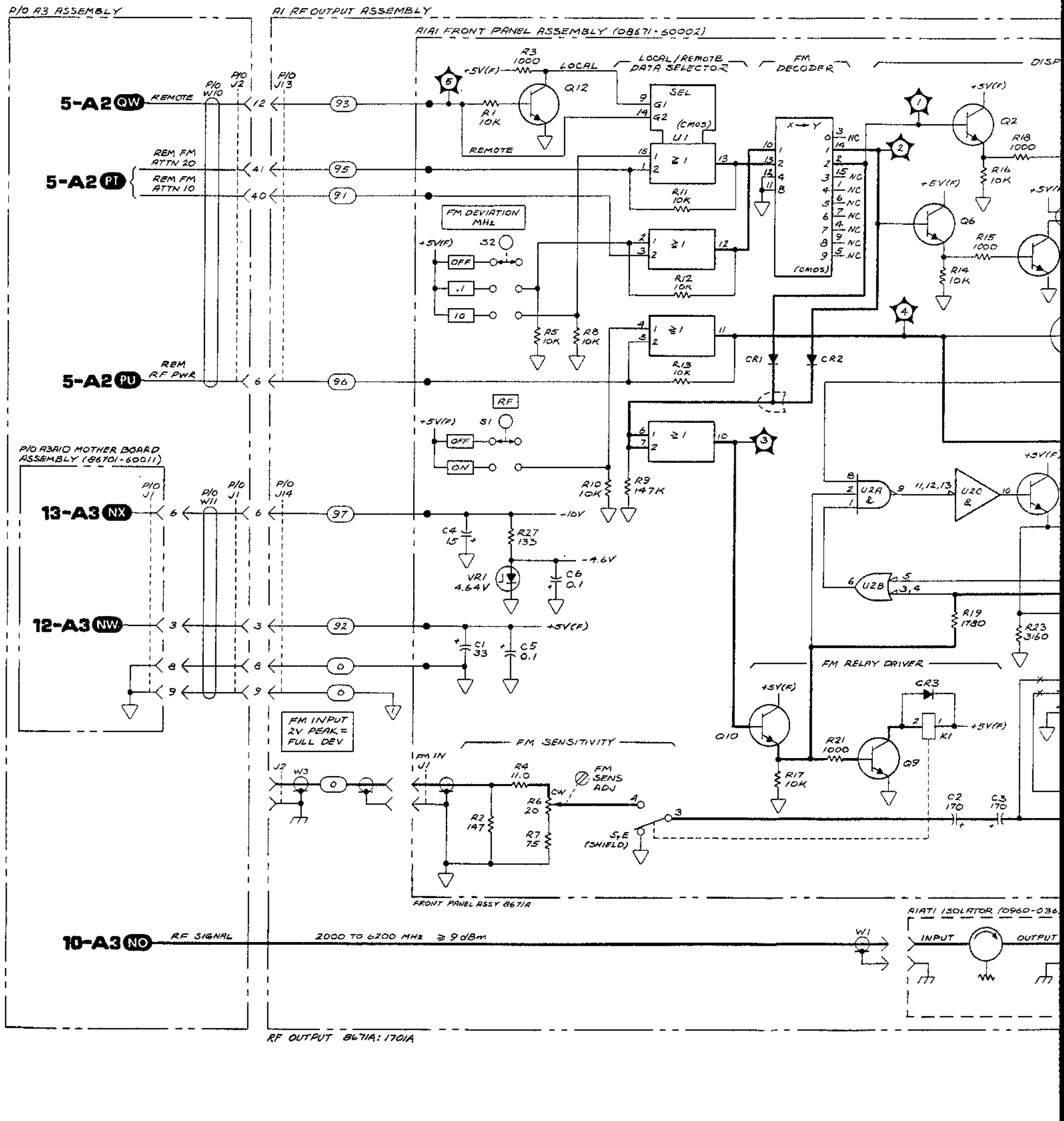
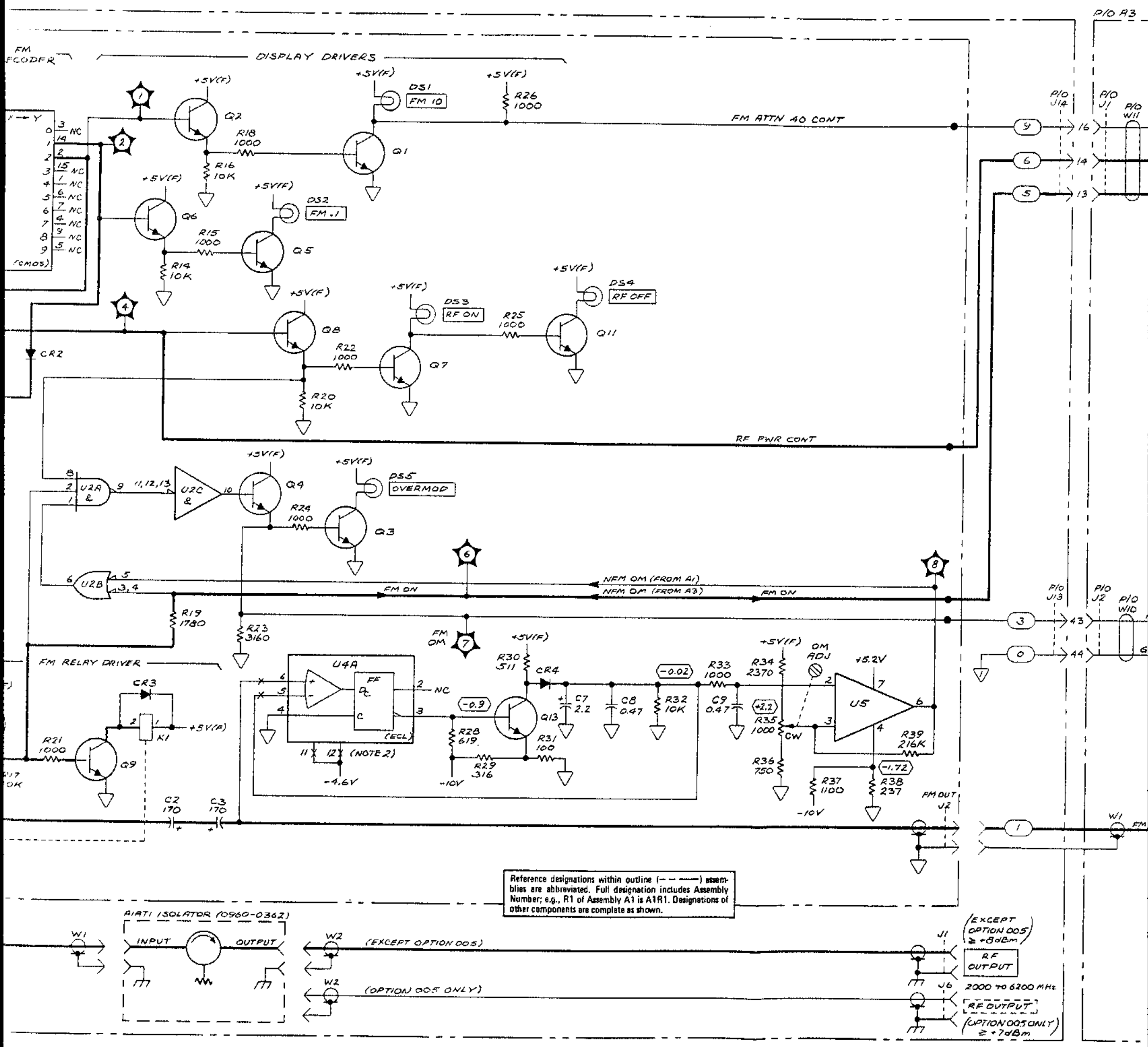
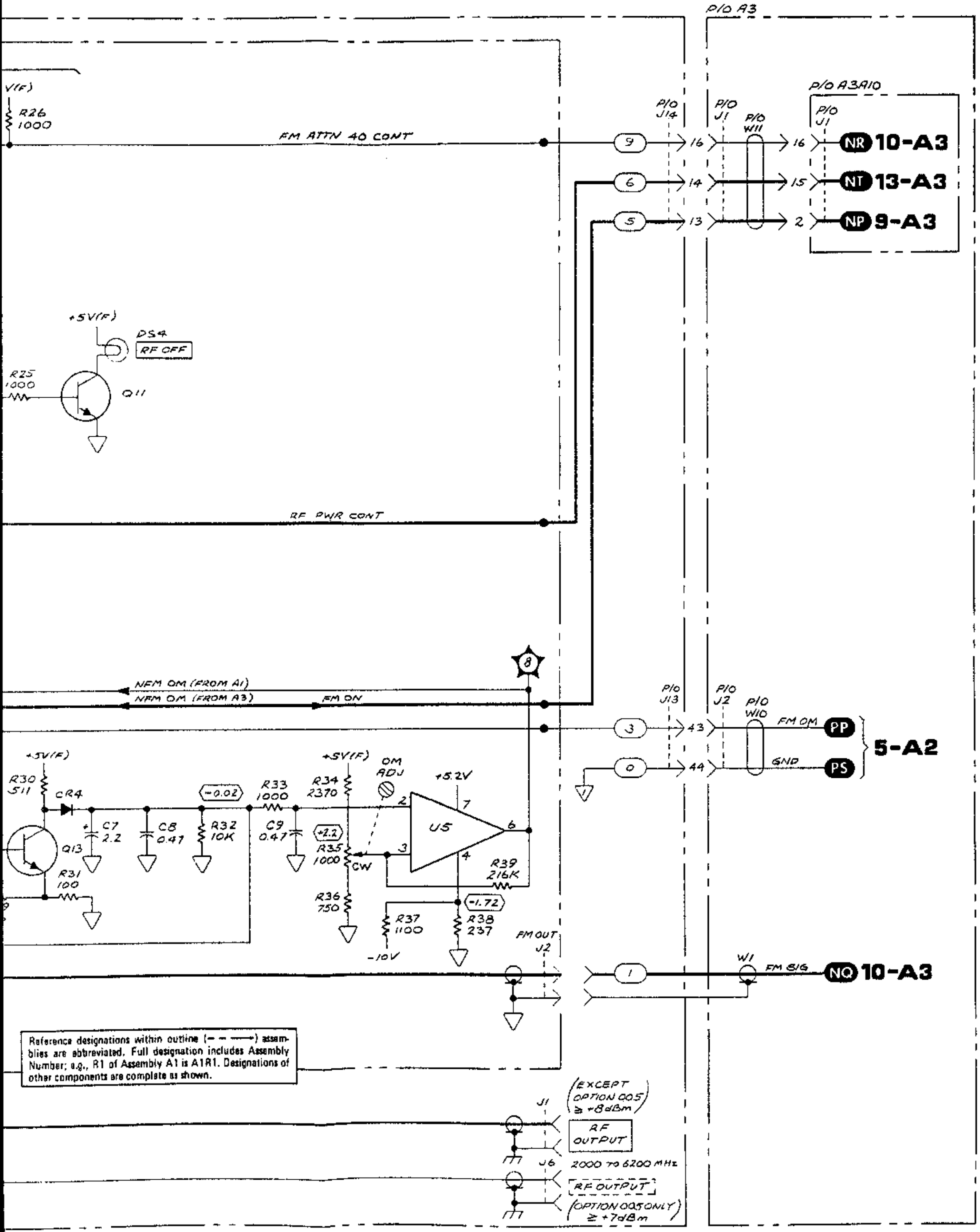


FIG. 8-26
Sht 2 of 3



Figure

FIG. 8-26
Sht 3 of 3



NOTES

1. Unless otherwise indicated:
   Resistance in ohms;
   Capacitance in microfarads;
2. Pins 11 and 12 of U4A are connected to −4.8V but do not affect the circuit operation.

REFERENCE DESIGNATIONS

A1A1	A1
C1-9 CR1-4 DS1-5 J1,2 K1 Q1-13 R1-39 S1,2 TP1-8 U1-5 VR1	AT1 J1,2,13,14 W1-3
	A3
	J1,2 W1,10,11
	A3A10
	J1

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 NUMBER
Q1-12	1854-0071
Q13	1854-0019
U1	1820-0951
U2	1820-0943
U3	1820-0927
U4	1820-0919
U5	1826-0013

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBER
U1,3	+5V - 16 ⏚ - 8
U2	+5V - 14 ⏚ - 7
U4	+5.2V - 7,10 −4.6V - 8 ⏚ - 1,16

1-A1
A1A1, A1AT1

Figure 8-26. A1A1 Front Panel Assembly Schematic Diagram

SERVICE SHEET 1-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout sheets
- Parts list — Page 6-11
- Performance tests — Page 4-10, 4-20
- Adjustment procedures — Page 5-21

PRINCIPLES OF OPERATION

LFS Loop

The 20/30 MHz Loop (LFS Loop) converts tuning information of the four least significant digits (1 MHz through 1 kHz) into a frequency between 20 MHz and 30 MHz. 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.

The 20/30 MHz divider (A2A5 board) consists 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 last four digits of the YTO frequency. The relationship is as follows:

$$N1 = 8\ (30\ \text{MHz} - D_4 .\ D_3 D_2 D_1\ \text{MHz})/80\ \text{kHz}$$

where:

D_4 = 1 MHz digit

D_3 = 100 kHz digit

D_2 = 10 kHz digit

D_1 = 1 kHz digit

If D_1 and D_2 are zero the prescaler divides by 11 for ten of its output cycles and by 10 for the rest, and the low frequency divider counts the programmed number of prescaler output pulses. When D_2 is not zero, unit division takes place. This is done by the prescaler, which divides by 11 one less time for each increment of D_2. For example if D_2 is 4, the prescaler will divide by 11 four less times. If D_1 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.

20/30 Divider

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 number 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 U16A 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

SERVICE SHEET 1-A2 (Cont'd)

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 D_2 information.

TROUBLESHOOTING

It is assumed that the troubleshooting information, Service Sheets 1, 2, and 3-A2 was used to isolate a 20/30 MHz divider problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Frequency Counter .... HP 5340A
Oscilloscope .... HP 180C/1801A/1821A

1. Install A2A5 on an extender board.

2. Observe the signal at A2A5TP2. You should see 2.5 ns wide pulses at an 80 kHz rate (12.5 μs period), TTL levels. If so, continue with this procedure; otherwise, troubleshoot the ÷125 counter.

3. Remove A2A3 and set the test switch to the TEST HIGH FREQ position. Reinstall A2A3. The output frequency should be greater than 240 MHz. This signal will be used to test the divider assembly.

4. Set the Synthesizer frequency to 3000.000 MHz. Attach a 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).

5. 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.

6. 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 8 μs spacing, TTL levels.

7. 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 in 9.9xx. If the pulse does not behave properly, troubleshoot the ÷10/11 controller and associated circuits.

8. Connect the oscilloscope or frequency counter to TP3. At 3000.000 MHz the frequency should be about 83.3 kHz (250 MHz divided by 3000). Change frequency to 2999.999 MHz and TP3 should go to about 125 kHz. (250 MHz divided by 2000.1). If both of these fre-

quencies are correct the A2A5 divider assembly is probably OK. Otherwise troubleshoot the LOW FREQUENCY DIVIDER (U14, U13, U11, U3 and U6).

9. 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 OK. Be sure to reset the TEST switch to the NORM position.

10. After any repairs to this board refer to Table 5-3 and perform the 20/30 Loop Divider Bias Adjustment and Signal-to-Phase Noise Ratio.

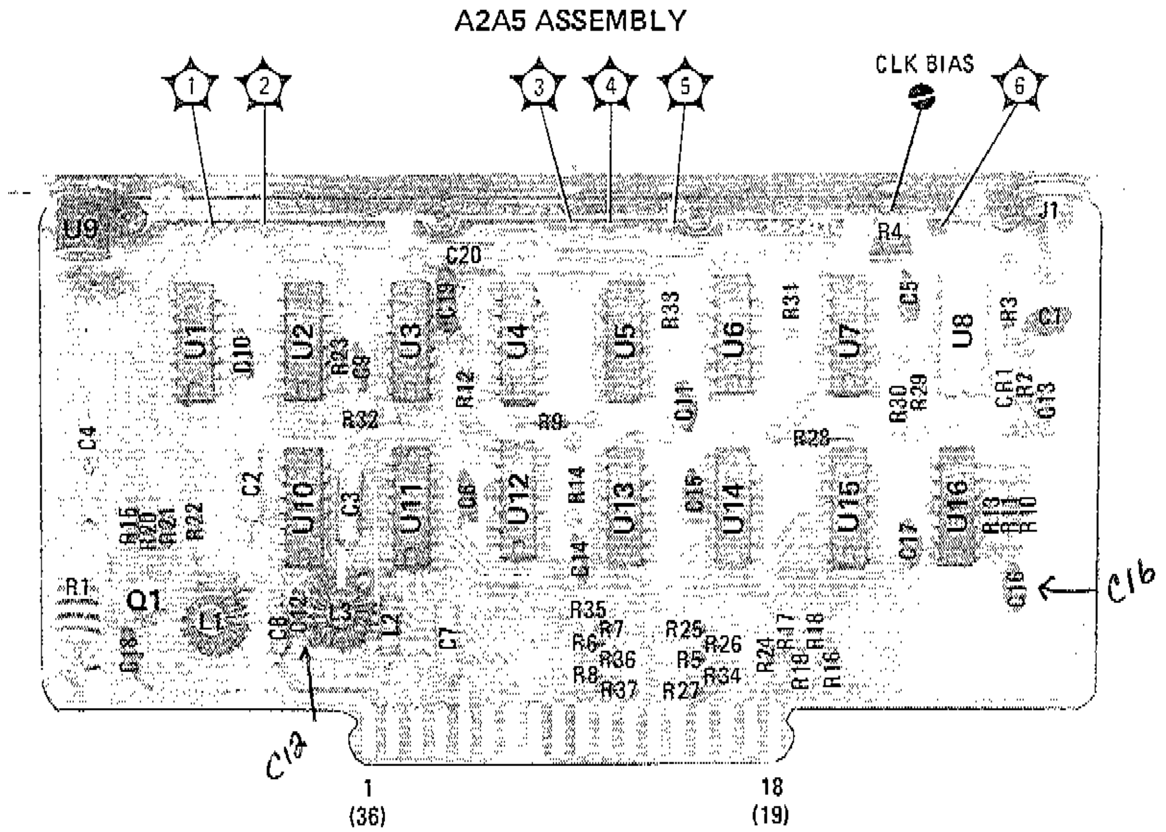


Figure 8-27. A2A5 20/30 MHz Divider Assembly Component, Adjustment and Test Point Location

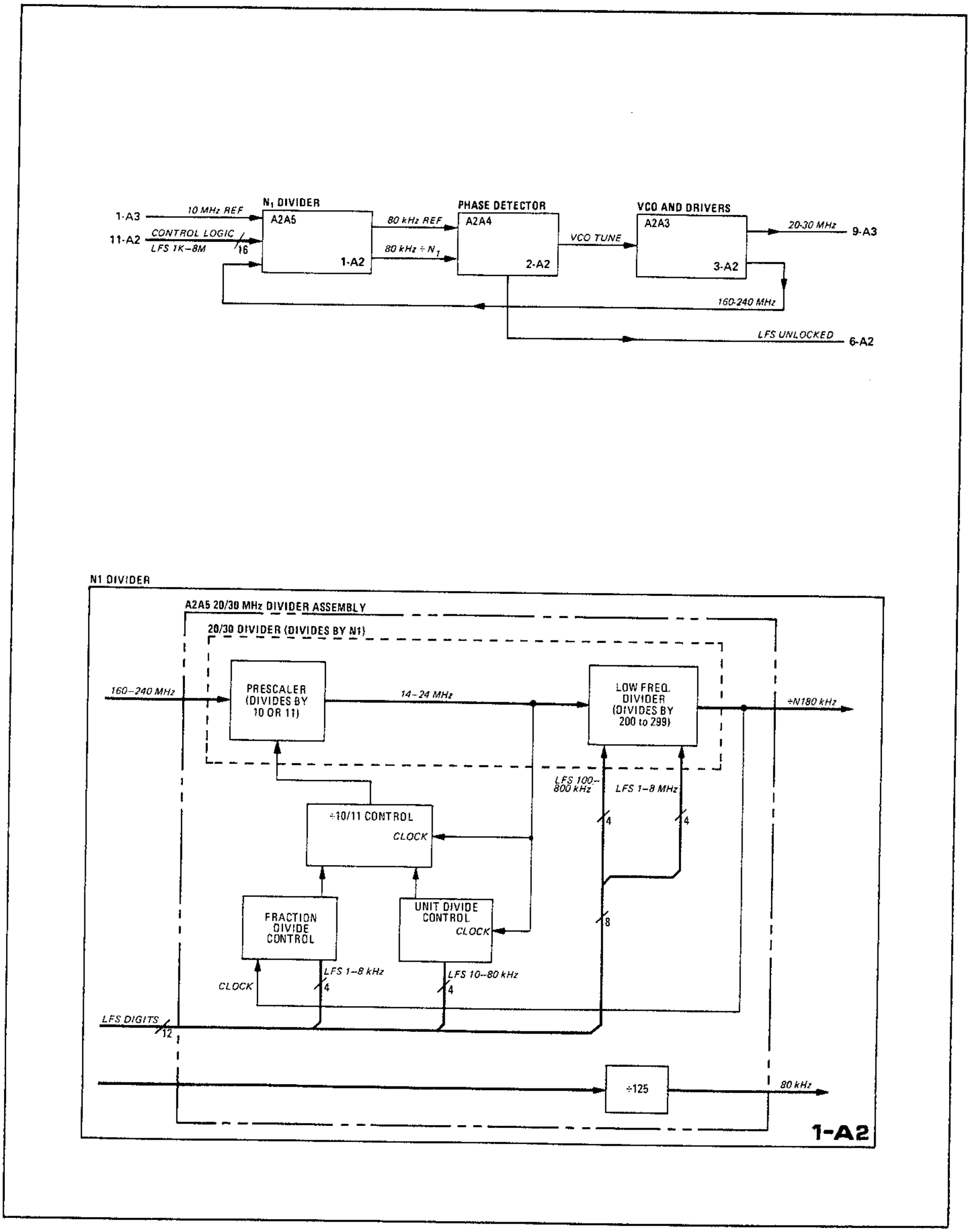


Figure 8-28. 20/30 MHz Divider Block Diagrams

FIG. 8-29
Sht 1 of 3

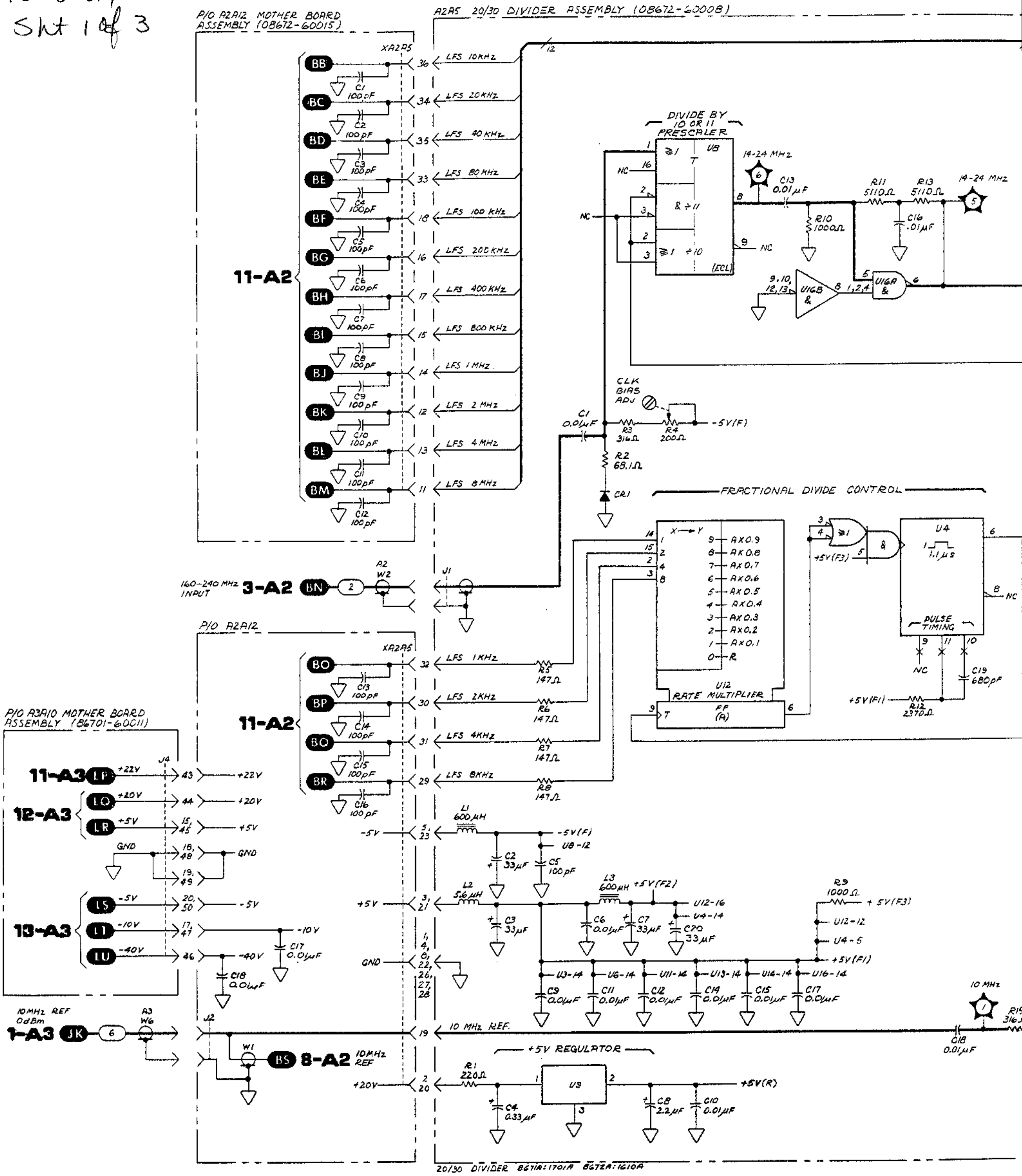
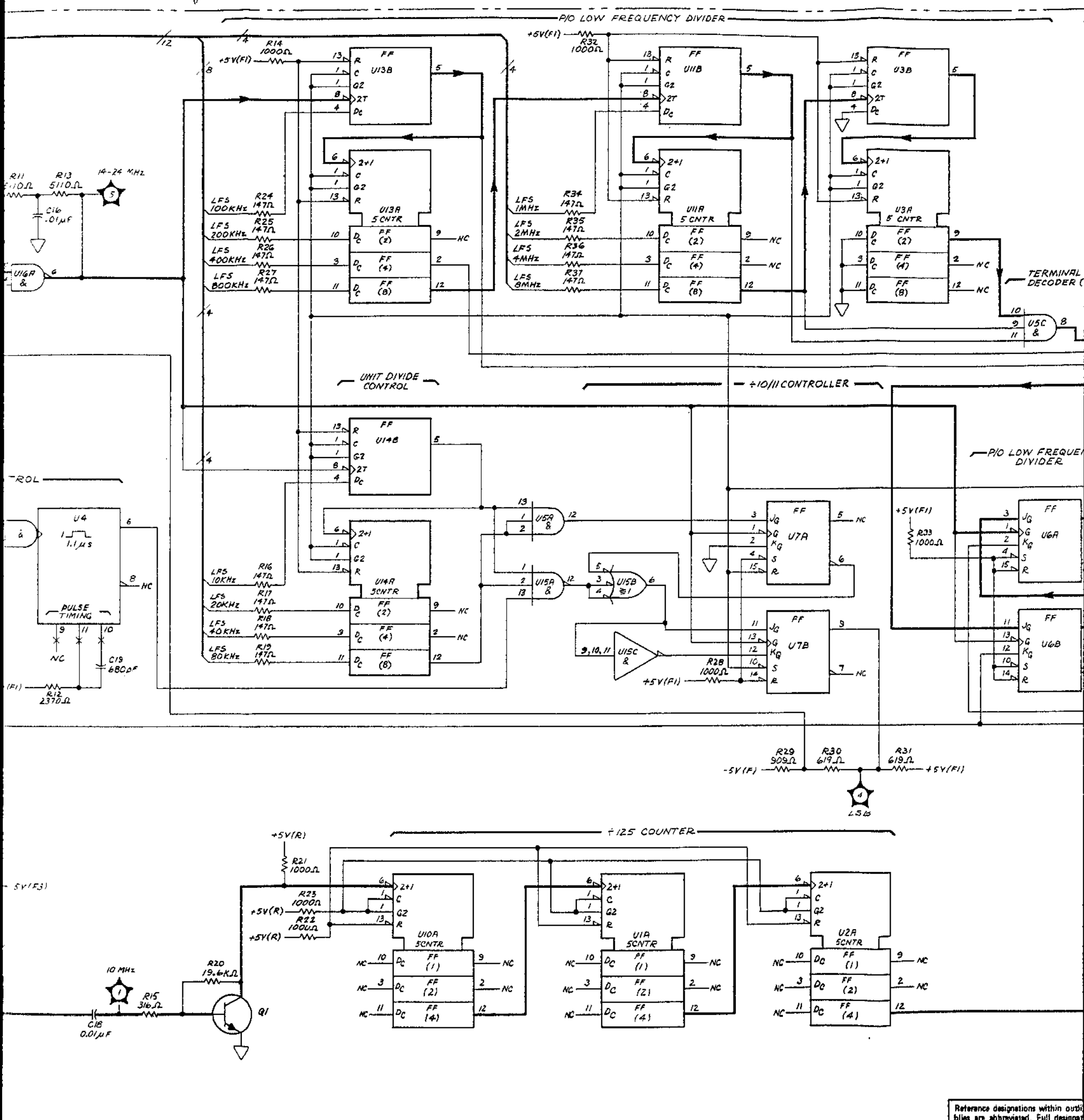
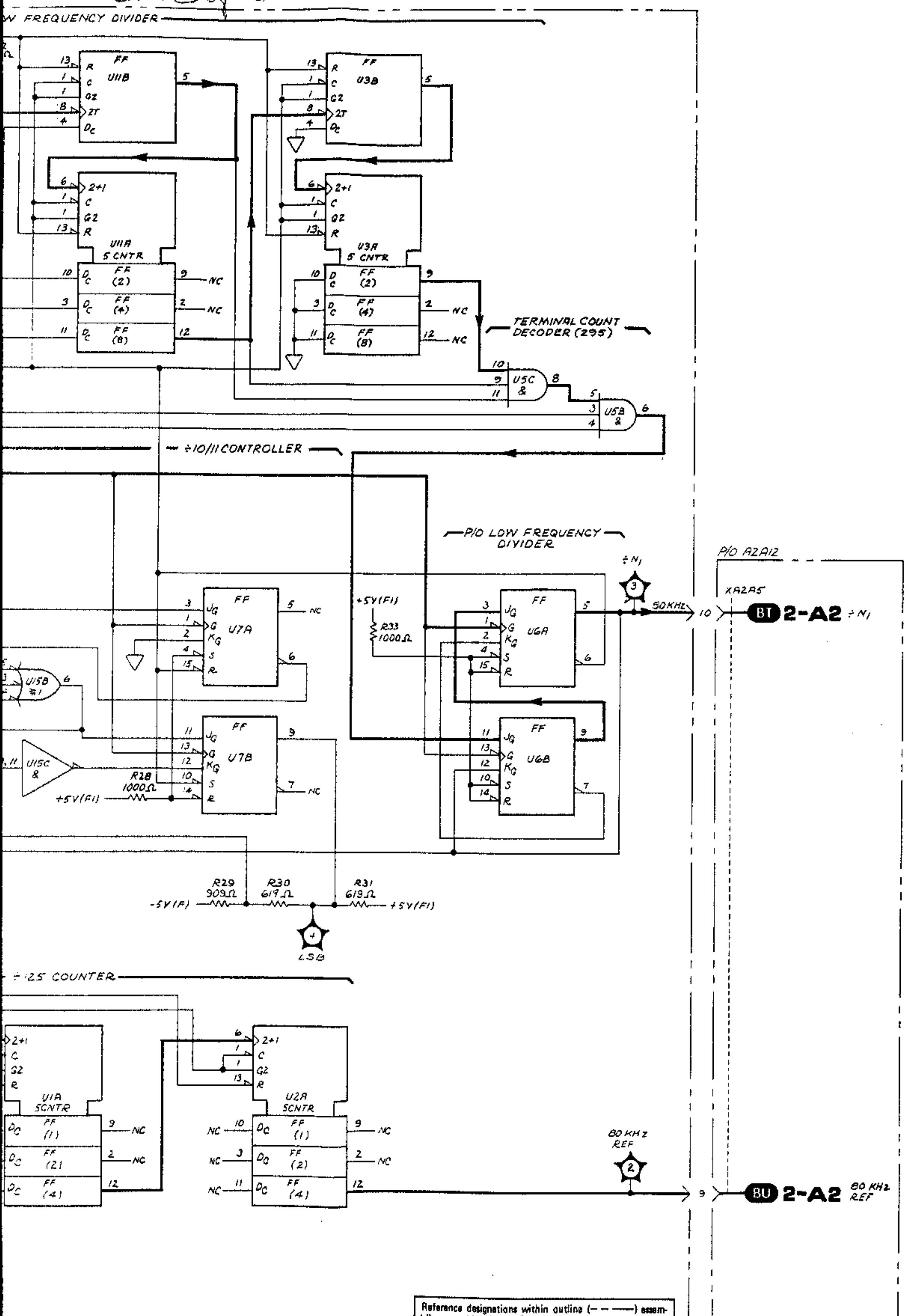


FIG. 8-29
Sht 2 of 3



Reference designations within outli...
blies are abbreviated. Full designat...
Number; e.g., R1 of Assembly A1 is...
other components are complete as sh...

FIG. 8-29
Sht 3 of 3



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.

REFERENCE DESIGNATIONS

A2	A2A12
W2	C1-18 J2 W1 XA2A5
A2A5	
C1 - 20 CR1 J1 L1-3 Q1 R1-37 TP1-6 U1-16	A3
	W6
	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
Q1	1854-0019
U1-3, 10, 11	1820-1251
U4	1820-0261
U5	1820-0686
U6, 7	1820-0629
U8	1820-1384
U9	1820-0429
U12	1820-0909
U13, 14	1820-0751
U15	1820-0685
U16	1820-0690

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 2, 10	+5V(R) - 14 ▽ - 7
U3, 5, 11, 13-16	+5V(F1) - 14 ▽ - 7
U4	+5V(F2) - 14 ▽ - 7
U6, 7	+5V(F1) - 16 ▽ - 8
U8	-5V(F) - 12 ▽ - 5
U12	+5V(F2) - 16 +5V(F3) - 12 ▽ - 8

1-A2
A2A5

Figure 8-29. 20/30 MHz Divider Assembly Schematic Diagram

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-10
- Performance tests — Page 4-10, 4-20
- Adjustment procedures — Page 5-23

PRINCIPLES OF OPERATION

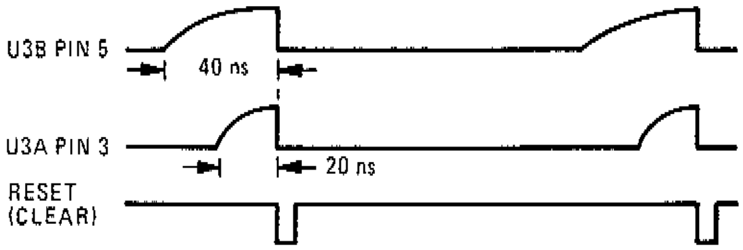
LFS Loop

The 20/30 MHz Loop (LFS Loop) converts tuning information of the four least significant digits (1 MHz through 1 kHz) into a frequency between 20 MHz and 30 MHz. 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 refcrence 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.

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 corrects the VCO frequency. Large frequency errors, especially those associated with a frequency change, result in an error voltage that may move the VCO out of the loop's locking bandwidth. When the 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 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.

20/30 Phase Detector

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-flops 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 differential input, means no change in the TUNE voltage. The timing relationship looks like the following drawing. 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 REF pulse will begin to rise about 20 ns before the ÷N1 pulse.



Phase Detector Timing

Q1 and U5 form an operational amplifier which amplifies and integrates differences between the inputs to produce the VCO TUNE voltage. R8, R12, R16 and C9 and 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, R13 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 activates 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 pin 6 goes high the D input to U8 is low and a low is clocked through to the switches. If a large phase error exists for more than 150 μs U8 pin 12 will still be high when the one shot's output pulse goes positive and a high will be clocked through U8.

One shot U6 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 U2A outputs negative pulses which are very short when the loop is unlocked for short periods but increases 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 2-A2 (Cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1, 3, and 3-A2 was used to isolate a 20/30 MHz phase detector problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter .... HP 3455A
Oscilloscope HP180C/1801A/1821A

1. Set the Synthesizer to standby and install A2A4 on a 2x18 extender board. Be sure all loop cables remain connected.

2. Turn the Synthesizer on and set 3000.000 MHz center frequency. Measure the TUNE OUT voltage at TP4. It should be about +14 Vdc.

3. Set the frequency to 2999.999 MHz. The TUNE OUT voltage should drop to about +4V. If both voltages are correct, A2A4 is probably OK. Continue to be sure. If a voltage is wrong, skip to step 7.

4. Measure the voltage at pin 11 of the edge connector. If the loop is locked this voltage should be a TTL low. (Less than 0.7 Vdc).

5. Disconnect the red coax. The voltage at pin 11 should be a TTL high, the LFS indicator on A2A7 should go out, and the NOT PHASE-LOCKED indicator on the front panel should light. Reconnect the coax and the loop should relock. If all measurements are correct A2A4 is OK.

6. If the lock indicator is not working properly per steps 4 and 5, measure the pulse widths at pin 6, U7 and U6, when the red coax is disconnected. Both one shots should be generating pulses when the loop is unlocked. U7 and U8 are intended to help the loop lock by causing loop gain to increase for 1.5 μs once an unlock condition has been detected. U6 generates a string of 140 μs pulses to control the LFS UNLOCKED line.

7. With an oscilloscope, observe the pulses at TP1 (20 ns) and TP2 (40 ns). These should be TTL levels with an 80 kHz repetition rate. The falling edge of the pulses should be coincident as shown in the principles of operation. If these pulses exist, the phase detector is probably OK. If the pulses are not present, check the input signals to the phase detector. A missing input will generally reveal itself by causing the corresponding output of the phase detector to remain low. If the input is missing, turn to service sheet 1-A2 to continue troubleshooting.

SERVICE SHEET 2-A2 (Cont'd)

8. Measure the inputs to U5 at pins 2 and 3. Both should be virtually the same at +12.1 Vdc. If these voltages are correct, troubleshoot U5 and associated components. Otherwise troubleshoot Q1 and associated components.

After any repairs to this board, perform the A2A4 Assembly Notch Filter Adjustment.

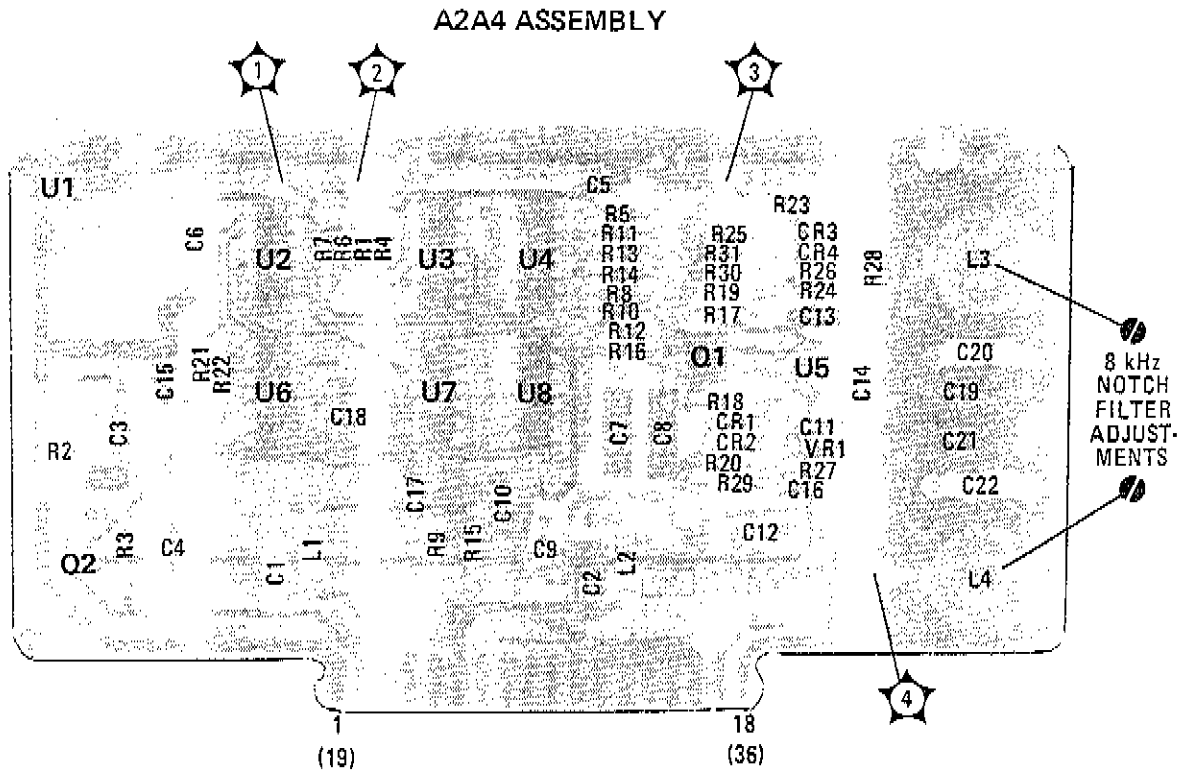
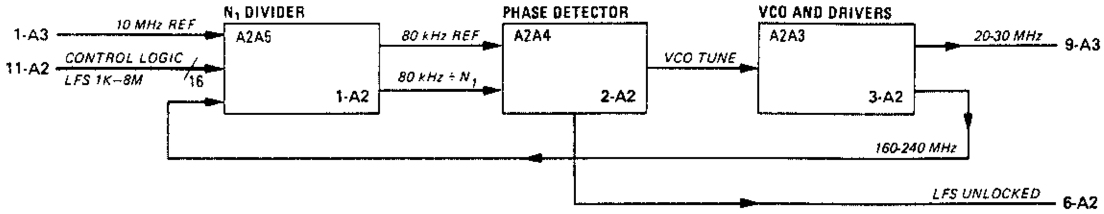


Figure 8-30. A2A4 20/30 MHz Phase Detector Assembly Component, Adjustment, and Test Point Locations



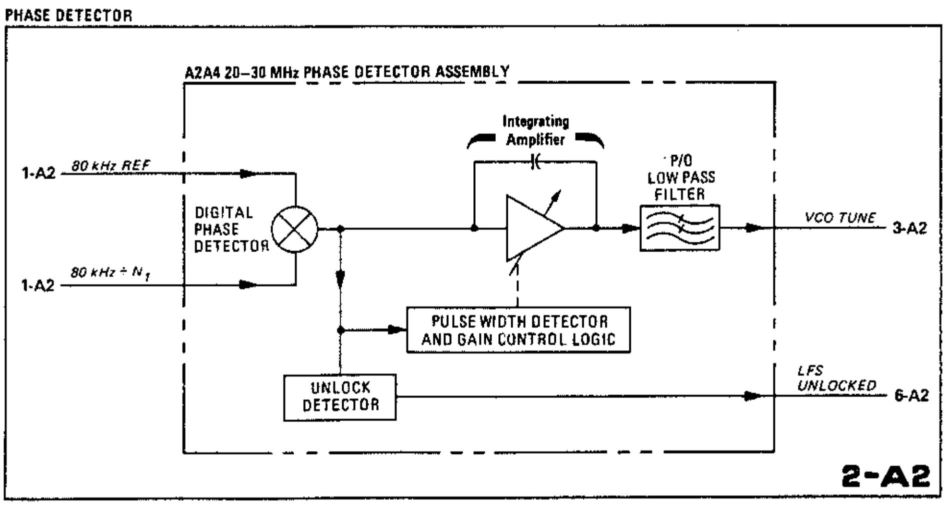


Figure 8-31. 20/30 MHz Phase Detector Block Diagrams

FIG. 8-32
Sht 1 of 3

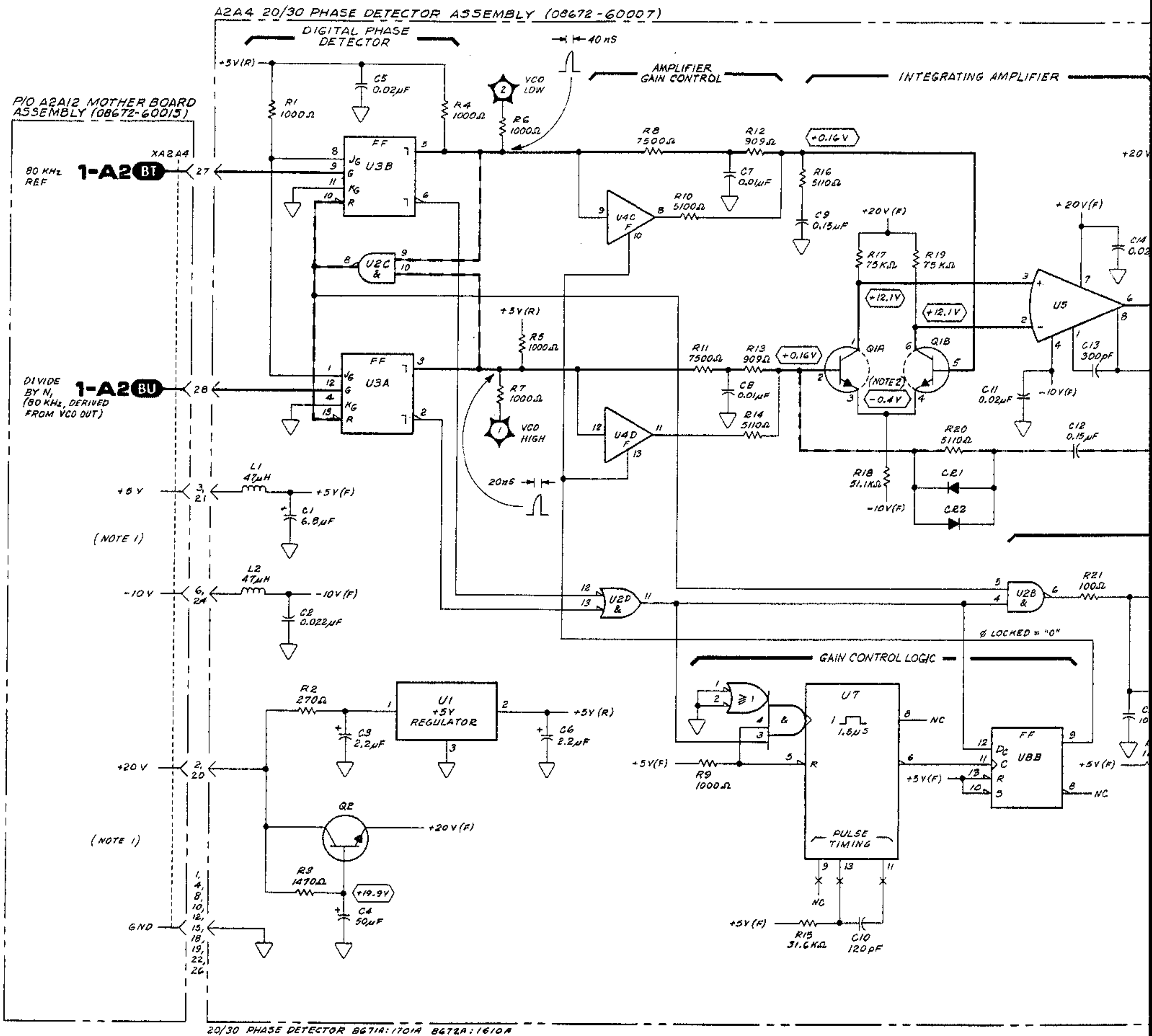
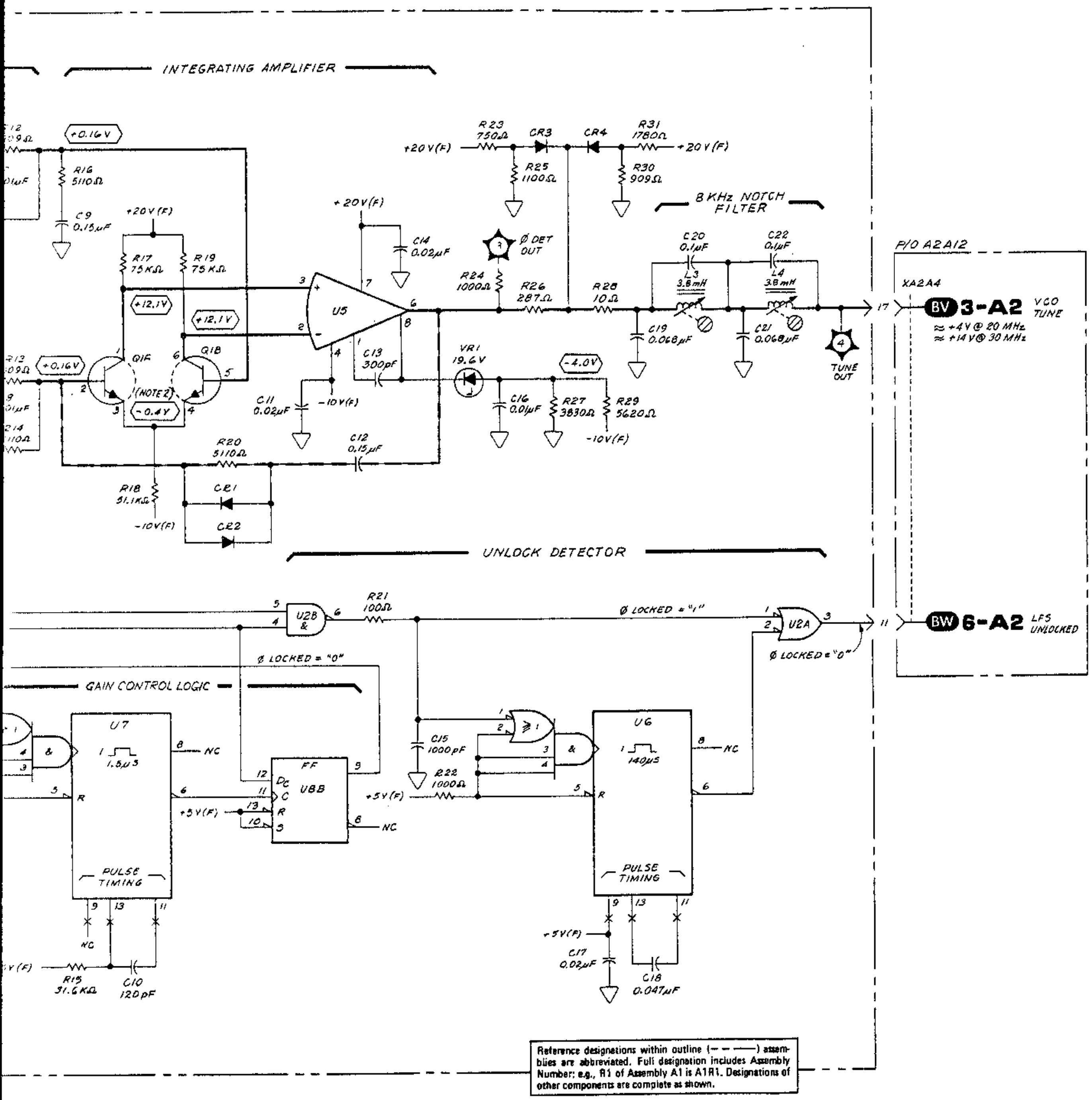


FIG. 8-32
Sht 2 of 3

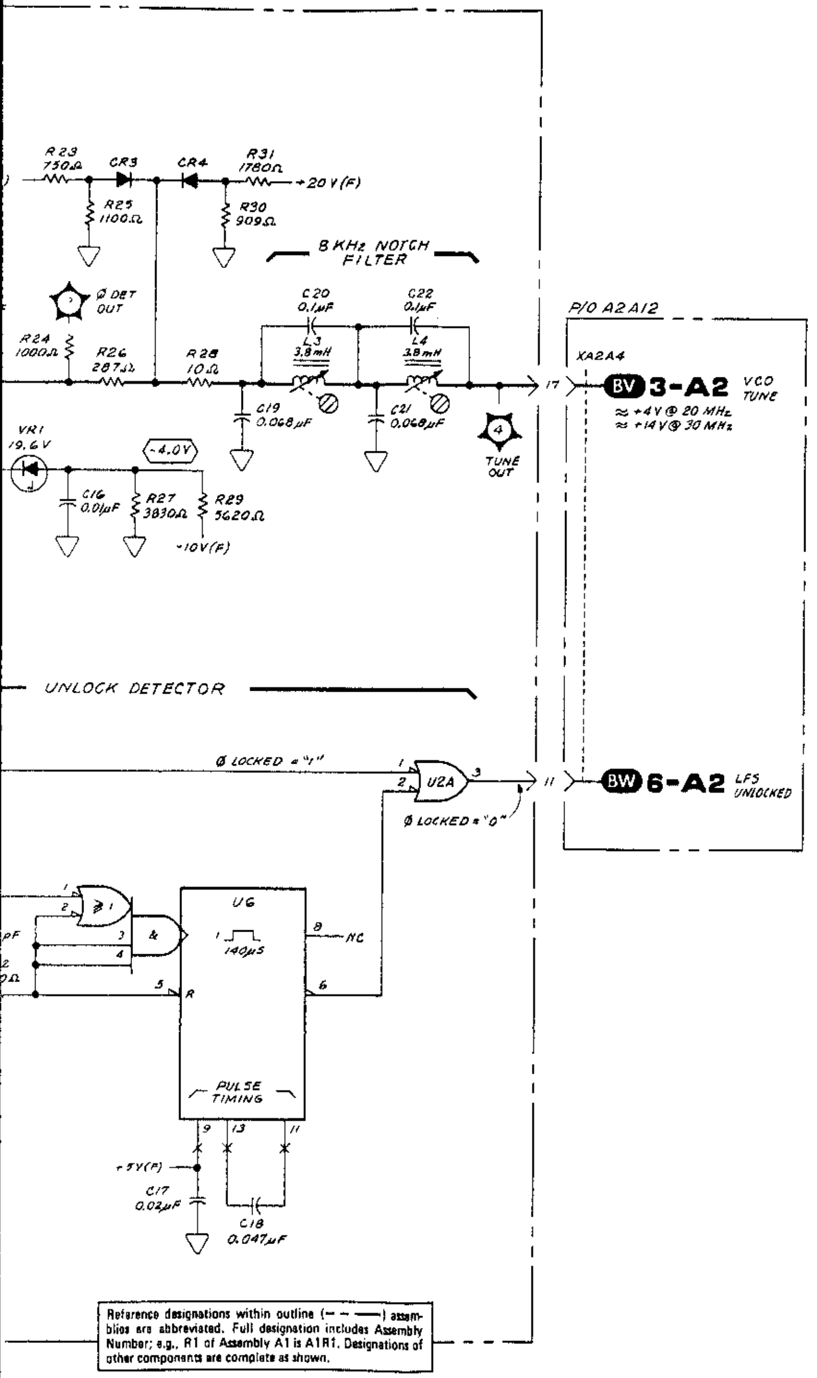


TRAN
AND INT
CIRCUIT PA

REFERENCE DESIGNATIO
Q1
Q2
U1
U2
U3
U4
U5
U6-7
U8

Figure 8-32. 20/30 MHz P

FIG. 8-32
Sht 3 of 3



NOTES

1. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1-A2.
2. REFER TO THE SCHEMATIC DIAGRAM NOTES FOR PHYSICAL PIN LOCATION.

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	1854-0475
Q2	1854-0071
U1	1820-0429
U2	1820-1197
U3	1820-0281
U4	1820-0846
U5	1826-0392
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

2-A2
A2A4

Figure 8-32. 20/30 MHz Phase Detector Assembly Schematic Diagram

SERVICE SHEET 3-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-35
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-8
• Performance tests	Page 4-10, 4-20
• Adjustment procedures	Page 5-20

PRINCIPLES OF OPERATION

LFS Loop

The 20/30 MHz Loop (LFS Loop) converts tuning information of the four least significant digits (1 MHz through 1 kHz) into a frequency between 20 MHz and 30 MHz. 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.

The VCO (A2A3) Assembly uses a varactor tuned oscillator and dividers to produce a 20—30 MHz signal, which is used in the YTO 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.

160—240 MHz VCO

The oscillator consists of Q1 with the primary of T1 and CR1 through CR4 for the tuned circuit, and C6 providing feedback. Varactor bias, 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 diodes, but in TEST HIGH FREQ or TEST LOW FREQ the loop is opened and dc voltage sets the VCO frequency to greater than 240 MHz or less than 160 MHz. Q1 is biased by the −40V 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. Q5 acts as a ripple filter for the Q2, Q3 and Q4 bias supply. Q2's output is filtered and applied to J2 as the 160—240 MHz OUTPUT. The signal at Q3's collector is divided by 8 by U2, U1A and U1B, filtered and applied to J1 as the 20/30 MHz output.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1 and 3 was used to isolate a 160—240 MHz VCO problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

SERVICE SHEET 3-A2 (Cont'd)

Test Equipment

Frequency Counter .... HP 5340A
Spectrum Analyzer .... HP 8553B/141T/8555A
High Impedance Probe .... HP 1121A
Digital Voltmeter .... HP 3455A

1. Set the Synthesizer to standby and install A2A3 on a 2 x 18 extender board.

2. Connect the frequency counter input to the A2A3 160—240 MHz OUTPUT. Common time base is not necessary for this measurement.

3. Set the test switch A2A3S1 to the TEST HIGH FREQ position. Turn on the synthesizer. The counter should indicate a frequency greater than 240 MHz.

4. Set the test switch to the TEST LOW FREQ position. The counter should indicate less than 160 MHz. If the results of either step 3 or 4 are incorrect, skip to step 8. Otherwise continue.

5. Connect the counter to the 20/30 MHz OUTPUT. The counter should indicate a frequency less than 20 MHz.

6. Set the test switch to the TEST HIGH FREQUENCY position. The counter should indicate a frequency greater than 30 MHz. If both steps 5 and 6 are correct, this board is functioning correctly. Return the test switch to the NORM position and reinstall the board.

7. Does loop appear to lock, but at the wrong frequency? If so, go to Service Sheet 1-A2 to troubleshoot the dividers.

8. If the loop fails to lock but the VCO checks out OK, go to Service Sheet 1-A2 to troubleshoot the phase detector or the inputs from the dividers.

9. Measure with a high impedance probe and spectrum analyzer the signal at A2A3U2 pin 7. The signal should be about −10 dBm at frequencies greater than 240 MHz. If this signal is OK, troubleshoot the ÷8 circuit, otherwise troubleshoot the power splitter and driver.

10. Measure the signal at the collector of Q4 with a high impedance probe and a spectrum analyzer. It should be about −10 dBm at less than 160 MHz. If this signal is correct, troubleshoot Q2 and associated components.

11. Measure these test voltages at R10:

    +15.4V at TEST HIGH FREQ

    +3.3V at TEST LOW FREQ

    If these voltages are correct, continue.

12. Measure Q1 dc bias voltages. They should be as shown on the schematic. If correct, continue; otherwise troubleshoot Q1, Q6 and associated components.

SERVICE SHEET 3-A2 (Cont'd)

13. Set the Test switch to the HIGH FREQ position. Measure the signal at the base of Q4 with a high impedance probe and spectrum analyzer. It should be 0 dBm at greater than 240 MHz. If this signal is correct, troubleshoot Q4. Otherwise troubleshoot Q1 (pay special attention to T1 and CR1—4.)

After any repairs to this board, perform the 20/30 Loop VCO Adjustment.

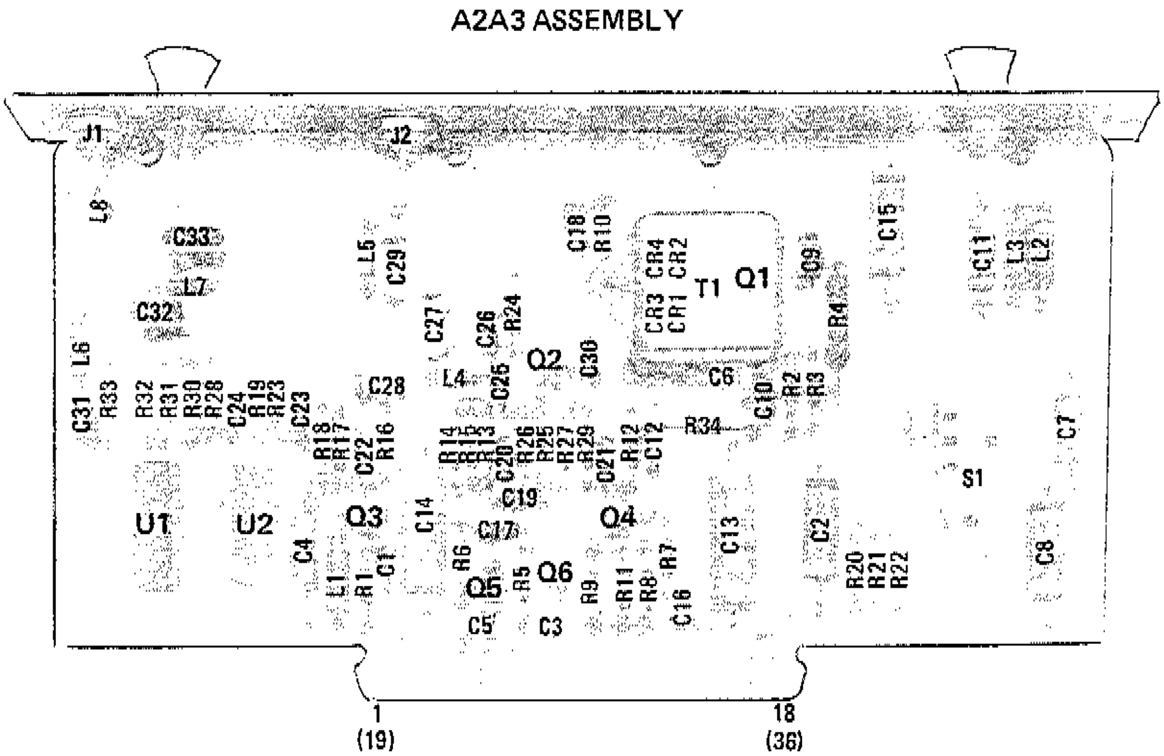
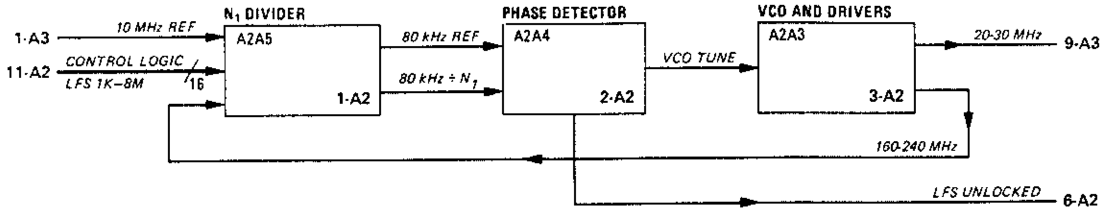


Figure 8-33. A2A3 160–240 MHz Assembly Component Locations



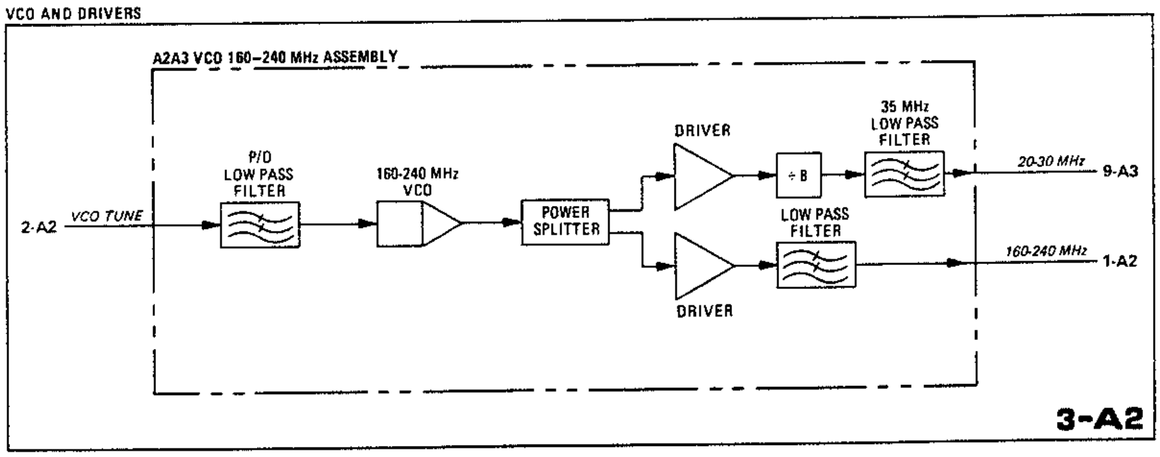


Figure 8-34. VCO 160–240 MHz Block Diagrams

FIG. 8-35
Sht 1 of 3

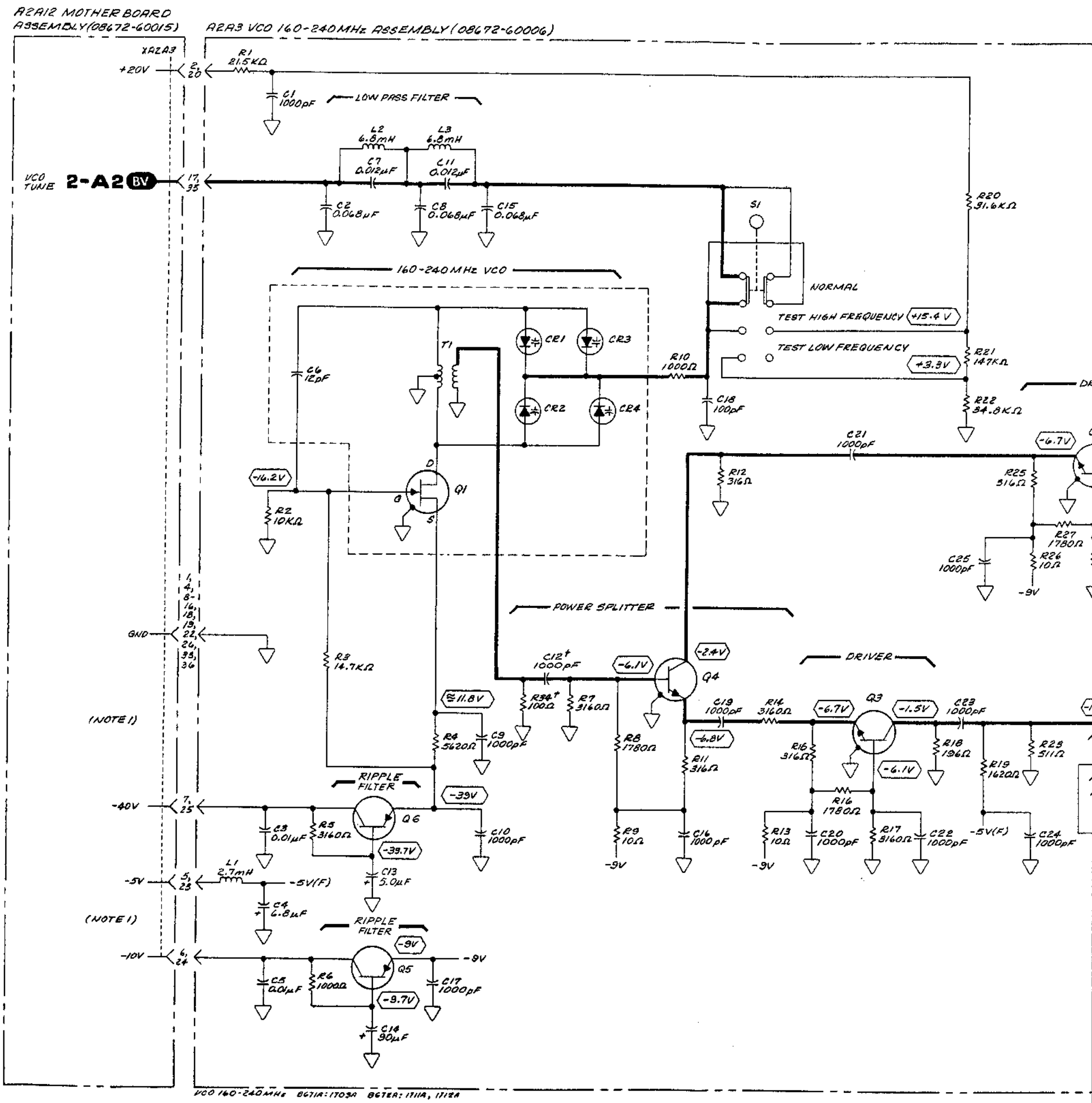
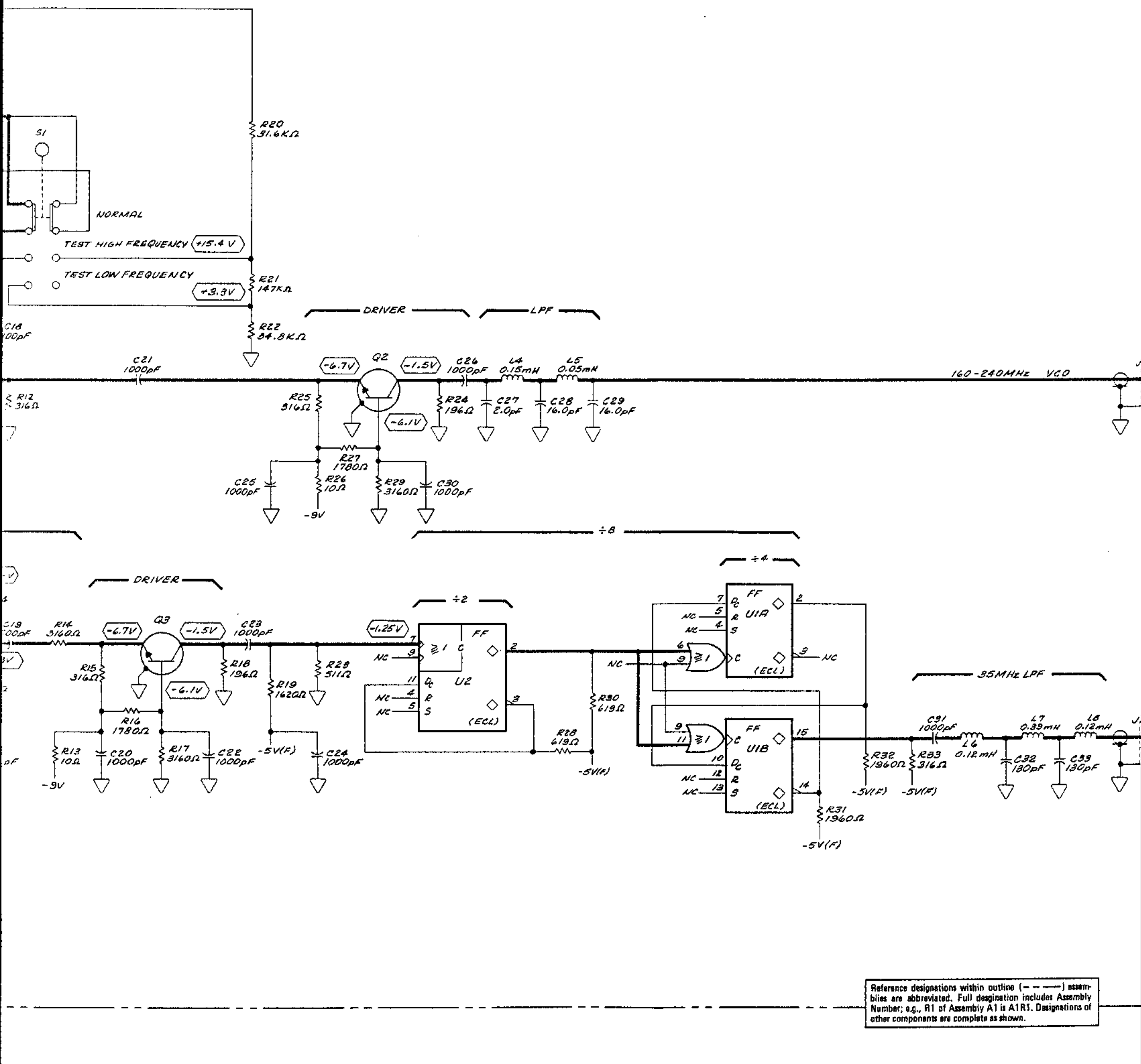


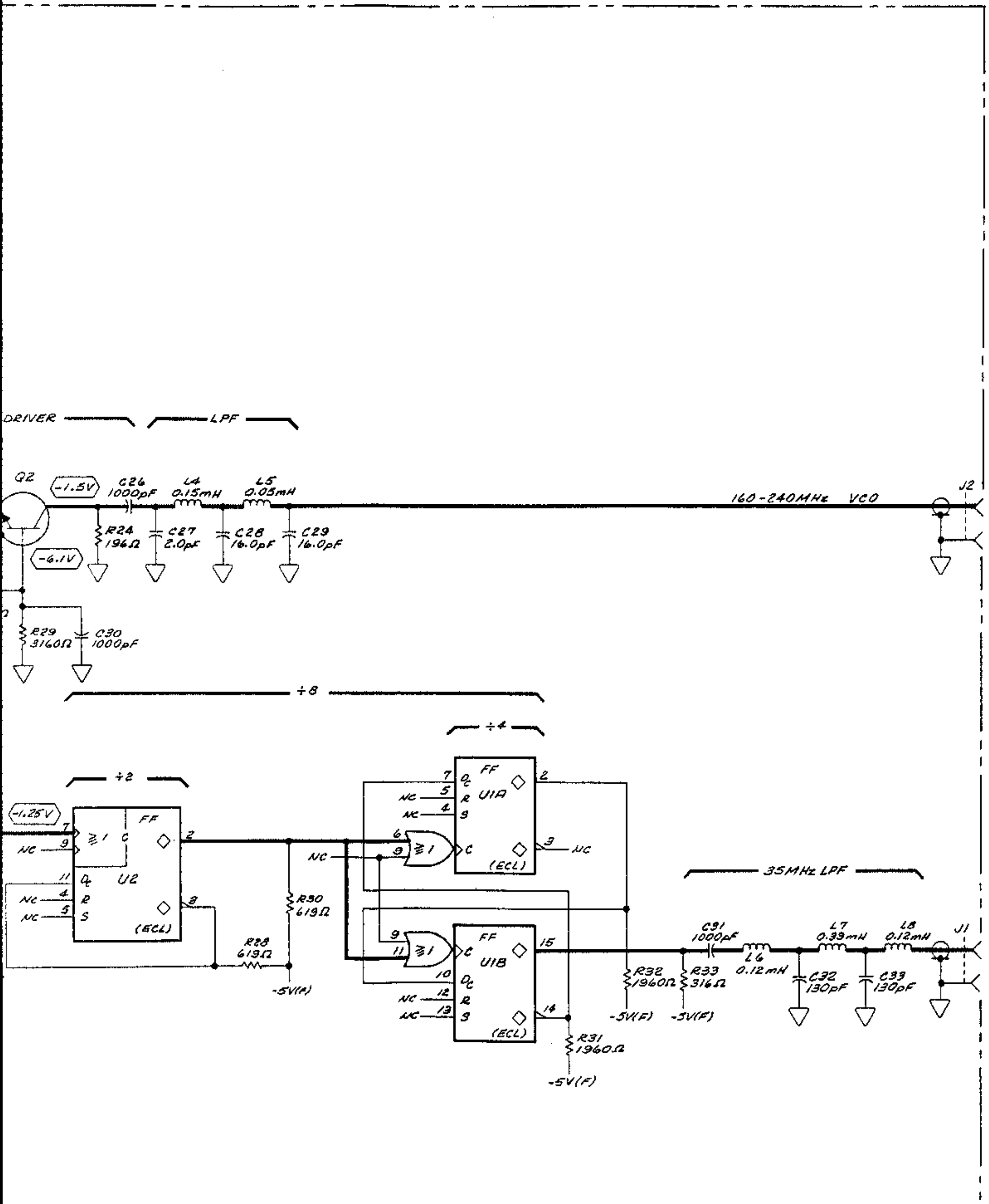
FIG. 8-35
Sht 2 of 3



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.

Figure 8-35. VCO 160-

FIG. 8-35
Sht 3 of 3



A2 W2 — 2 — BN 1-A2
160-240MHz OUTPUT

A3 W14 — 5 — KX 8-A2
20/30MHz OUTPUT 0dBm

NOTES

1. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1-A2.

† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

A2	A2A3
W2 A2A12 XA2A3 A3 W14	C1-33 CR1-4 J1, 2 L1-8 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 Q2-4 Q5 Q6 U1 U2	1855-0392 1854-0345 1853-0020 1853-0421 1820-1225 1820-0734

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 2	-5V(F) -8 ⏚ -1,16

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.

3-A2
A2A3

Figure 8-35. VCO 160–240 MHz Assembly Schematic Diagram

SERVICE SHEET 4-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-35
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-15
• Performance verification	Last 3 foldout pages and page 8-16
• Programming	Page 3-1
• HP-IB connector	Page 2-5

PRINCIPLES OF OPERATION

General

The HP-IB Interface converts ASCII characters on the bus' data lines into RF section program information and frequency digits. Also, it converts status information from other parts of the Synthesizer into a status byte which it sends on the 8 data lines. This section of the Synthesizer consists of two boards: HP-IB Address Assembly (A2A9), and the HP—IB Interface Assembly (A2A7).

The HP-IB Address Assembly (A2A9) receives a character from the data lines under the control of the 3 handshake lines. Then it decodes the 5 control lines to determine if the character is an address, a command, or a data character. If the character is an address, and it matches the Synthesizer's talk or listen address switch setting (see address selection in Section II), the Synthesizer will talk or listen. If the character is a command, the Synthesizer will respond to it if it has the capability (see Table 3-5). If the character is data and the Synthesizer has already been addressed to listen, the Address Assembly tells the Interface Assembly to decode it.

The HP-IB Interface Assembly (A2A7) determines whether character is a program code or an argument. If the character is a program code, it selects the correct route for the next character which will usually be an argument.

HP-IB Address Assembly

The Remote Bus Transceivers do three things. They allow the Synthesizer to send or receive over the same bus line. They invert logic levels; the bus uses low true logic and the Synthesizer uses high true logic. Also, they buffer the Synthesizer from the bus. Received characters (DI 1—7) go to the address selectors, command decoders, RF program selectors, and Interface storage register. If the Attention (ATN) line is true, the address selectors decode the DI 1—7 lines as an address or command. Switches S2 and S3 select the Synthesizer's Talk and Listen address. If the selected address appears at the same time as a STOR pulse from U20B, the TALK, LISTEN or REMOTE flip-flops will set. The schematic illustrates the logic for setting and resetting the three flip-flops. When the Synthesizer is in remote, addressed to listen, and the attention line (ATN) is false, an NRSTOR pulse tells the Interface Assembly to treat the DI 1—7 lines as an internal address (instruction) or as an argument to be stored at the previously determined address. All characters are transferred asynchronously over the bus DIO 1—8 lines in a bit parallel byte serial format. The handshake circuitry controls the transfer. Beginning with receive, the Acceptor Handshake circuit lets the not ready for data line (NRFD) go high when the Synthesizer is ready to receive a character. Then, when the controller pulls the data valid (DAV) line low, nand gate U13B waits about 2.5 μs and triggers one shot U20B. The resulting STOR and NSTOR pulses do several things. The leading edge of STOR clocks the serial poll flip-flop, enables the NRSTOR gate (U9B), and clocks the TALK, LISTEN and REMOTE flip-flops. The trailing edge of NSTOR clocks U5B, which after another 2.5 μs delay allows the not data accepted line (NDAC) to go high. This signals the talker that the character transfer is complete.

For sending characters, the source handshake circuit monitors the not ready for data line (NRFD). When this line goes high, and the other conditions shown on the schematic are met, U20A is triggered. The resulting System Delay State pulse (SDYS and NSDYS) clocks the character onto the bus and after a 2 μs settling delay sets the data valid line (DAV) low (true). When the not data accepted line (NDAC) goes high, U5A resets and the circuit is ready to send another character.

The parallel poll circuitry outputs a status bit on a switch selected data line (DIO 1—8) when the controller sets the end or identify line (EOI) true. Logic polarity of the status bit is switch selected and the bit will be true when any of the conditions monitored by the status encoder are true.

The service request flip-flop (U23B) stores the states of the RSV bit (bit 7) of the status byte and the bus service request line (SRQ).

The state of the status encoder is clocked through U23A when the Synthesizer is addressed to talk. U23B will set the service request line (SRQ) true if the output of the status encoder is true for more then 50 μs. This time delay is set by R23 and C9. The SRQ line is cleared when the output of the status encoder goes false or when the Synthesizer is addressed to talk with the SPMS line (serial poll mode state) true.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1 and 3 was used to isolate an HP-IB Address problem to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter or Logic Probe . . . . HP 3490A
Oscilloscope or Bus System Analyzer . . . . . HP 180C/1801A/1821A

NOTE

This procedure requires the use of a remote programming device such as the 9830 or 9825 controllers or the 59401A Bus System Analyzer.

1. Determine the address to which the synthesizer is set.
2. Program the Synthesizer to 15345.678 MHz with both FM and RF on. The data string to do this is "Q5345678ZQN101". Make sure the remote enable line is set true. If the Synthesizer accepts this data, most of the remote circuits are working

properly. If this data is not accepted, go to step 12 to troubleshoot. Make sure front panel controls are disabled.

3. Program the Synthesizer to an out-of-range frequency "P8Z1" (80 GHz) and check for a service request on the bus (SRQ true). If the Synthesizer is not requesting service, go to step 16.

4. Set the Synthesizer to talk and then check the status byte. It should be a decimal 96. (Binary 01100000).

5. Program an in-range frequency "Q4Z1" and check to see if the service request (SRQ) has cleared. If SRQ has not cleared, troubleshoot the service request flip-flop, U23.

6. Program a device clear command. The synthesizer should go to 3000.000 MHz with RF and FM off. If the response is incorrect skip to step 18.

7. Program an ABORT command if your controller has the capability. After the abort has been set, transmit data "Q5Z0" without addressing the Synthesizer to listen. If the abort was properly executed, the Synthesizer should not accept the data. If the data is accepted, troubleshoot U19B, the listen flip-flop, with particular attention to the REF line. However, be sure the controller did not automatically readdress the Synthesizer before sending the data.

8. Program a LOCAL command. The REMOTE lamp should go out and the front panel controls should be operational.

9. Program a remote enable command and program the Synthesizer to an out-of-range frequency — "P8Z1".

10. Program a parallel poll (if your controller has the capability) to see if the Synthesizer is sending a require service message on its assigned line. The line assignment and logic sense are set by rotary switches on A2A9. With a 9825 controller use the line shown below to avoid setting REN false during the parallel poll. If the results are incorrect, troubleshoot the status encoder circuit and the parallel poll response circuit. Parallel poll line for 9825:

    moct; wti 0,7; wti 7,226; rdi 7→A; rdi 6→B; wti 7,202

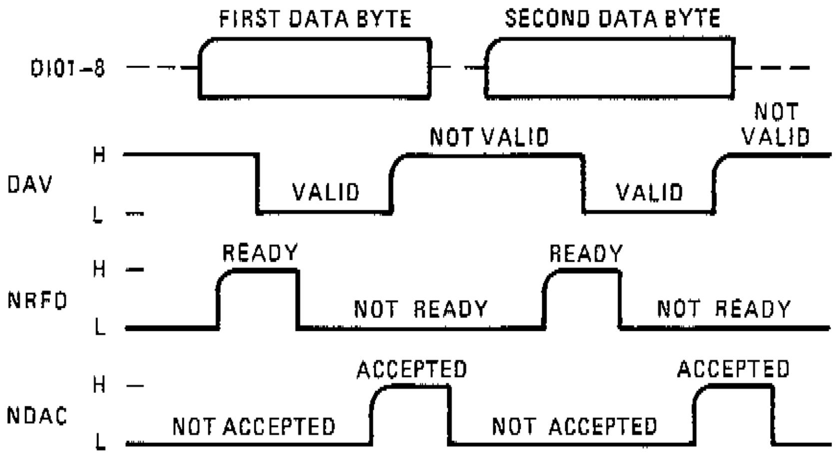
11. If everything has worked properly so far, the A2A9 board is working properly. Return the Synthesizer to local.

12. This step should be done if a problem was noted in step 2 of this procedure. Install A2A9 on an extender board. Program a remote enable command followed by the Synthesizer's listen address. Measure edge connector pin 24, the REMOTE line, with a logic probe or voltmeter. It should be a CMOS high. If the line is not high troubleshoot the remote flip-flop (U17B) and the address select circuit.

13. Attach a voltmeter or logic probe to edge connector pin 25 (ATN line). In the command mode this line should be TTL high and in the data mode it should be TTL low. If this line is not

performing correctly, troubleshoot the remote flip-flop U17B or the circuit (U20B and associated gates). If the line is operating properly, continue with this procedure.

14. Monitor the handshake operation with an oscilloscope or Bus System Analyzer. The handshake should proceed approximately as shown below. The pulse widths probably will not be as shown but the rise-fall relationships should be approximately correct. If the handshake is working correctly, proceed with this procedure. Otherwise troubleshoot the handshake circuits.



HP-IB Handshake

15. Check data lines DI1 to DI7. If the data accurately reflects the data being transmitted, but the Synthesizer does not respond properly, troubleshoot A2A7. Otherwise troubleshoot the Remote Bus Transceivers or the bus itself.

16. This step should be done if a problem was noted in step 3 of this procedure. Observe the front panel frequency display; it should indicate 80005.678 MHz and the OUT OF RANGE lamp should be on. If the frequency is correct, measure the ERRS line at edge connector pin 11. The line should be high. If the line is correct, troubleshoot the status encoder circuit and service request flip-flop. If the line is incorrect, troubleshoot A2A11.

17. If the frequency is incorrect, resend it to be sure there has been no error in the remote command. Be sure the letters transmitted by the controller are upper case. The Synthesizer does not respond to lower case letters. If the frequency is still wrong, check the data on line DI1 to DI7. If correct, troubleshoot A2A7; otherwise troubleshoot the Remote bus Transceivers.

18. Install A2A9 on extender board and measure the DC (device clear) line, edge connector pin 23, while sending a device clear command. The line should go high during the command. If the line responds correctly, troubleshoot A2A7 (Service Sheet 5-A2) otherwise troubleshoot U1B, U1C, U15A and the bus command decoder circuit.

MNEMONICS

Mnemonic	Definition	Explanation
HP-IB Lines		
Data:		
DIO 1–8	Data Input Output	Addresses, commands, data, or Synthesizer status.
Control:		
ATN	Attention	Identifies bus mode (command or data).
EOI	End Or Identify	Used for initiating a poll.
IFC	Interface Clear	Causes Synthesizer to stop talking or listening.
REN	Remote Enable	Enables Synthesizer to be in remote.
SRQ	Service Request	Synthesizer sets true when it needs the controllers attention.
Handshake:		
NRFD	Not Ready For Data	Listener is ready to accept a character when false.
NDAC	Not Data Accepted	Listener accepted the data (when high).
DAV	Data Valid	Talker has valid data on the bus.
Commands		
GTL DC SPE SPD	Go to Local Device Clear Serial Poll Enable Serial Poll Disable	See remote programming information in Section III.
MTA	My Talk Address	Synthesizer's talk address
MLA	My Listen Address	Synthesizer's listen address
NSPMS	Not Serial Poll Mode State	Low means an SPE command was received.
NSPAS	Not Serial Poll Address State	Low means the above (SPE) is true and the Synthesizer is addressed to listen.
SDYS	System Delay State	Puts output data on bus when Synthesizer is addressed to talk.
STOR	Store	Clocks talk, LISTEN, and REMOTE flip-flops.
NRSTOR	Not Remote Store	Makes clock for instruction decoder.

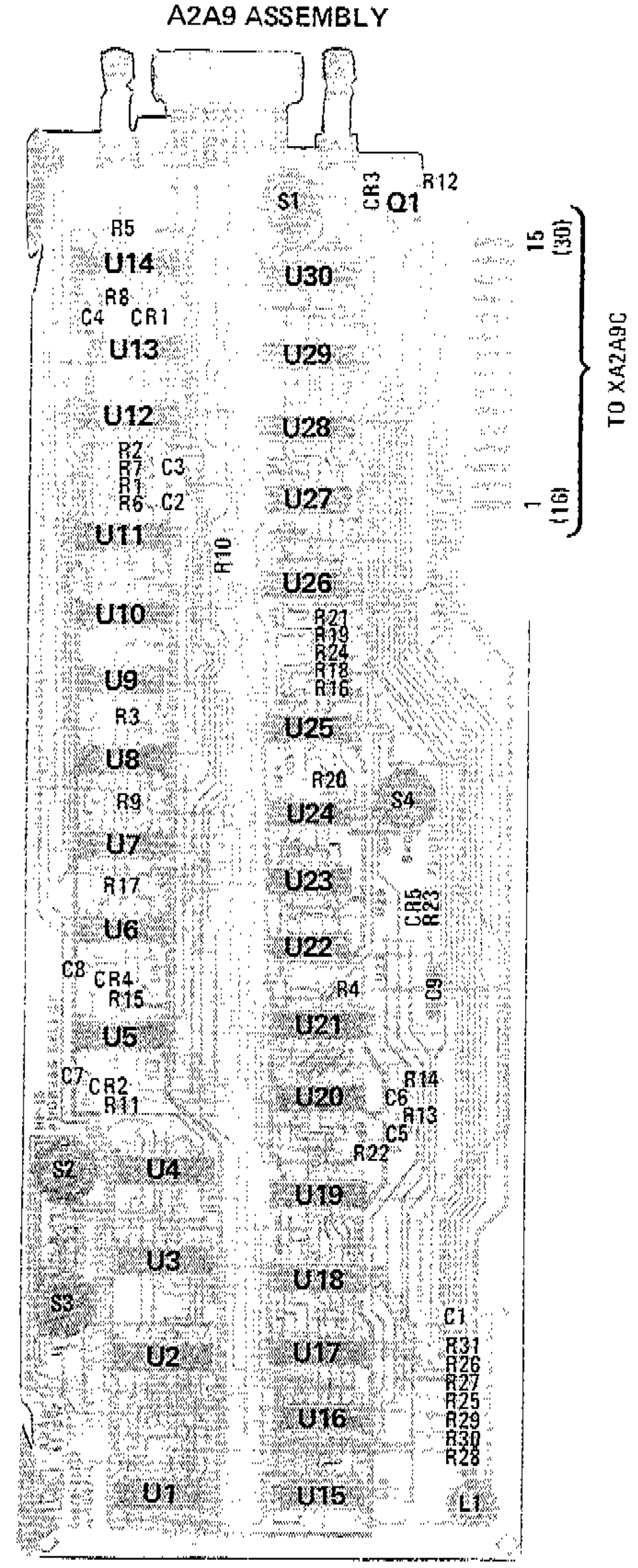


Figure 8-36. A2A9 HP-IB Address Assembly Component Locations

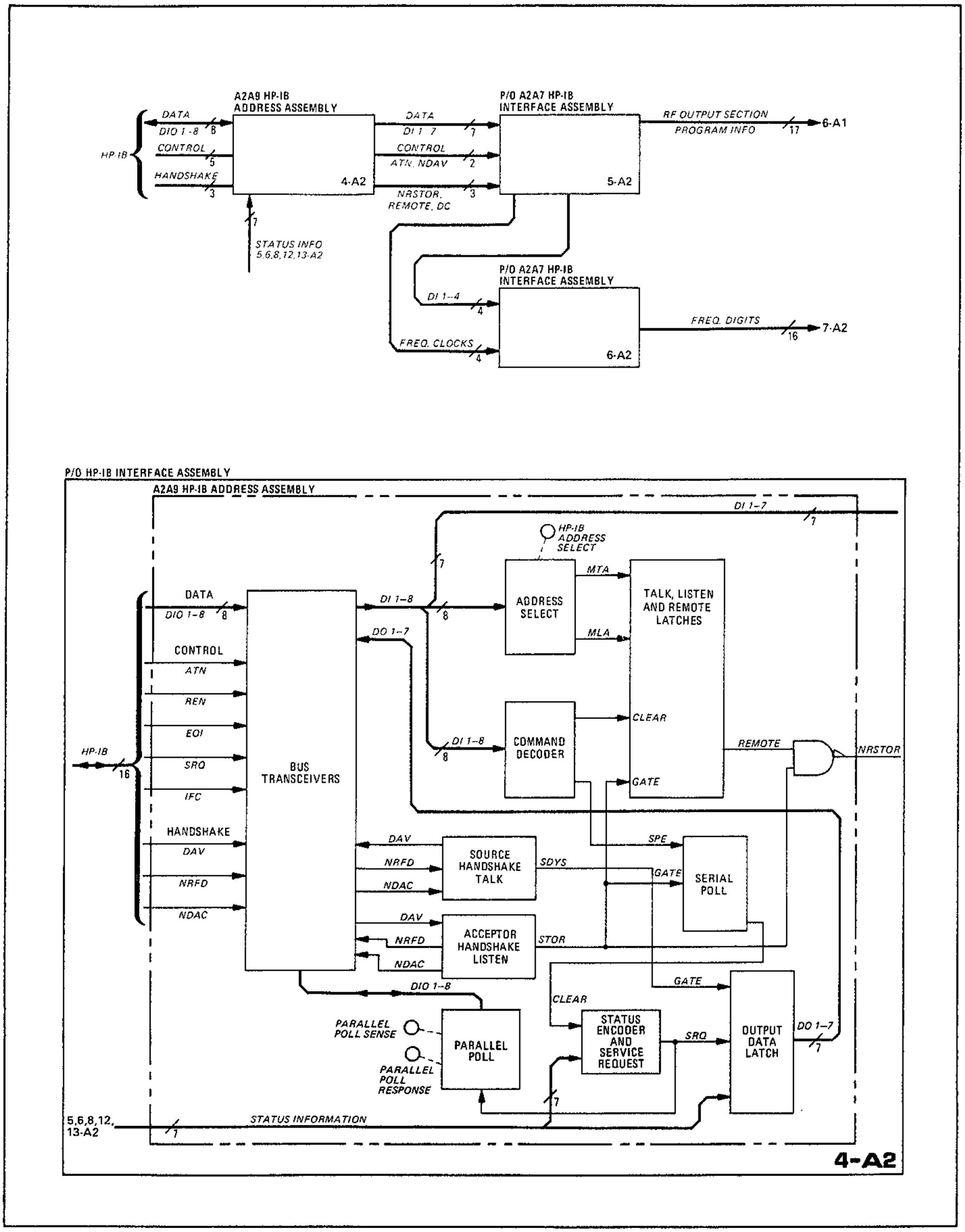


Figure 8-37. HP-IB Address Block Diagrams

FIG. 8-38
Sht 1 of 4

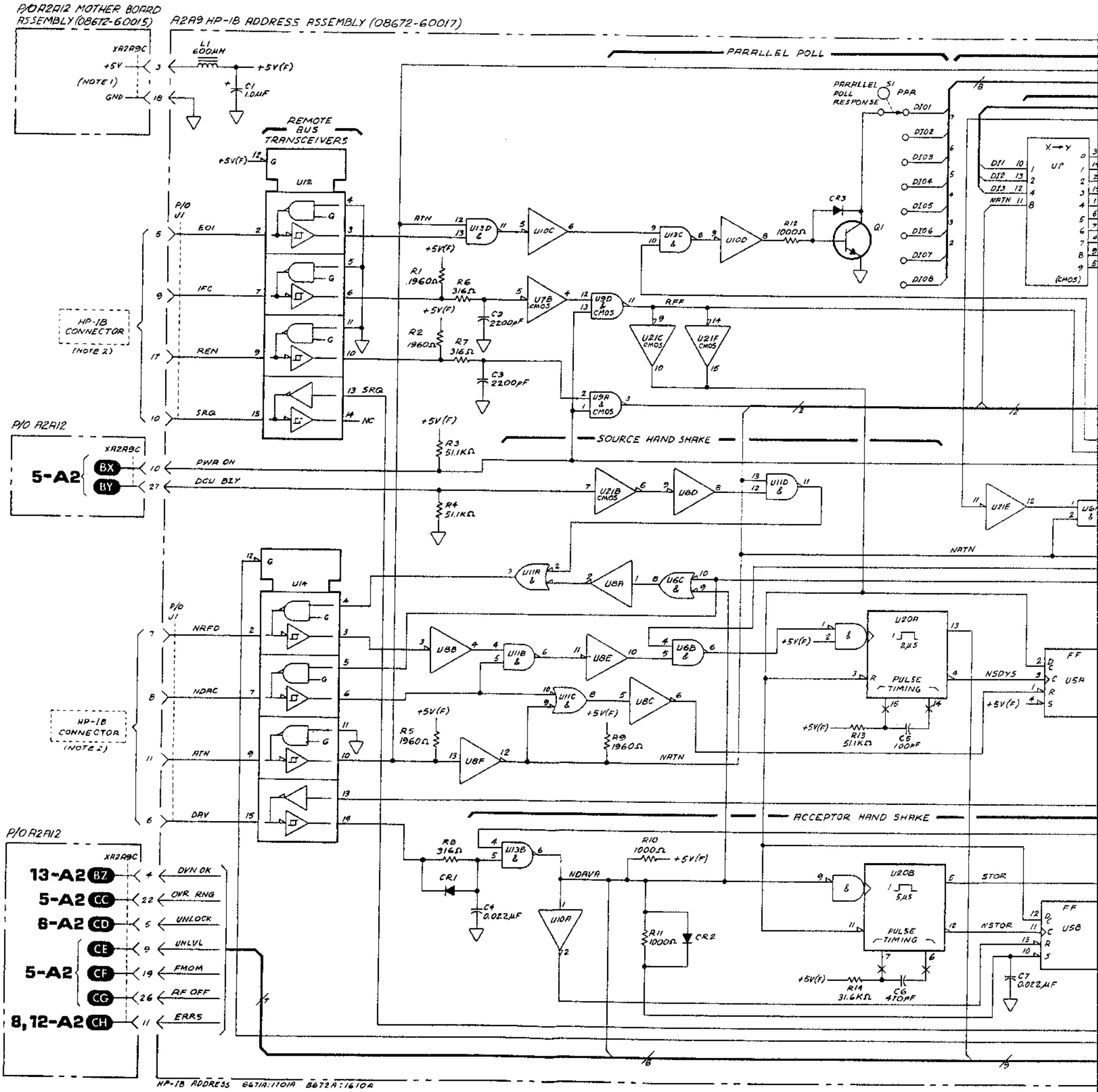


FIG. 8-38
Sht 2 of 4

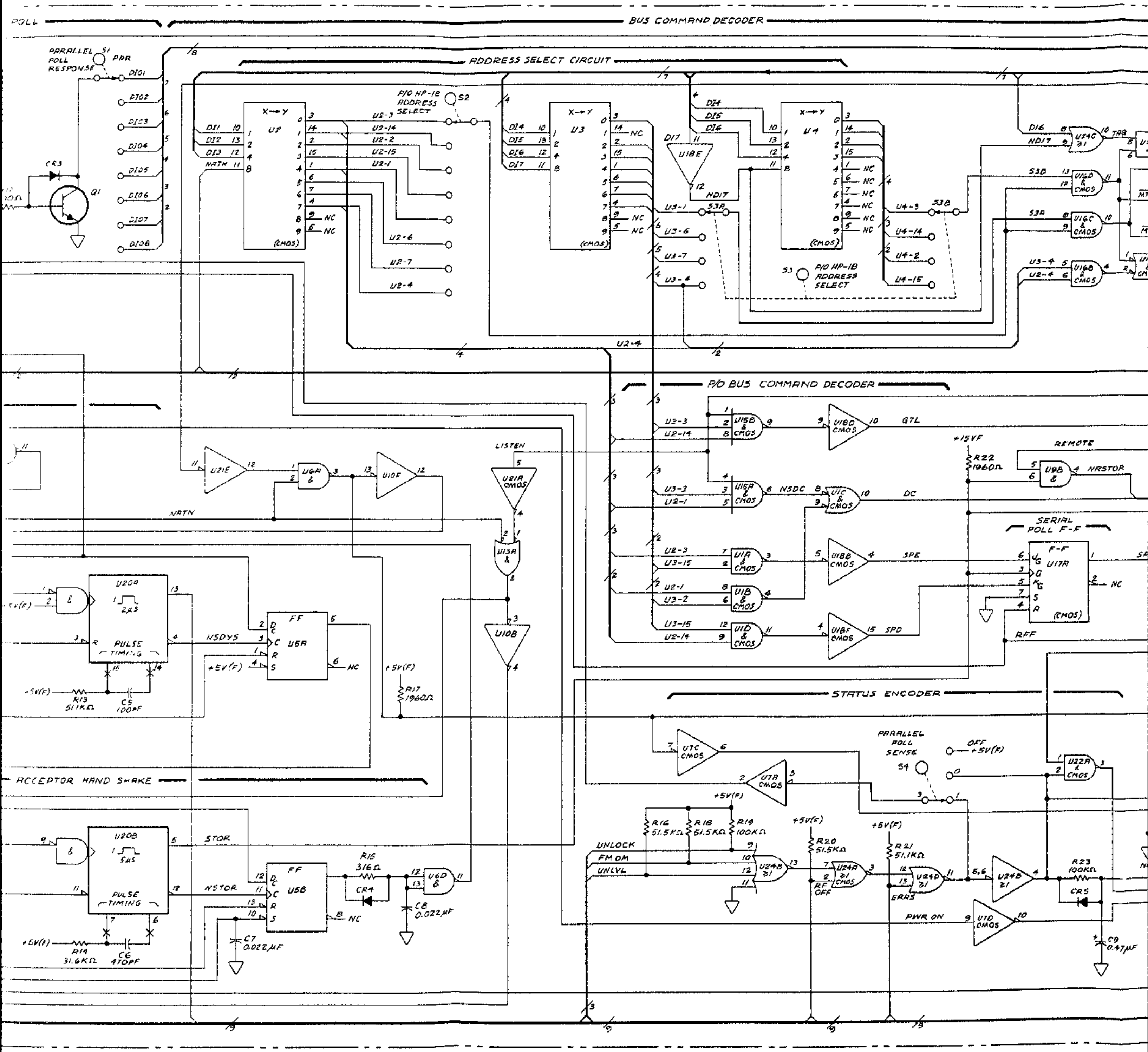


FIG. 8-38
Sht-3 of 4

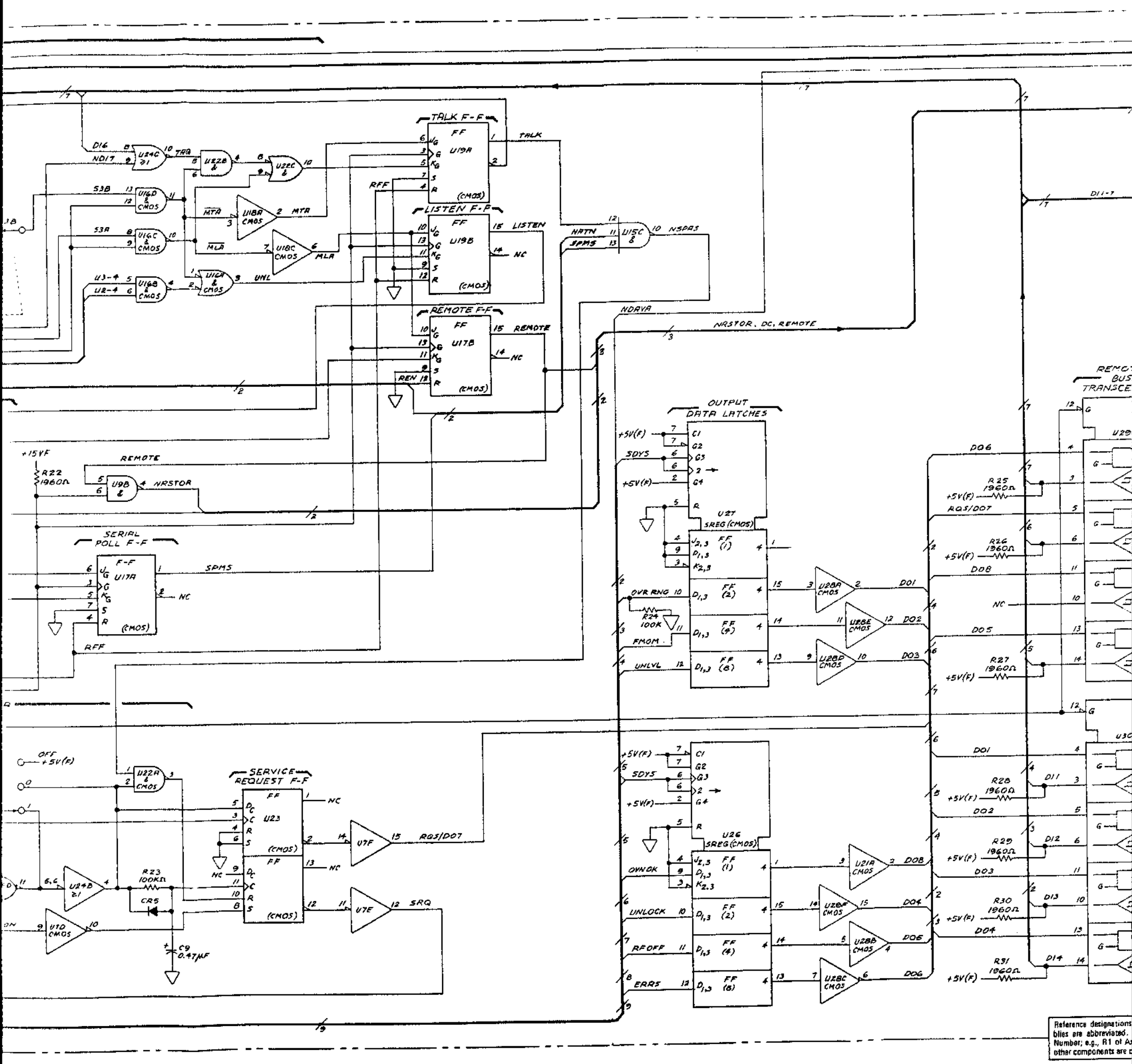
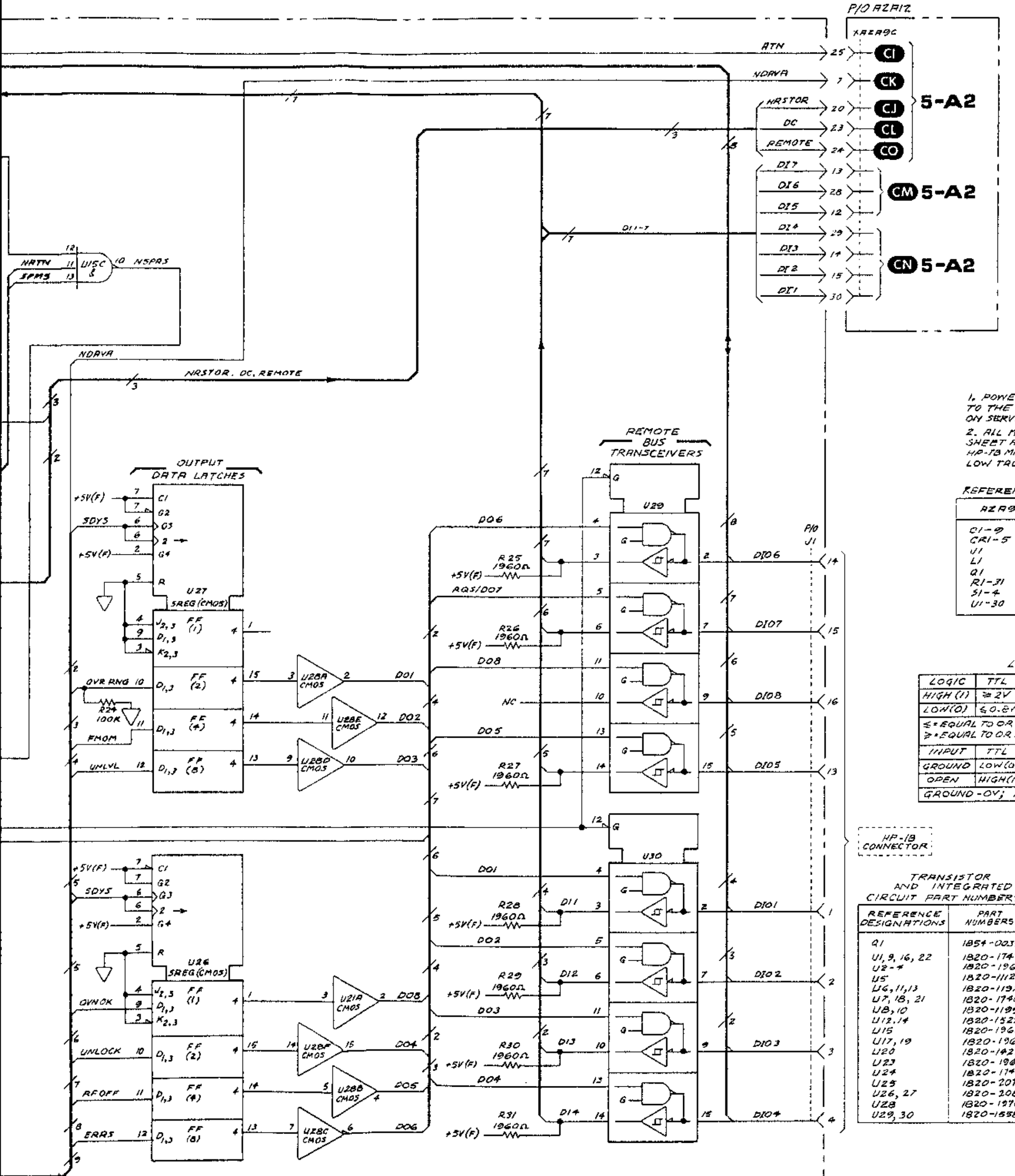


FIG. 8-38
Sht 4 of 4



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 1-A2
2. ALL MNEMONICS ON THIS SERVICE SHEET ARE HIGH TRUE EXCEPT FOR HP-IB MNEMONICS WHICH ARE LOW TRUE.

REFERENCE DESIGNATIONS

A2A9	A2A12
C1-9 CR1-5 J1 L1 Q1 R1-31 S1-4 U1-30	XA2A9C

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	1854-0039
U1, 9, 16, 22	1820-1747
U2-4	1820-1962
U5	1820-1112
U6, 11, 13	1820-1197
U7, 18, 21	1820-1746
U8, 10	1820-1199
U12, 14	1820-1522
U15	1820-1961
U17, 19	1820-1964
U20	1820-1423
U23	1820-1963
U24	1820-1745
U25	1820-2019
U26, 27	1820-2080
U28	1820-1976
U29, 30	1820-1558

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 5, 6, 8-11 13, 15, 16, 22-25	+5V(F) - 14 ▽ - 7
U2-4, 17, 19, 20, 26, 27	+5(F) - 16 ▽ - 8
U7, 18, 21, 28	+5(F) - 1 ▽ - 8
U12, 14, 29, 30	+5(F) - 16 ▽ - 1,8

4-A2
A2A9

Figure 8-38. HP-IB Address Assembly Schematic Diagram

SERVICE SHEET 5-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-35
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-12
• Performance verification	Last 3 foldout pages and page 8-16
• Programming	Page 3-1

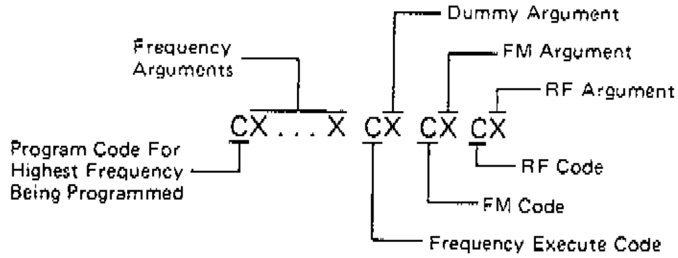
PRINCIPLES OF OPERATION

General

The HP-IB Interface converts ASCII characters on the bus' 8 data lines into RF section program information and frequency digits. Also, it converts status information from other parts of the Synthesizer into a status byte which it sends on the 8 data lines. This section of the Synthesizer consists of two boards: HP-IB Address Assembly (A2A9), and the HP-IB Interface Assembly (A2A7).

P/O HP-IB Interface Assembly

This board decodes program codes and routes the argument to the appropriate assembly. Any character on the bus will appear on the seven data lines (DI1—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 Synthesizer. 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 string format is as follows (see Section III for complete programming information):



WHERE: C REPRESENTS A PROGRAM CODE
X REPRESENTS AN ARGUMENT

The transfer order is left to right. When the first character appears on the data lines, the program code/argument decoder will look at bits DI5 to DI7 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 as shown above. 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 occured in the address counter.

Switching delays are timed by U15 and U16 to allow the Synthesizer to finish processing 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 1, 3, and 4-A2 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 180C/1801A/1821A
or
Logic Probe .... HP 545A

1. Load and run the operator's check program. If the program runs properly, A2A7 is OK. If a specific portion did not function properly, retest that section for proper operation in local.

2. If local operation is correct but remote operation is incorrect, continue with this procedure; otherwise go to the service sheet involved with the malfunctioning circuit.
   - If the problem involves frequency, start with step 3.
   - If the problem involves modulation or RF output, start with step 6.

3. Attach a logic probe or oscilloscope to A2A7TP1. Program the Synthesizer's center frequency "Q5345678ZØ". When the frequency execute command "ZØ" is received by the Synthesizer, 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.

4. Observe pulses at pins 14 (INTF CLK1) and 15 (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 sent. 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 "Q2345Z0" 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.

Service Sht 5-A2
Sht 1 of 2

SERVICE SHEET 5-A2 (Cont'd)

5. Program frequency "Q5345678Z0". Check the outputs of U3 REM 1000 CLK to REM 1CLK. 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 6-A2 to troubleshoot the Interface Storage Register. If the pulses are incorrect, troubleshoot U3, U4 and associated gates.

6. The following troubleshooting step should be performed if the remote problem involves FM or RF output. Program "N00". outputs of U2, U1, and U9 should all be low; AM and RF should be 10 MHz. If the outputs of U2, U1, and U9 are correct but the front panel indications are incorrect, go to Service Sheet 6-A1 to continue troubleshooting.

7. Measure the pulses at U3 pin 2 (REM FM CNTL) and pin 15 (REM ALC CNTL). A single pulse should occur at the appropriate pin when remote data for the function is received. If the pulse occurs properly but the output data is incorrect, troubleshoot the appropriate RF Program Selector IC, U2, U1, or U9. If the pulse does not occur troubleshoot the message decoder, address counter (U4) and the instruction decoder (U3).

SERVICE SHEET 5-A2 (Cont'd)

MNEMONICS

Mnemonics	Definition	
DI 1–7	Data In	Data lines fro
ATN	Attention	Low means D argument. Hig and instructio character.
NRSTOR	Not Remote Stor	Enables Progr
DC	Device Clear	Line used to e controller. Se
INTF CLK	Interface CLock	Tells Data Re next four digi
INTF REG RST	Interface Register Reset	Resets the re
NDAV	Not Data Valid	Low means th
DCU BZY	Digital Control Unit Busy	High while th a received cha

ASCII CHARACTER CODING

			DI-7 DI-6 DI-5	ASCII Program Codes		Program Code Meaning	Instruction Decoder Outputs	
				1 0 0	1 0 1		Instruction Decoder 2 Output	Instruction Decoder 1 Output
DI-4	DI-3	DI-2	DI-1					
0	0	0	0	@	P	Not Used		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	[	Not Used		REM ATTN CNTL
1	1	0	0	L	\	Not Used		
1	1	0	1	M	]	Not Used		
1	1	1	0	N	⌒	FM	REM FM CNTL	
1	1	1	1	O	—	RF		

Service Sht 5-A2
Sht 2 of 2

ont'd)

Q5345678Z0". Check the outputs of U3
EM 1CLK. The rem 1000 CLK line should
) GHz digit and once for the 1 MHz digit.
should perform similarly for their digits.
rrect, go to Service Sheet 6-A2 to trouble-
torage Register. If the pulses are incorrect,
and associated gates.

eshooting step should be performed if the
lves FM or RF output. Program "N00".
and U9 should all be low; AM and RF
the outputs of U2, U1, and U9 are correct
dications are incorrect, go to Service Sheet
ibleshooting.

t U3 pin 2 (REM FM CNTL) and pin 15
A single pulse should occur at the appro-
te data for the function is received. If the
but the output data is incorrect, trouble-
RF Program Selector IC, U2, U1, or U9.
occur troubleshoot the message decoder,
and the instruction decoder (U3).

SERVICE SHEET 5-A2 (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 Stor	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 which half to load the next four digits into.
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-3	DI-2	DI-1					
0	0	0	@	P	Not Used		INTF CLK1
0	0	1	A	Q	1 GHz	REM 100 CLK	INTF CLK1
0	1	0	B	R	100 MHz	REM 10 CLK	INTF CLK1
0	1	1	C	S	10 MHz	REM 1 CLK	INTF REG RST
1	0	0	D	T	1 MHz	REM 1000 CLK	INTF CLK2
1	0	1	E	U	100 kHz	REM 100 CLK	INTF CLK2
1	1	0	F	V	10 kHz	REM 10 CLK	INTF CLK2
1	1	1	G	W	1 kHz	REM 1 CLK	INTF CLK2
0	0	0	H	X	Not Used		
0	0	1	I	Y	Not Used		
0	1	0	J	Z	Freq. execute		INTF CLK GO
0	1	1	K	[	Not Used		REM ATTN CNTL
1	0	0	L	\	Not Used		
1	0	1	M	]	Not Used		
1	1	0	N	⌒	FM	REM FM CNTL	
1	1	1	O	—	RF		

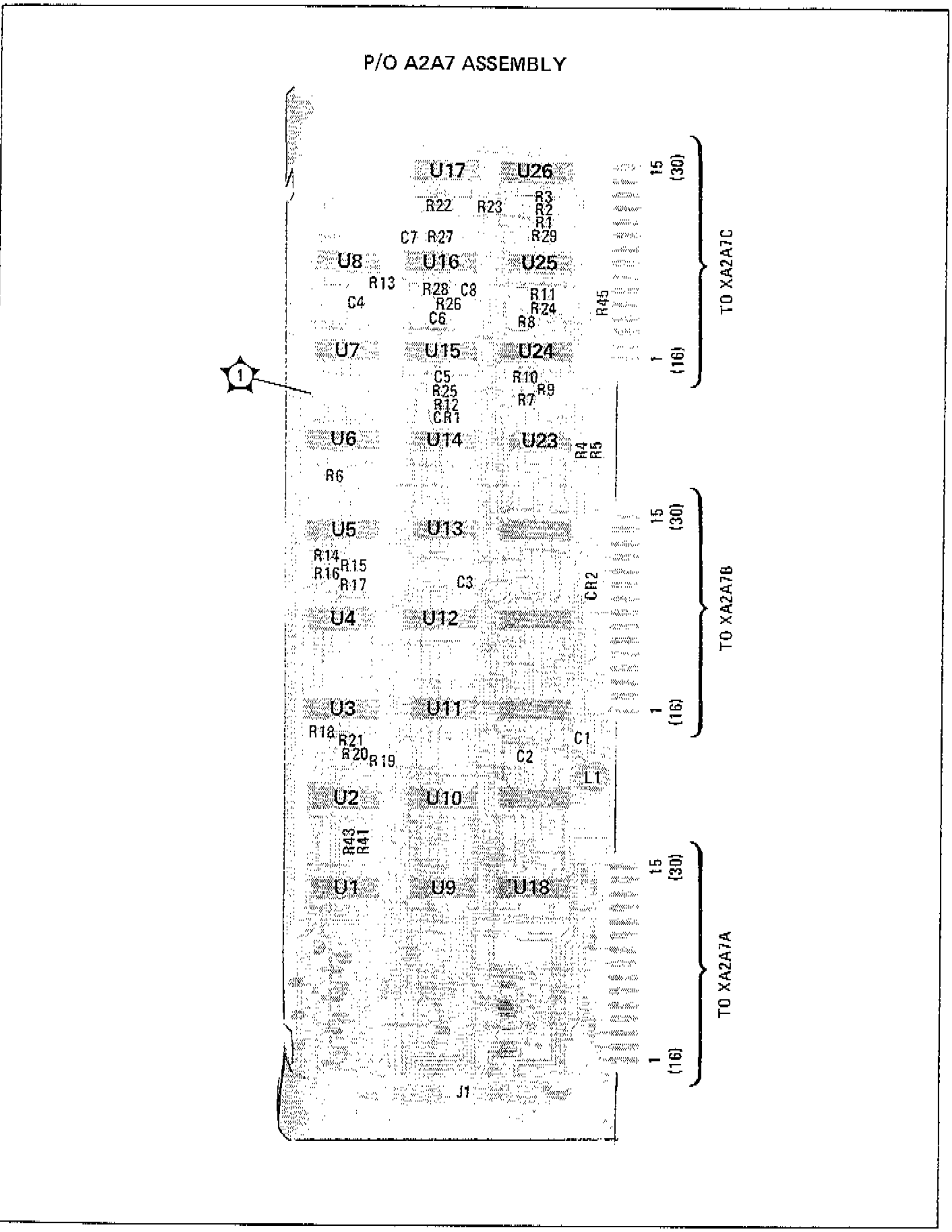


Figure 8-39. P/O A2A7 Interface Assembly Component and Test Point Locations

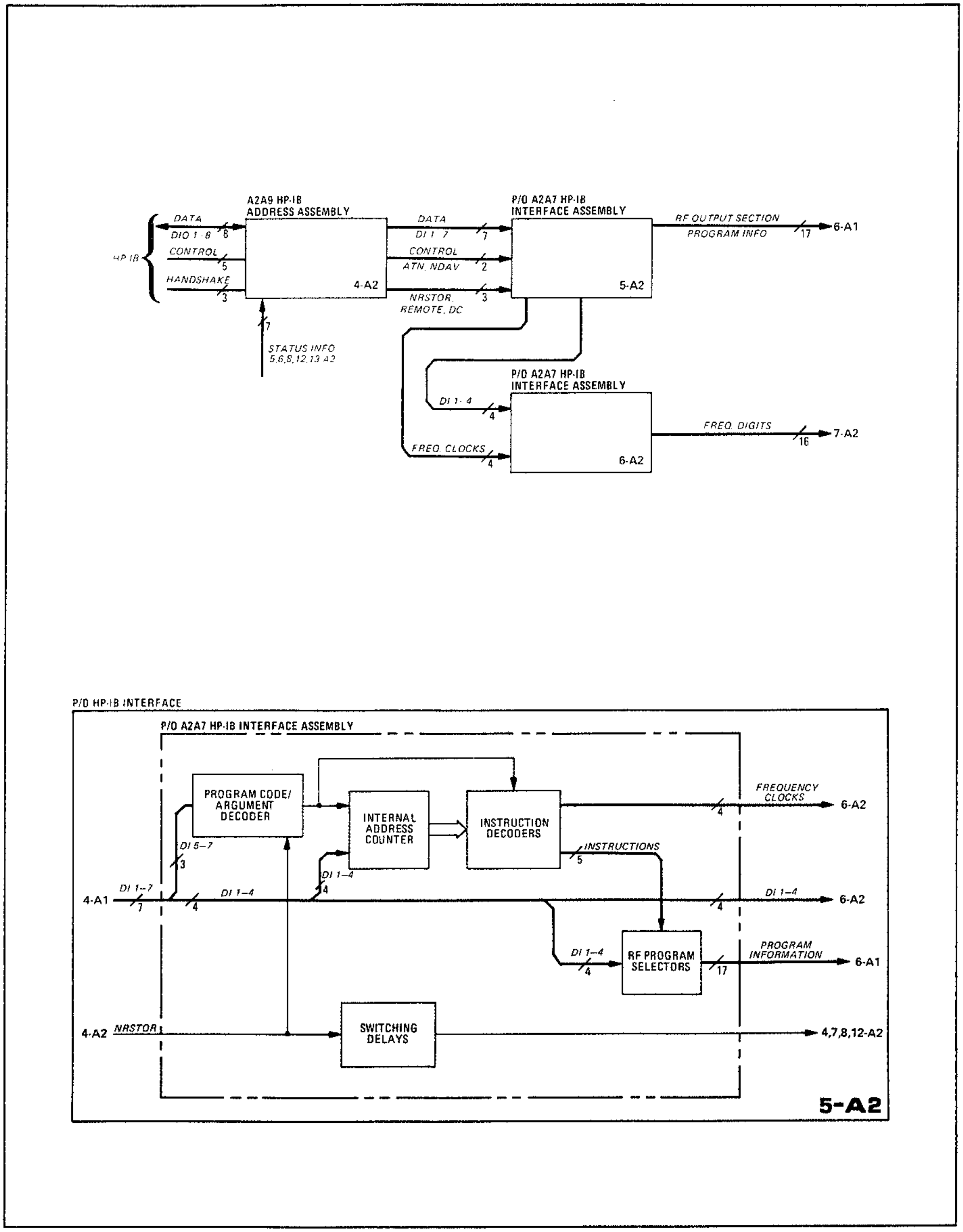


Figure 8-40. P/O Interface Block Diagrams

FIG. 8-41
Sht 1 of 4

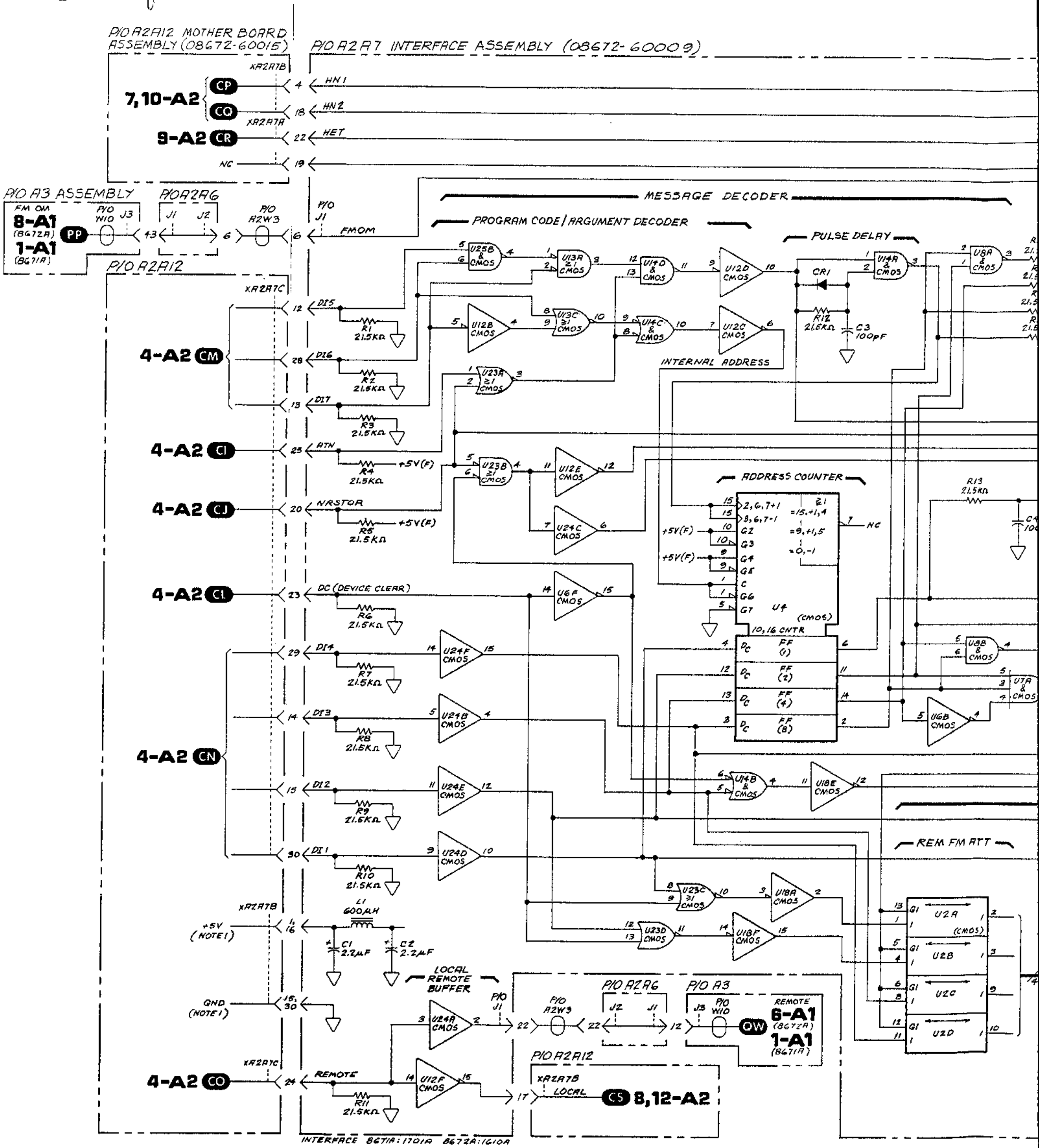


FIG. 8-41
Sht 2 of 4

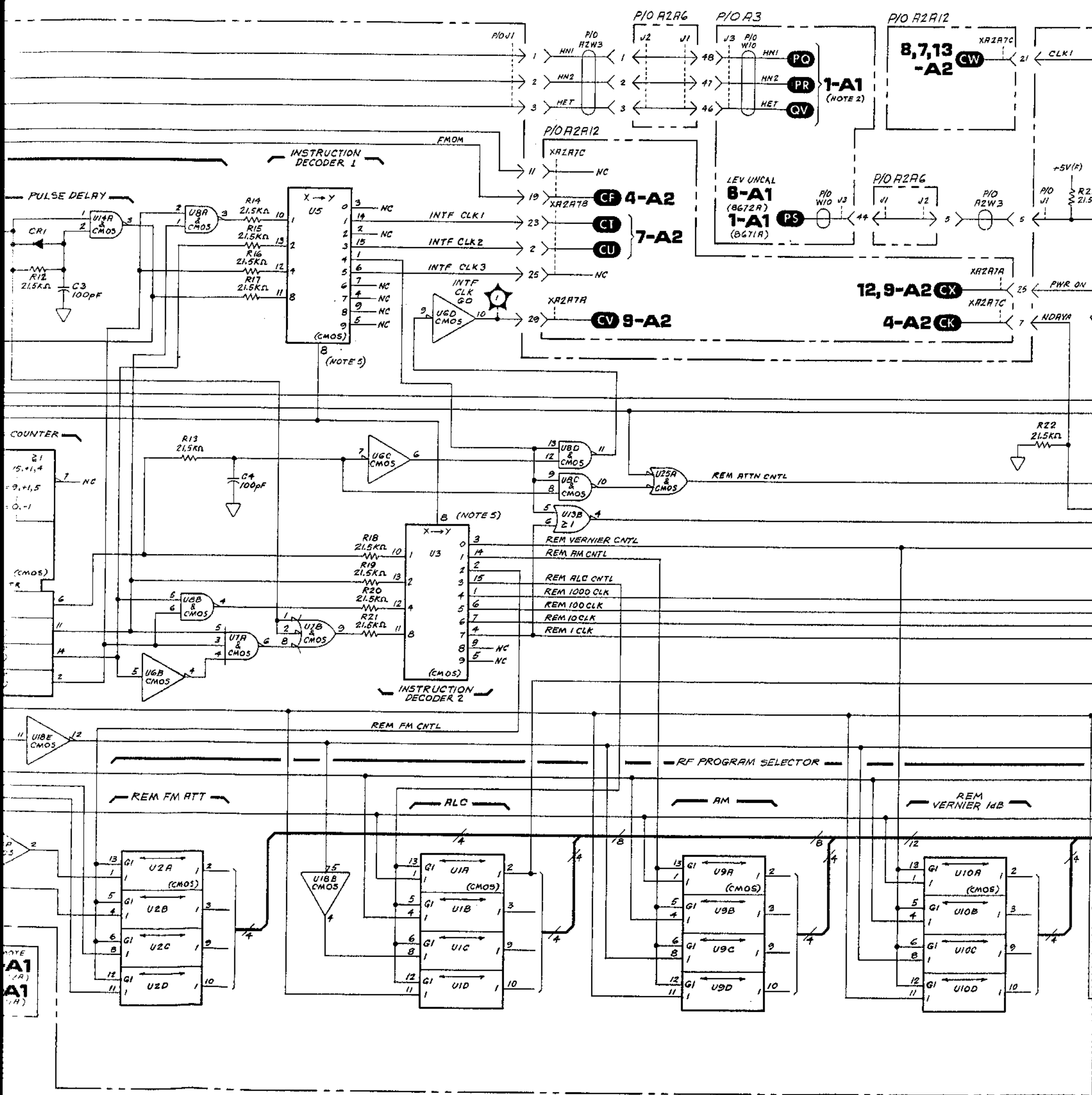


FIG. 8-41
Sht 3 of 4

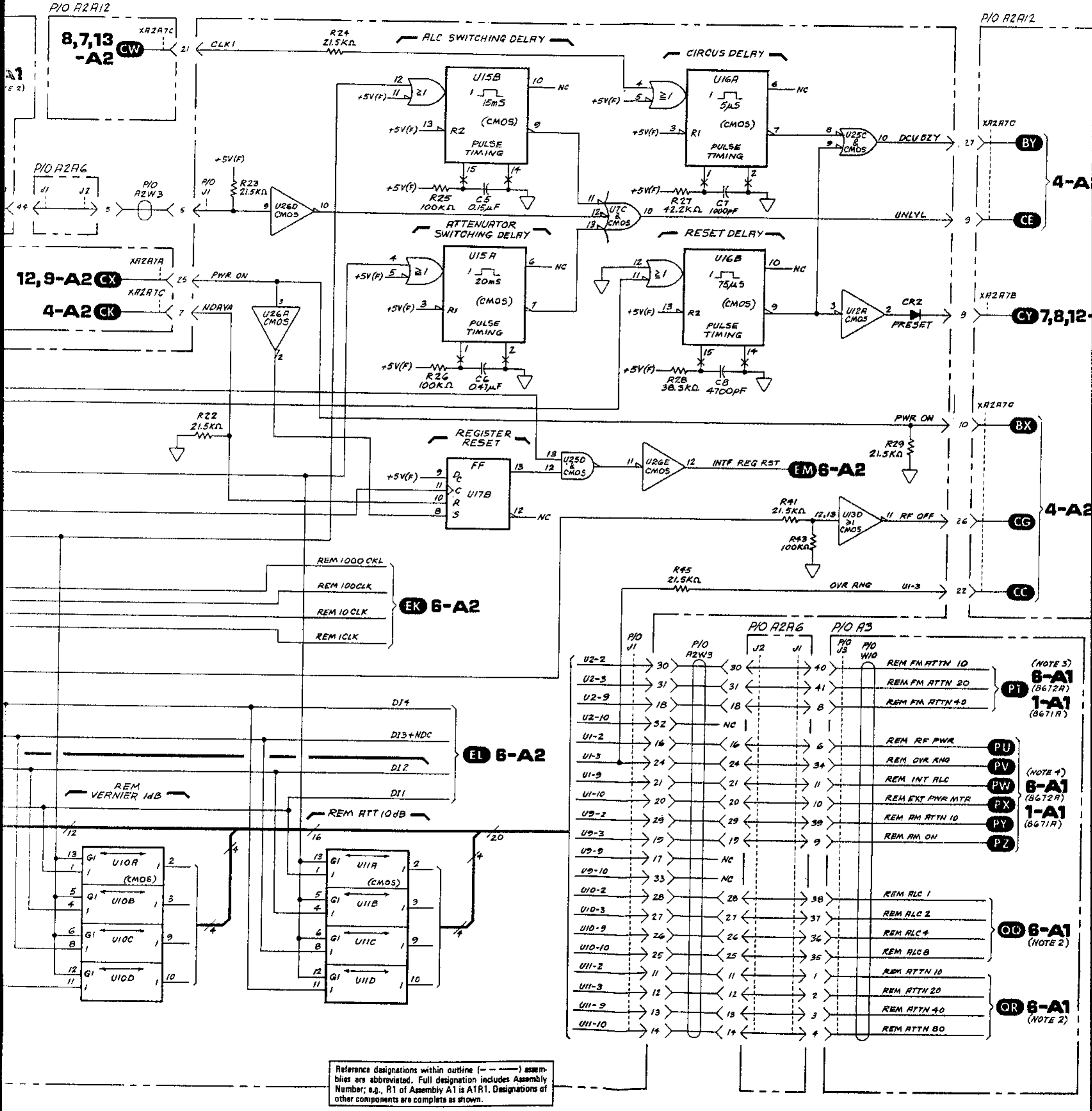
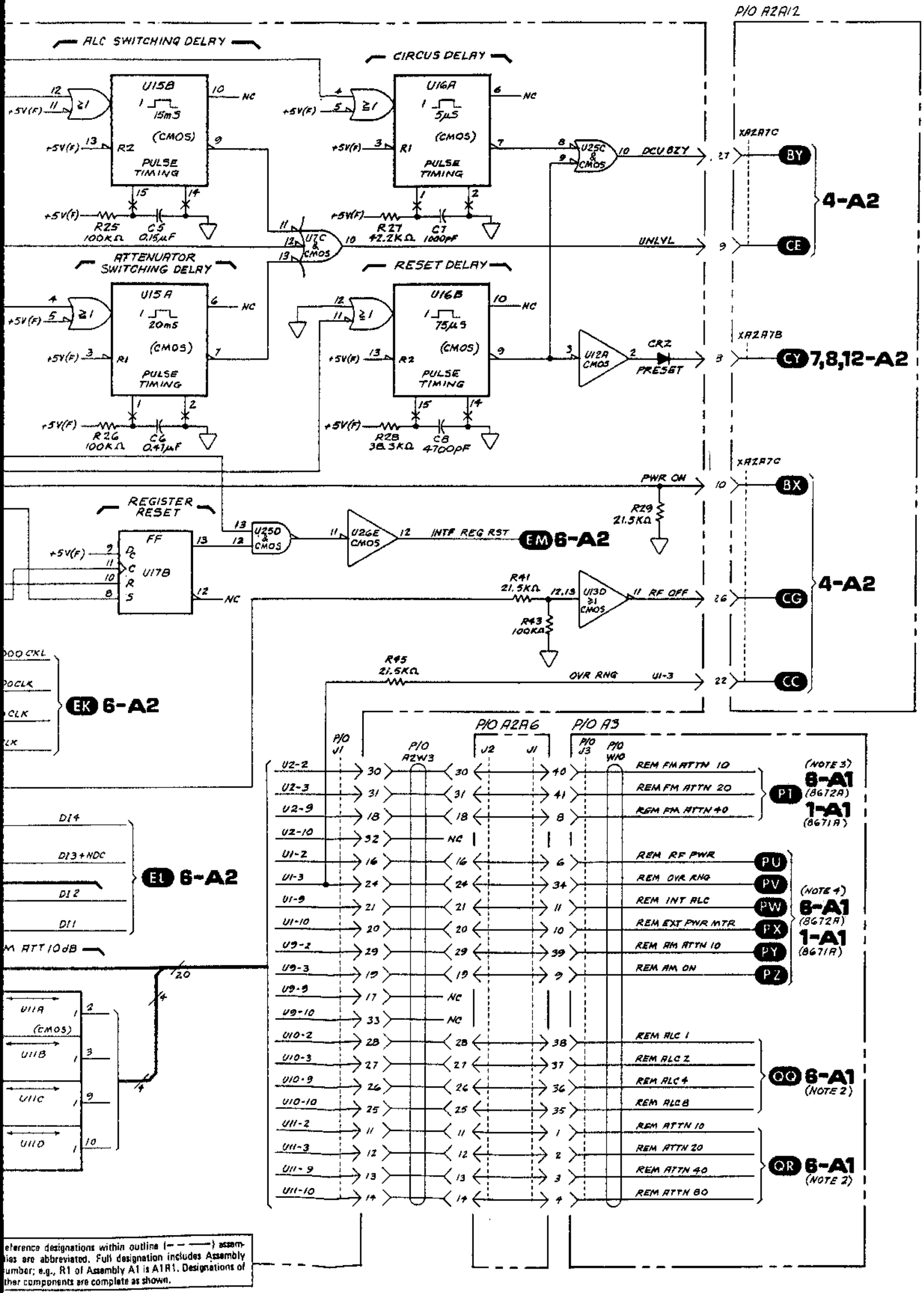


Figure 8-41. P/O HP-IB I

FIG. 8-41
Sht 4 of 4



NOTES

1. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOW IN SERVICE SHEET 1-A2
2. NO CONNECTION IN 8671A.
3. REM FM ATTN 40 NOT CONNECTED IN 8671A.
4. ONLY REM RF PWR CONNECTED IN 8671A.
5. PIN 8 IS USED AS CHIP ENABLE.

REFERENCE DESIGNATIONS

A2	A2A6
W3	J1, 2
A2A7	A2A12
C1-8 CR1, 2 J1 L1 R1-29, 41, 43, 45 U1-18, 23-26	XA2A7A, B, C A3 J3 W10

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
U1, 2, 9-11	1826-0502
U3, 5	1820-1962
U4	1820-2083
U6, 12, 18, 26	1820-1746
U7	1820-1961
U8, 14, 25	1820-1747
U13, 23	1820-1745
U15, 16	1820-1356
U17	1820-1963
U24	1820-1976

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 2, 7-11, 13, 14, 17, 23, 25	+5V(F) - 14 ▽ - 7
U3-5, 15, 16	+5V(F) - 16 ▽ - 8
U6, 12, 18, 24, 26	+5V(F) - 1 ▽ - 8

Figure 8-41. P/O HP-IB Interface Assembly Schematic Diagram

SERVICE SHEET 6-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-12
- Performance verification — Last 3 foldout pages
- Programming — Page 3-1

PRINCIPLES OF OPERATION

General

The HP-IB Interface converts ASCII characters on the 8 bus data lines into RF output section program information and frequency digits. Also, it converts status information from other parts of the Synthesizer into a status byte, which it sends on the 8 data lines. This part of the HP-IB Interface Assembly stores programmed frequency information, and consolidates loop unlock information.

P/O HP-IB Interface Assembly

Frequency digits 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 Synthesizer's phase lock 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 1, 3 and 4-A2 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 3455A
Logic Probe .... HP 545A

1. Set the Synthesizer to 3 GHz with RF switch ON and rear panel reference switch set to INT with jumper cable in place. Observe the lock indicator LED's on A2A7. All four indicators should

*Normally zero.

be on and the front panel NOT PHASE-LOCKED indicator should be off. If any of the LED indicators are not on, measure the unlocked signal from the appropriate phase lock 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.

   a. Set rear panel REF switch to EXT. The REF Loop indicator should go out. Return the switch to INT and the indicator should relight.

   b. Set front panel RF switch OFF. The YTO Loop indicator should go out. Return the switch to ON.

   c. Unplug the blue coax from A3A1A1. The LFS Loop indicator should go out. (This also disables the A2 controller). Reconnect the cable. The YTO indicator may also extinguish at this step.

   d. Unplug the white/red coax at A3A1A5. The M/N Loop indicator should go out. The YTO indicator may also extinguish at this step. Reinstall the cable. All the lock indicators should be on.

3. Quickly tune the frequency in 100 MHz steps. Measure the voltage at A2A7 edge connector A pin 9. 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: "Q0000". 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 "T1" through "T9" to assure that the outputs of U21 remain correct for all inputs.

6. Program "U1" through "U9" to assure that the outputs of U20 remain correct for all inputs.

7. Program "V1" through "V9" to assure that the outputs of U22 remain correct for all inputs.

8. Program "W1" through "W9" to assure that the outputs of U19 remain correct for all inputs.

9. Program "Q534567SZ1". The front panel frequency display should indicate 52345.678 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.

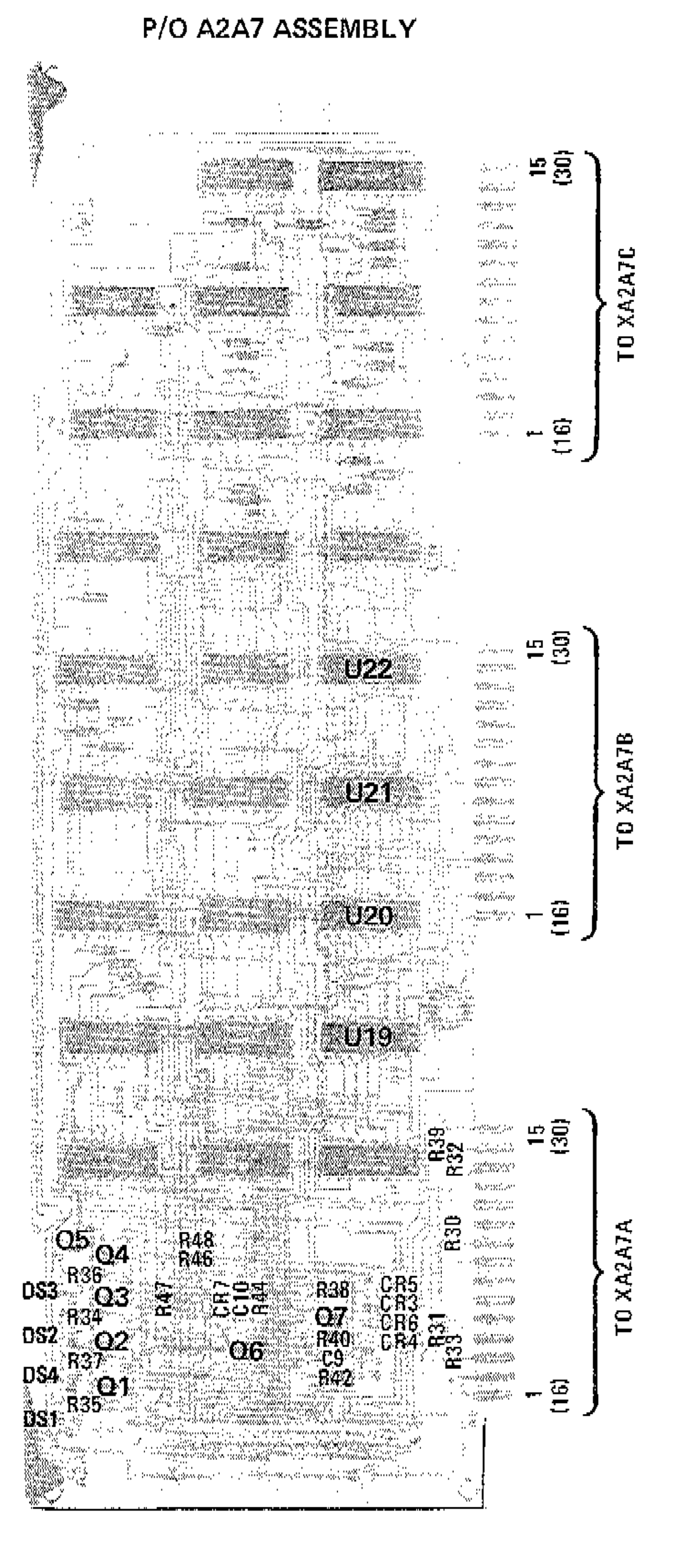
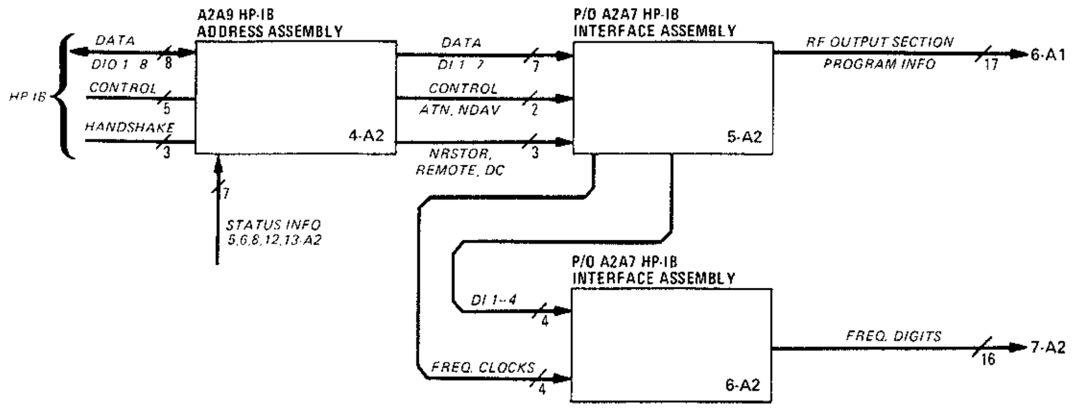


Figure 8-42. P/O A2A7 Interface Assembly Component Locations



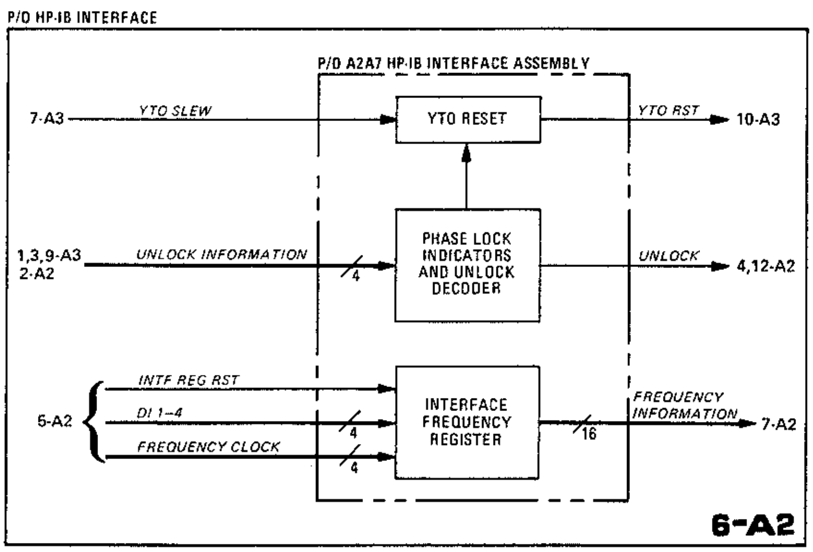
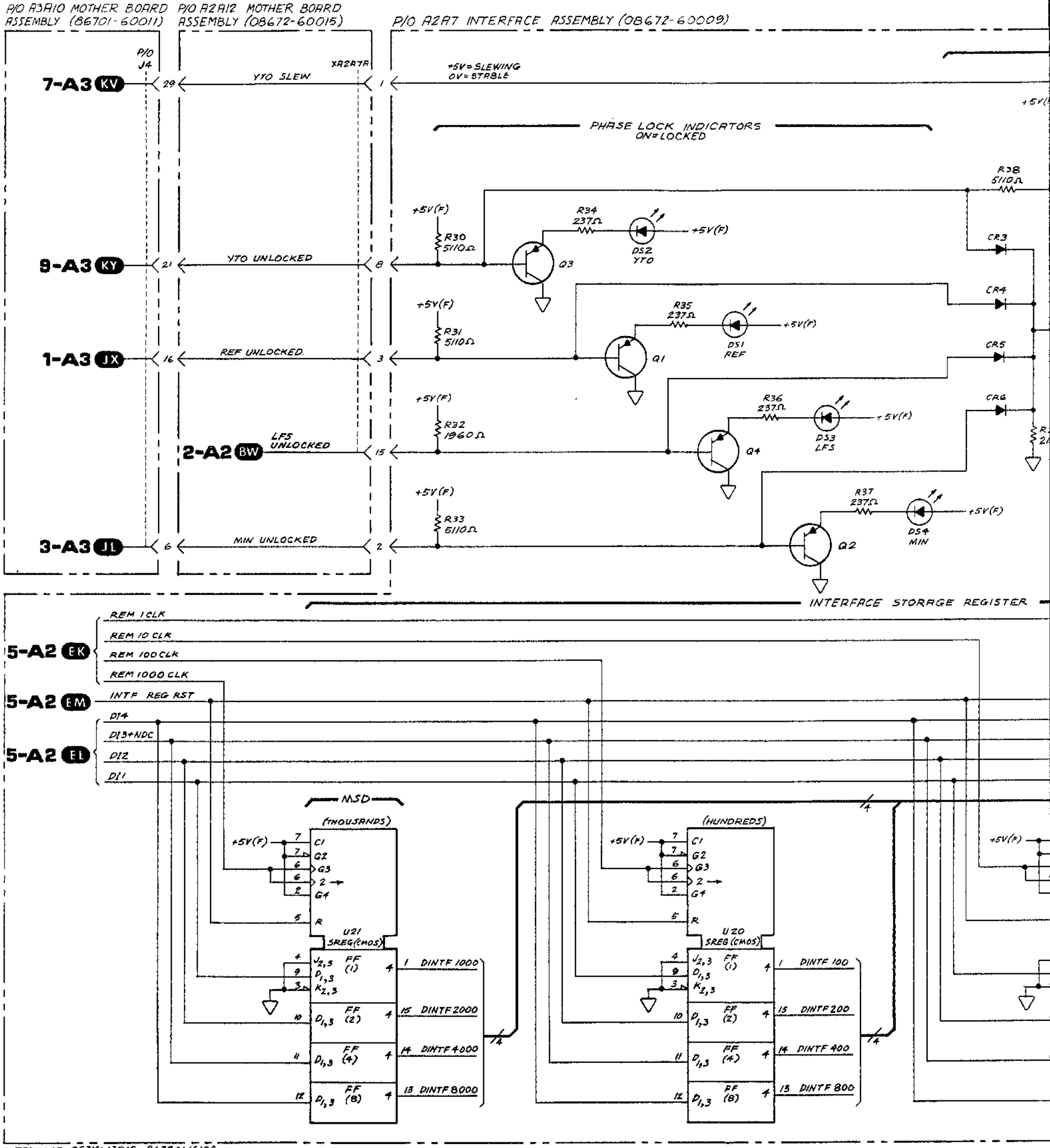


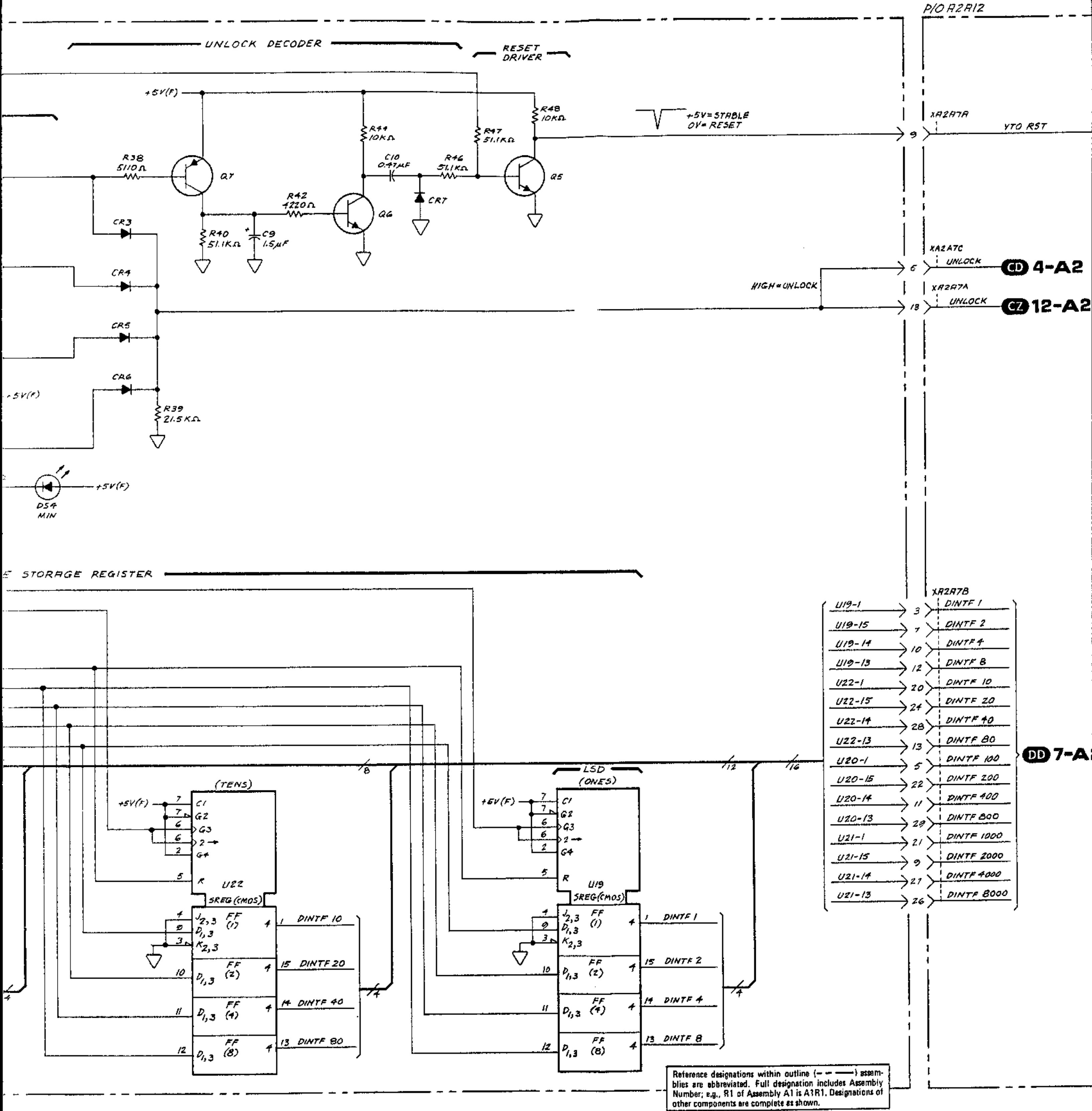
Figure 8-43. P/O Interface Block Diagrams

FIG. 8-44
Sht 1 of 3



INTERFACE 8671A:1701A 8672A:1610A

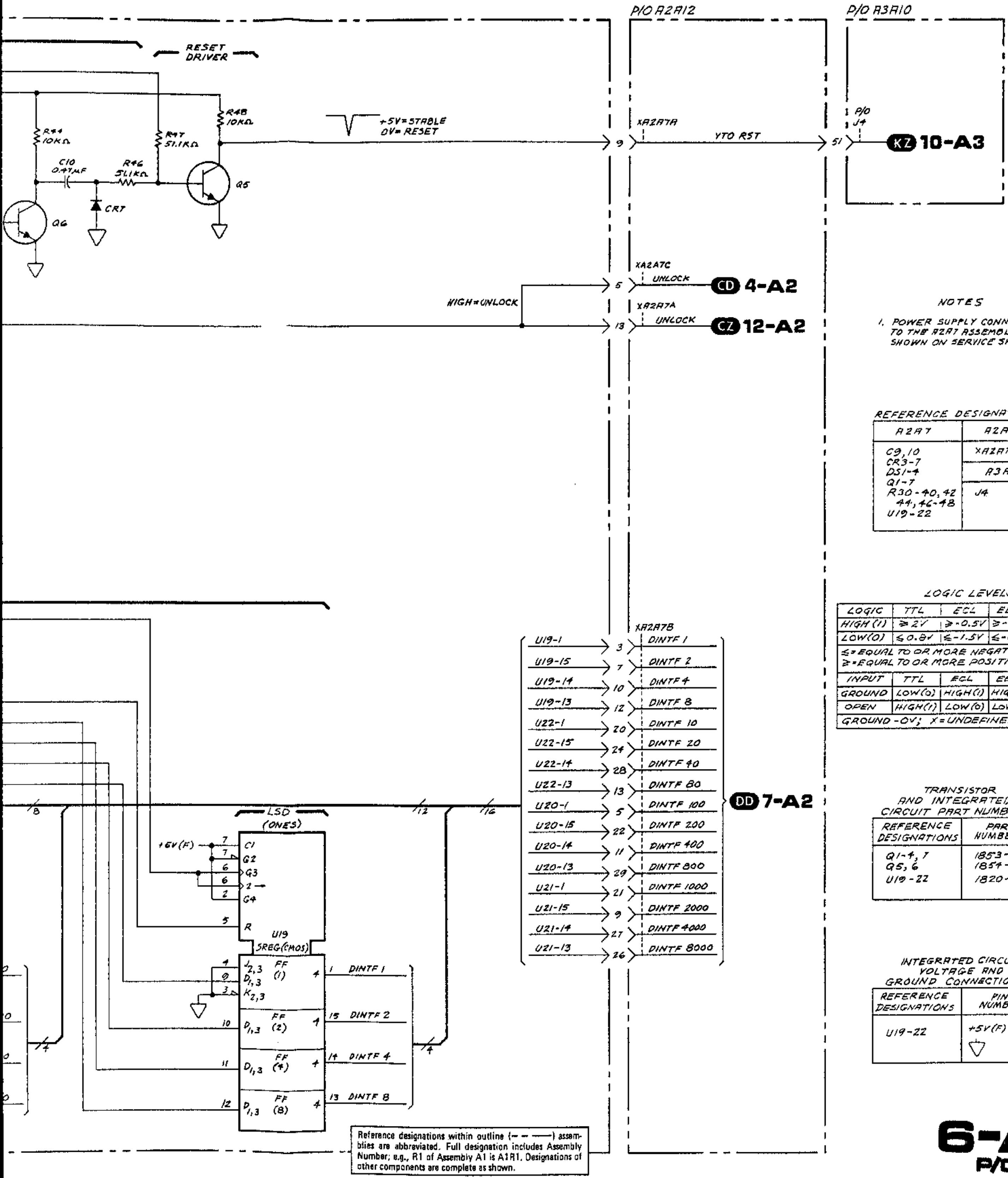
FIG. 8-44
Sht 2 of 3



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.

Figure 8-44. P/O In

FIG. 8-44
Sht 3 of 3



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 A2A7 ASSEMBLY ARE SHOWN ON SERVICE SHEET 5-A2

REFERENCE DESIGNATIONS

A2A7	A2A12
C9,10 CR3-7 DS1-4 Q1-7 R30-40,42 44,46-48 U19-22	XA2A7A,B,C 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
Q1-4, 7	1853-0020
Q5, 6	1854-0071
U19-22	1820-2080

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U19-22	+5V(F) - 16 ▽ - 8

6-A2
P/O A2A7

Figure 8-44. P/O Interface Assembly Schematic Diagram

SERVICE SHEET 7-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-16

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 Synthesizer's frequency. A battery keeps the register active when Mains power is off. The band and error decoding circuit examines the Synthesizer frequency for errors and tells the divider on the Output Register Assembly (A2A8) whether to divide by 1, 2, or 3. Since the maximum frequency is 6.2 GHz the divider always divides by one (during normal operation).

Register 1 Assembly

Shift registers U7—U9 and U19—U23 store the Synthesizer'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 Registers 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 effect 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	Low**	2**
12400.002—18599.997	0	1	Low**	3**
>18600.000 MHz	—	—	Low	Out of range

*Always zero
**Out of range frequency

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1, 3, and 10-A2 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 1601A
Digital Voltmeter . . . . HP 3455A

1. Tune the Synthesizer frequency to 5345.678 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 Synthesizer for at least one minute. Reapply Mains power. The frequency should be the same as shown before power was removed. If not correct, troubleshoot battery A2BT1 and the charging circuit plus the clock protect circuitry on A2A11 (see Service Sheet 9-A2). If everything is OK so far, skip to step 5.

3. Press the PRESET (3 GHz) pushbutton. Attach a 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 A2A11TP1 is shorted together with an alligator clip. If CLK1 is not correct, go to Service Sheet 8-A2.

5. Observe the HN1 and HN2 lines with a voltmeter. Below 6.2 GHz both lines should be a TTL low.

6. Tune to the highest possible frequency. It should be 6199.999 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.

MNEMONICS

Mnemonics	Definition	Explanation
GO (NGO)	Do a data cycle	Puts the shift registers in the serial shift mode.
CLK1	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.
INTF CLK2	Interface Clock 2	Shifts the 1 MHz to 1 kHz digits into the bottom 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 the band of the frequency stored in Data Register 1.

DEFINITION

Data Cycle — The process of changing the Synthesizer's frequency by adding or subtracting 1 from one of the digits.

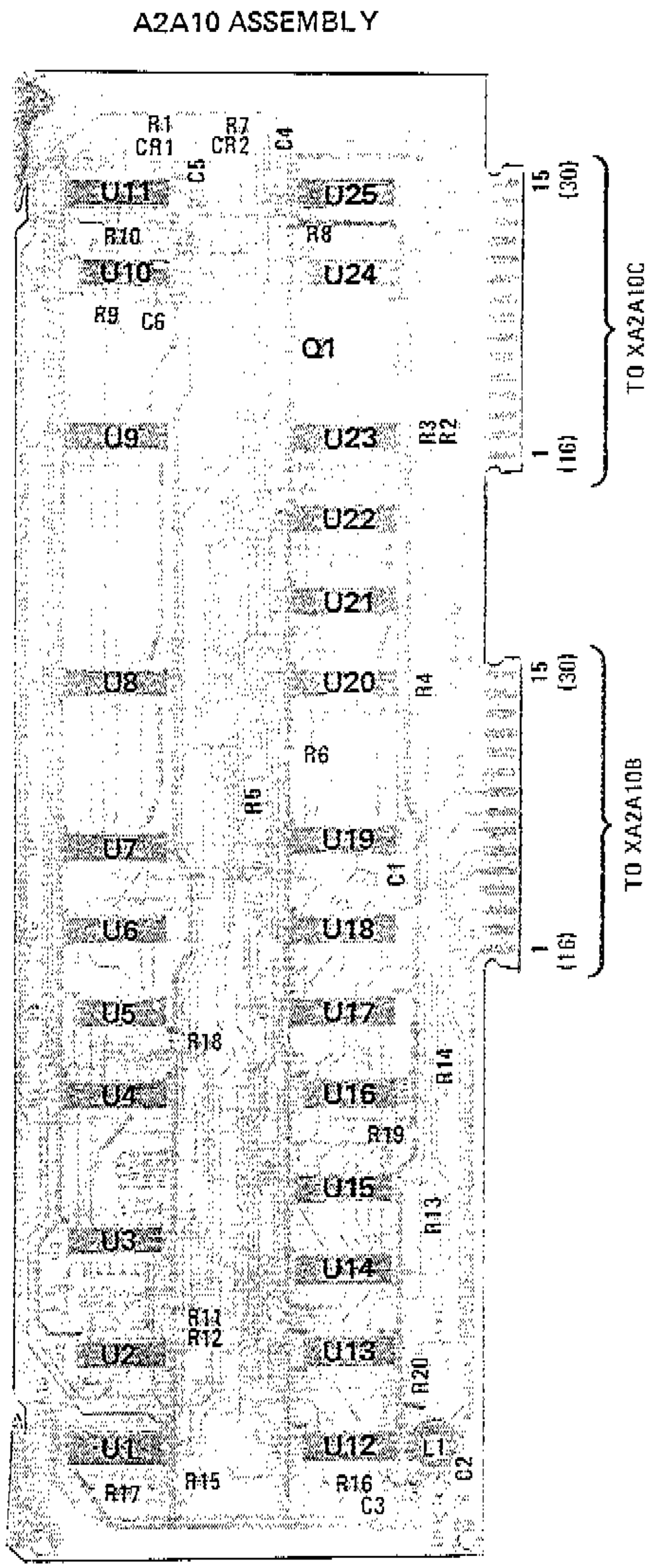


Figure 8-45. A2A10 Register 1 Assembly Component Locations

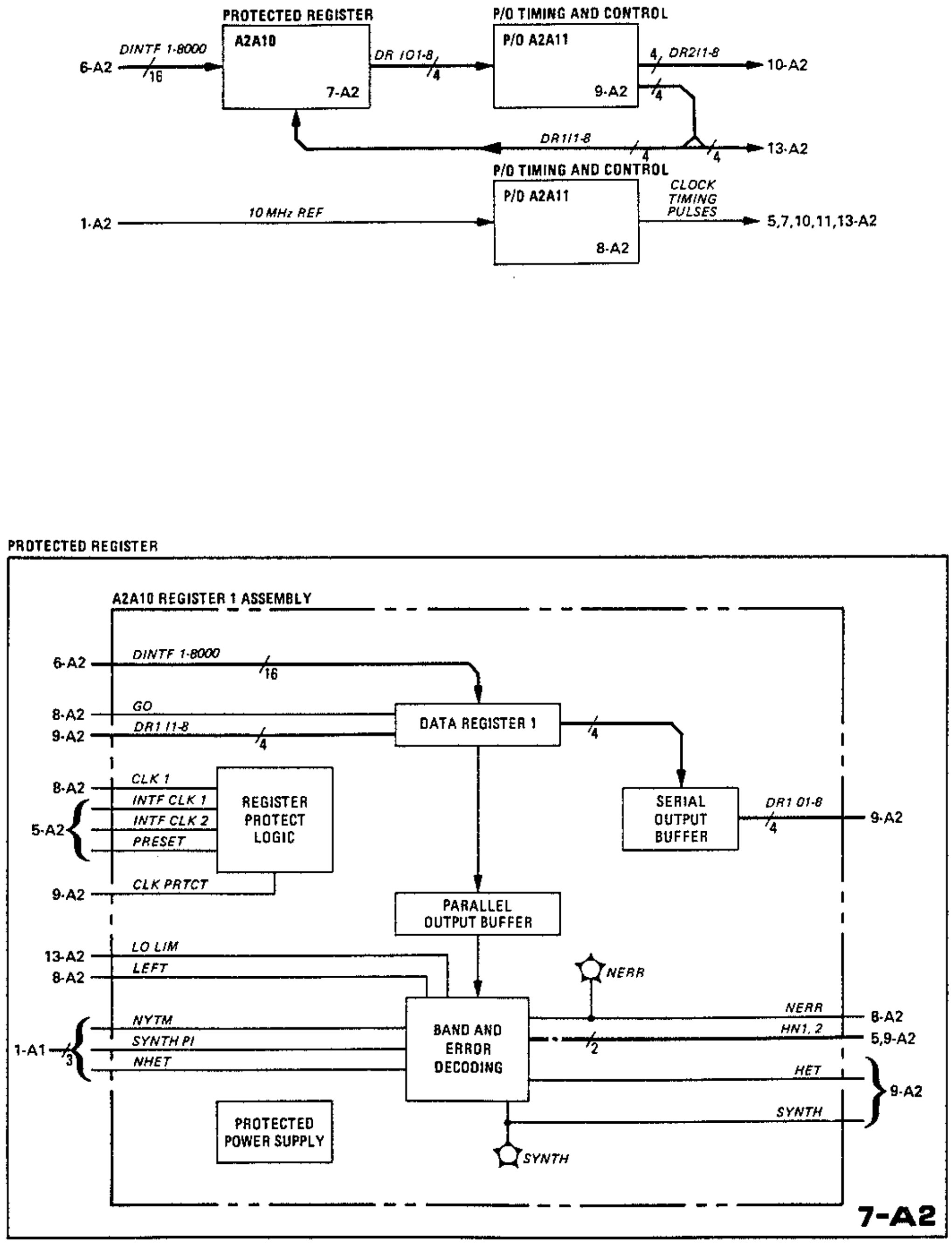


Figure 8-46. Register 1 Block Diagrams

8.51a

FIG. 8-47
Sht 1 of 4

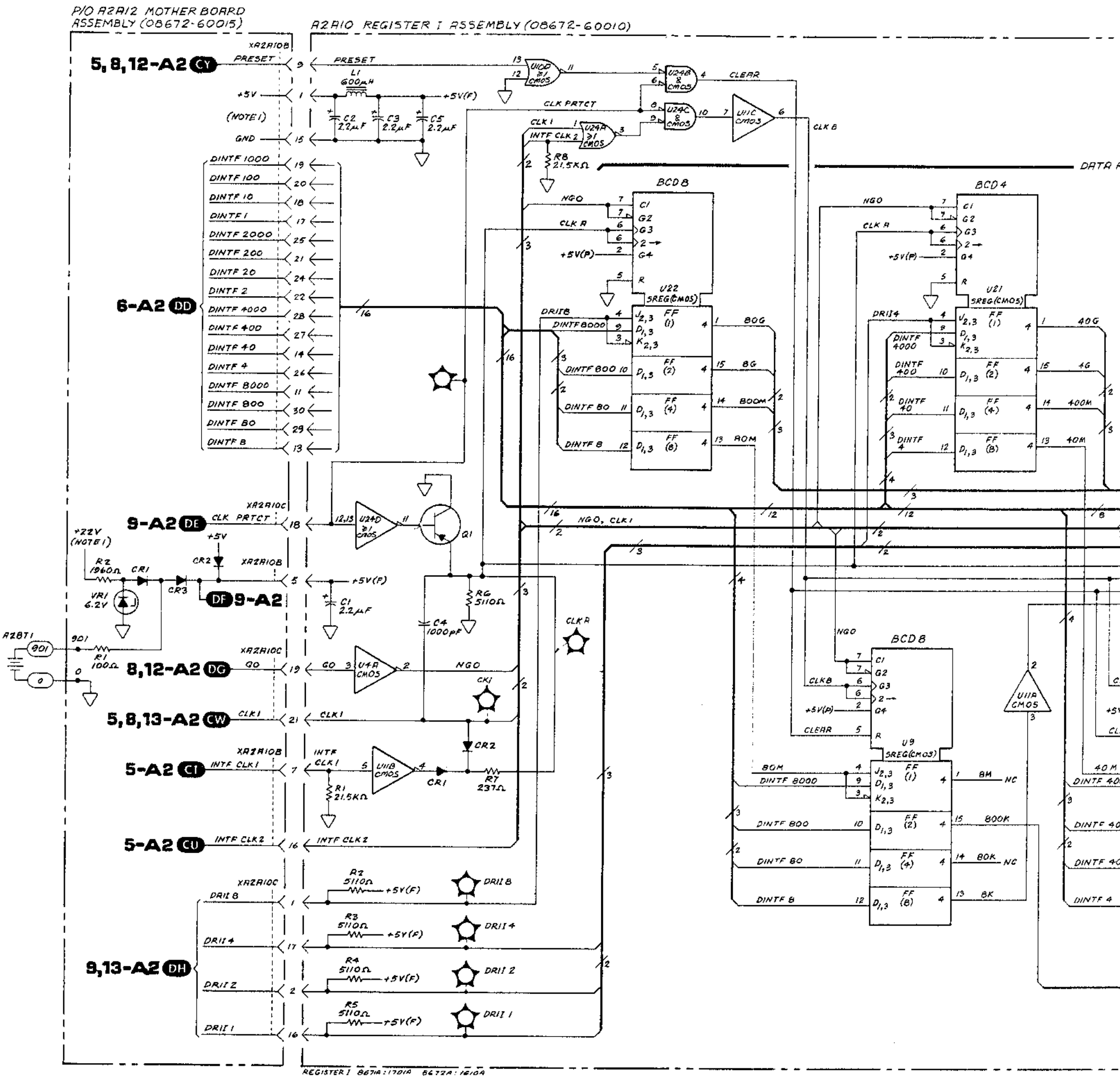


FIG. 8-74
Sht 3 of 4

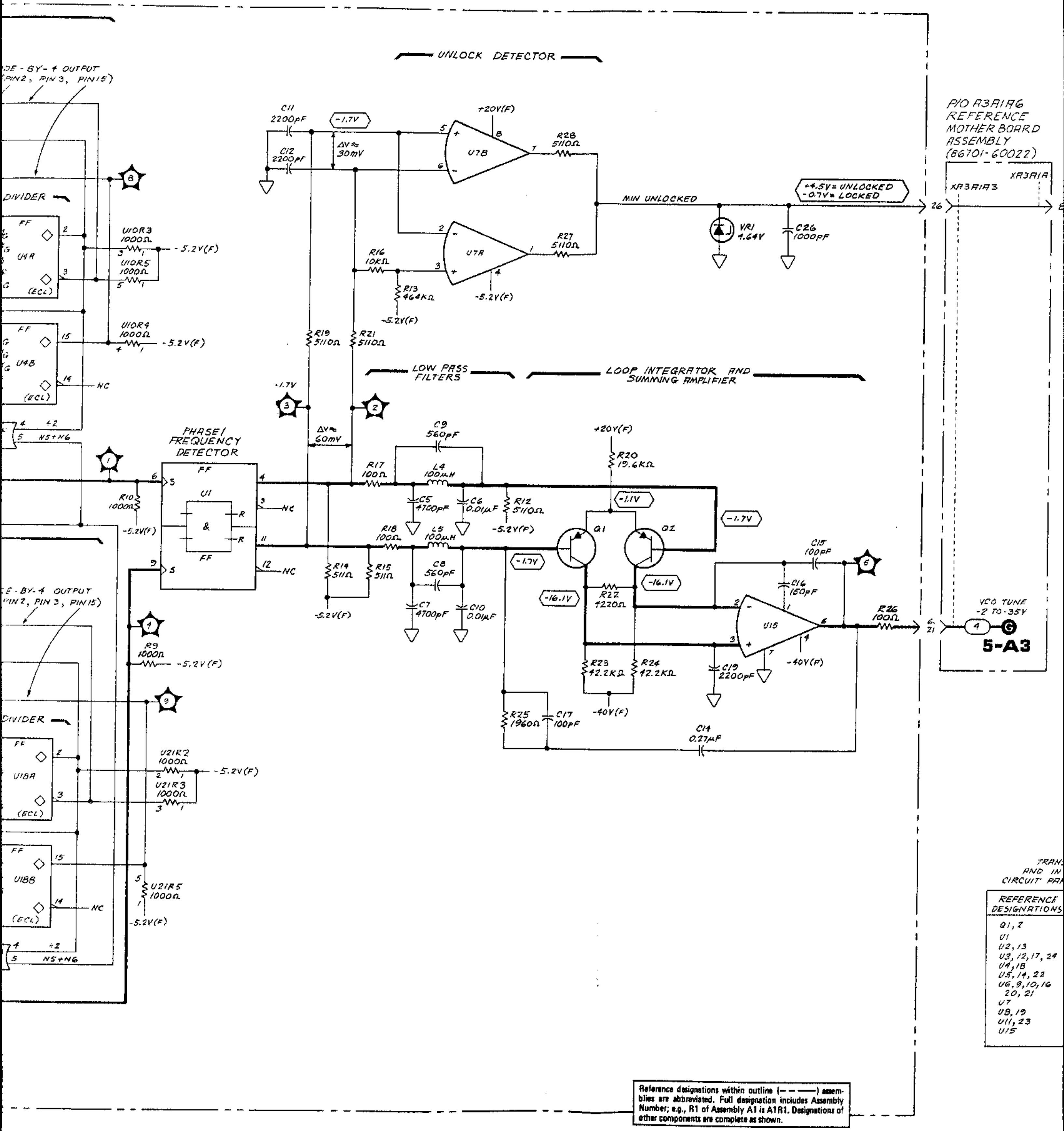
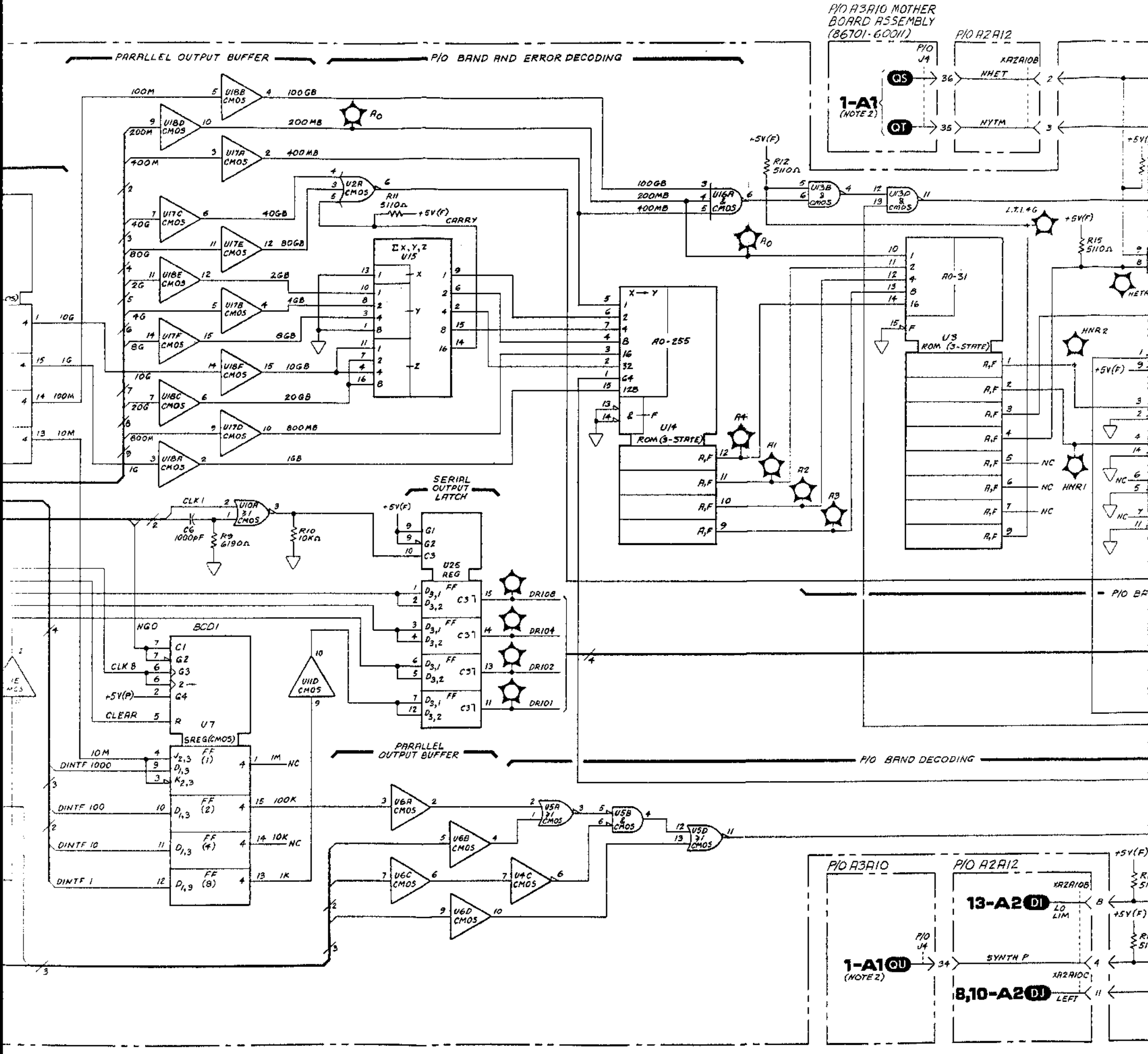
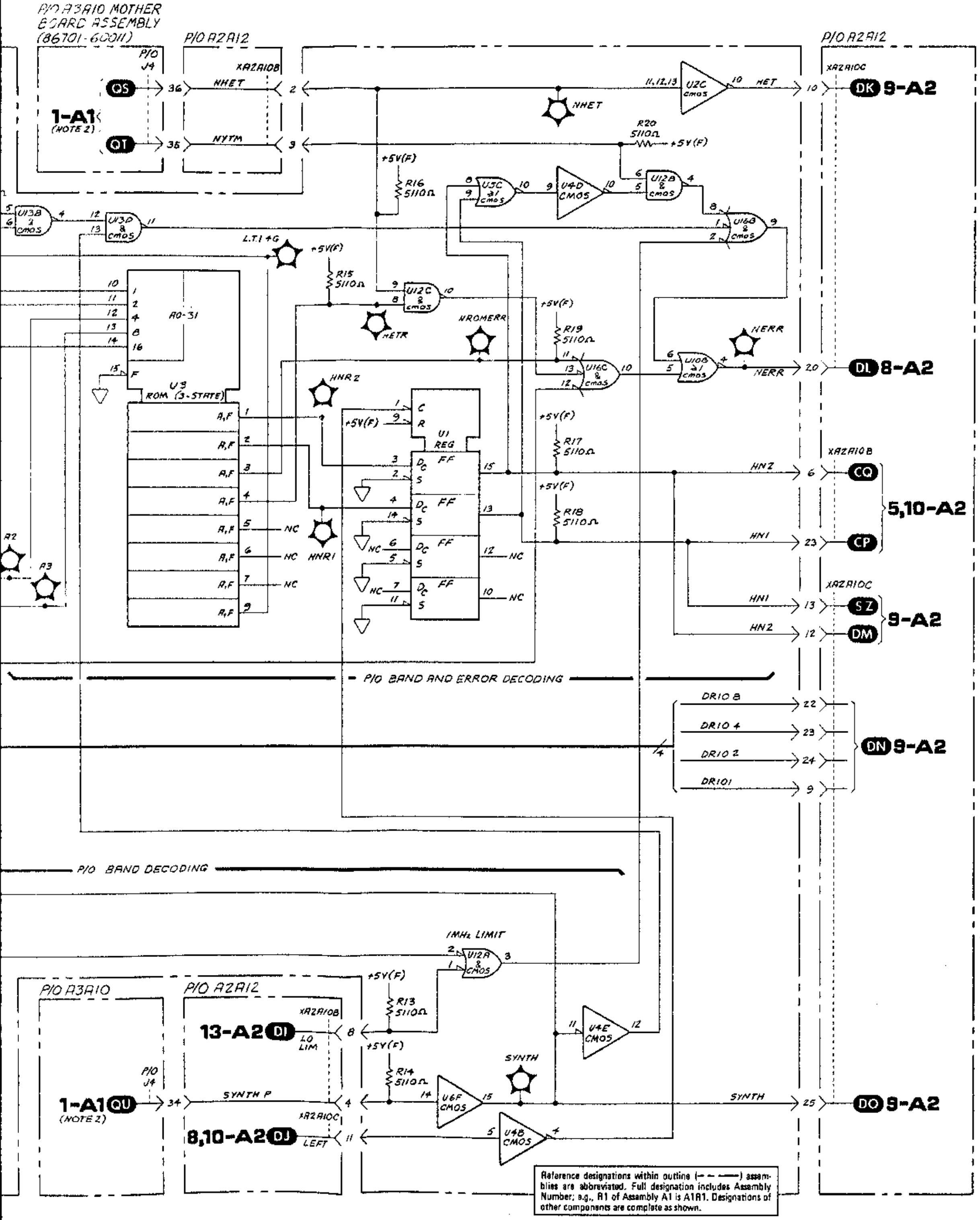


Figure 8-74. M/N Phase

FIG. 8-47
Sht 3 of 4



F16. 8-47
Sht 4 of 4



NOTES

1. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1-A2.
2. NO CONNECTION IN 8671A.

REFERENCE DESIGNATIONS

A2	A2A12
BT1	CR1-3 R1, 2 VR1 XA2A10B,C
A2A10	A3A10
C1-6 CR1, 2 L1 Q1 R1-20 U1-25	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 CIRCUITS PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1853-0020
U1	1820-0701
U2	1820-1965
U3	1816-0916
U4	1820-1746
U5, 10, 24	1820-1745
U6, 11, 17, 18	1820-1976
U7-9, 19-23	1820-2080
U12, 13	1820-1747
U14	1816-0782
U15	1820-0910
U16	1820-1961
U25	1820-0656

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 3, 14, 25	+5V(F) -16 ▽ -8
U2, 5, 10, 12, 13, 16	+5V(F) -14 ▽ -7
U4, 6, 11, 17, 18	+5V(F) -1 ▽ -8
U7-9, 19-23	+5V(P) -16 ▽
U15	+5V(F) -5 ▽ -12
U24	+5V(P) -14 ▽ -7

7-A2
A2A10

Figure 8-47. Register 1 Assembly Schematic Diagram

SERVICE SHEET 8-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-17

PRINCIPLES OF OPERATION

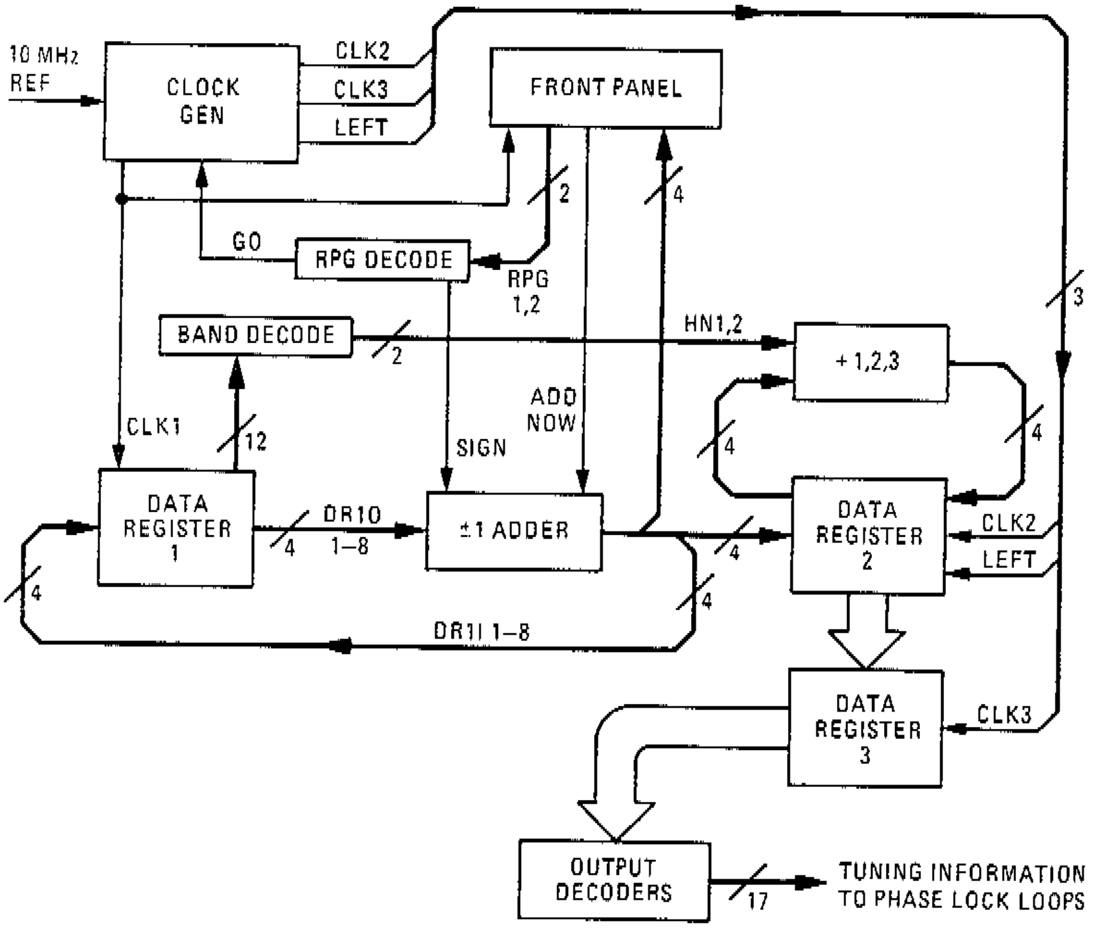
General

The timing and control assembly generates signals that initiate and control DATA CYCLES. A data cycle is the process of changing the Synthesizer'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.

Schematics are on Service Sheets 8-A2 and 9-A2 while a complete block diagram appears to the left of each schematic. The shaded area indicates the circuitry on the adjacent schematic. Notice that the main signal flow (the frequency data) is on Service Sheet 9 and most of the timing and control circuitry is covered by Service Sheet 8.

Relation to the Rest of the Instrument

The Digital Controller (see block diagram below) is static between frequency changes. The information is latched in Register 3 and applied, through output decoders, to the phase lock loops. Since



Digital Controller Block Diagram

SERVICE SHEET 8-A2 (Cont'd)

this data is the basis for all future frequency changes, it is also stored in the Protected Register (Register 1) and displayed by the front panel.

The frequency (2—6.2 GHz) is displayed and stored as 8 BCD digits (10 GHz* to 1 kHz) and the YTO Loop tunes from 2—6.2 GHz. 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 Controller 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 button.
- Update the display.
- Shift the new frequency data into Register 3.
- Stop!

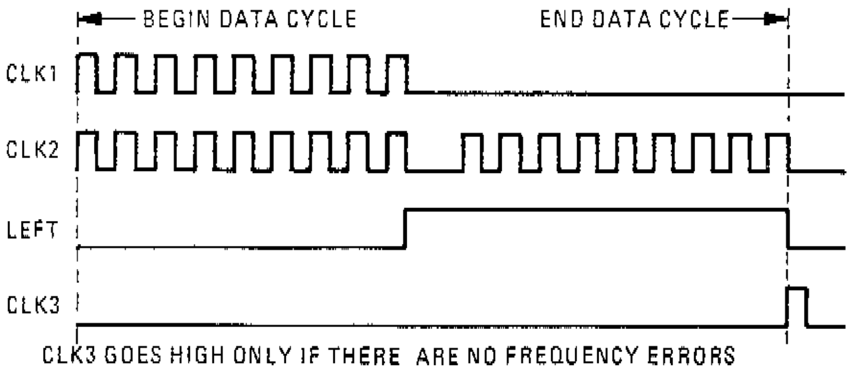
In Local when PRESET is pushed:

- Clear Register 1.
- Add 3 to the 1 GHz digit.
- Update the display.
- Shift the new frequency data (3 GHz) into Register 3.
- Stop!

In remote when a new frequency is programmed:

- Shift the new frequency into Register 1.
- Update the display.
- Shift the new frequency into Register 3.

A data cycle begins when the GO line goes true. The clock generator produces timing signals as shown below:



Clock Generator Outputs

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 buttons. The new frequency goes to three places: the front panel display, back into Register 1, and into Register 2. Then LEFT goes high, changing Register 2 to the left shift modes, 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 in 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-lock loops.

---

*Always zero.

SERVICE SHEET 8-A2 (Cont'd)

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 controller 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 Synthesizer's frequency will increase. The presence of the squarewaves tells the Controller 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 Errs 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 6.2 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 Controller 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 1, 3, and 10-A2 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.

SERVICE SHEET 8-A2 (Cont'd)

Test Equipment

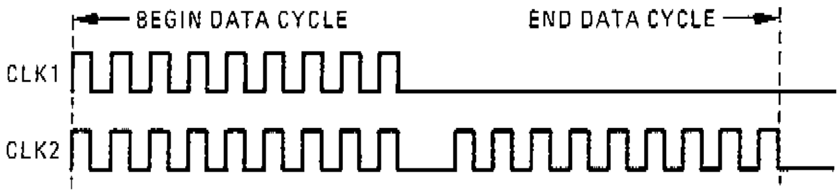
Oscilloscope . . . . HP 180C/1801A/1821A
Digital Voltmeter . . . . HP 3455A

This assembly contains several test point pairs which are designed to set certain lines to known conditions. By shorting the pair together with an alligator clip, the line will be connected high or low as appropriate.

A2A11TP1 — causes controller to continually cycle data
A2A11TP2 — suppresses frequency error limits
A2A11TP3 — suppresses operation of the ±1 adder
A2A11TP4 — suppresses round off
A2A11TP5 — aborts controller operation

This assembly also contains a manual clock switch. Use this switch by unplugging the blue coax on A3A1A1 to disconnect the controller clock. (Disconnecting this cable also causes the LFS loop to unlock but that is not important when troubleshooting the controller.)

1. Connect alligator clip to test point pair A2A11TP1. Observe CLK1 and CLK2 test points on 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

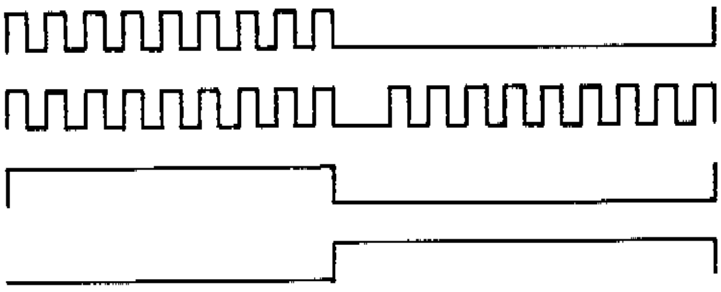
If these clock signals are OK, the clock divider, clock counter and clock drivers are OK. Also the RECYCLE flip-flop (U27B) is OK.

2. Attach one oscilloscope probe to A2A11 edge connector pin A30 (CLK3). Leave the other probe attached to CLK1. The timing relationship of CLK3 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 oscilloscope or voltmeter to A2A11 edge connector pin B1. This line should be a CMOS low for all in-range frequencies. If everything is correct so far, turn to Service Sheet 9-A2.



Clock, Cycle, and Left Timing Relationship

MNEMONICS

Mnemonic	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.
CLK 1	Clock 1	Nine 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 ± 1 ADDER whether to add or subtract. High = subtract, low = add.

*Should always be false (high).

DEFINITION

Data Cycle — The process of changing the Synthesizer's frequency by adding or subtracting 1 from one of the digits.

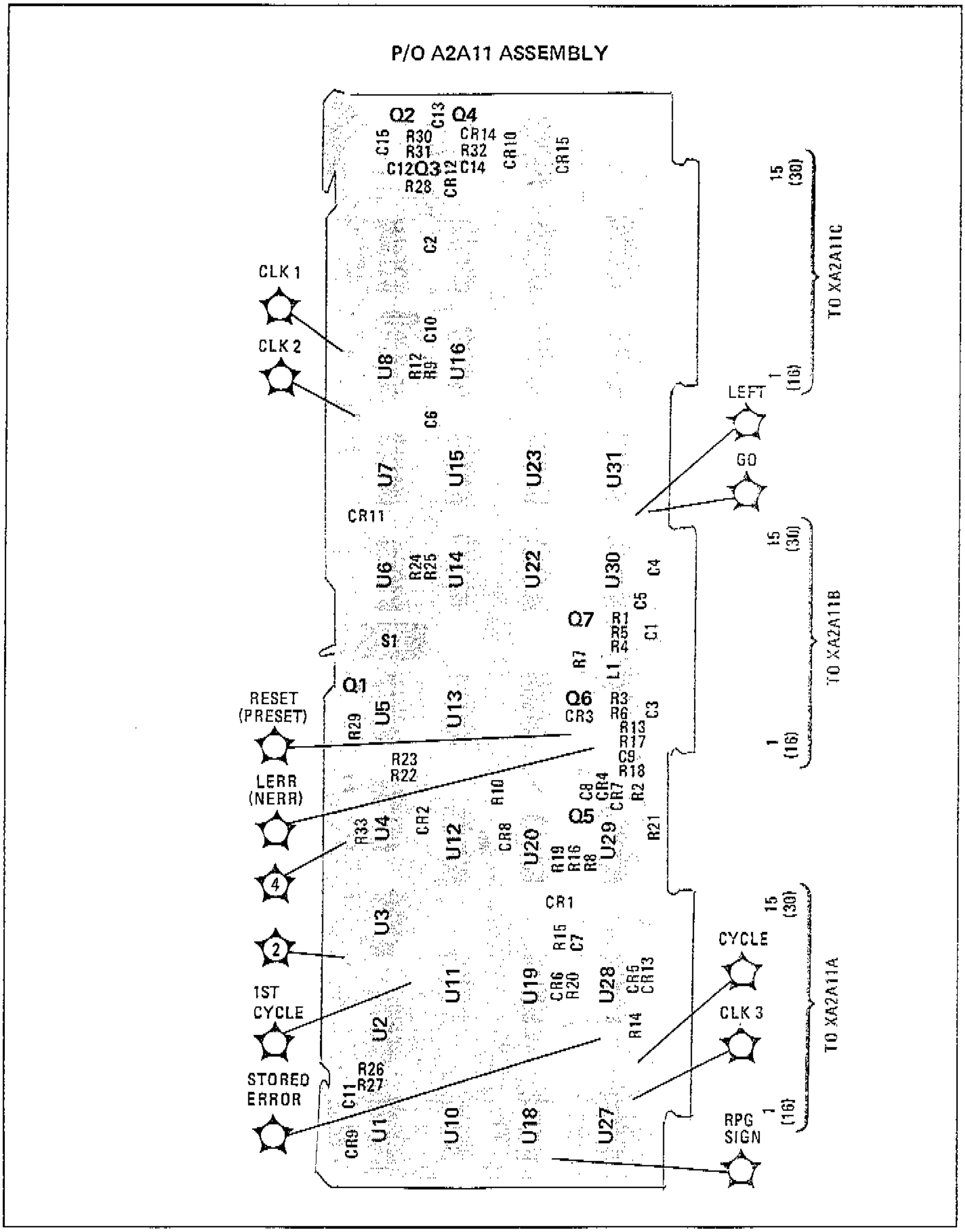


Figure 8-48. P/O A2A11 Timing and Control Assembly Component and Test Point Locations

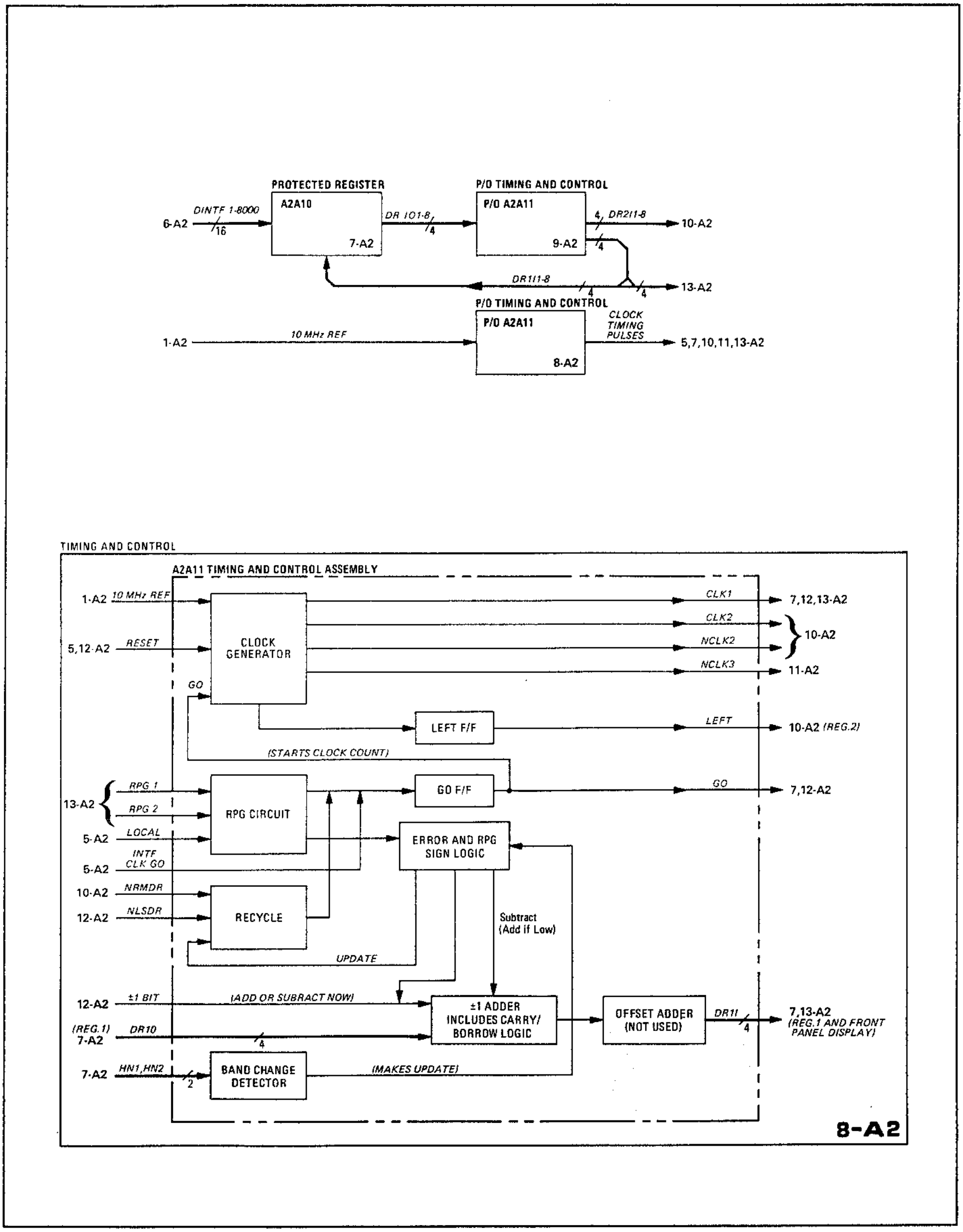


Figure 8-49. P/O Timing and Control Block Diagrams

FIG. 8-50
Sht 1 of 3

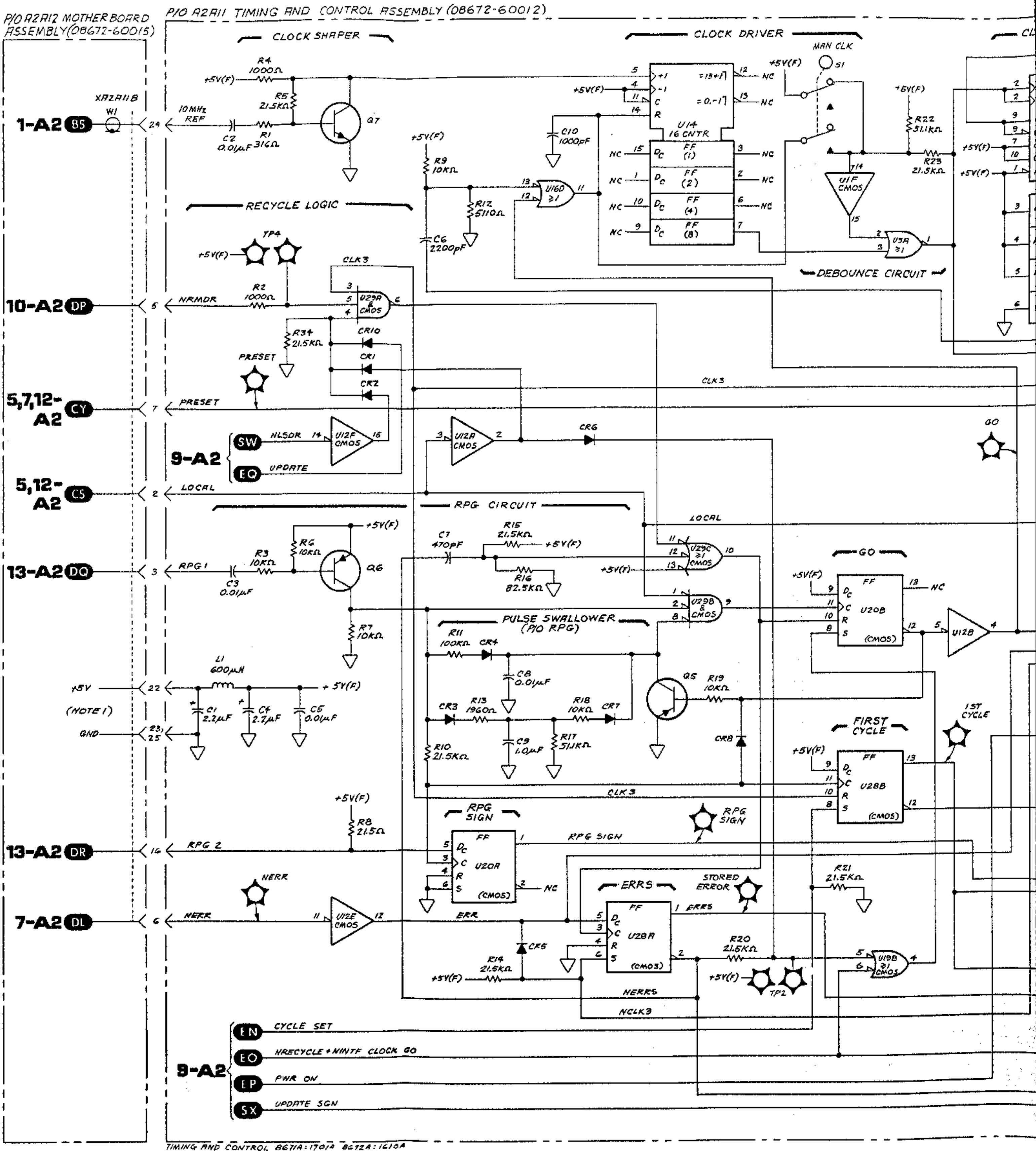


FIG. 8-50
Sht 2 of 3

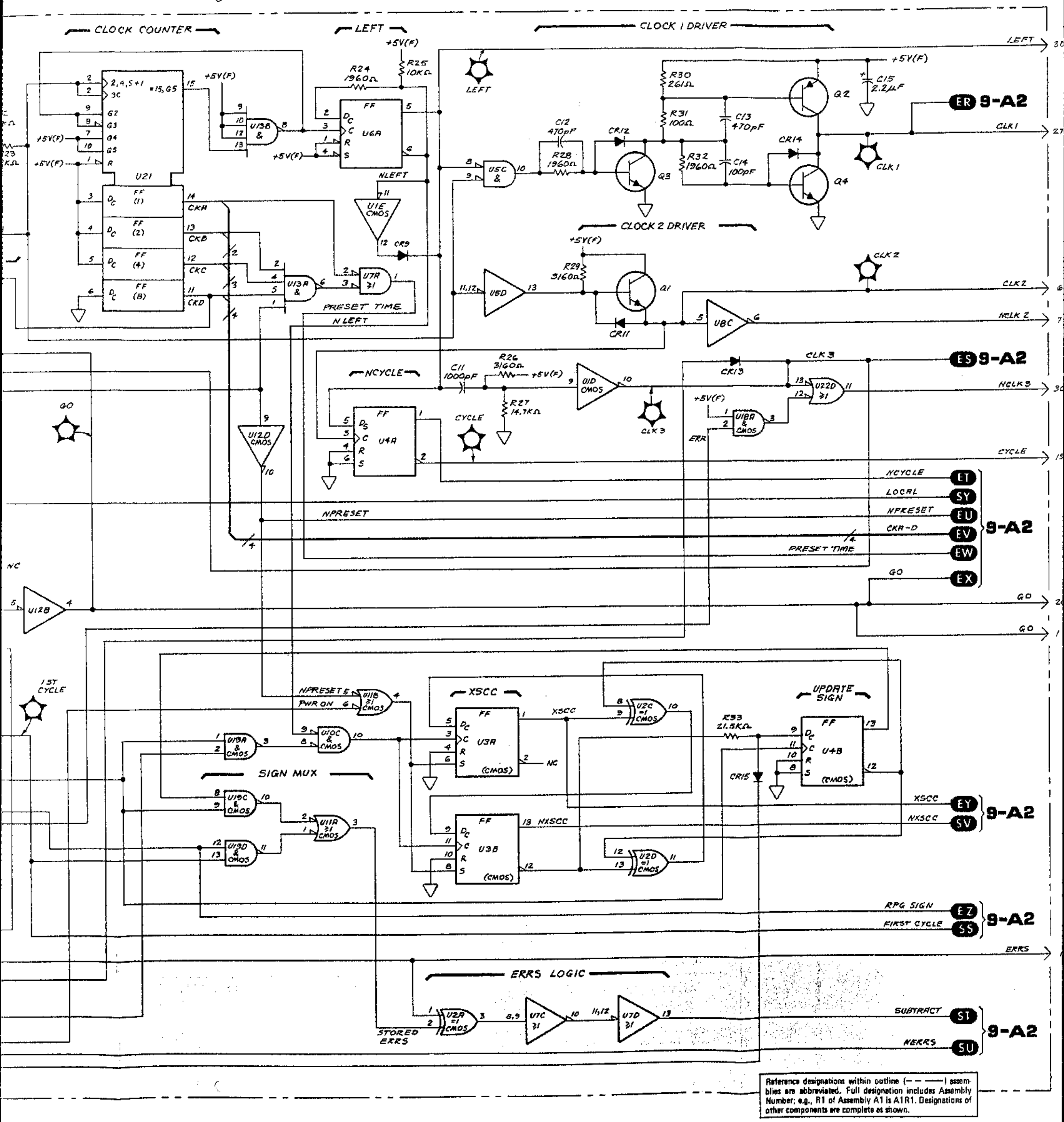
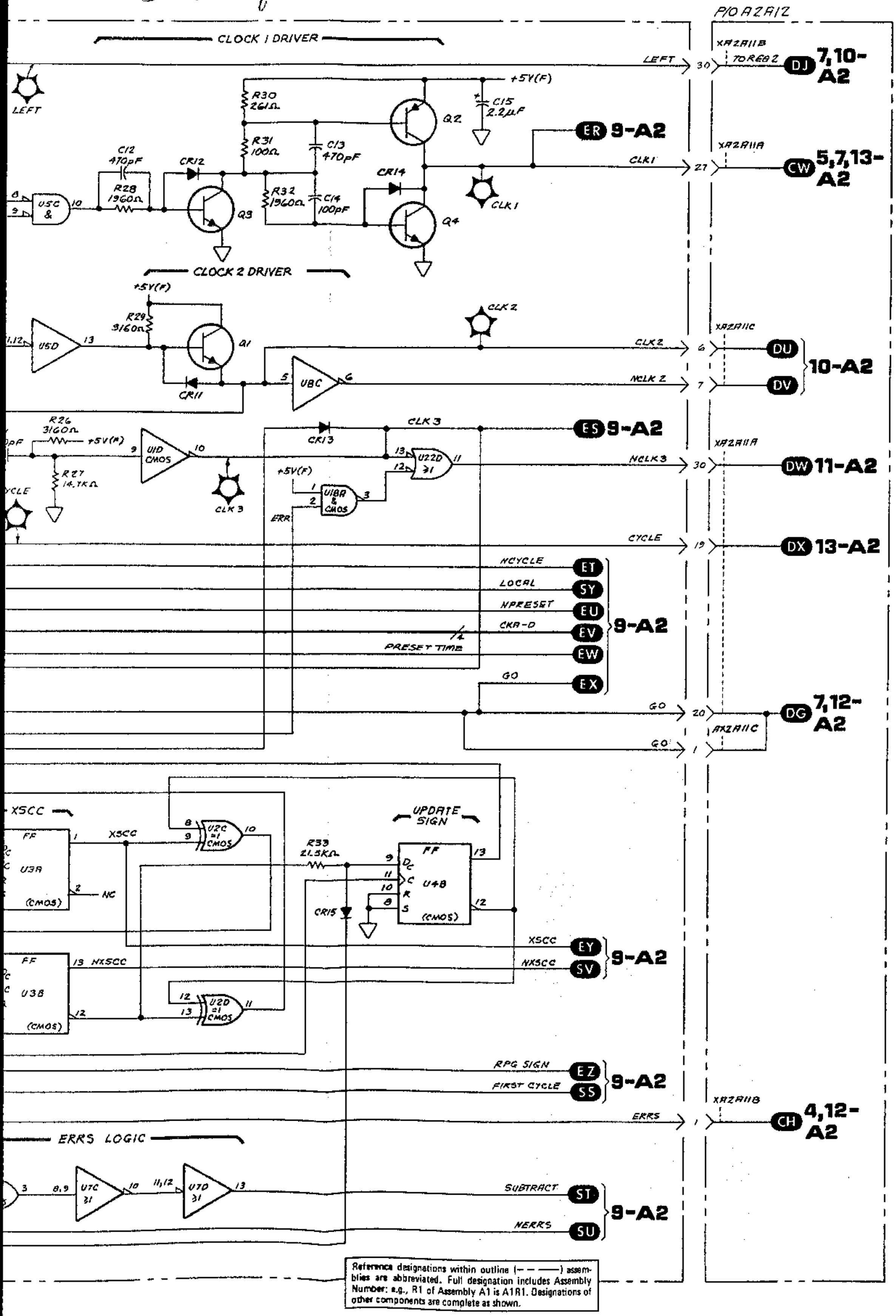


Figure 8-5

FIG. 8-50
Sht 3 of 3



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 1-A2

REFERENCE DESIGNATIONS

A2A11	A2A12
C1-15 CR1-15 L1 Q1-7 R1-34 S1 TP1, 4 U1-8, 10-14, 16, 18-22, 28, 29	W1 XA2A11A, B, C

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	1854-0071
Q2	1853-0015
Q5, 6	1853-0020
Q7	1854-0019
U1, 12	1820-1746
U2	1820-2015
U3, 4, 20, 28	1820-1963
U5, 7	1820-1144
U6	1820-1112
U8	1820-1199
U10	1820-1745
U11, 18, 19	1820-1747
U13	1820-1204
U14	1820-1194
U16, 22	1820-1197
U21	1820-0778
U29	1820-1961

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 12	+5V(F) - 1 ▽ - 8
U2-8, 10, 11, 13, 16, 18-20, 22, 28, 29	+5V(F) - 14 ▽ - 7
U14, 21	+5V(F) - 16 ▽ - 8

8-A2
P/O A2 A11

Figure 8-50. P/O Timing and Control Assembly Schematic Diagram

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-17

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 Synthesizer'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.

As shown by the shaded blocks of Figure 8-74, 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 not used in the standard Synthesizer but the frequency data passes through it. It may be used to add an IF offset in special instruments.

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

SERVICE SHEET 9-A2 (Cont'd)

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 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 button is pushed. Pin 13 of U32D and pin 1 of 32A go high when the 1 GHz digit leaves the ± Adder.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1, 3, and 10-A2 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 1601A

1. Observe the front panel frequency display and press the PRESET (3 GHz) pushbutton. 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 8-A2 or check the data entering the display.

NOTE

An open pin on the front panel display LED's will cause that pin to float high.

2. Attach a 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. Otherwise continue.

3. Press the least significant digit (1 kHz) RESOLUTION pushbutton. 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 assure 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 Synthesizer from 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 7-A2.

MNEMONICS

Mnemonics	Definition	Explanation
±1 BIT	Add or subtract 1 from the digit now at the Adders input.	High means operate on the digit at the Adders input.
FIRST CYCLE	First data cycle.	Distinguishes between a normal data cycle and extra data cycles done to eliminate round-off error.
NLSDR	Not Least Significant Digit Resolution	Low means the 1 kHz RESOLUTION button has been pushed.
NCYCLE	Not Cycle.	High during the first half of a data cycle.
NERRS	Not Error Stored	Low means that an out-of-range frequency is stored in Data Register 1.
NCLK 3	Not Clock 3	Low going pulse at the end of an error free data cycle.
RPG SIGN	Rotary Pulse Generator Sign	Indicates TUNING direction.
XSCC	Excess Cycle Counter	Two bits used to tally the extra data cycles done to obtain an evenly divisible frequency.*
HN1 HN2	Harmonic Number	Indicates band number of the frequency in Data Register 1: Band HN1 HN2 2—6.199 999 GHz 1 0 0 Out of range 2 1 0 Out of range 3 0 1
DR1O 1—8	Data Register 1 Out	Binary Coded Decimal digits from Data Register 1.
DR1I 1—8	Data Register 1 In	Binary Coded Decimal digits to the front panel, Data Register 2, and back to Data Register 1.
DR2I 1—8	Data Register 2 In	Binary Coded Decimal digits to Data Register 2.
UPDATE SIGN	Change state of SUBTRACT line	Indicates whether previous round-off was an addition or subtraction.**
UPDATE	Correct band change	Initiates more data cycles to correct the 1 kHz digit after a band change.**

*Frequency is always divisible.

**Does not apply to this instrument configuration.

DEFINITION

Data Cycle — The process of changing the Synthesizer's frequency by adding or subtracting 1 from one of the digits.

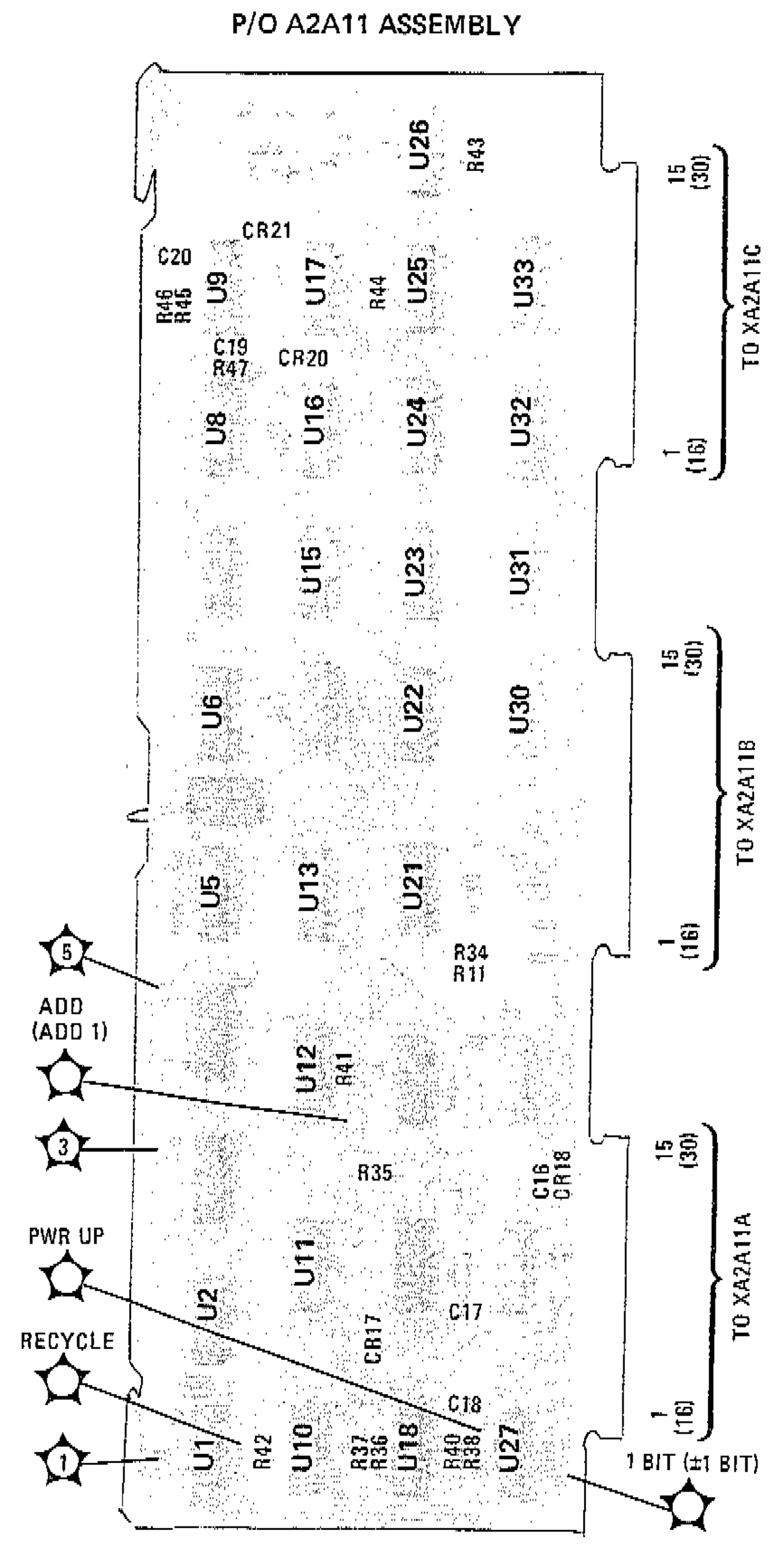


Figure 8-51. P/O A2A11 Timing and Control Assembly Component and Test Point Locations

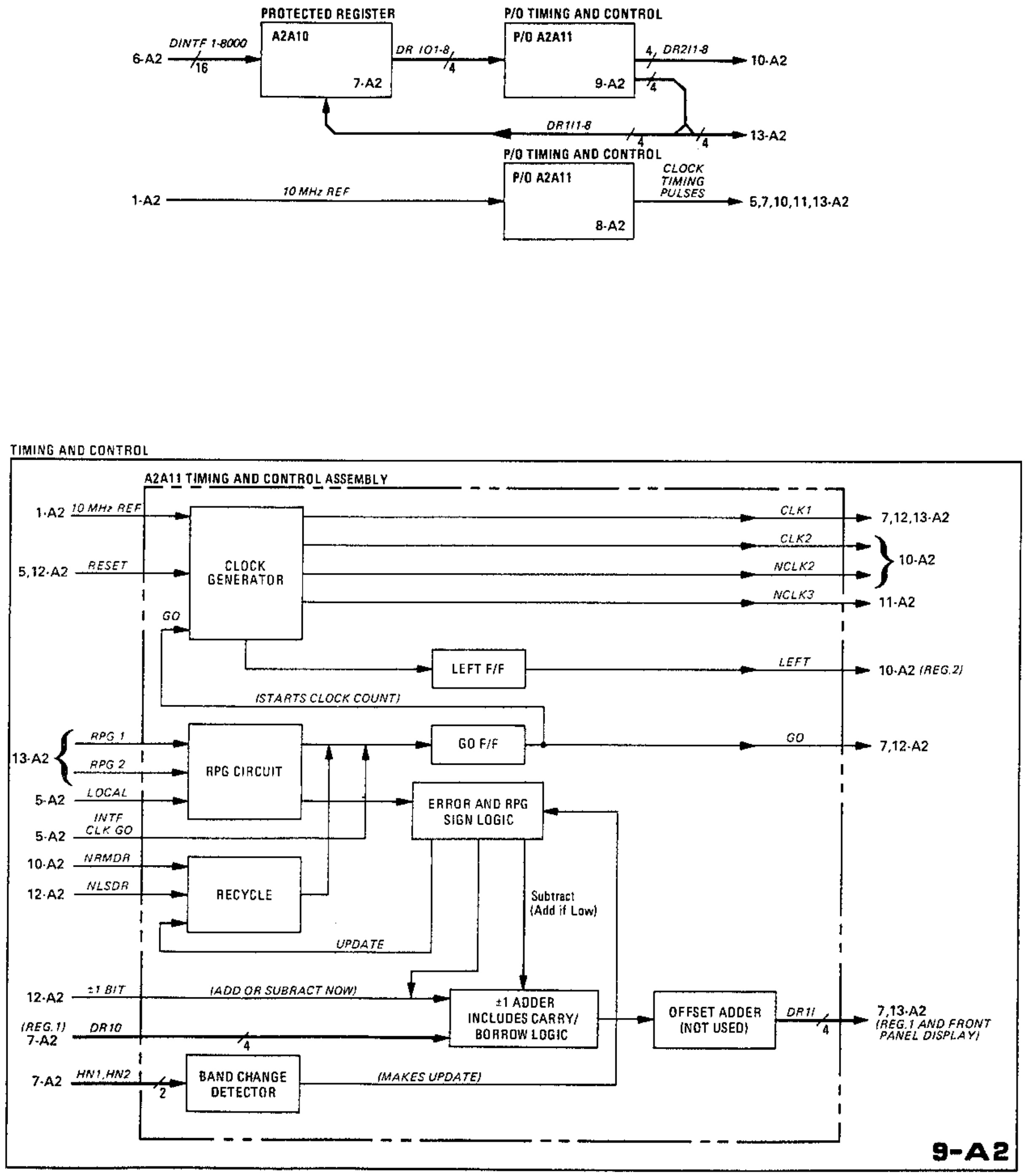


Figure 8-52. P/O Timing and Control Block Diagrams

FIG. 8-53
Sht 1 of 3

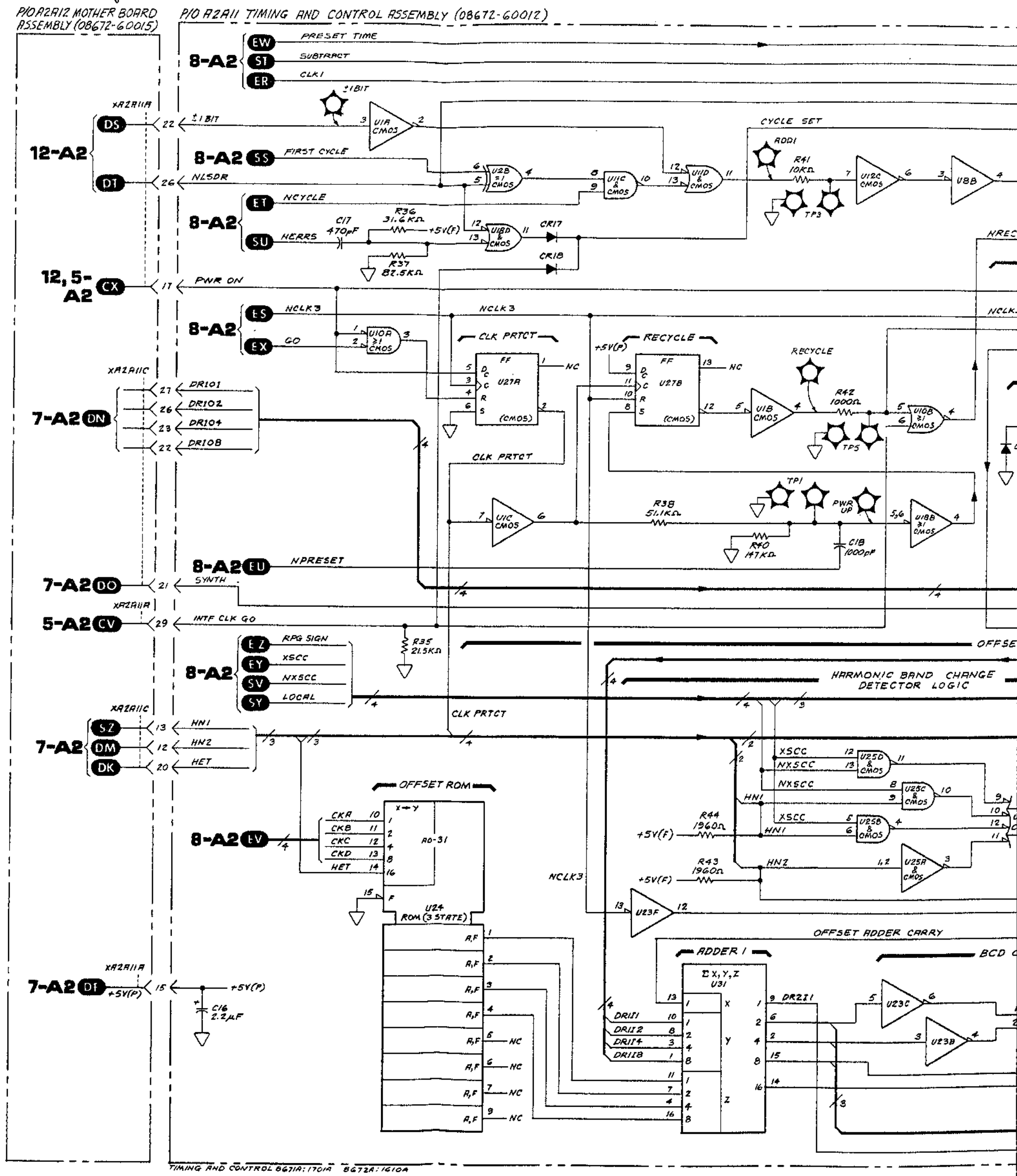
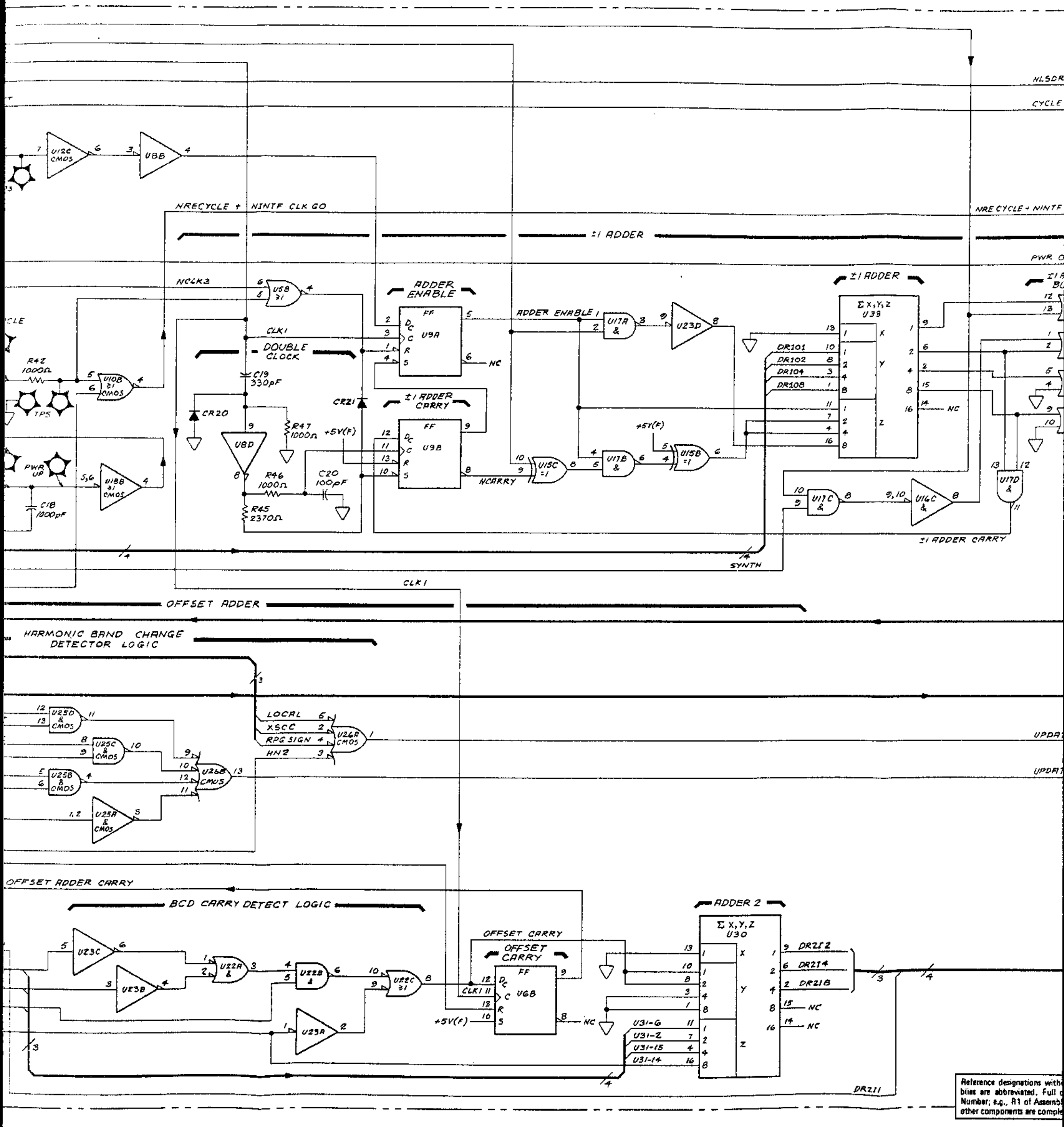
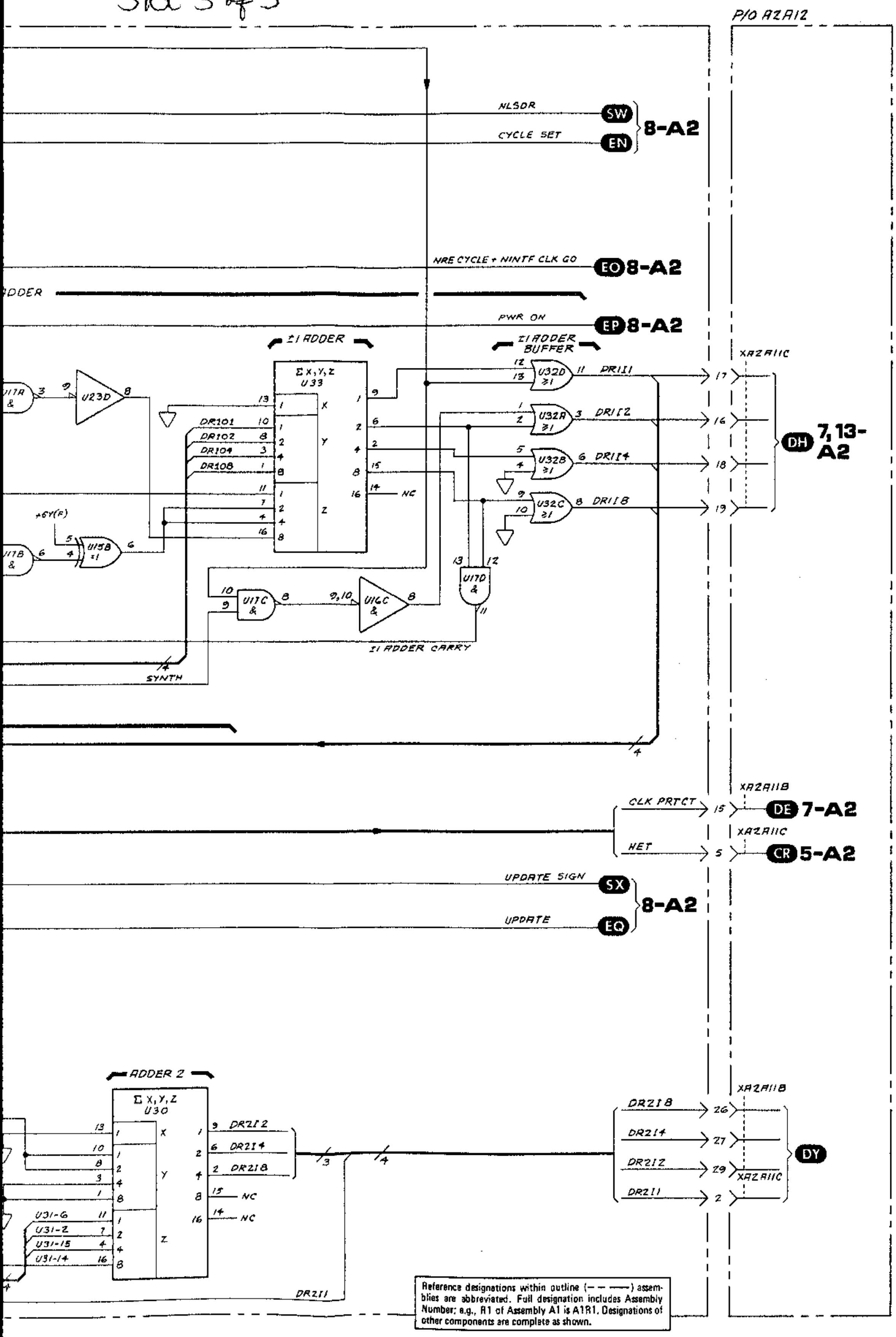


FIG. 8-53
Sht 2 of 3



Reference designations withi... blies are abbreviated. Full c... Number; e.g., R1 of Assemb... other components are comple...

FIG. 8-53
Sht 3 of 3



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 A2A11 ASSEMBLY ARE SHOWN ON SERVICE SHEET 8-A2.
2. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1-A2.

REFERENCE DESIGNATIONS

A2A11	A2A12
C16-20 CR17, 18, 20, 21 R35-38, 40-47 TP1, 3, 5 U1, 2, 5, 6, 8-12, 15-18, 22-27, 30-33	XA2A11A, B, C

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
U1, 12	1820-1746
U2	1820-2015
U5	1820-1144
U6, 9	1820-1112
U8, 23	1820-1199
U10	1820-1534
U11, 18, 25	1820-1747
U15	1820-1211
U16, 17, 22	1820-1197
U24	1816-0916
U26	1820-1960
U27	1820-1963
U30, 31, 33	1820-0910
U32	1820-0661

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 12	+5V(F) - 1 - 8
U2, 5, 6, 8-11, 15-18, 22, 23 25, 26, 32	+5V(F) - 14 - 7
U24	+5V(F) - 16 - 8
U27	+5V(P) - 14 - 7
U30, 31, 33	+5V(F) - 5 - 12

9-A2
P/O A2A11

Figure 8-53. P/O Timing and Control Assembly Schematic Diagram

SERVICE SHEET 10-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-14

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 10-A2 covers the Digital Divider and Data Register 2 and Service Sheet 11-A2 covers the rest. Additionally, Service Sheet 10-A2 shows 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 loop 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 CLK2, 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.

---

*Divides by 1 during normal instrument operation.

SERVICE SHEET 10-A2 (Cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1 and 3 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.

Test Equipment

Digital Voltmeter . . . . HP 3455A
Logic Analyzer . . . . HP 1601A

1. Install A2A8 on an extender board or on the Output Register Test Board. (HP Part Number 11712-60001.)

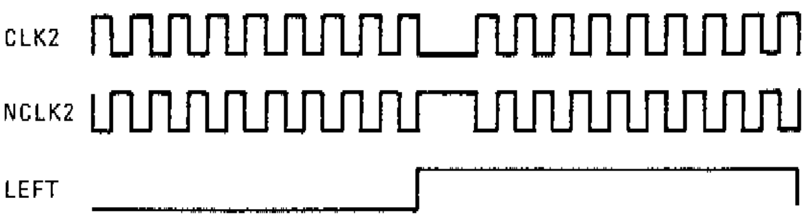
2. Set frequencies as shown in the following table. The edge connector pins with arrows should be measured with a logic probe or voltmeter or the data should be observed on the output register test board. By checking all four frequencies, each output line will be cycled high and low.

Frequency	A		B		C	
	Front	Rear	Front	Rear	Front	Rear
6169.969	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

3. Check the input data by connecting a logic analyzer to DR2I 1—8 lines and to CLK1. Set the analyzer to END DISPLAY. Set the SYNTHESIZER FREQUENCY to 52345.678 MHz and set the logic analyzer to trigger on the "1". Connect an alligator clip to test point pair A2A11TP1. If the input data is correct, continue with this procedure. Otherwise go to Service Sheet 9-A2 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      0100
```

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 7-A2 to continue troubleshooting.

Frequency (MHz)	HN1	HN2
2000—6199.999	L	L
6200—12399	H	L out of range
12400—18599	L	H out of range

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 a 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.

MNEMONICS

Mnemonic	Definition	Explanation
HN1 HN2	Harmonic Number	Tells the digital divider whether to divide by 1, 2, or 3. ÷ HN1 HN2 1 0 0 2 1 0 3 0 1
CLK2	Clock 2	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 changing the Synthesizer's frequency by adding or subtracting 1 from one of the digits.

*Should always be band 1.

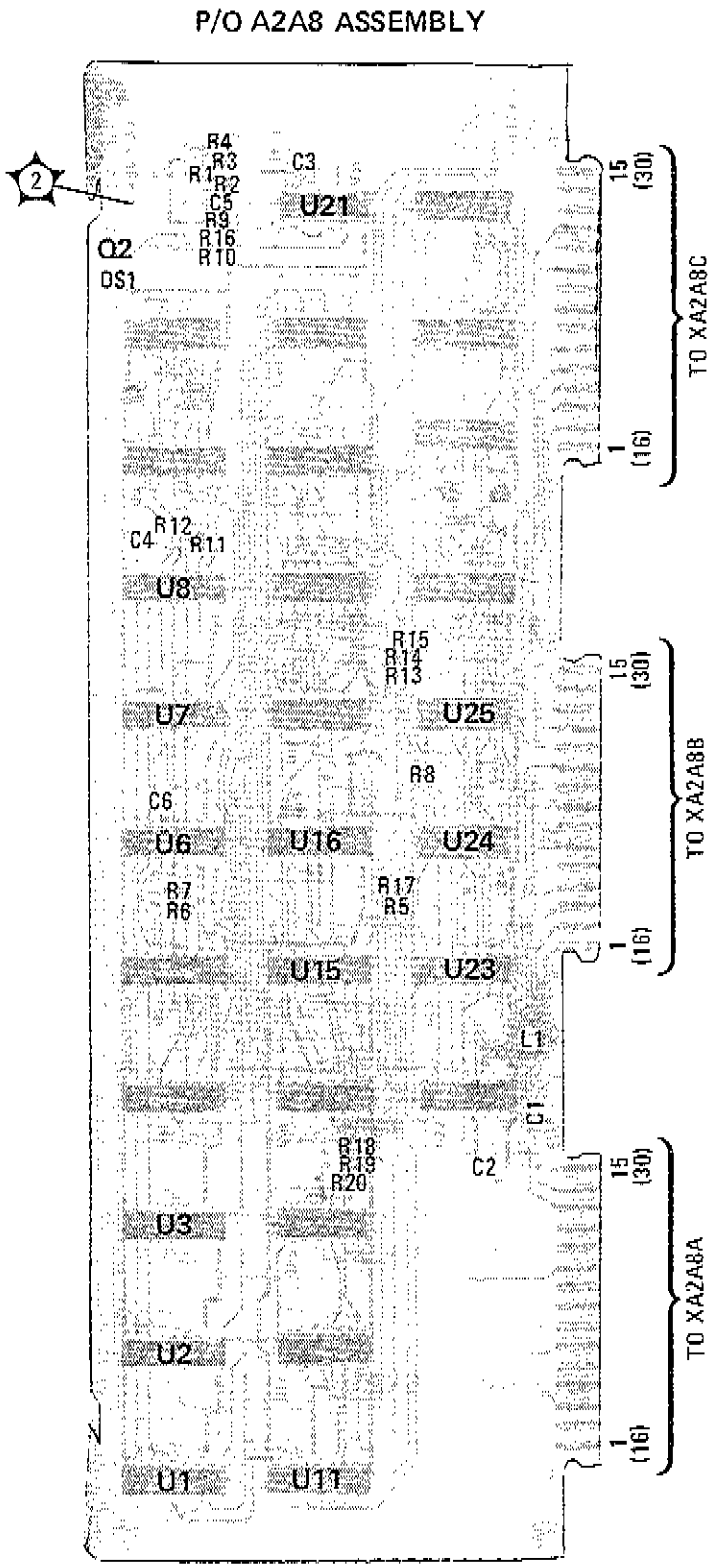
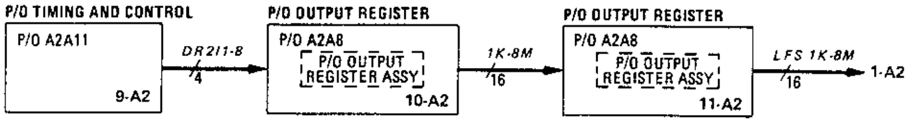


Figure 8-54. P/O A2A8 Output Register Assembly Component and Test Point Locations



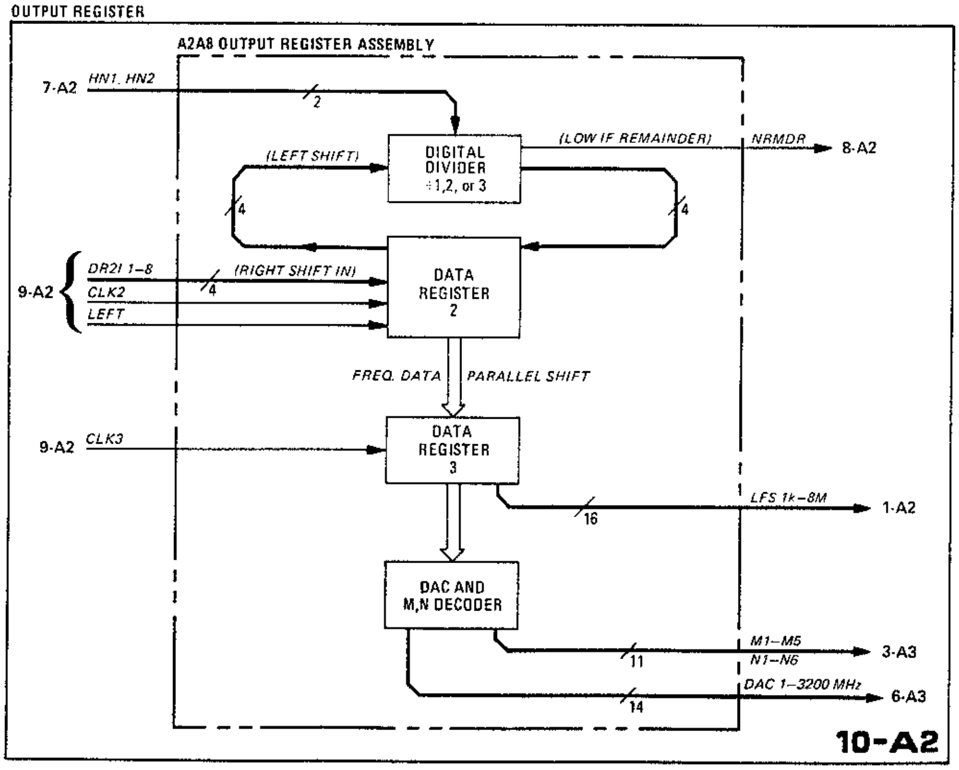


Figure 8-55. P/O Output Register Block Diagrams

FIG. 8-56
Sht 1 of 4

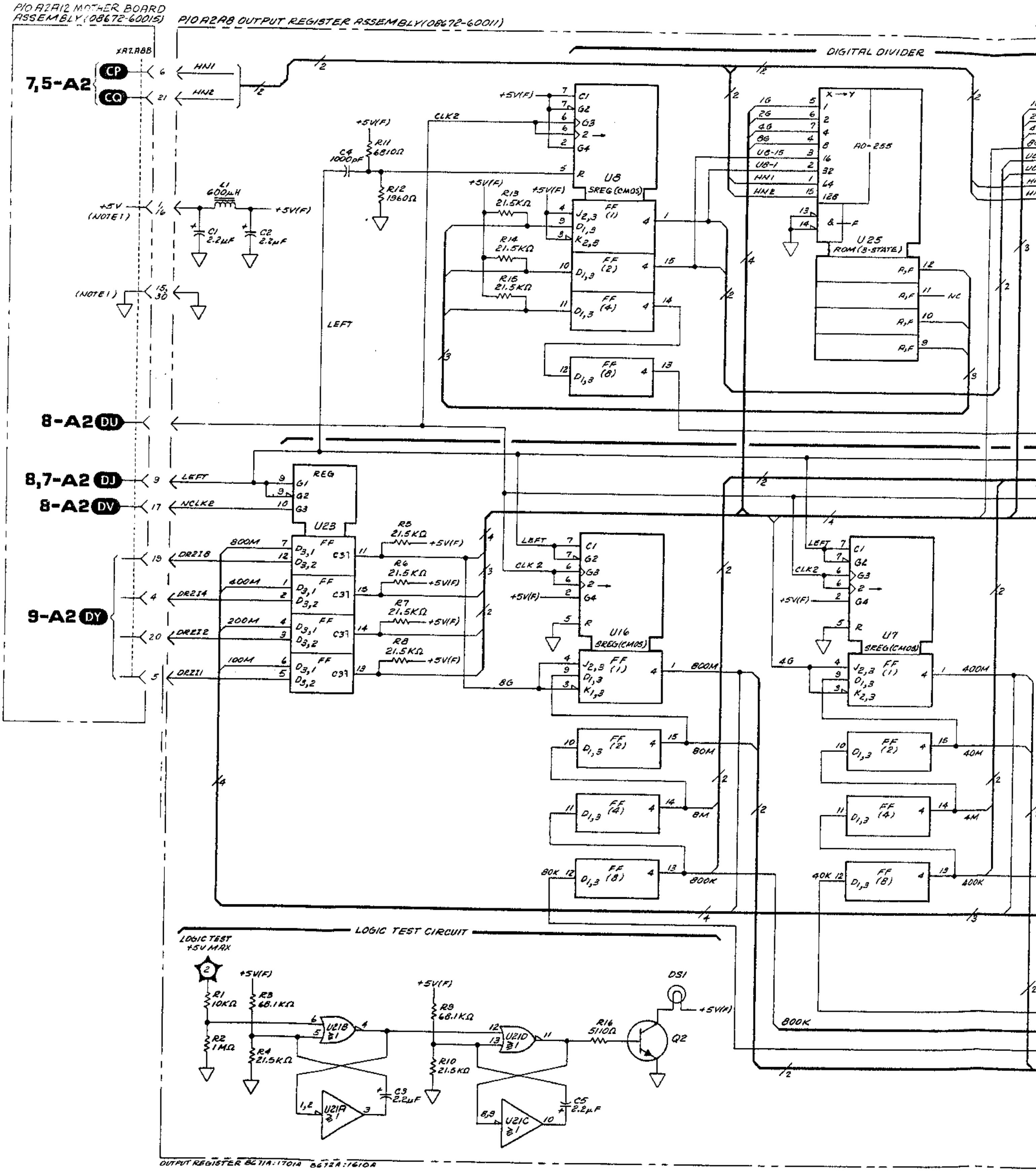


FIG. 8-56
Sht 2 of 4

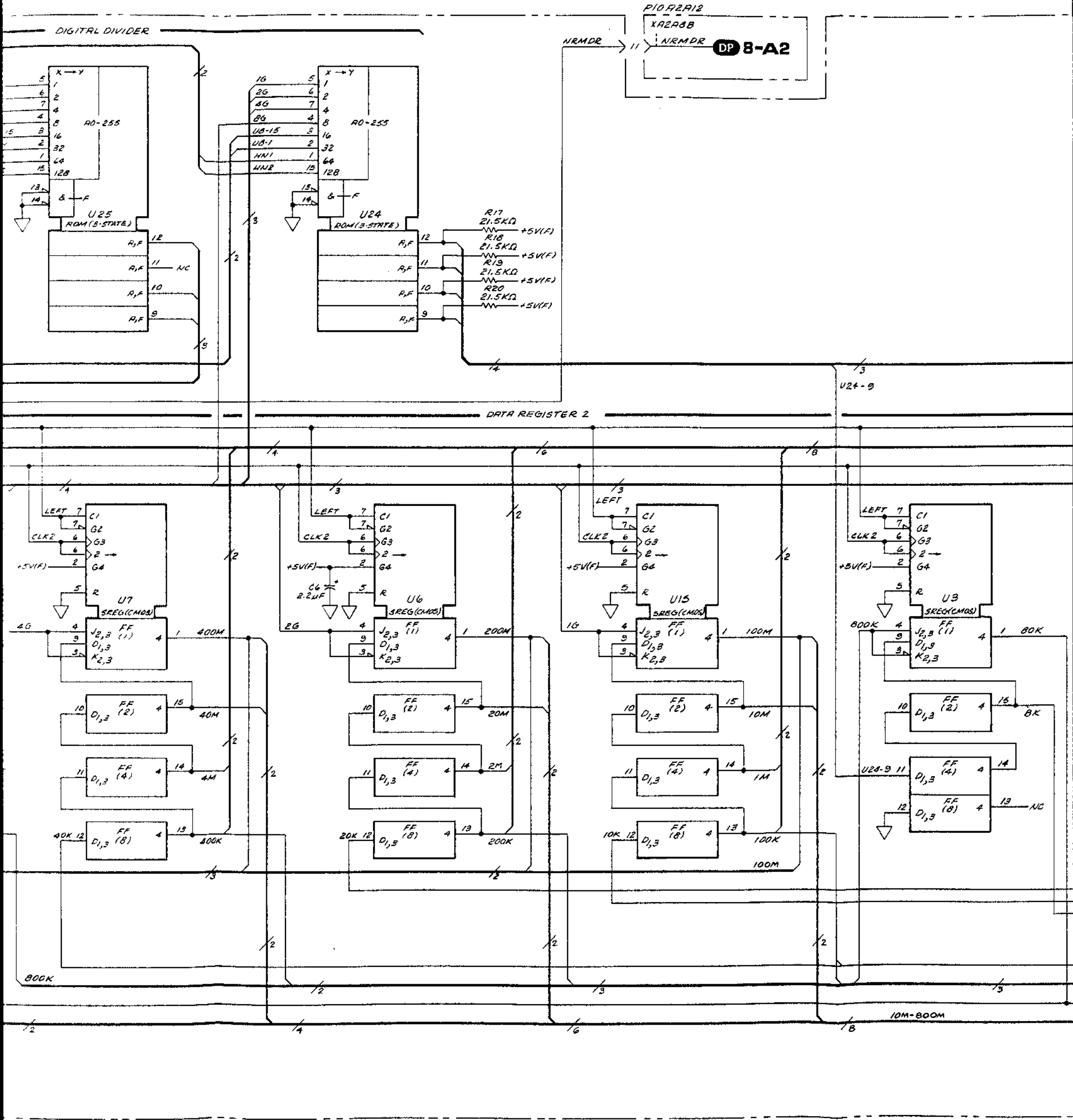
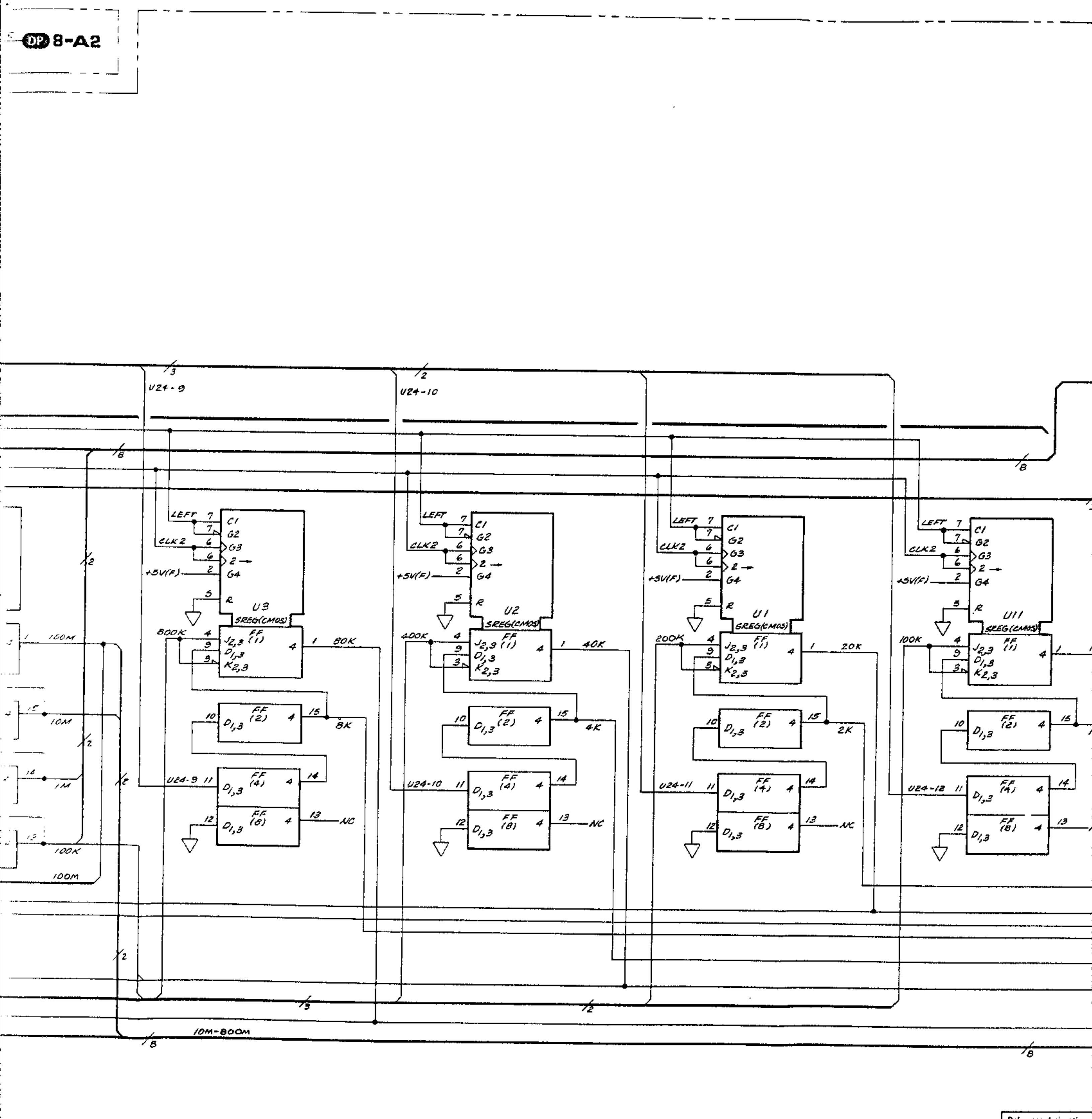


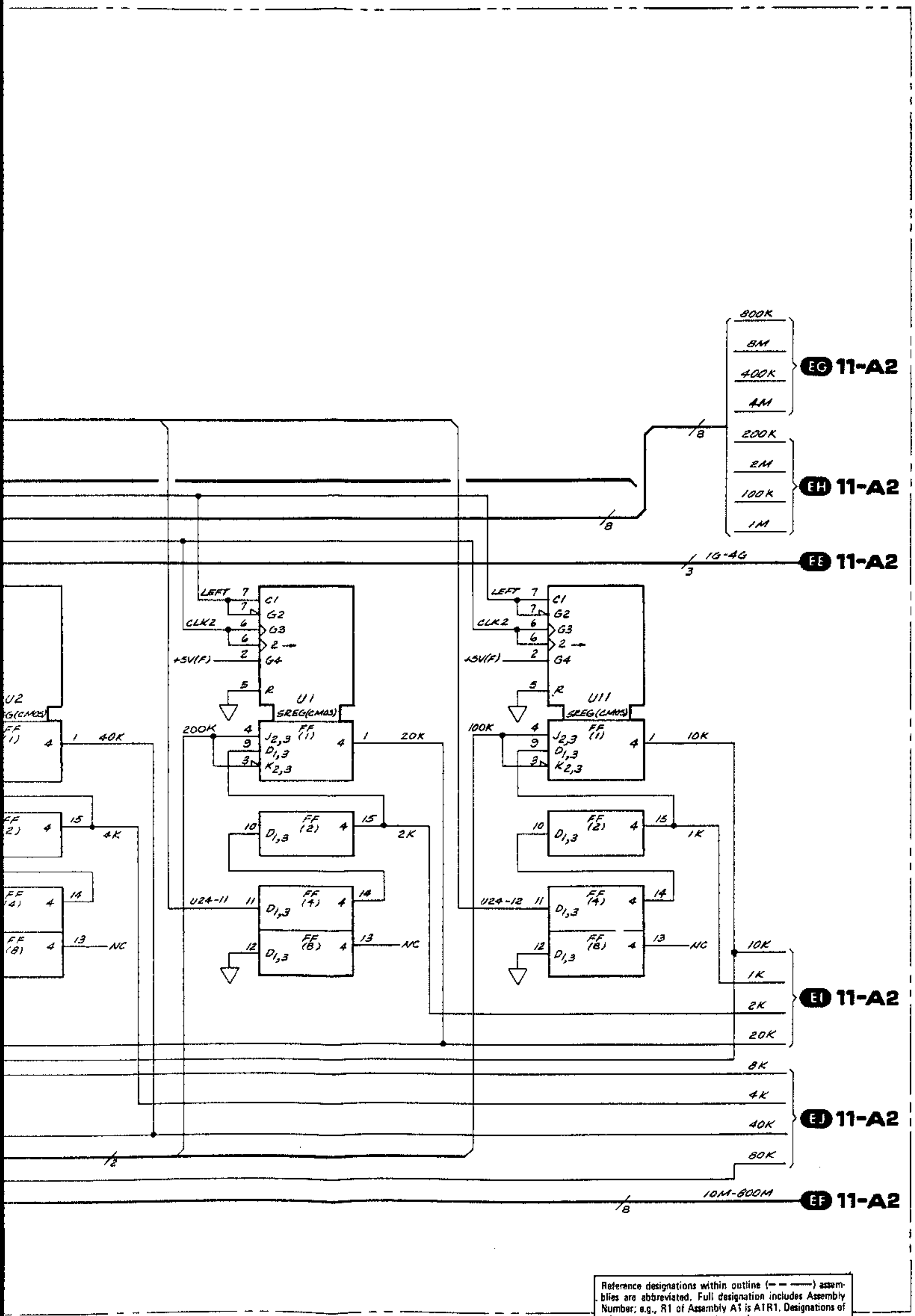
FIG. 8-56
Sht 3 of 4



Reference designations
blies are abbreviated.
Number; e.g., R1 of As
other components are c

Figu

FIG. 8-56
Sht 4 of 4



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 1-A2

REFERENCE DESIGNATIONS

A2A8	A2A12
C1-6 DS1 L1 Q2 R1-20 TP2 U1-3, 6-8, 11, 15, 16, 21, 23-25	XA2A8B

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
Q2	1854-0071
U1-3, 6-8, 11, 15, 16	1820-2080
U21	1820-1745
U23	1820-0656
U24, 25	1816-0782

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1-3, 6-8, 11, 15, 16, 23-25	+5V(F) - 16 ▽ - 8
U21	+5V(F) - 14 ▽ - 7

10-A2
P/O A2A8

Figure 8-56. P/O Output Register Assembly Schematic Diagram

SERVICE SHEET 11-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-14

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 here the 1 kHz through 8 MHz digit information goes directly to the LFS loop. The DAC and M/N Decoder translates the remaining digits into tuning information for the YTO loop. The outputs relate to the Yig Tuned Oscillator (YTO) frequency as follows:

DAC 1—3200 MHz: round down to nearest 10 MHz

M and N look up the frequency in Table 8-4 and convert M and N to binary.

TROUBLESHOOTING

Troubleshooting is covered on Service Sheet 10-A2.

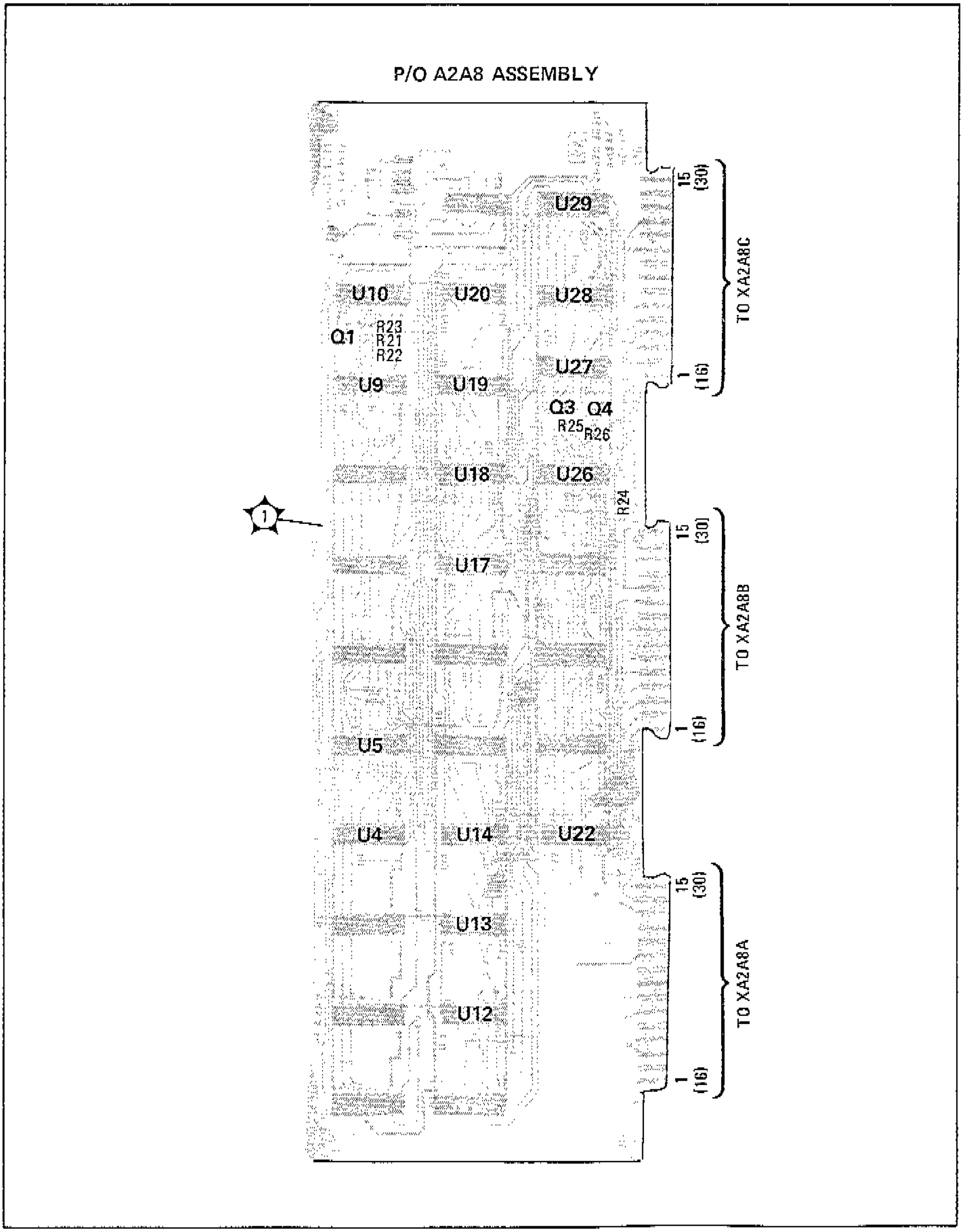
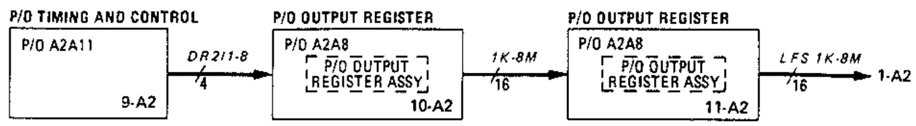


Figure 8-57. P/O A2A8 Output Register Assembly Component and Test Point Locations



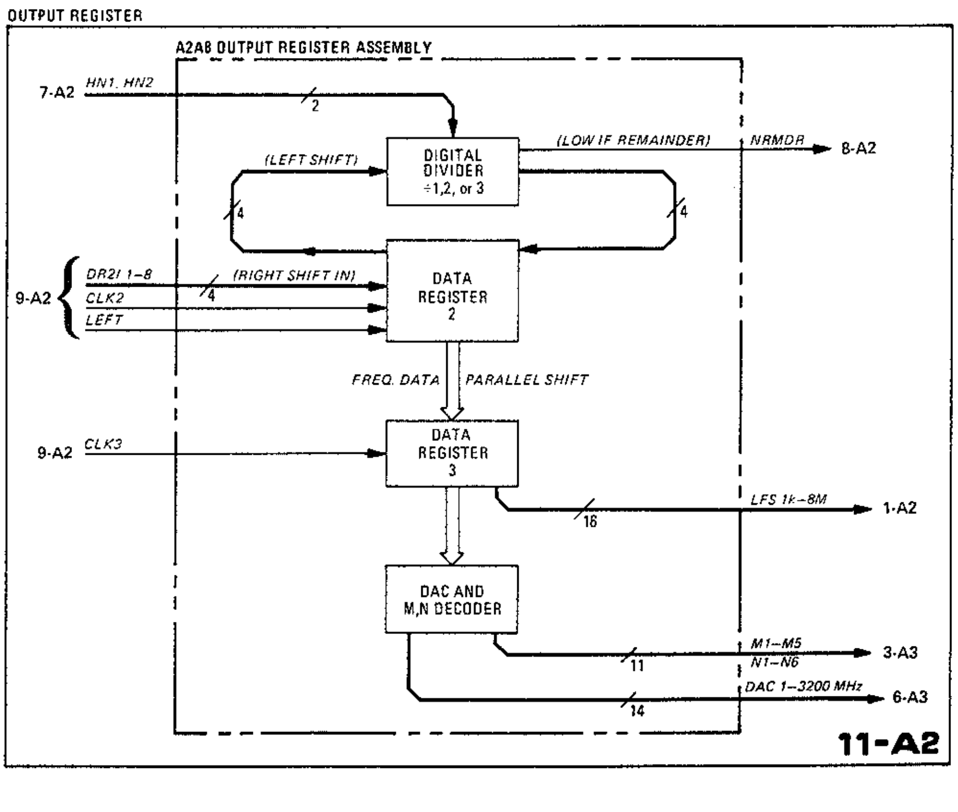


Figure 8-58. P/O Output Register Block Diagrams

FIG. 8-59
Sht 1 of 4

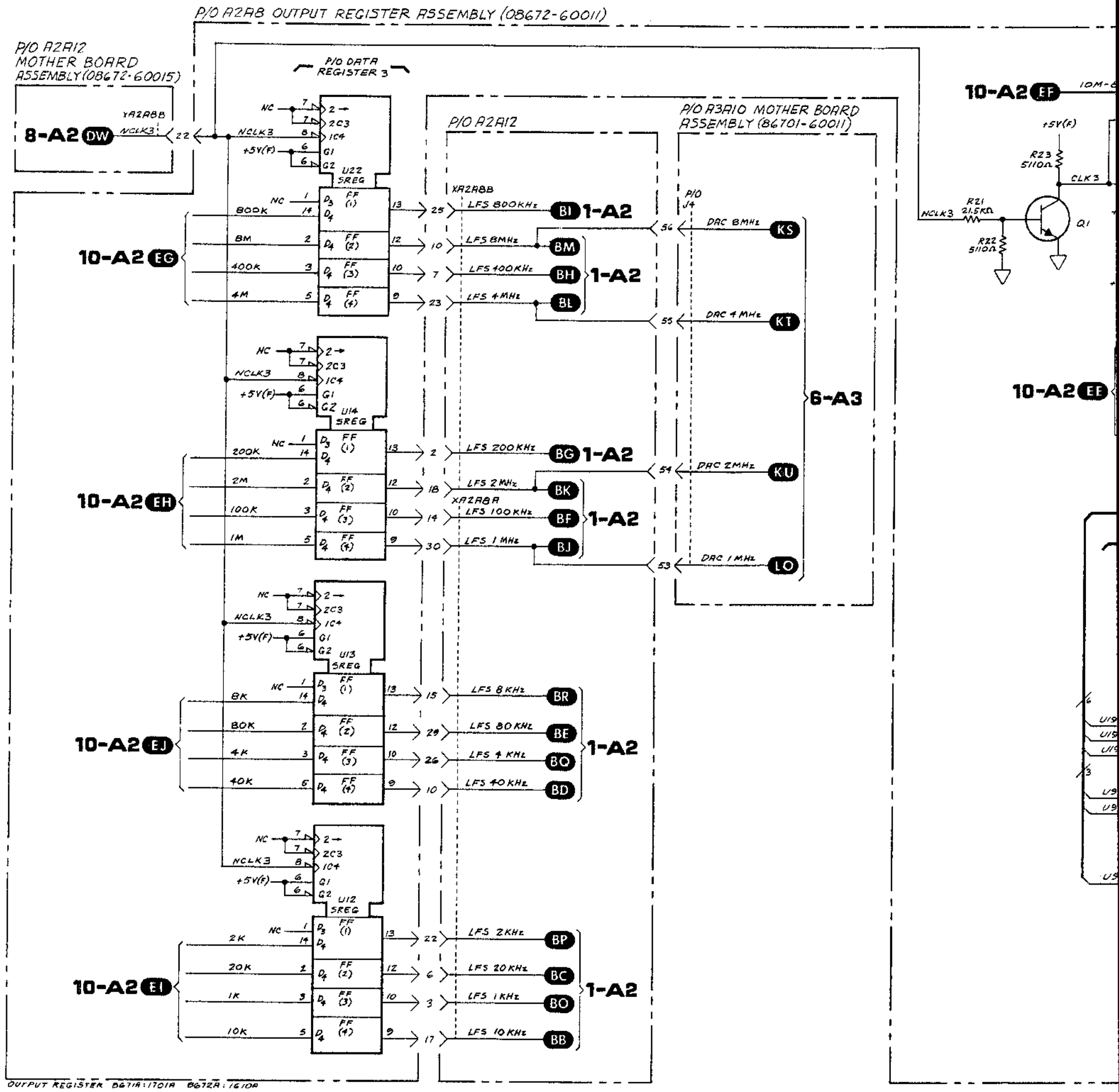


FIG. 8-59
Sht 2 of 4

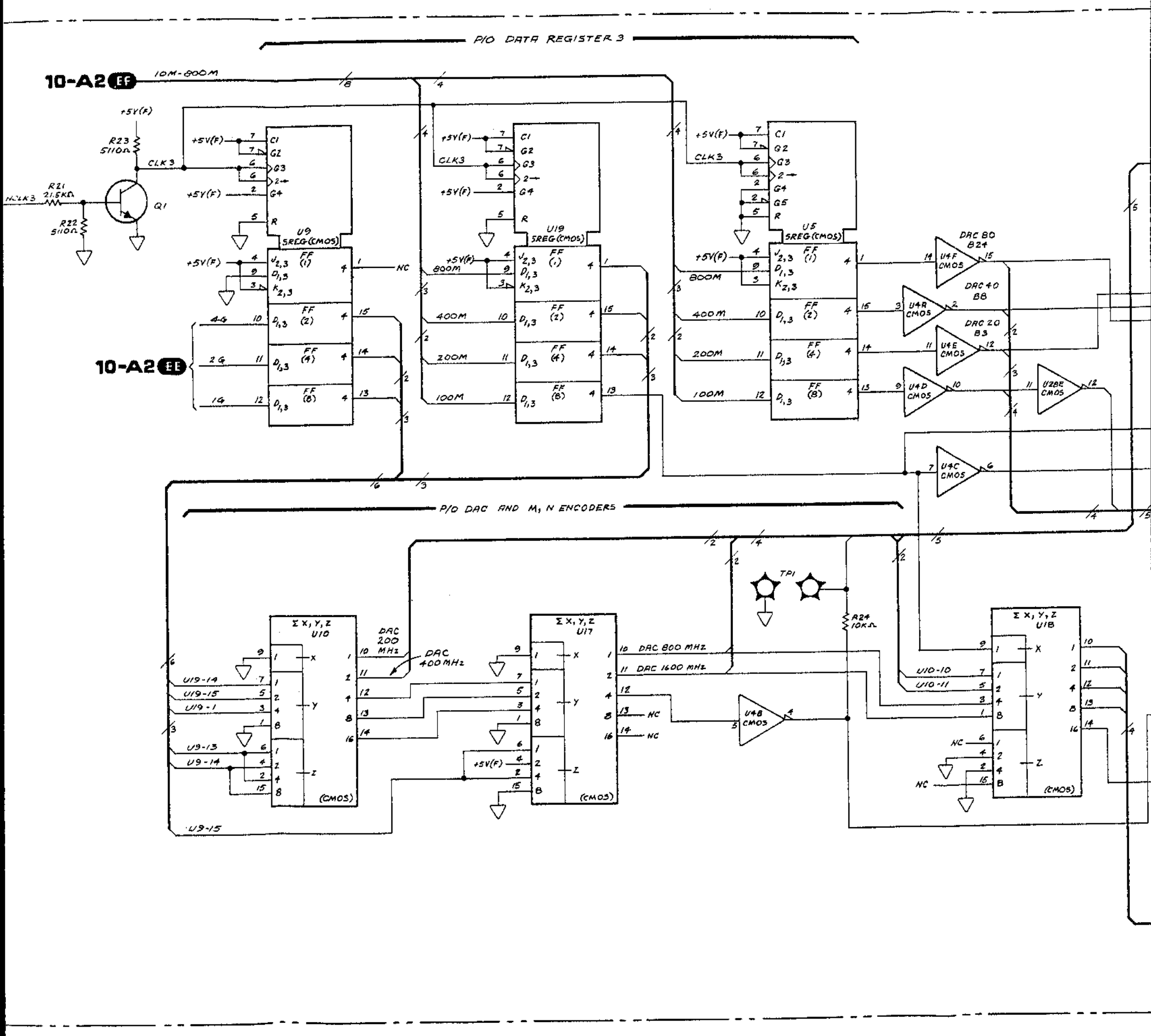
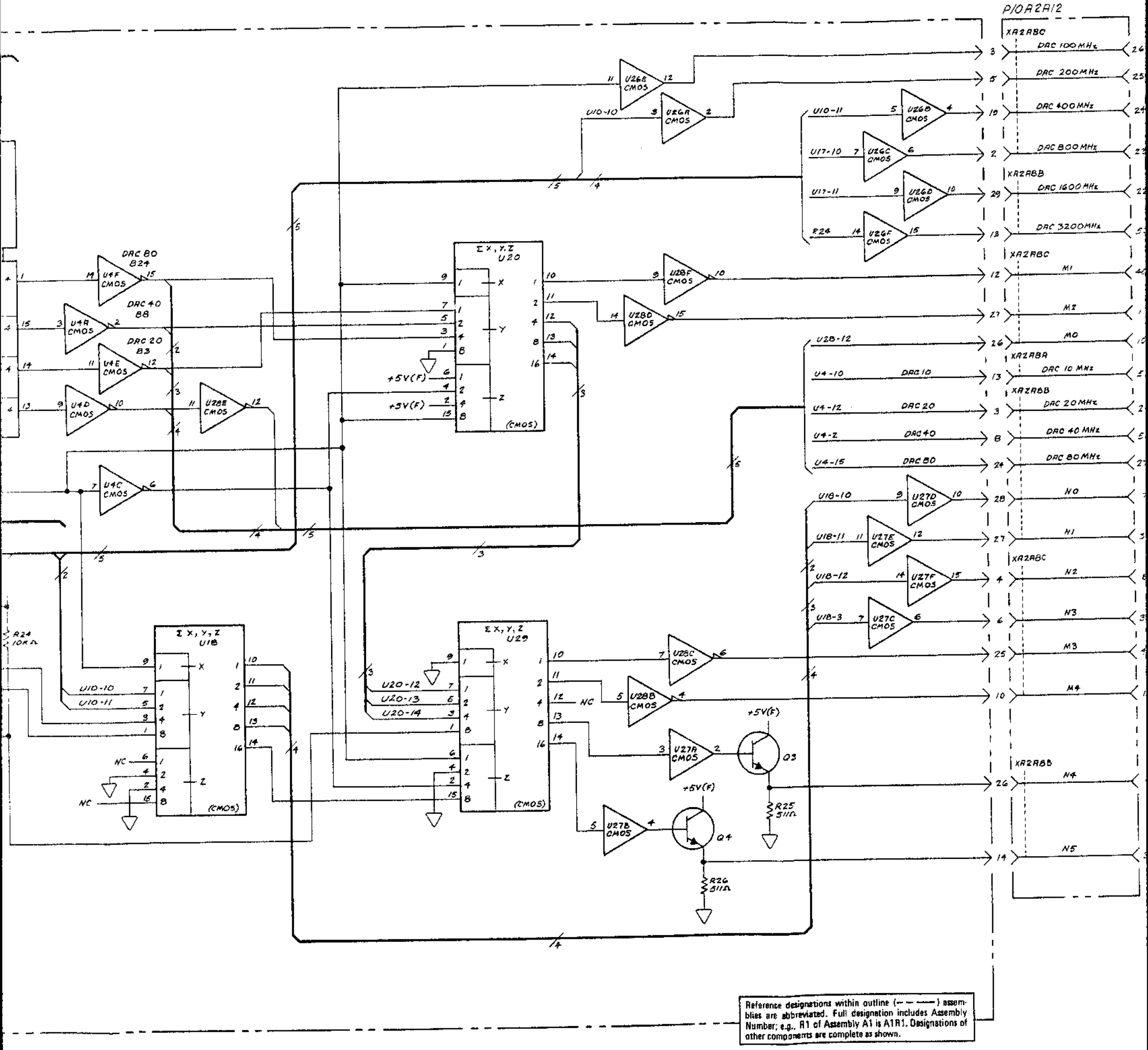


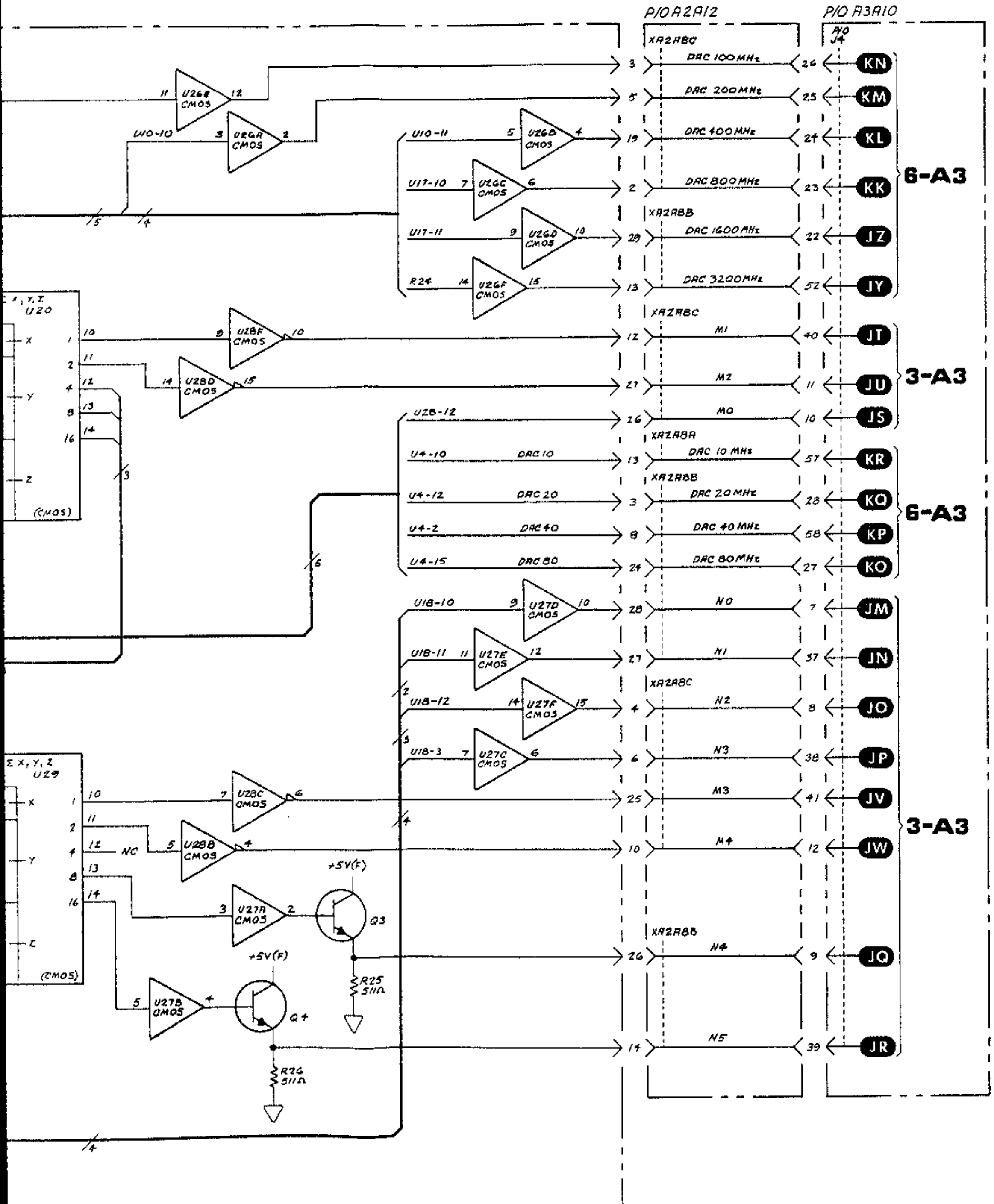
FIG. 8-59
Sht 3 of 4



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.

Figure 8-

FIG. 8-59
Sht 4 of 4



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 A2A8 ASSEMBLY ARE SHOWN ON SERVICE SHEET 10-A2

REFERENCE DESIGNATIONS

A2A8	A2A12
Q1,3,4 R21-26 TP1 U4,5,9,10, 12-14, 17-20, 22, 26-29	XA2A8A,B,C
	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
Q1,3,4	1854-0071
U4, 28	1820-1746
U5, 9, 19	1820-2080
U10, 17, 18, 20, 29	1820-1955
U12-14, 22	1820-0497
U26, 27	1820-1976

INTEGRATED CIRCUITS VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U4, 26-28	+5V(F) - 1 ▽ - 8
U5, 9, 10, 17-20, 29	+5V(F) - 16 ▽ - 8
U12-14, 22	+5V(F) - 4 ▽ - 11

11-A2
P/O A2A8

Figure 8-59. P/O Output Register Assembly Schematic Diagram

SERVICE SHEET 12-A2

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-7

PRINCIPLES OF OPERATION

General

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

This portion of the A2A1 Assembly contains status indicators, tuning resolution indicators and the ±1 bit control circuitry. The lamp drivers and status indicators show, by front panel lights, the following conditions; INT 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 Synthesizer tuning. If one of the RESOLUTION buttons is pressed, the frequency resolution indicators and lamp drivers will indicate 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 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 goes low, 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 switches. OR gate Buffer, U1, drives the frequency resolution indicator circuitry, insuring that the selected resolution light and any higher significant digit lights are on.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1, 3, and 10-A2 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 180C/1801A/1821A

SERVICE SHEET 12-A2 (Cont'd)

1. Set Synthesizer to ON. Press the PRESET (3 GHz) pushbutton. Push the right hand (least significant digit) tuning resolution pushbutton. All four tuning resolution indicators should light. Rotate the TUNING knob clockwise and counterclockwise. The frequency should change in 1 kHz steps. If not OK, skip to step 9.

2. Press the next tuning resolution pushbutton. The least significant indicator should unlight. The frequency should tune in 10 kHz steps.

3. Press the next tuning resolution pushbutton. The 10 kHz resolution indicator should unlight. The frequency should tune in 1 MHz steps.

4. Press the most significant tuning resolution pushbutton. Only the most significant resolution indicator should remain lit. The frequency should tune in 100 MHz steps.

5. Press the HOLD pushbutton. The remaining tuning resolution indicator should unlight and the frequency should not change when the TUNING knob is turned. If everything is OK so far, the tuning circuits on the Service Sheet are OK. Otherwise, skip to step 9.

6. Set the rear panel REF switch to EXT. The INT REFERENCE OFF and NOT PHASE LOCKED lamps should light. Return the switch to INT.

7. Remote program the synthesizer to 40 GHz (out of range). The REMOTE and OUT OF RANGE lamps should light.

9830		9825
CMD "?U3", "P4Z1"	or	wrt 719, "p4Z1"

   If everything is OK thru this step, the circuits on 12-A2 are OK.

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

   NOTE

   When the Synthesizer is returned to local with an out of range frequency displayed, it will begin to search in 1 kHz steps until a legal frequency is reached. If one of the tuning resolution pushbuttons is pressed, the instrument will search in the resolution selected.

9. If the frequency tunes but one or more of the resolution lamps do not light, troublehsoot 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 Board (8-A3)
    - Reference phase lock loop (1-A3)
    - Rotary Pulse Generator (13-A2)
    - Register 1 (7-A2)
    - Resolution Register (this service sheet).

SERVICE SHEET 12-A2 (Cont'd)

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 OK, the circuits on 12-A2 are OK.

If the pulses are not correct or not present, check A2A1U9 pin 10 for the presence of CLK1 before troubleshooting U5 and U9 and U6.

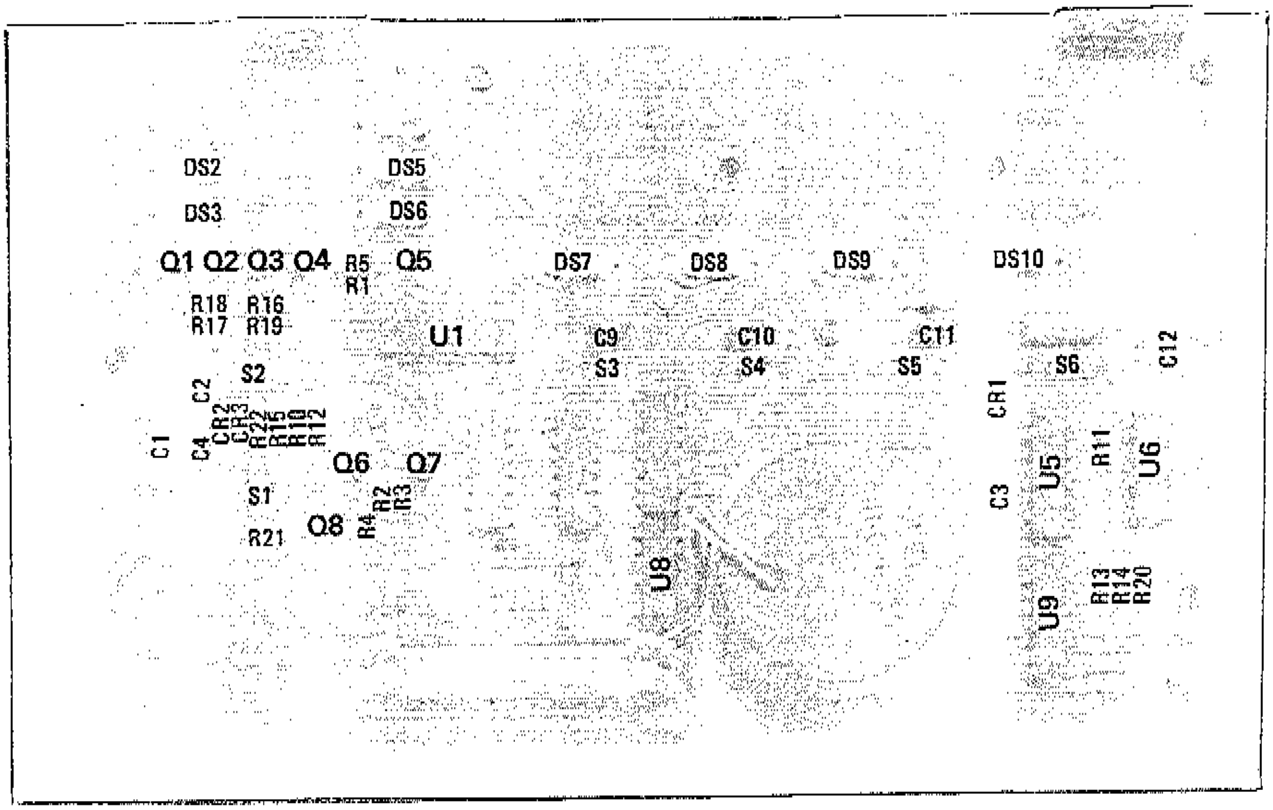
MNEMONICS

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 Least 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 pulse occuring during the first half of a data cycle. Each pulse corresponds to a frequency digit.

DEFINITION

Data Cycle — The process of changing the Synthesizer's frequency by adding or subtracting 1 from one of the digits.

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 8-60. P/O A2A1 Front Panel Assembly Component Locations

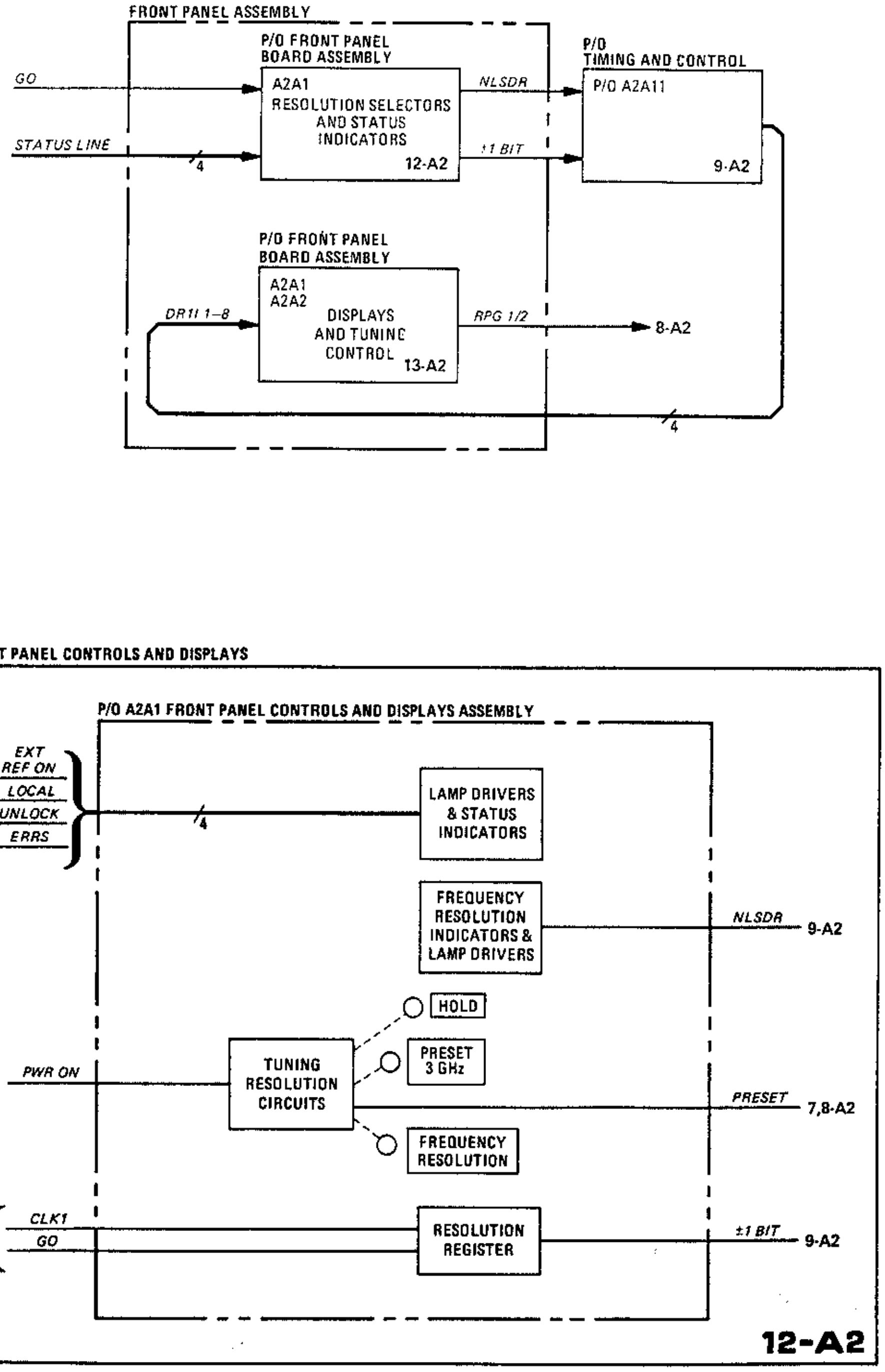


Figure 8-61. P/O Front Panel Block Diagrams

FIG. 8-62
Sht 1 of 3

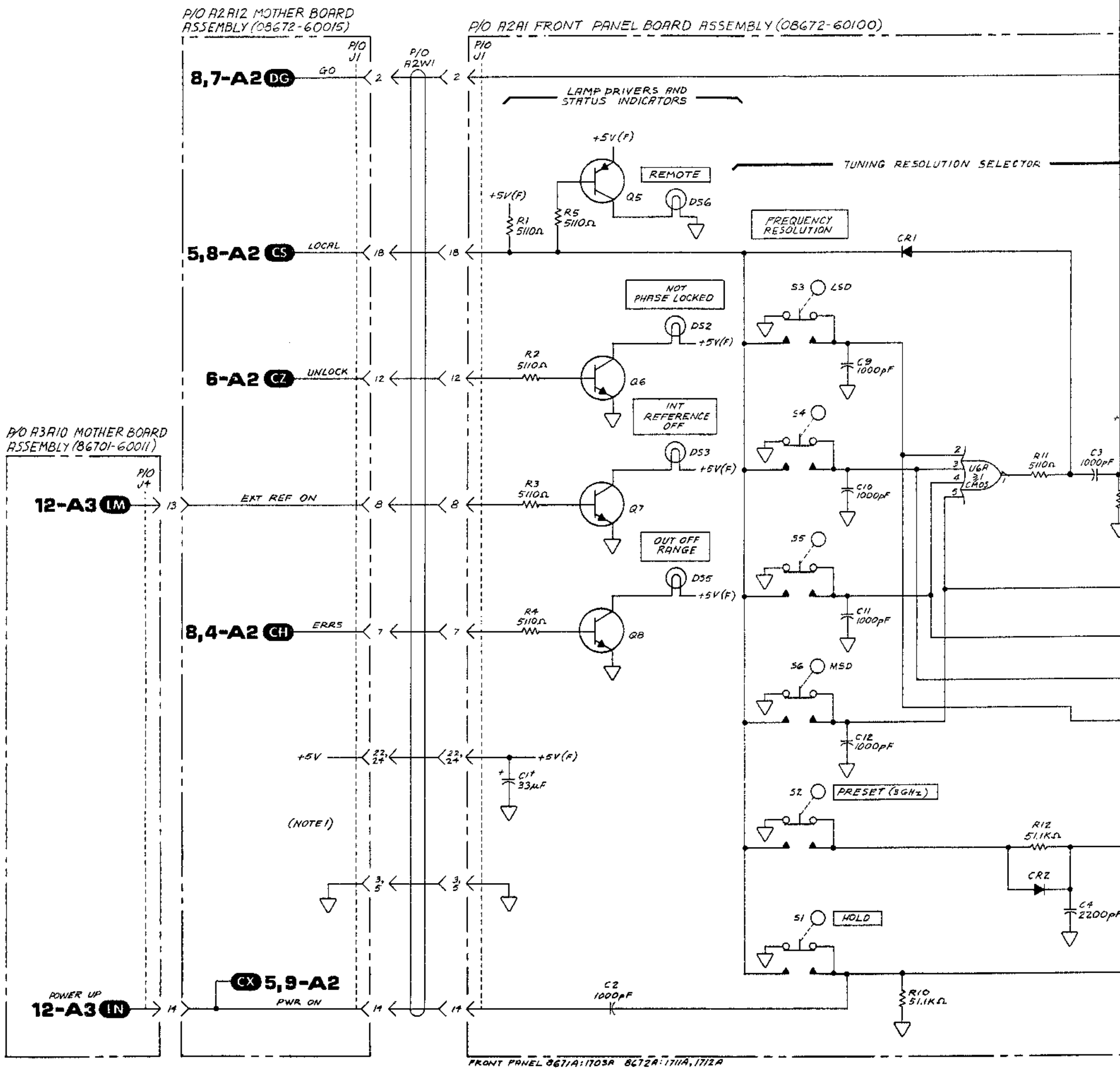
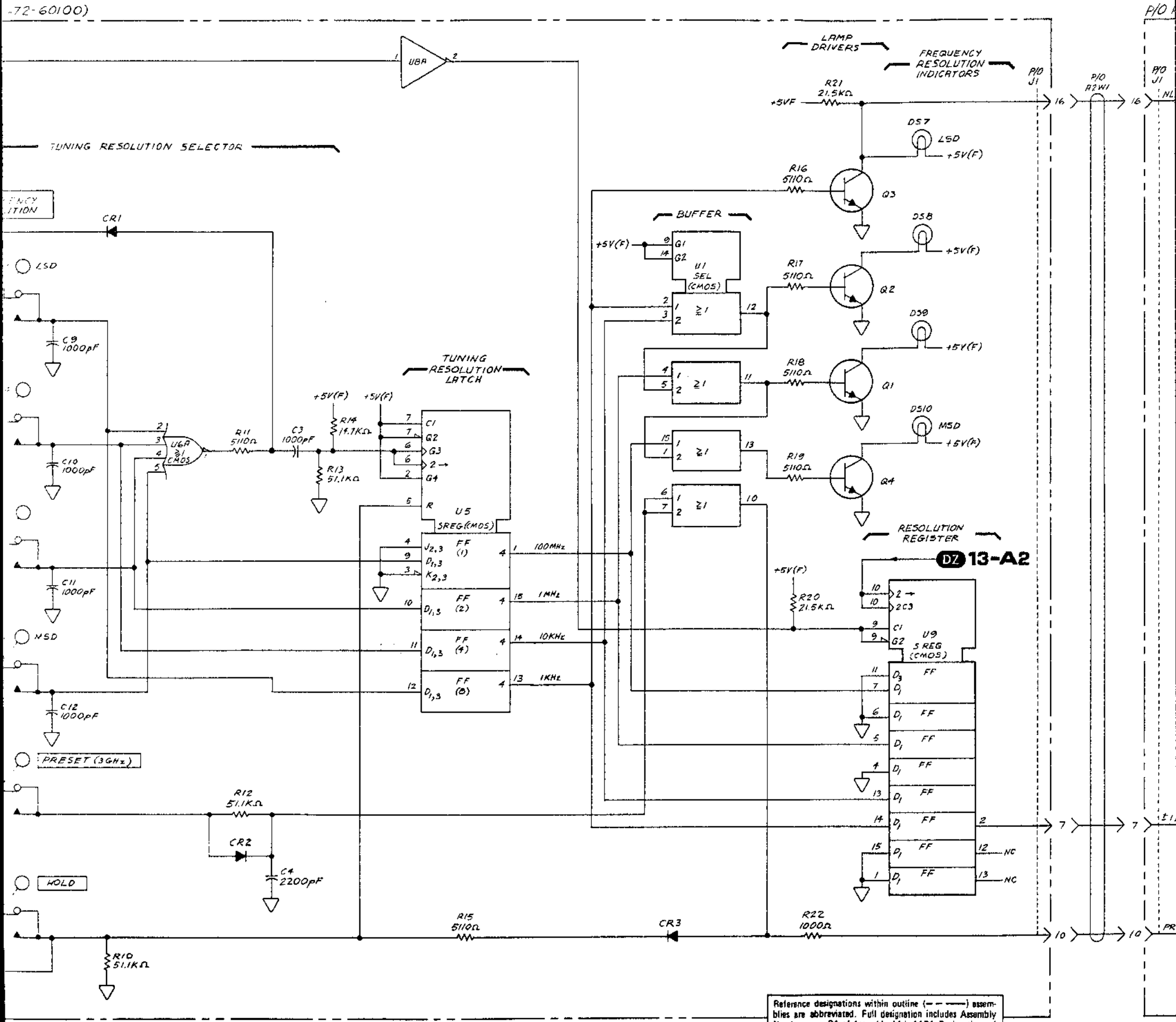


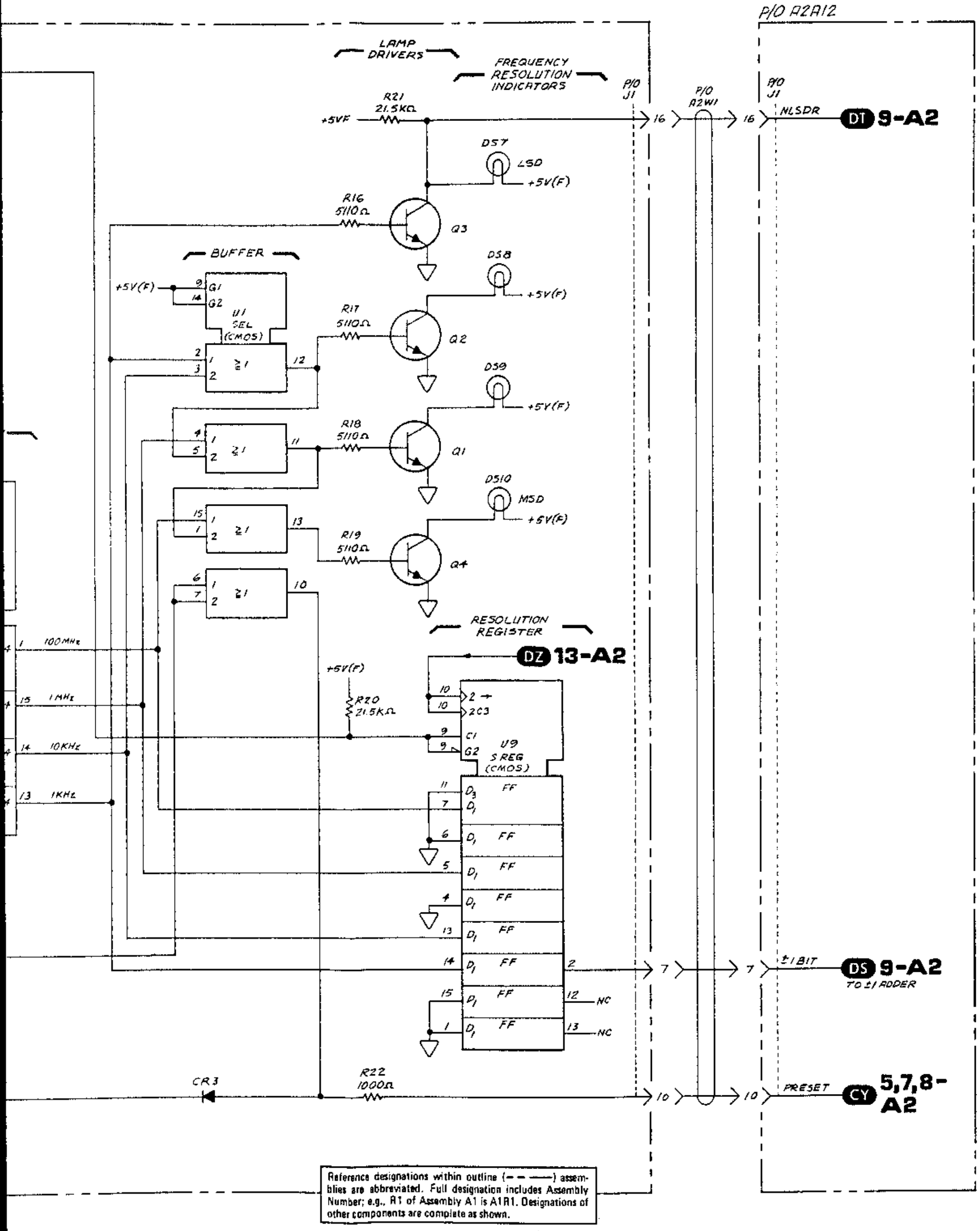
FIG. 8-62
Sht 2 of 3



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.

Figu

FIG. 8-62
Sht 3 of 3



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 1-A2.

† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

A2A1	A2
C1-4, 9-12 CR1-3 DS2,3,5-10 J1 Q1-8 R1-5,10-22 S1-6 U1,5,6,8,9	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
Q1-4, 6-8	1854-0071
Q5	1853-0020
U1	1820-2085
U5	1820-2080
U6	1820-2079
U8	1820-1199
U9	1820-2031

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1	+5V(F) - 8 ▽ - 14
U5, 9	+5V(F) - 16 ▽ - 8
U6, 8	+5V(F) - 14 ▽ - 7

12-A2
P/O A2A1

Figure 8-62. P/O Front Panel Assembly Schematic Diagram

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-35
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-7

PRINCIPLES OF OPERATION

General

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

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

P/O Front Panel Board Assembly

Decoder/display chips DS1 through DS8 display the Synthesizer'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 display chips. U4 is clocked by CLK1 which is delayed by R23, C5, U8C and U8E. The delay allows for 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 insuring that only leading zeros are blanked. NOR gate U6B indicates zeros by outputting a high. This high 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 light comes on when the 10 MHz crystal 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 1, 3, and 10-A2 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 3455A

SERVICE SHEET 13-A2 (Cont'd)

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 display LED's are properly receiving data.

NOTE

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

2. Set the frequency to 2345.678 MHz. Disconnect the 10 MHz clock signal (blue coax) from A3A1A1. Set tuning the resolution to 1 kHz. If the frequency cannot be changed, go to step 5.

3. Turn the TUNING knob clockwise.

4. With the manual clock switch on A2A11 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 pulses. If the data does not clock in properly, check the input data (DR1I 1–8) with a logic analyzer or probe to assure it is correct. If the data is OK, troubleshoot U4, U3, and A2DS 1–8. If the data is incorrect, go to Service Sheet 9-A2 to continue troubleshooting.

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

6. Unplug the instrument for 1–2 minutes. Reconnect Mains. The OVEN and STANDBY lamps should both come on. If neither of them come on, suspect a burned out lamp (with the OVEN light A2A1U7 or the A3A8 Reference Oscillator could be defective). If everything is OK to this step, the A2A1 and A2A3 assemblies are OK.

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 an 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 OK and troubleshooting should proceed to Service Sheet 8-A2.

MENMONICS

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 a 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 changing the Synthesizer's frequency by adding or subtracting 1 from one of the digits.

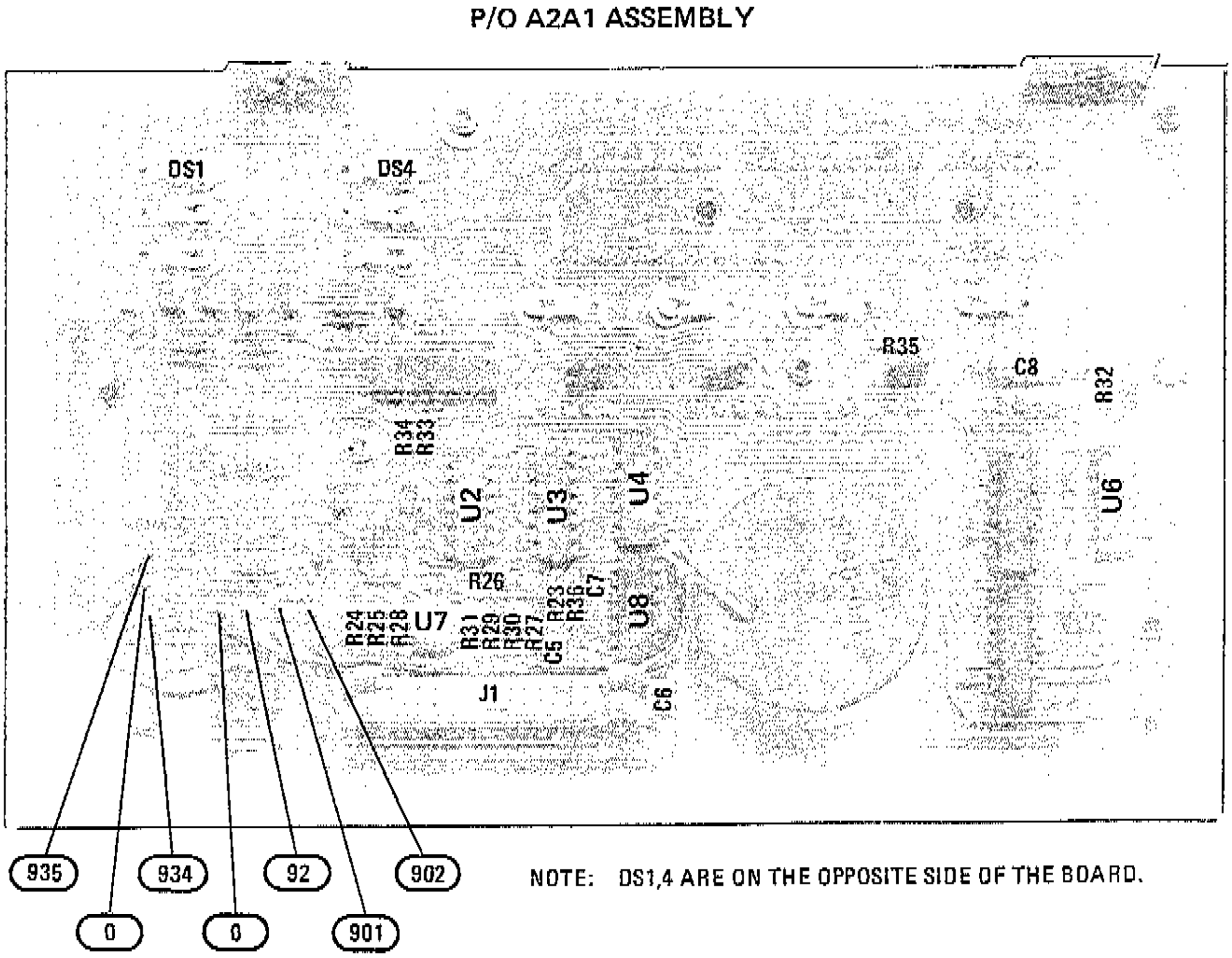
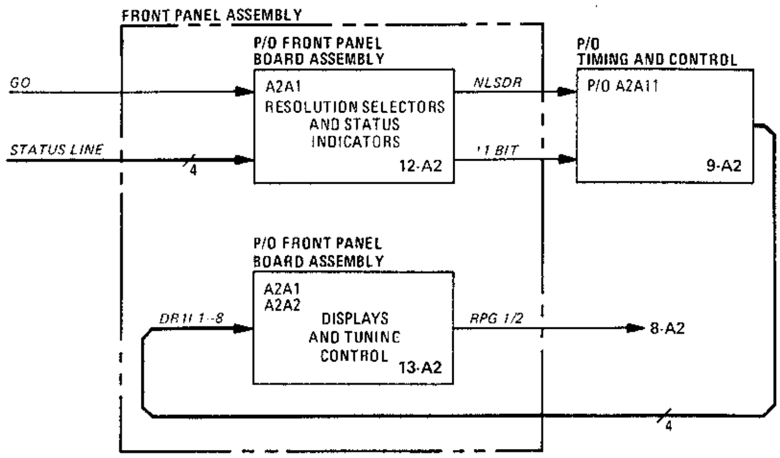


Figure 8-63. P/O A2A1 Front Panel Assembly Component Locations



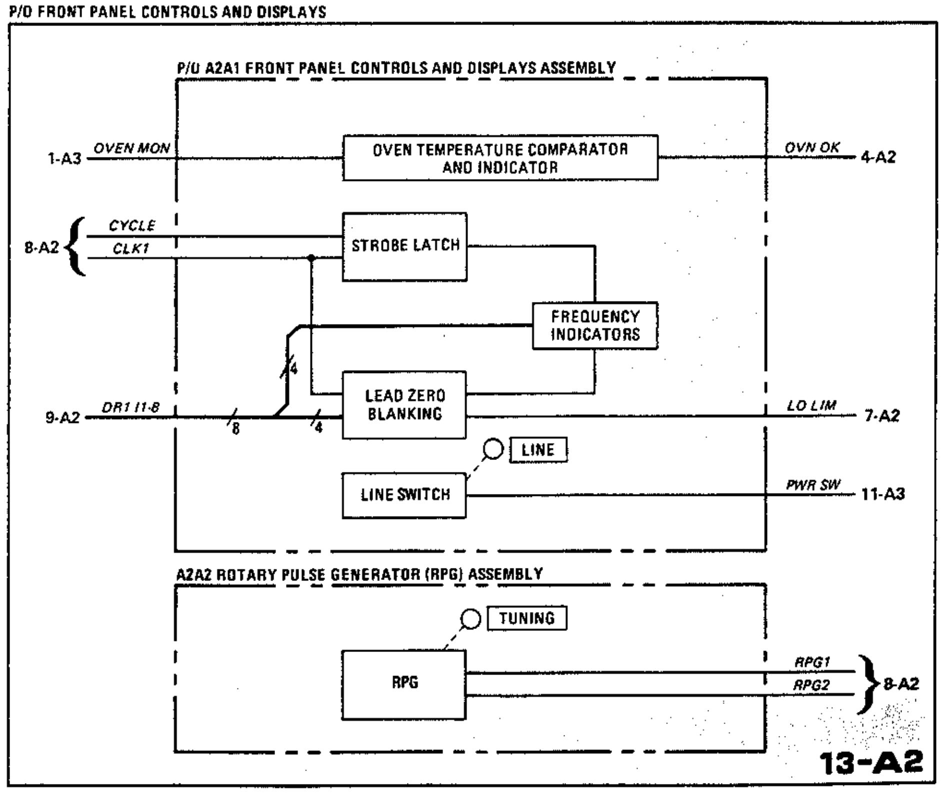


Figure 8-64. P/O Front Panel Block Diagrams

FIG. 8-65
Sht 1 of 2

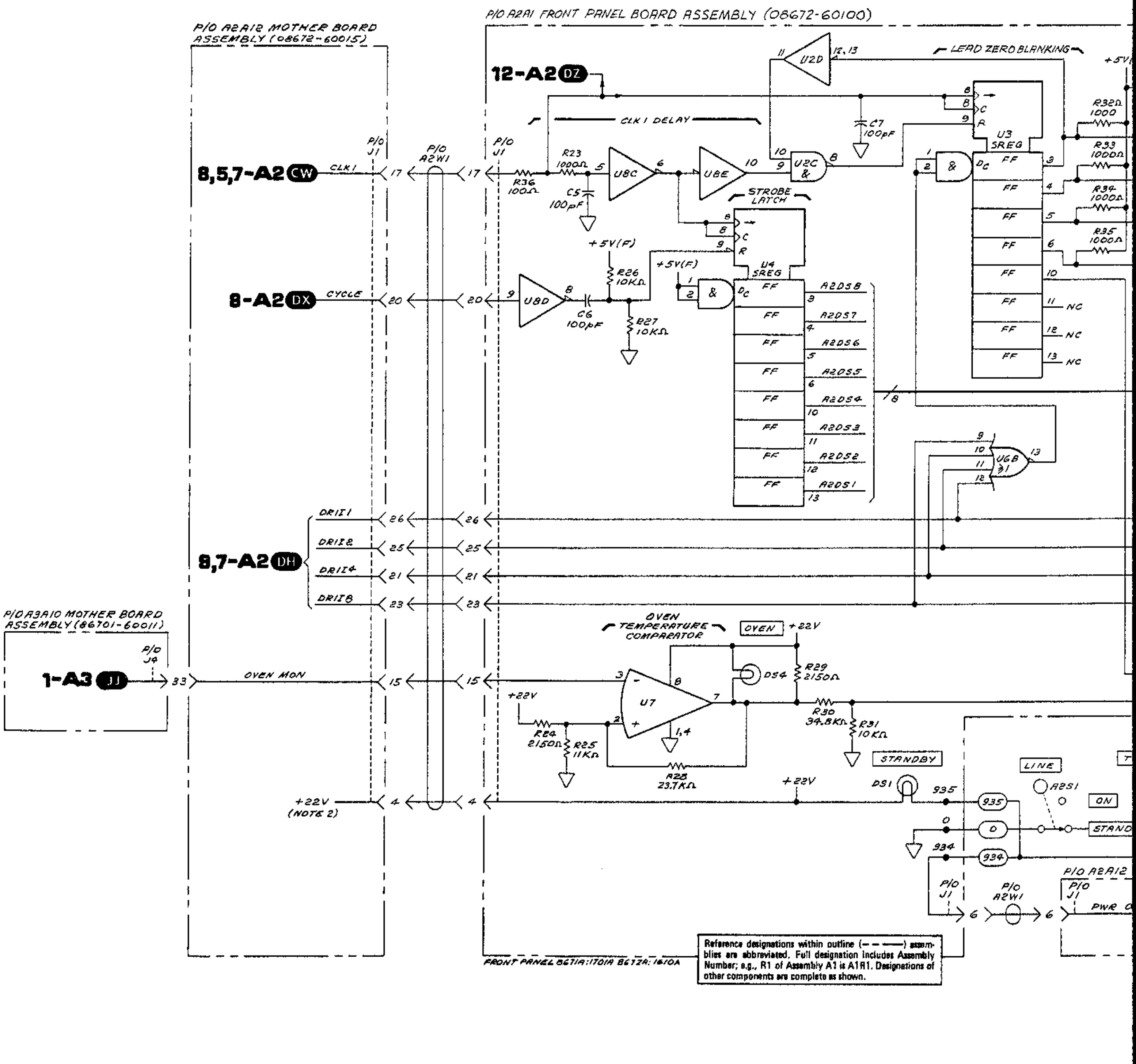
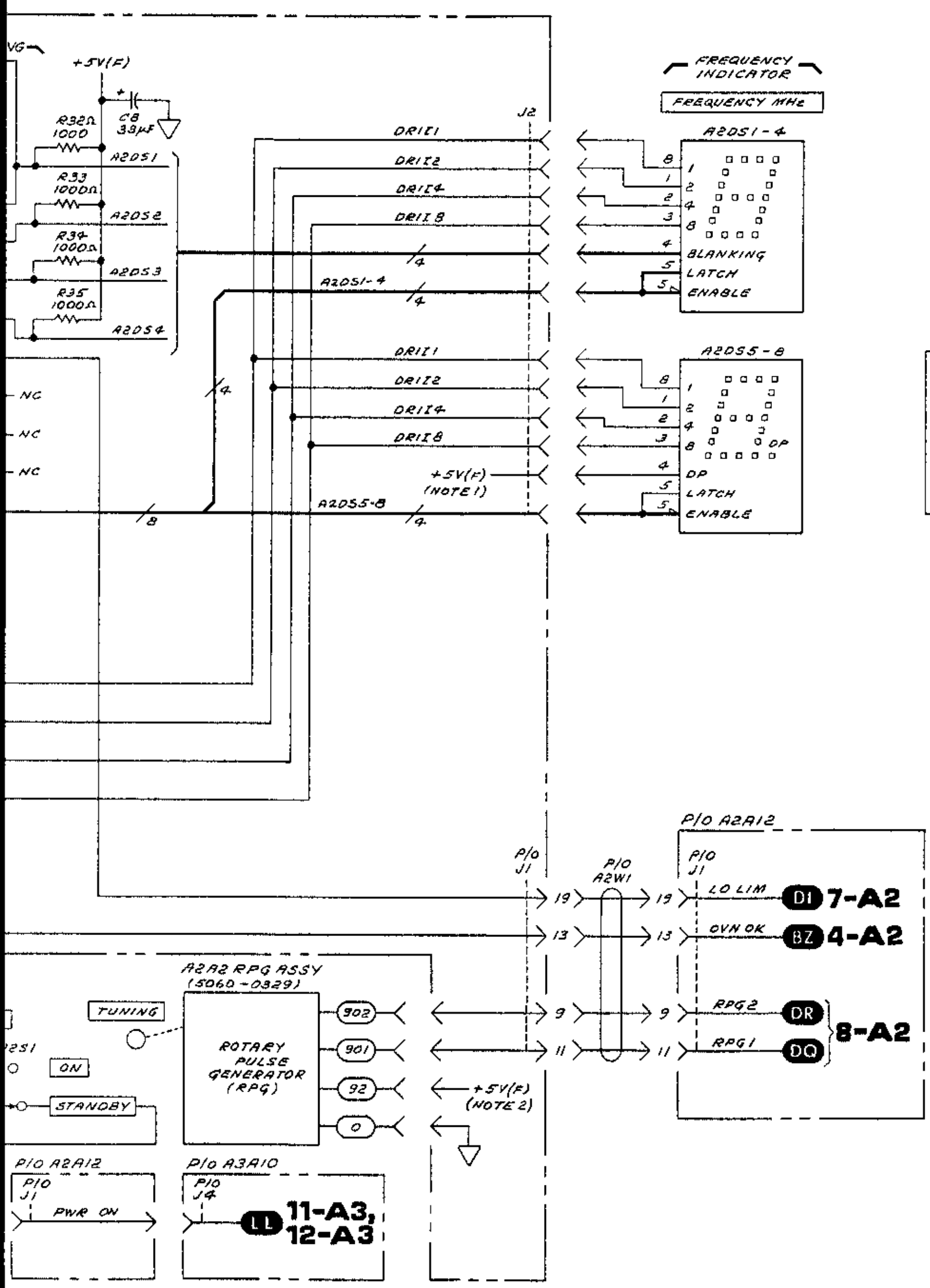
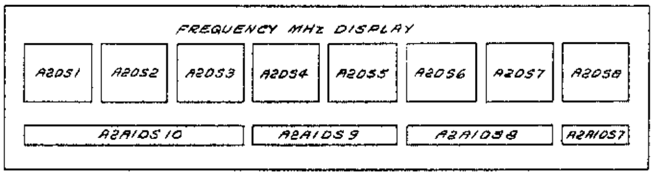


FIG. 8-65
Sht 2 of 2



NOTES
1. PIN 4 OF A2DS5 IS CONNECTED TO GROUND.
   PIN 4 OF A2DS6-8 IS CONNECTED TO +5 V(F).
2. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1-A2.



REFERENCE DESIGNATIONS

A2A1	A2
C5-8 DS1,4 J1 R23-36 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	
DS 1-4	1990-0651
DS 5-8	1990-0504
A2A1	
U2	1820-1197
U3,4	1820-1433
U6	1820-2079
U7	1826-0026
U8	1820-1199

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
A2 DS 1-8	+5V(F) - 7 ▽ - 6
A2A1 U2-4,6,8	+5V(F) - 14 ▽ - 7

13-A2
P/O A2A1

Figure 8-65. P/O Front Panel Assembly Schematic Diagram

SERVICE SHEET 1-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-33
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-21, 6-40
- Performance tests — Refer to Table 5-3 on Page 5-3
- Adjustment procedures — Page 5-2

PRINCIPLES OF OPERATION

General

The Reference Loop locks the M/N Loop and 20/30 MHz (LFS) Loop to the Synthesizer's time base. Two reference signals, 20 and 400 MHz, are provided for the M/N Loop. The 10 MHz signal is the reference for the 20/30 MHz Loop. It also is the master clock for the controller's digital circuits.

The output of the 100 MHz VCXO is used to generate the reference signals and to phase lock the Reference Loop. The signal is multiplied by 4, to 400 MHz. It is also buffered and output to the rear panel's 100 MHz OUT connector. A portion of the 100 MHz is divided by 5 to 20 MHz. The 20 MHz signal is divided by two to 10 MHz. A portion of this signal is phase compared to the 10 MHz time base signal. The resulting error voltage tunes the VCXO to achieve phase lock.

A3A8 10 MHz Reference Oscillator

The oscillator's oven temperature is held constant by an internal heater control unit. This unit is powered by the +22V supply and therefore receives power any time the Synthesizer is connected to the line power. The OVEN MONITOR signal controls a front panel OVEN annunciator which indicates that the oscillator has not reached operating temperature. The oscillator's RF operation is controlled by the rear panel FREQUENCY STANDARD INT/EXT switch through the +11V switched supply voltage.

A3A1A1 Reference Phase Detector Assembly

Phase Lock Sampler. This circuit outputs a dc level which is proportional to the phase difference between its two input frequencies. The sampling signal comes from the 10 MHz Reference Oscillator Assembly. The sampled signal is derived from passing the 100 MHz VCO output through a divide-by-ten circuit.

The Sampling signal passes through the Limiting Amplifier. Here the output level is converted to TTL logic levels before being input to the Pulse Generator. U2D squares up the output of the Limiting Amplifier. The signal to U2A pin 2 and 3 is inverted and delayed by R11 and C5. The delay causes a narrow pulse at TP1. The Buffer Amplifier supplies sufficient current to drive Phase Lock Sampler diodes CR3 and CR4.

The feedback (sampled) signal from the 100 MHz VCXO is divided-by-ten, amplified, phase shifted +45° and coupled to the Phase Lock Sampler. The Phase Lock Sampler output (the input to the integrating amplifier) is proportional to the phase difference between the reference and feedback signal. (This has been purposely set to 0 Vdc when the loop is locked). The small error voltage that is present when the loop is locked is integrated, amplified and output to the 100 MHz VCXO as a TUNE VOLTAGE.

SERVICE SHEET 1-A3 (Cont'd)

Lock Indicator Sampler. The operation of the Lock Indicator Sampler is similar to the Phase Lock Sampler. The only difference is that the feedback signal's phase at the Lock Indicator Sampler lags by 45°. The total difference in phase between the sampler inputs is 90°. This causes a maximum negative output from the Lock Indicator Sampler when the reference loop is locked. The Phase Lock Detector indicates the locked condition with a low output (equal to or more negative than −0.7 Vdc).

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1 and 2 was used to isolate a reference loop malfunction. The following information will allow further isolation to circuits shown by one of the two reference loop schematics 1-A3 or 2-A3. If the malfunction is on 1-A3, this information will also aid in isolating the defective component.

Test Equipment

Oscilloscope . . . . HP 180C/1801A/1821A
Digital Voltmeter . . . . HP 3455A
Power Supply . . . . HP 6202B
Spectrum Analyzer . . . . HP 8555A/8552B/141T
Power Meter . . . . HP 436A/8481A
Frequency Counter . . . . HP 5340A

NOTE

The power meter and frequency counter are to be used in place of the spectrum analyzer where precise power and frequency measurements are required.

1. Connect the A3A1A2 TUNE test point to a −8 Vdc power supply. The counter should measure 100 MHz ±100 Hz. If the signal is incorrect, go to Service Sheet 2-A3 to troubleshoot the VCXO. (The VCXO may only need to be adjusted.) Otherwise, continue with step 2.

2. Connect the Synthesizer to the line voltage. Set the LINE switch to ON and allow 15 minutes for warm up. When the Synthesizer is first plugged in, the OVEN and NOT PHASE LOCKED lights should be on. The NOT PHASE-LOCKED light will generally go out after 15 minutes when the crystal reference is 10 MHz ±50 Hz. Make sure the rear panel reference jumper is installed, the FREQUENCY STANDARD INT/EXT switch is set to INT and the front panel RF switch is ON.

3. To test phase lock of the reference loop, connect an oscilloscope's vertical amplifier to the rear panel 10 MHz OUTPUT (A3J8). Insert a BNC tee between the FREQUENCY STANDARD output (A3J9) and the cable. Connect the open port to the oscilloscope's horizontal input. Obtain a lissajous pattern on the oscilloscope. If the loop is locked, a steady 1:1 pattern should be seen. Use a 50 ohm load on each line to reduce harmonic content. If the loop is locked proceed to Step 7. Otherwise continue with Step 4.

4. Measure the FREQUENCY STANDARD output at A3J9 with power meter and frequency counter. The signal should be 10 MHz ±10 Hz at

0 dBm. Harmonic content is not particularly important for this signal. If this signal is not correct, check the A3A8 10 MHz Reference Oscillator for proper operation and calibration. Check the heater voltage (+22 Vdc). Also, check the +11V switched input which supplies power to the oscillator. (See Service Sheet 12-A3.)

5. Connect the 100 MHz TUNE test point A3A1A2TP1 to −8 Vdc from a low voltage power supply. This opens the loop and tunes the 100 MHz VCXO to approximately the correct frequency.

6. Measure the frequency of the 100 MHz OUT signal from A3A1A2. It should be 100 MHz about ±100 Hz. If this signal is correct, continue with step 7. Otherwise go to Service Sheet 2-A3 and troubleshoot the A3A1A2 Assembly. Disconnect the clip lead from the 100 MHz TUNE and −8 Vdc.

7. Measure the voltage at the 100 MHz TUNE test point, A3A1A2TP1. It should be nominally −8 Vdc with a range between −5 Vdc and −20 Vdc. If the voltage is near nominal, continue with this procedure. Otherwise skip to step 11.

8. Measure the 10 MHz outputs of A3A1A1. The three outputs should deliver 0 dBm into a 50 ohm load at exactly 10 MHz.

9. Measure the 20 MHz output. It should deliver +3 dBm into a 50 ohm load at exactly 20 MHz.

10. Install A3A1A1 on an extender board and measure the voltage at edge connector pins 7 or 22. When the loop is locked the voltage should be −0.7 Vdc. Switch rear panel reference switch to external. The loop should unlock and the voltage should be +4.6 Vdc. If the voltages are correct then A3A1A1 is operating normally. Otherwise, troubleshoot the lock indicator circuitry.

11. Measure the signal at A3A1A1TP1 with an oscilloscope. It should be 3 volt pulses at a 10 MHz rate. If correct continue. Otherwise, troubleshoot the limiting amplifier pulse generator and reference oscillator.

12. Measure the signal at the junction of C27 and L3. It should be a 10 MHz sine wave at 3 Vp-p. If the loop is not phase locked, the frequency of this signal will be incorrect. If the signal is not present, troubleshoot the VCXO divider and the 45° Phase Lead and Buffer Amplifier. If the signal is present, continue.

13. Measure the signal at the base of Q4A. If the signals in steps 10 and 11 are at different frequencies, the difference between them (beat frequency) should be measureable here. If not present, troubleshoot the Phase Lock Sampler. If present, troubleshoot the Integrating Amplifier. If no problem is found continue troubleshooting on Service Sheet 2-A3.

NOTE

After repairing the A3A1A1 assembly, perform the Voltage Controlled Crystal Oscillator Adjustment in Section V. After replacing the A3A8 assembly, perform the 10 MHz Reference Oscillator Adjustment in Section V.

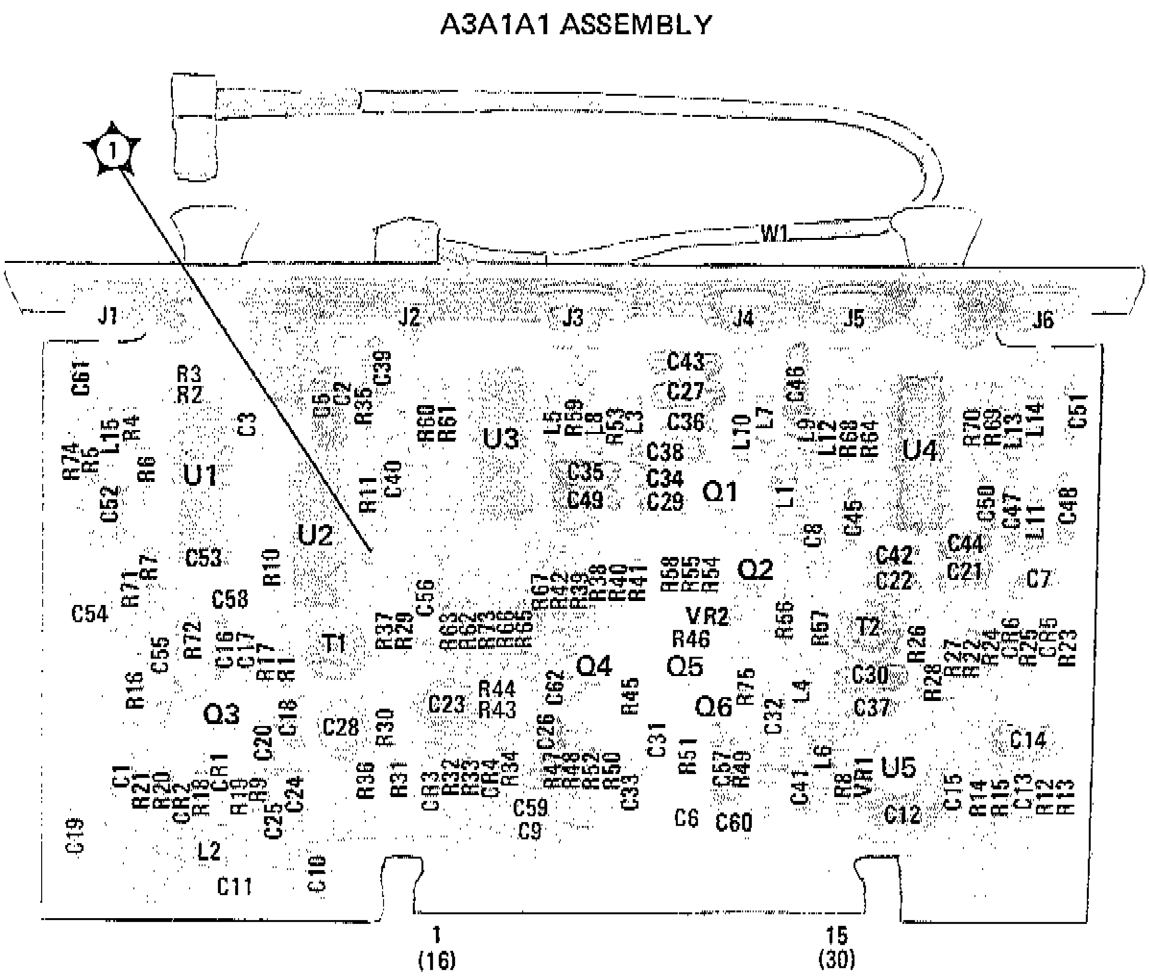
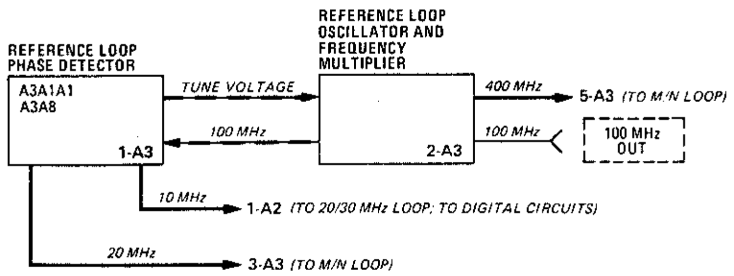


Figure 8-66. A3A1A1 Reference Phase Lock Board Assembly Component and Test Point Locations



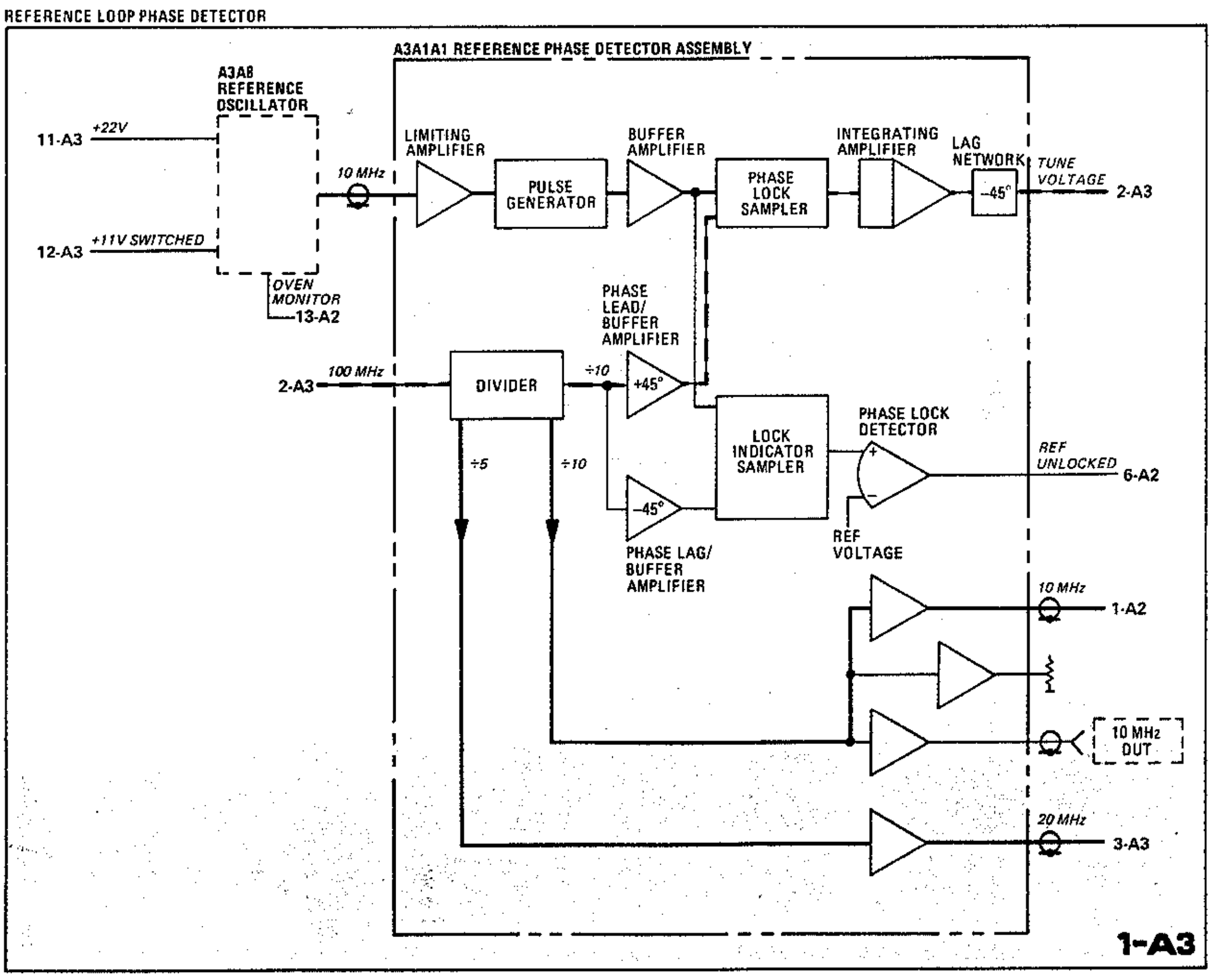


Figure 8-67. Reference Phase Lock Block Diagrams

FIG. 8-68
Sht 1 of 3

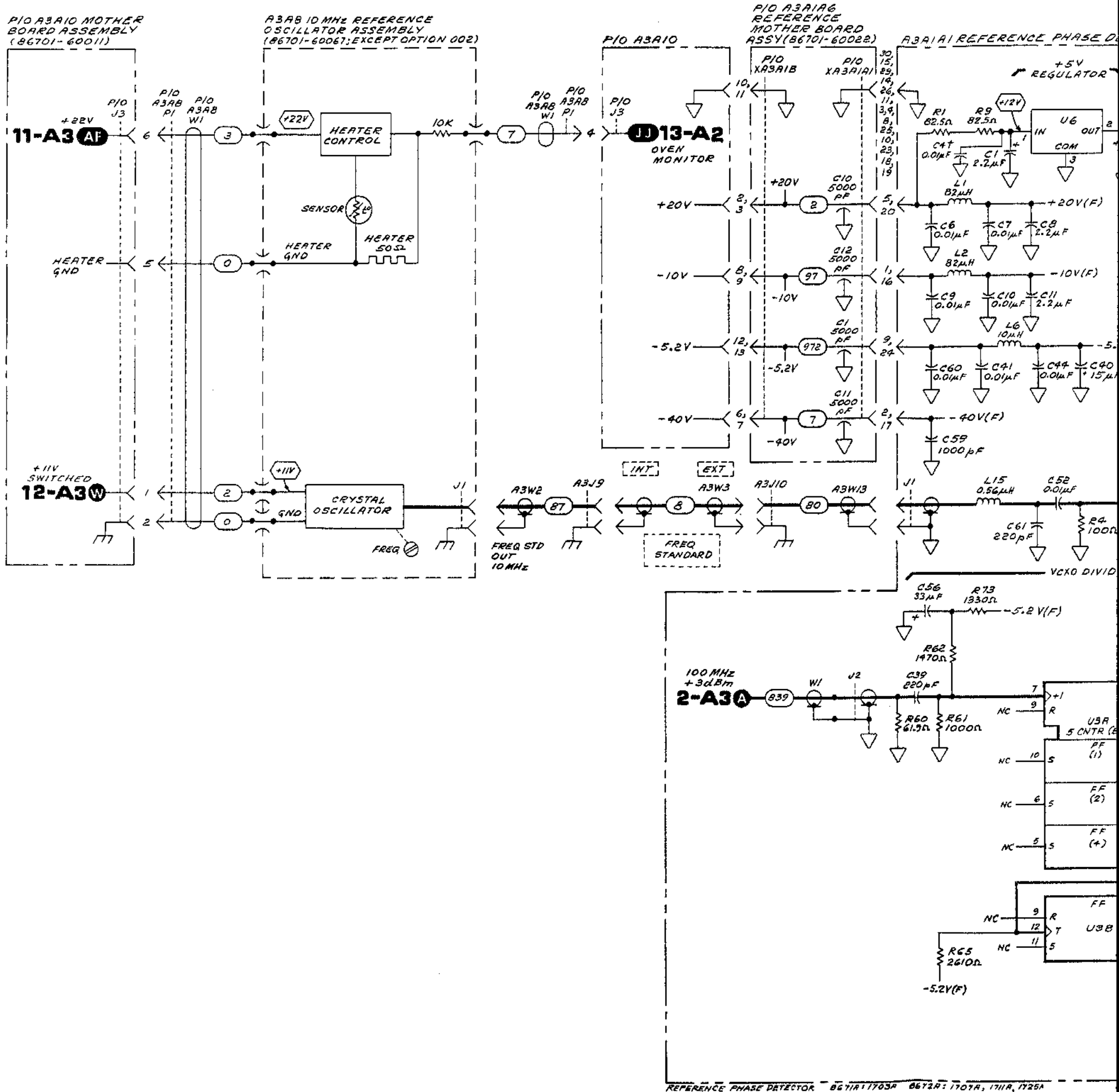


FIG. 8-68
Sht 2 of 3

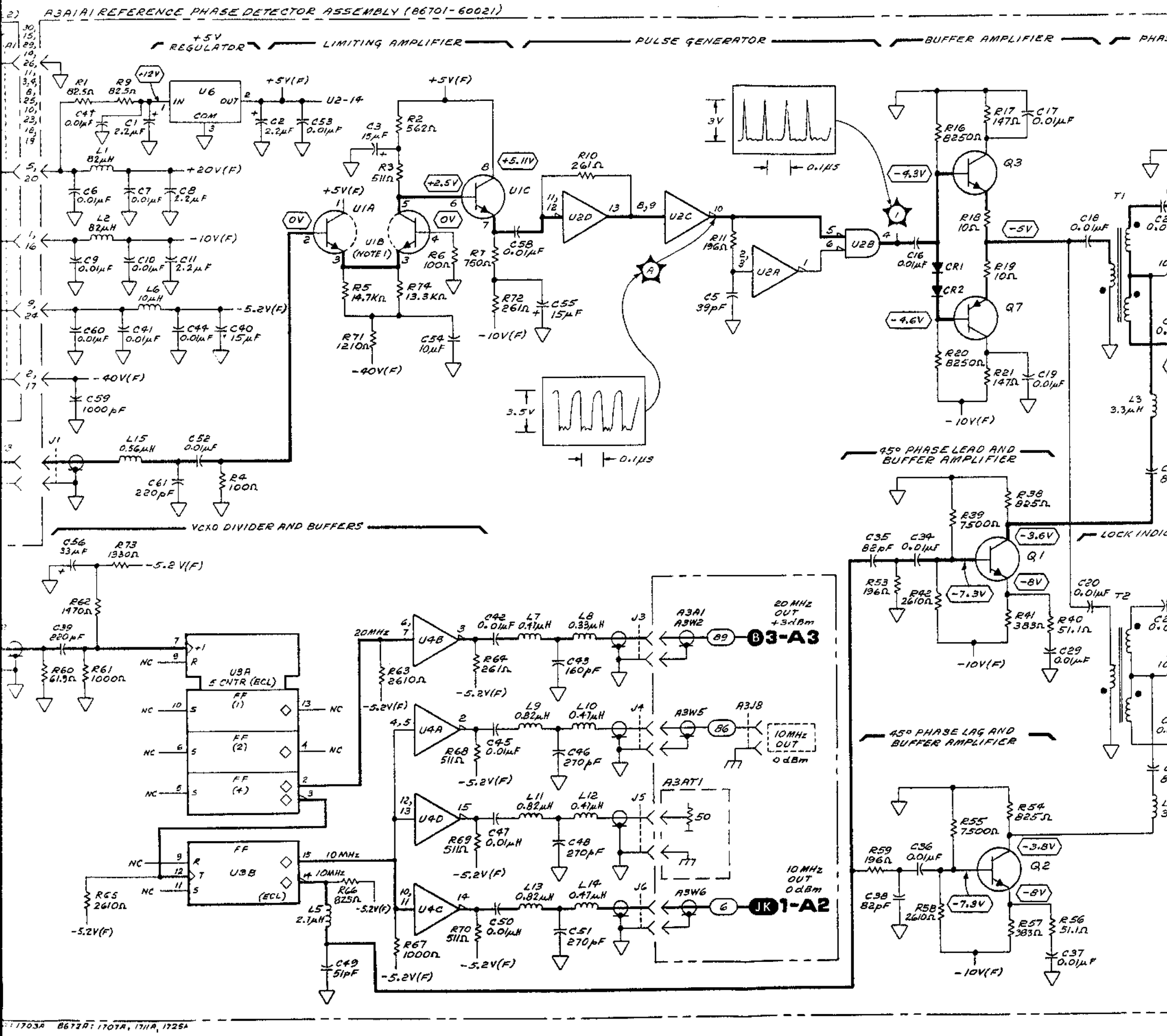
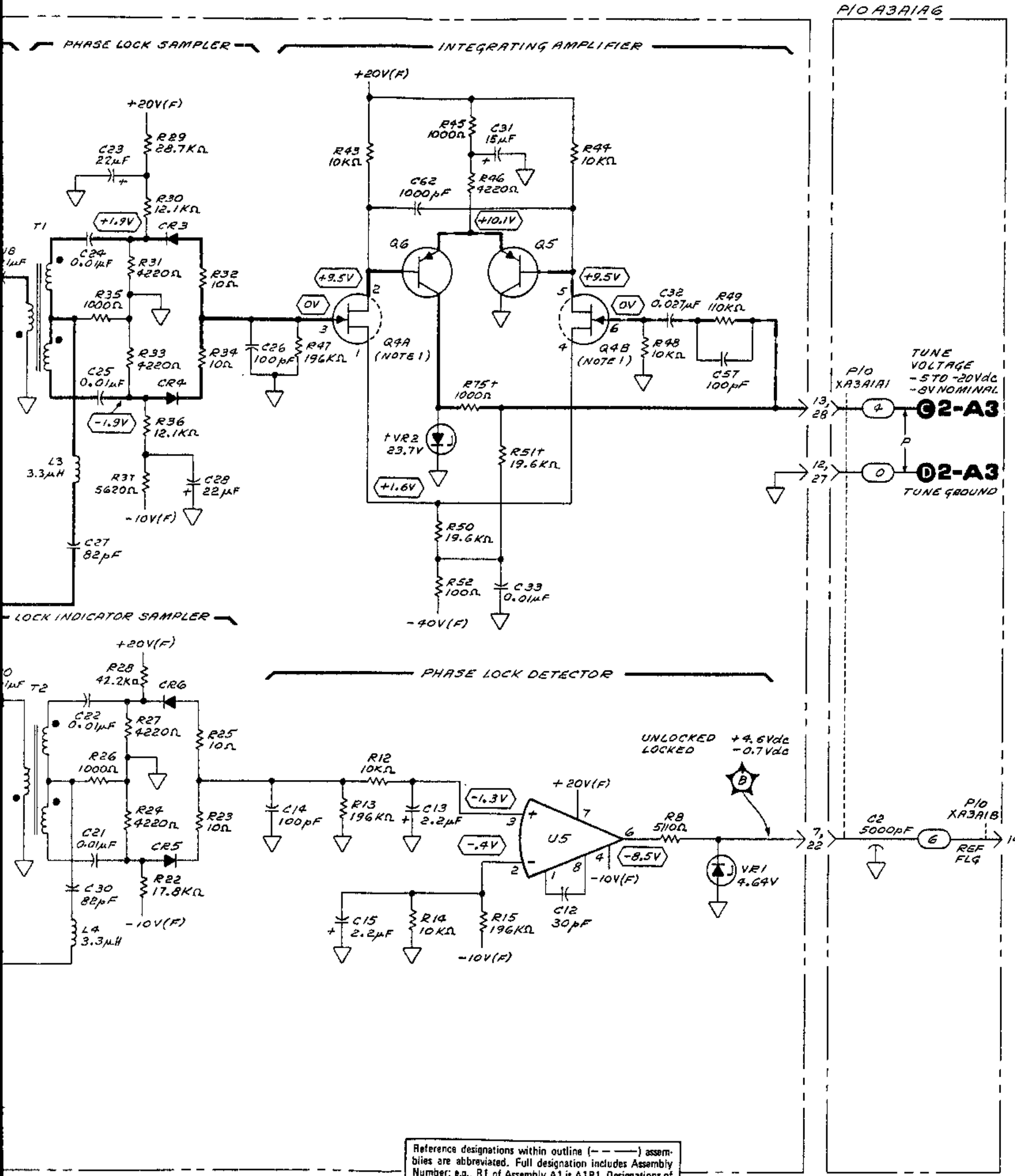


FIG. 8-68
Sht 3 of 3



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. REFER TO SCHEMATIC DIAGRAM NOTES FOR THE DUAL J-FET PIN LOCATION.

† BACKDATING INFORMATION IN SECTION VII

REFERENCE DESIGNATIONS

A3	A3A1A3
AT1, J8-10, W2,3,5,6,13	W2
	A3A1A6
A3A1A1	C1,2,10-12, XA3A1B, XA3A1A1
C1-62, CR1-6, J1-5, L1-15, Q1-7, R1-75, T1,2, TP1, U1-6, VR1,2, W1	A3A8
	P1, W1
	A3A10
	J3

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	1854-0019
Q4	1855-0099
Q5,6	1853-0451
Q7	1854-0034
U1	1821-0001
U2	1820-0328
U3	1820-1383
U4	1820-0802
U5	1820-0223
U6	1820-0429

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U2	+5V(F) - 14 ▽ - 7
U3	-5V(F) - 8 ▽ - 1,16
U4	-5V(F) - 8 ▽ - 16

1-A3
A3A1A1,A3A8

Figure 8-68. Reference Phase Lock Assembly Schematic Diagram

SERVICE SHEET 2-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-33
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-23
- Performance tests — Refer to Table 5-3 on Page 5-3
- Adjustment procedures — Page 5-2

PRINCIPLES OF OPERATION

General

The Reference Loop locks the M/N Loop and 20/30 MHz (LFS) Loop to the Synthesizer's time base. Two reference signals, 20 and 400 MHz, are provided for the M/N Loop. The 10 MHz signal is the reference for the 20/30 MHz Loop. It also is the master clock for the controller's digital circuits.

The output of the 100 MHz VCXO is used to generate the reference signals and to phase lock the Reference Loop. The signal is multiplied by 4, to 400 MHz. It is also buffered and output to the rear panel's 100 MHz OUT connector. A portion of the 100 MHz is divided by 5 to 20 MHz. The 20 MHz signal is divided by two to 10 MHz. A portion of this signal is phase compared to the 10 MHz time base signal. The resulting error voltage tunes the VCXO to achieve phase lock.

A3A1A2 100 MHz VCXO Assembly

Oscillator. The heart of the Reference Phase Locked Loop is the 100 MHz voltage controlled crystal oscillator. The crystal which sets the frequency and the varactor diode which allows a small deviation are both found in the oscillator's feedback path. Diodes CR3 and CR4 are placed at the oscillator output and limit the output to ±4 Vpk. The output is amplified and split by the tuned 100 MHz buffer. One output is connected back to the A3A1A1 Assembly where it is sampled by the phase detector circuits. The other output is coupled through a power splitter to the Quadrupler and another tuned 100 MHz amplifier.

Quadrupler. The Quadrupler is a Class C push-push amplifier. The output approximates a pulse and is rich in even harmonics. The amplifiers which follow are tuned to and therefore amplify the 400 MHz signal. The output level to the M/N loop is critical and is set by selecting the values of R67, R68 and R69 (50Ω attenuator discrete resistors).

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 2 and 1-A3 was used to isolate a reference loop malfunction to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter	HP 3455A
Power Supply	HP 6202B
Spectrum Analyzer	HP 8555A/8552B/141T
Power Meter	HP 436A/8481A
Frequency Counter	HP 5340A

NOTE

The power meter and frequency counter may be used in place of the spectrum analyzer and vice versa.

1. Connect the TUNE test point A3A1A2TP1 to −8 Vdc from a low voltage power supply.

2. Measure the 400 MHz output with a spectrum analyzer or power meter and frequency counter. It should be −10 to −11 dBm at 400 ±.004 MHz (with the loop locked it should be exactly 400 MHz). If the frequency or level is incorrect, perform the Voltage Controlled Crystal Oscillator (VCXO) Adjustment in Section V.

3. Measure the rear panel 100 MHz output. It should be 0 dBm at precisely one fourth the frequency measured in step 2. If correct continue with step 4. Otherwise troubleshoot Q6 and its associated components.

4. Measure the remaining two 100 MHz outputs from A3A1A2. They should both deliver 0 dBm.

5. Ground the TUNE test point. Verify that the VCXO is oscillating at less than 100 MHz.

6. Connect the TUNE test point to −25 Vdc from a low voltage power supply. Verify that the VCXO frequency is greater than 100 MHz. If the results of steps 5 and 6 are not correct, a change in the value of A3A1A2L4 may be needed. See the VCXO adjustment procedure in Section V.

7. If the results of steps 2 through 6 are correct, A3A1A2 is working properly. If there are no outputs, check power supply inputs and troubleshoot the 100 MHz oscillator or buffer (Q5, Q8 and Q9 and associated components). If some outputs are correct, refer to the schematic and continue troubleshooting.

NOTE

After repairing the A3A1A2 assembly, perform the Voltage Controlled Crystal Oscillator Adjustment in Section V.

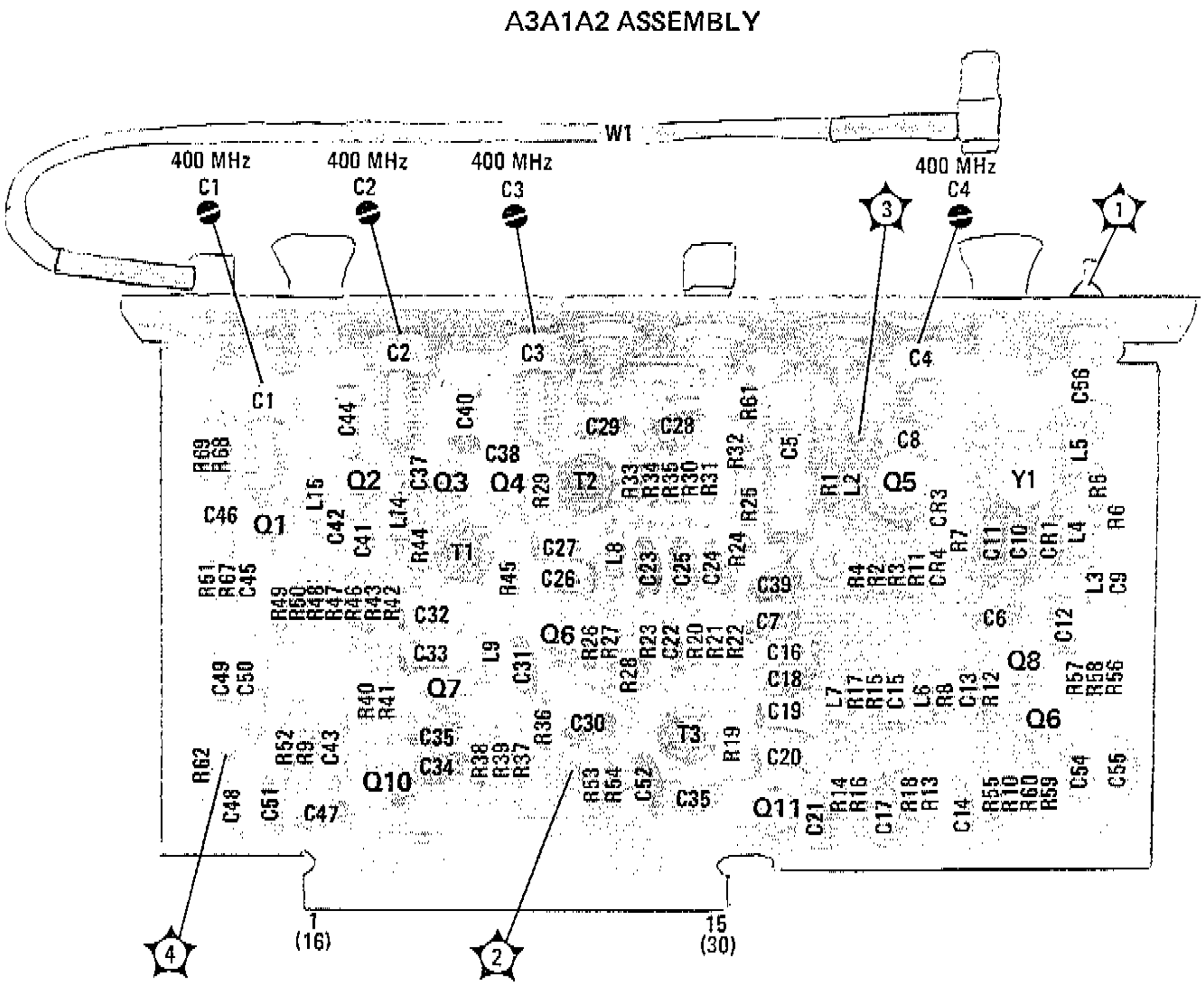
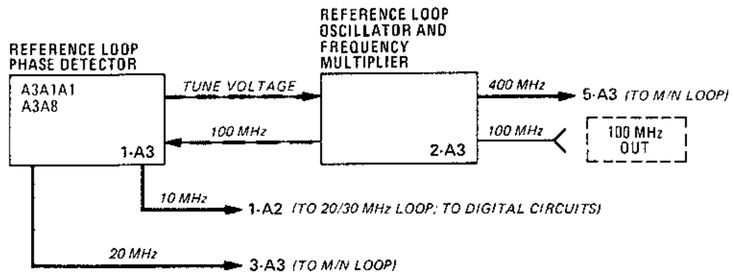


Figure 8-69. A3A1A2 100 MHz VCXO Assembly Component, Adjustment, and Test Point Locations



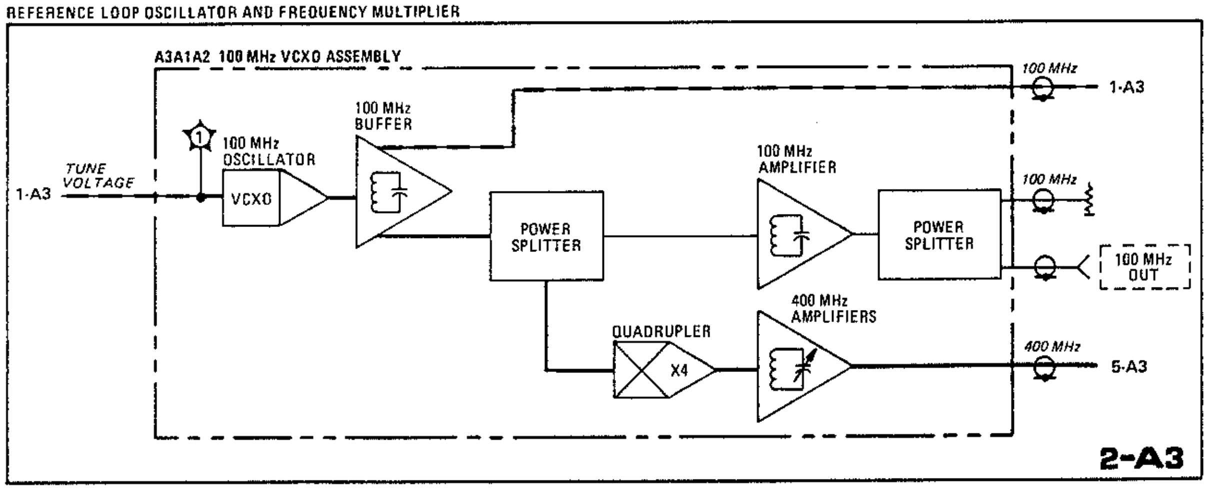
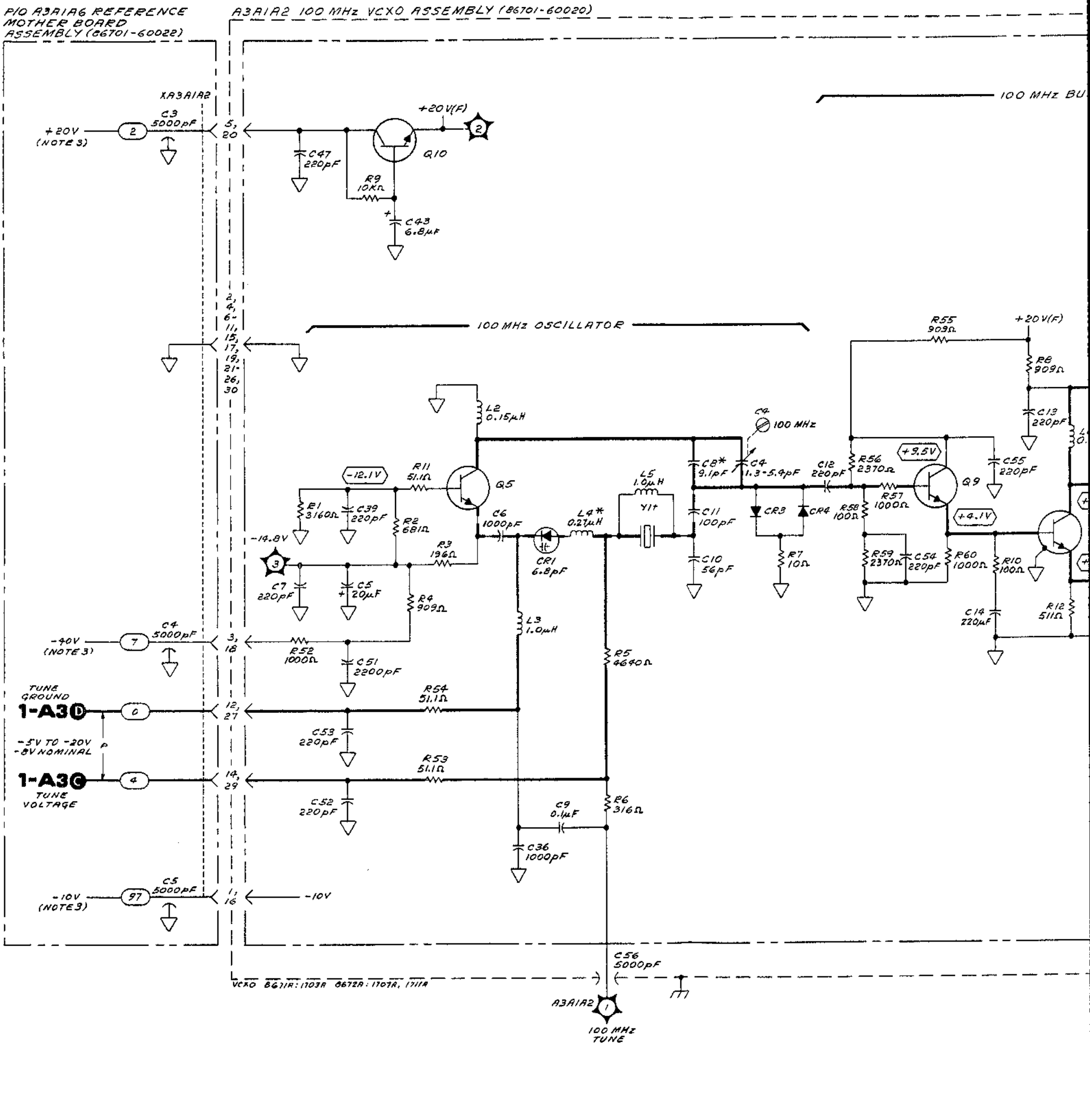


Figure 8-70. 100 MHz VCXO Block Diagrams

FIG. 8-71
Sht 1 of 3



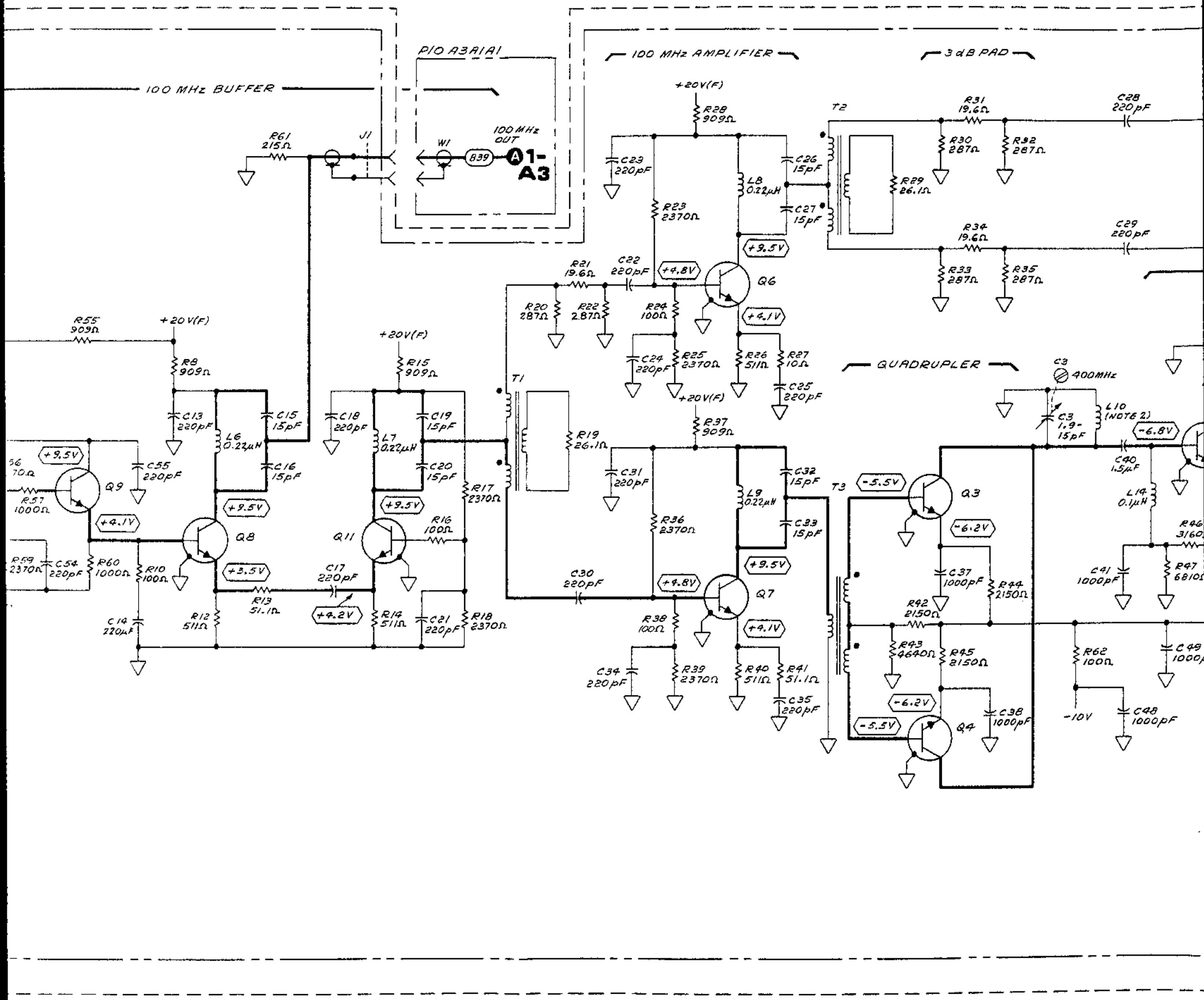
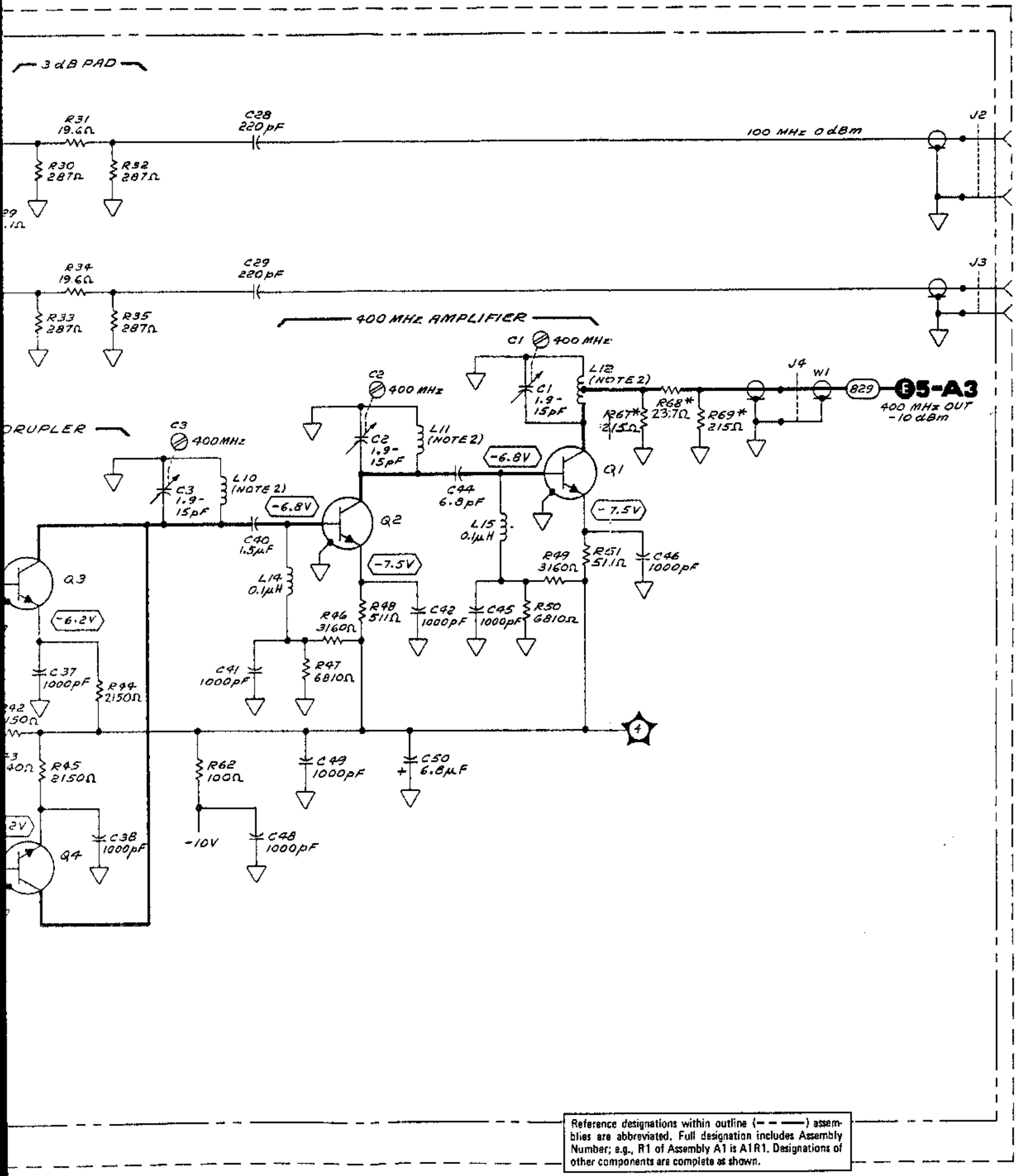
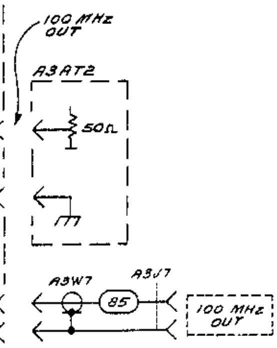


FIG. 8-71
Sht 2 of 3

FIG. 8-71
Sht 3 of 3





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 A3A1 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1-A3.

† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

A3	A3A1A2
AT2 J7 W7	C1-56 CR1,3,4 J1-4 L1-12,14,15 Q1-11 R1-62,67-69 T1-3 TP1-4 W1 Y1
A3A1A1	
W1	
	A3A1A6
	C3-5 XA3A1A2

TRANSISTOR PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1-4,6-9,11	1854-0345
Q5	1854-0247
Q10	1854-0404

2-A3
A3A1A2

Figure 8-71. 100 MHz VCXO Assembly Schematic Diagram

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-33
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-26
- Performance tests — Refer to Table 5-3 on Page 5-3
- Adjustment procedures — Page 5-2

PRINCIPLES OF OPERATION

M/N Phase Lock Loop

The frequency output of the M/N loop 1) is dependent on the front panel frequency and 2) in part, controls the YTO output frequency. A digital equivalent (dependent on the front panel frequency's most significant digits 10 MHz to 10 GHz) is input to the M/N 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 20/30 MHz loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N Loop, YTO pretuning and 20/30 MHz Loop are able to tune the YTO from 2000.000 to 6199.999 MHz in 1 kHz steps.

The M/N 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 loop is phase locked by comparing a subharmonic (fraction) of 20 MHz (20 MHz divided by the N number) to a subharmonic of the IF signal (5 to 45 MHz divided by the M number) in the phase detector. The phase detector generates an error voltage that is integrated and coupled to the VCO as a tuning signal. The M and N numbers are determined by the A2 controller 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

For example, if the ratio is 1-to-1 (M=N) then $f_{M/N}$ = 190.0000 MHz. If the ratio is 1-to-2 (M=2N) then $f_{M/N}$ = 195.000 MHz. Refer to Table 8-4, M and N Numbers and Resulting Frequencies for a complete list..

A3A1A3 M/N Phase Detector Assembly

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 Controller Assembly). The resulting output pulses are frequency and phase compared to produce an error voltage which ultimately tunes the M/N VCO. The following formulas show the frequency relationship of the inputs and outputs of the dividers:

$$f_N = \left(\frac{4}{N}\right) 20\ \text{MHz}$$

$$f_M = \left(\frac{4}{M}\right) f_{IF}$$

where f_N - N Divider Output pulse repetition frequency (PRF) (MHz).

f_M = M Divider Output PRF (MHz).

N = N Divide Number

M = M Divide Number

f_{IF} = M Divider Clock frequency (MHz)

20 MHz - N Divider Clock frequency

f_N = $f_{M\div}$ when the loop is phase locked

therefore $(\frac{4}{N})$ 20 MHz - $(\frac{4}{M})\ f_{IF}$

and $f_{IF} = \left[(\frac{M}{N})\ 20\right]$ MHz for the phase locked condition.

Because of the similarities of the M and N Dividers, only the N Divider will be described in detail.

N Divider Operation. The 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 R=O. 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 times with a spacing of 5 clock pulses.

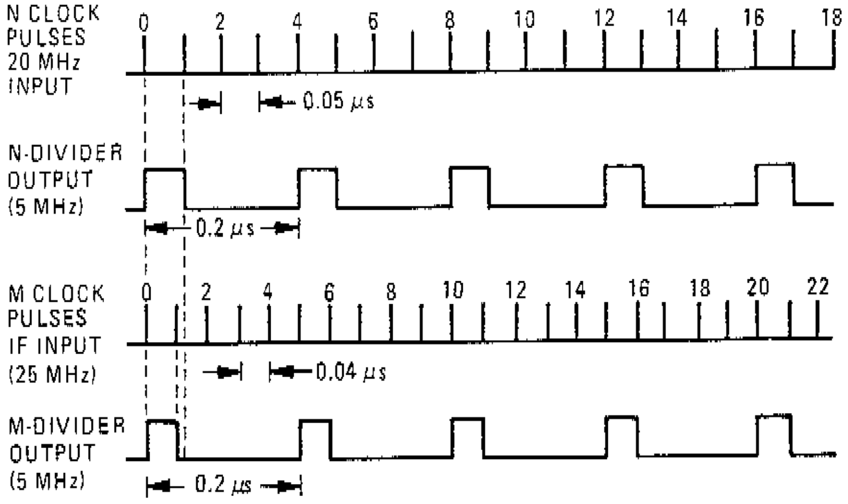
a. **Counting Operation and Control.** Refer to the schematic block diagram and the following figure and table entitled Divider Operation, and consider the example of N=16. At the beginning of a divide sequence (clock 1), the 4 most significant bits (MSB) of the N number (0100) are loaded into the programmable 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, the Count Control and Output Flip-Flops are set. The Count Control outputs 1) inhibit the End of Count Decoder 2) cause the Programmable Counter to enter its load mode and 3) clocks the Divider Flip-Flops. The Output Flip-Flop 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.

b. **Increment Decoder Operation.** The Increment Decoder and Divider (divide-by-four) circuits come into play if the N number cannot be divided by 4 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 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 the table entitled Increment Decoder Operation. Note that for the N=16 sequence, N2=N1=0. As explained in Counting Operation and Control, 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 three 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

SERVICE SHEET 3-A3 (Cont'd)

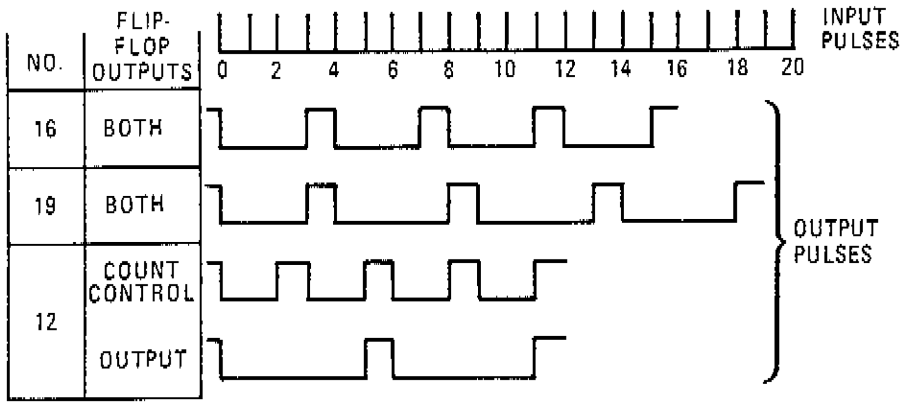
U11A. This allows the extra count to occur. The rest of the sequence occurs as indicated in the previous section. See also the table and figure entitled Divider Operation for N=19.

Divide-by-1 or 2 Operation. With the N input 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 the table entitled Divider Operation and the figure entitled Divider Clock Pulses versus Output Pulses). This circuit reduces the apparent gain of the Phase/Frequency Detector. This keeps the $\Delta F_{VCO}/\Delta V$ sensitivity of the VCO in a specific portion of its tuning curve thereby keeping the M/N loop bandwidth constant. Note that the N5 and N6 inputs are also connected to the M-Divider in the same manner as in the N Divider. Note also that the frequency of the M and N Divider Outputs is halved for N<16.



FREQUENCY AND TIME RELATIONSHIPS FOR N=16 AND M=20

Divider Clock Pulses Versus Output Pulses Frequency and Time Relationships



Divider Operation

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1, 2, and 5-A3 was used to isolate a M/N Loop malfunction to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Frequency Counter . . . . HP 5340A
Digital Voltmeter . . . . HP 3455A

1. Press the PRESET (3 GHz) pushbutton.

2. Observe the M/N loop 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 loop operation.

3. Connect the frequency counter to the M/N loop output on A3A1A5. Use a common time base for this measurement. The frequency should be 189.375 000 MHz.

4. Check the following frequencies (the extremes of the M/N loop)

RF Output Frequency	M/N Loop Output
2100 MHz	177.500 000 MHz
6090 MHz	197.419 355 MHz

   If the frequencies are correct, the loop has adequate tuning range and is probably operating correctly.

5. Measure the signal at A3A1A3TP1 with the Synthesizer set to 6100 MHz. The signal should be 20 MHz divided by 4/N (N=32 at 6100 MHz) or exactly 2.50 MHz at ECL levels. (Refer to Schematic Notes.)

6. Tune the Synthesizer to 2900 MHz. The signal at TP1 should be 5.0 MHz (N=16).

7. Tune to 2700 MHz. The signal at TP1 should be 2.666 666 MHz (2/N x 20 MHz; N=15). If steps 6, 7 and 8 were correct, The N-divider is working properly and the N-decoder in the controller is operating properly. Otherwise, check the input data and, if necessary, troubleshoot the divider.

8. Connect the IF IN white-red coax 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.

9. Tune to 2820 MHz (M=15). The frequency at TP4 should be 2.666 666 MHz. If steps 9 and 10 are correct the M-divider is working properly and the M-decoder in the controller is operating properly.

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 approximately correct, the Phase Detector Assembly is operating correctly.

NOTE

After repairing the A3A1A3 assembly, perform the M/N Loop Adjustments in Section V.

Divider Operation

N	Input Clock Pulses	Operation	N number in Counter (4 MSB)	End of Count Decoder	Flip-Flop Count Control	Flip-Flop Output
16	0,4,8,12	Load Counter	0100	Inactive	Reset	Reset
	1,5,9,13	Minus 4	0011	Inactive	Reset	Reset
	2,6,10,14	Minus 4	0010	Active	Reset	Reset
	3,7,11,15	Minus 4	0001	Inactive	Set	Set
19	0,4,9,14	Load Counter	0100	Inactive	Reset	Reset
	1,5,10,15	Minus 4	0011	Inactive	Reset	Reset
	2,6,11,16	Minus 4	0010	Inactive[1]	Reset	Reset
	3,7,12,17	Minus 4	0001	Active[2]	Reset[3]	Reset[3]
	8,13,18	Minus 4	0000	Inactive	Set	Set
12	0,3,6,9	Load Counter	0011	Inactive	Reset	Reset
	1,4,7,10	Minus 4	0010	Active	Reset	Reset
	2,5,8,11	Minus 4	0001	Inactive	Set	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.

Increment Decoder Operation

Increment Decoder Control Inputs N2	Increment Decoder Control Inputs N1	Increment Decoder Output Sequence* 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-pin 2 and U4B-pin 15 respectively).

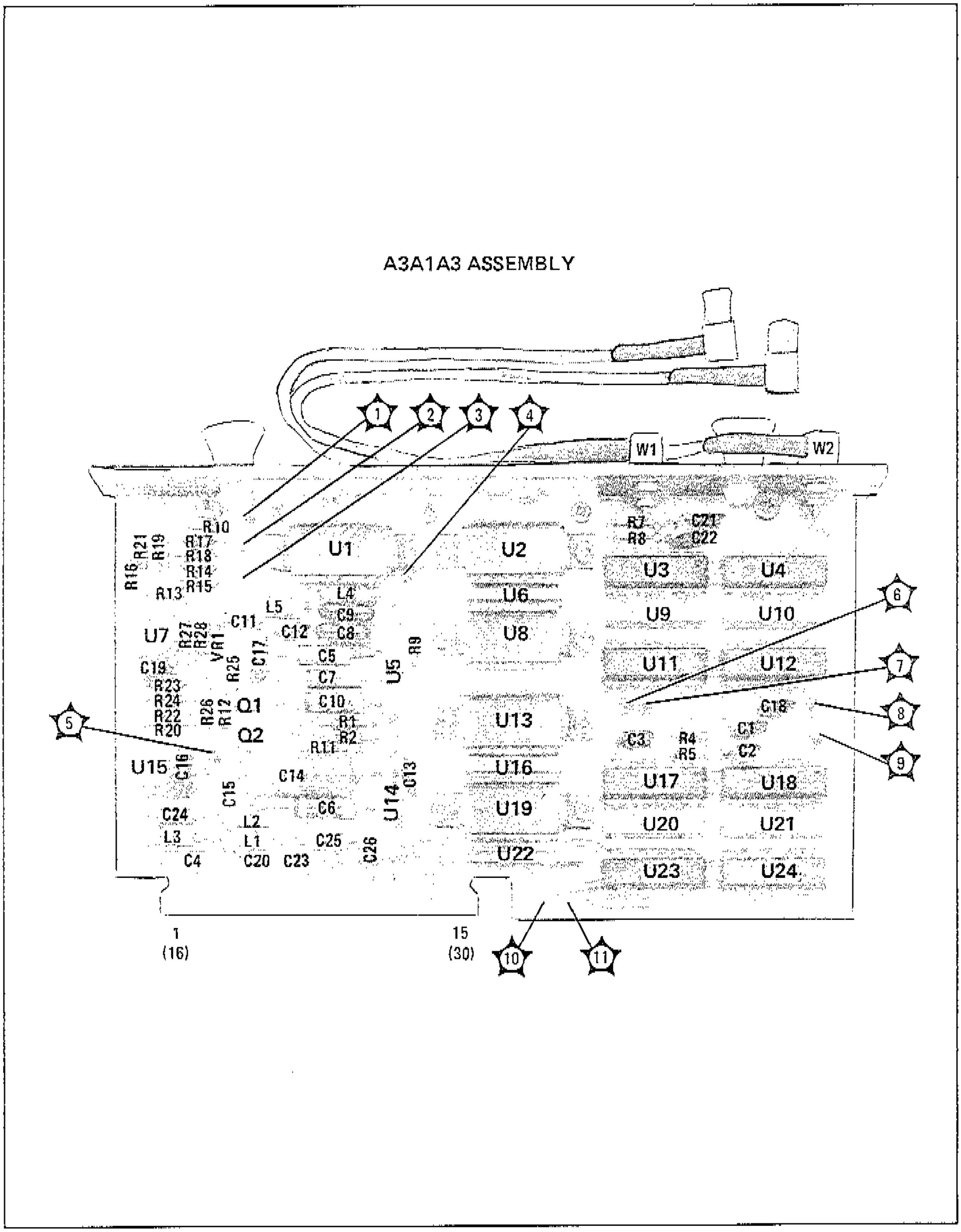


Figure 8-72. A3A1A3 M/N Phase Detector Assembly Component and Test Point Locations

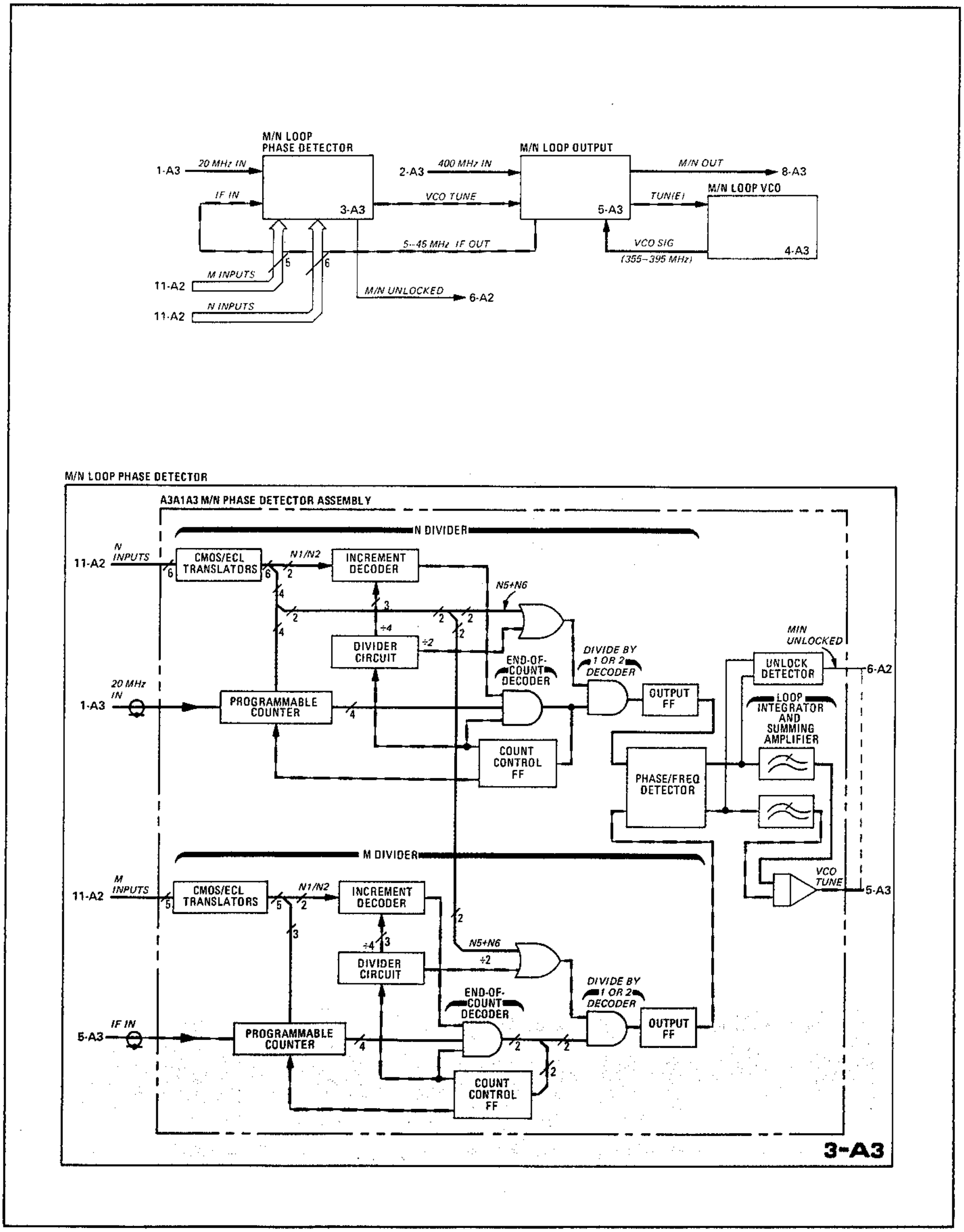


Figure 8-73. M/N Phase Detector Block Diagrams

FIG. 8-74
Sht 1 of 4

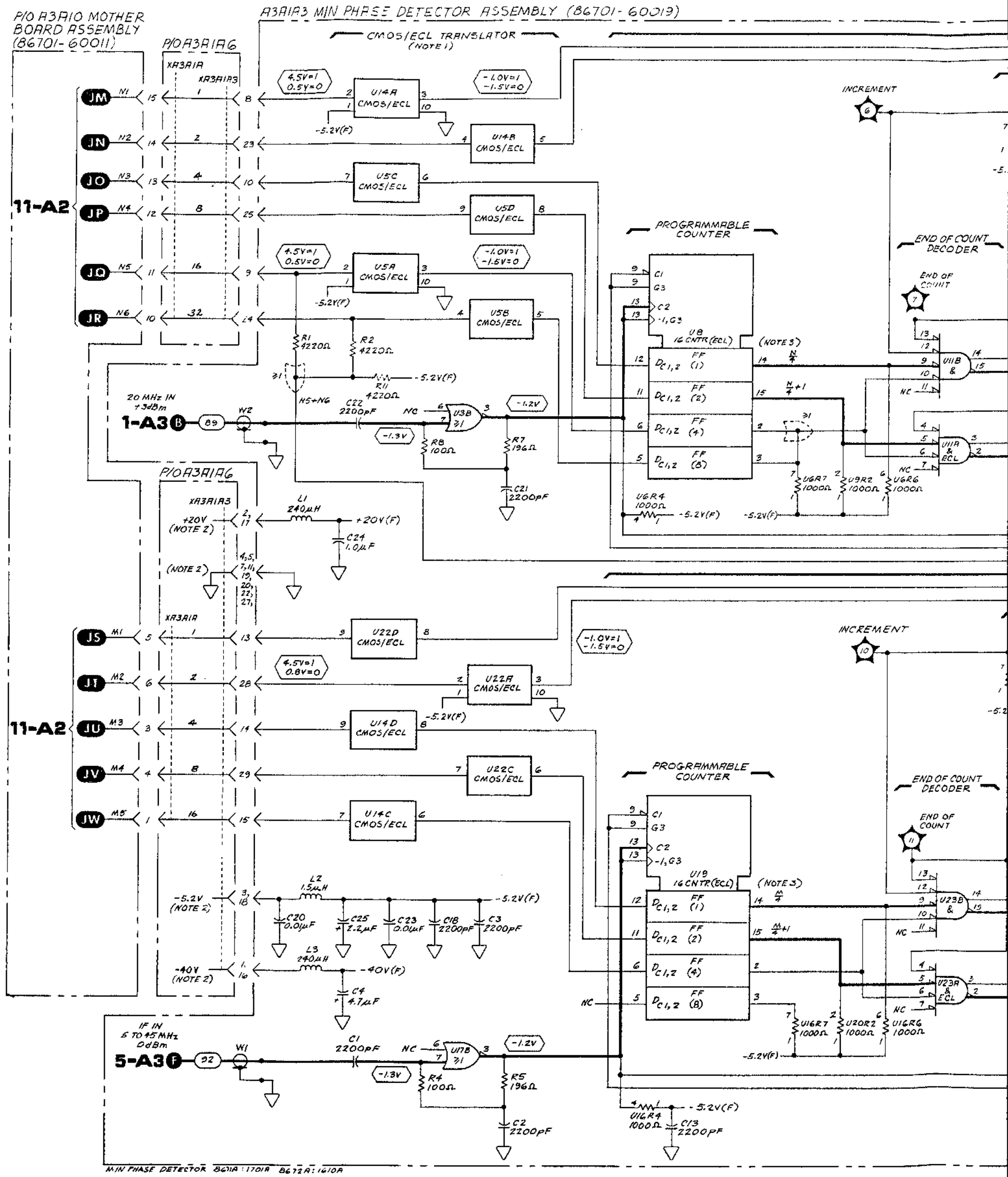


FIG. 8-74
Sht 2 of 4

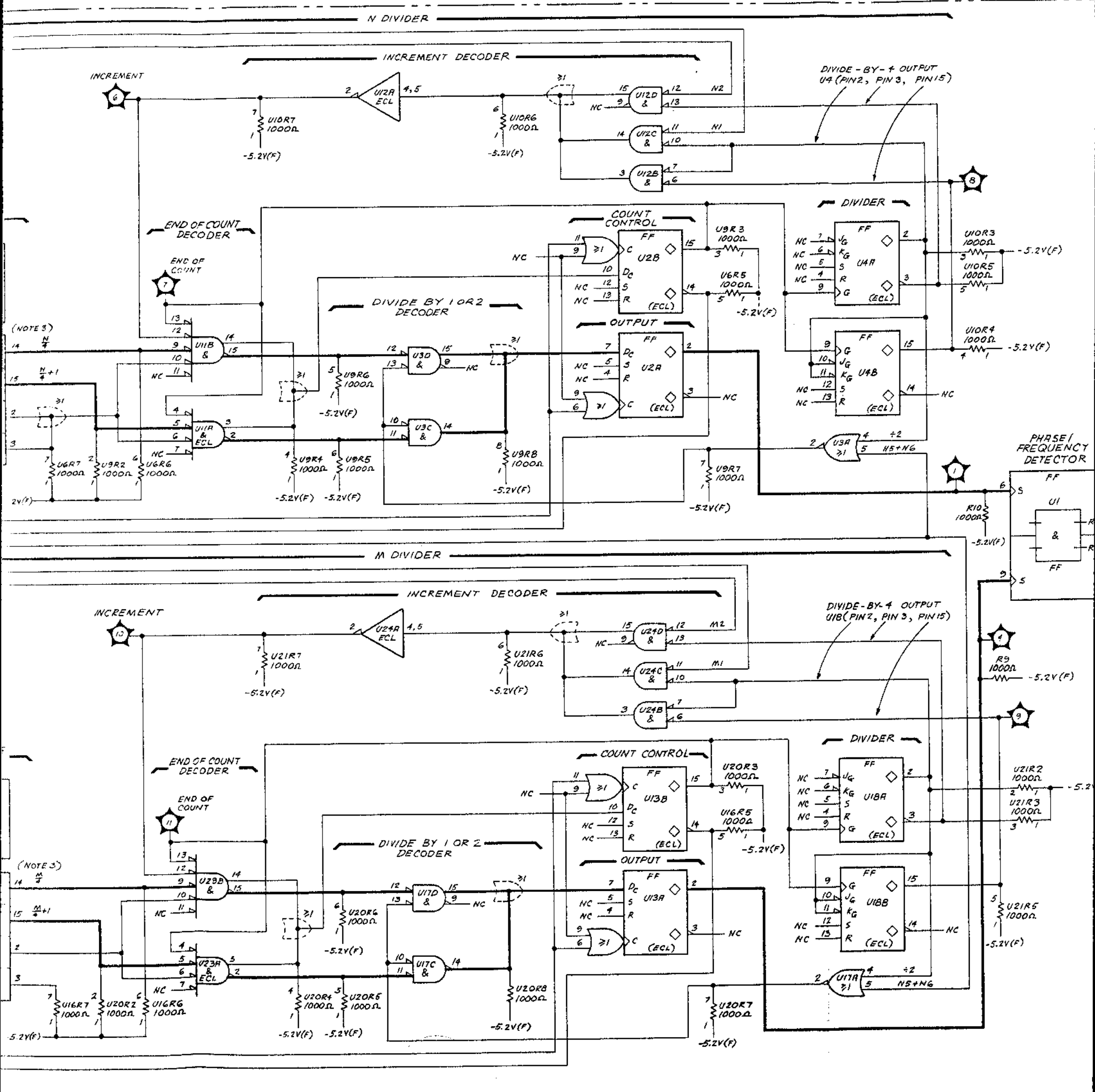


FIG. 8-74
Sht 3 of 4

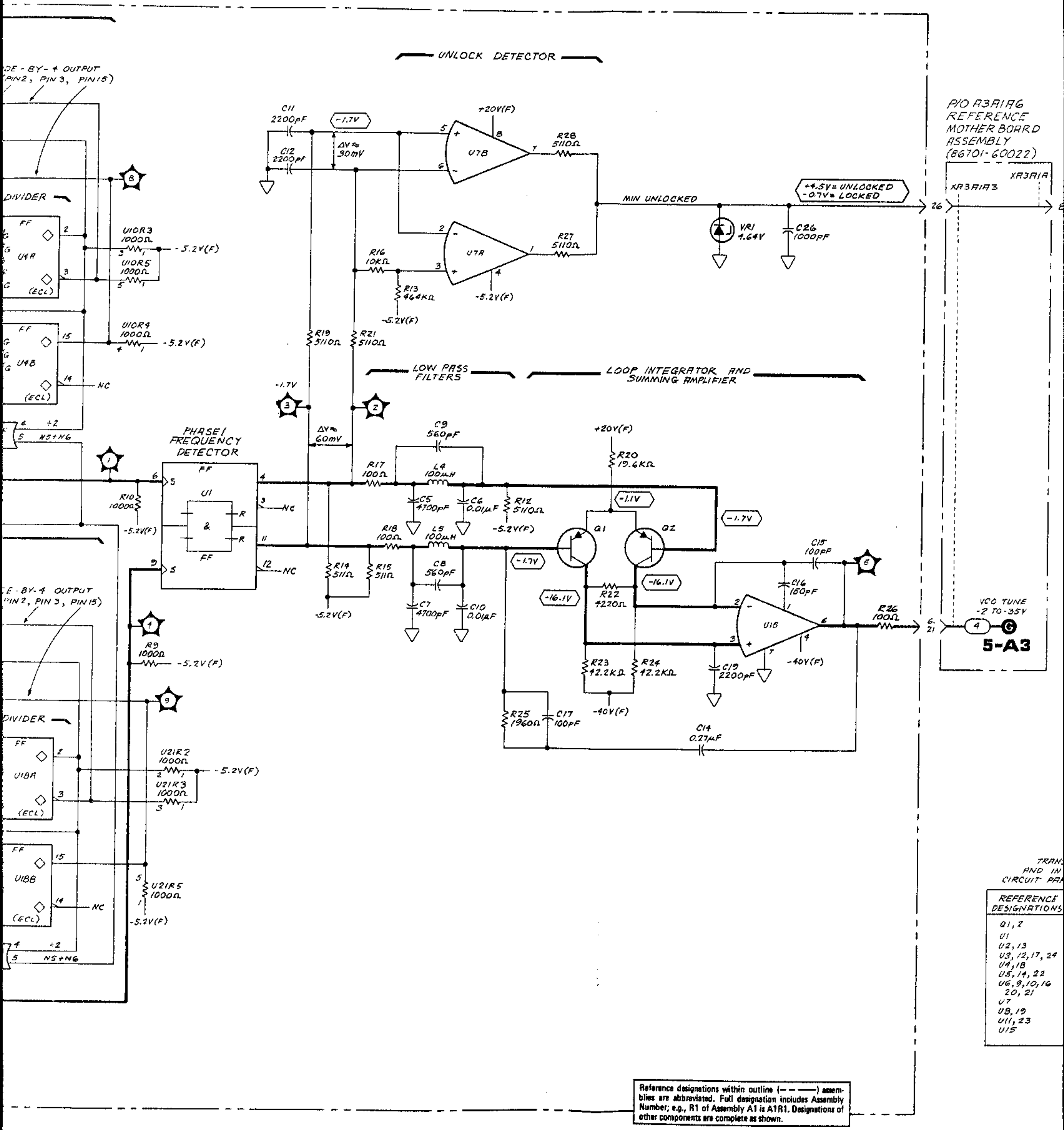
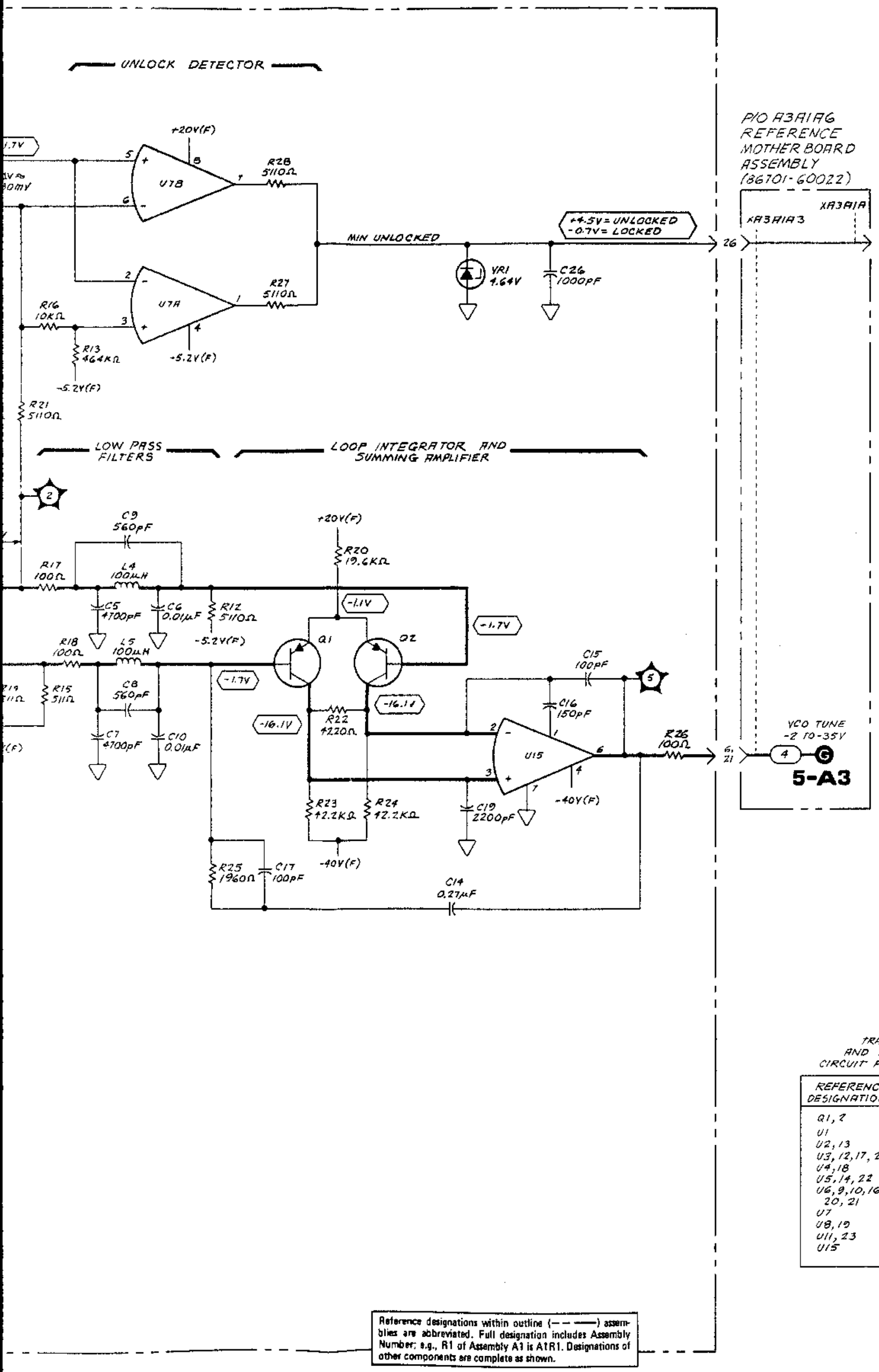
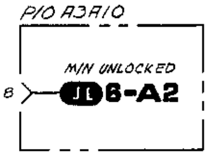


Figure 8-74. M/N Phase

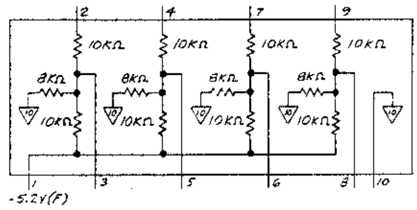
FIG. 8-74
SHT 4 of 4





NOTES

1. U5, 14, 22 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-A3.
3. PINS 4, 7, 10 OF U8 AND U19 ARE NOT SHOWN.

REFERENCE DESIGNATIONS

A3A1A3	A3A1A6
C1-26 L1-5 Q1, 2 R1, 2, 4, 5, 7-28 TP1-11 U1-24 VR1 W1, 2	XA3A1A XA3A1A3

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH (1)	≥2V	≥-0.5V	≥-0.11	≈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, 2	1853-0451
U1	1820-1344
U2, 13	1820-1225
U3, 12, 17, 24	1820-0802
U4, 18	1820-0820
U5, 14, 22	1810-0251
U6, 9, 10, 16 20, 21	1810-0204
U7	1826-0092
U8, 19	1820-0821
U11, 23	1820-0806
U15	1826-0059

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1	-5.2V(F) -7 ▽ -1, 14
U2-4, 8, 11-13, 17-19, 23, 24	-5.2V(F) -8 ▽
U5, 14, 22	-5.2V(F) -1 ▽ -10

3-A3
A3A1A3

Figure 8-74. M/N Phase Detector Assembly Schematic Diagram

SERVICE SHEET 4-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-27
• Performance tests	Refer to Table 5-3 on Page 5-3
• Adjustment procedures	Page 5-2

PRINCIPLES OF OPERATION

M/N Phase Lock Loop

The frequency output of the M/N loop 1) is dependent on the front panel frequency and 2) in part, controls the YTO output frequency. A digital equivalent (dependent on the front panel frequency's most significant digits 10 MHz to 10 GHz) is input to the M/N 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 pre-tuning) 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 20/30 MHz loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N Loop, YTO pretuning and 20/30 MHz Loop are able to tune the YTO from 2000.000 to 6199.999 MHz in 1 kHz steps.

The M/N 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 loop is phase locked by comparing a subharmonic (fraction) of 20 MHz (20 MHz divided by the N number) to a subharmonic (fraction) of the IF signal (5 to 45 MHz divided by the M number) in the phase detector. The phase detector generates an error voltage that is integrated and coupled to the VCO as a tuning signal. The M and N numbers are determined by the A2 controller 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 $f_{M/N}$ = M/N OUT frequency

M = M number

N = N number

For example, if the ratio is 1-to-1 (M=N) then $f_{M/N\ VCO} = 380.000$ MHz. If the ratio is 1-to-2 (M=2N) then $f_{M/N\ VCO} = 390.000$ MHz.

SERVICE SHEET 4-A3 (Cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 2 and 5-A3 was used to isolate a M/N loop malfunction to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Power Supply	HP 6202B
Spectrum Analyzer	HP 8555A/8552B/141T
High Impedance Spectrum Analyzer Probe	HP 1121A
Digital Voltmeter	HP 3455A

1. Install A3A1A4/A5 on an extender board.

CAUTION

Do not apply a positive voltage to A3A1A4TP1. A positive voltage will forward bias the VCO tuning diodes and may destroy them.

2. Connect the positive output of a low voltage power supply to chassis ground. Connect the negative output to A3A1A4TP1 TUNE test point. Connect the white M/N VCO OUT cable to the spectrum analyzer.

3. Set power supply to −35.0 ±0.5 Vdc. The M/N VCO output should be about 395 MHz at 0 ±1 dBm.

4. Slowly reduce the voltage to −2 Vdc while monitoring the VCO power output and frequency. The power should remain greater than −1 dBm over the entire frequency span. At −2 Vdc the frequency should be about 355 MHz. See troubleshooting data in the table for some typical voltages and frequencies. If the frequency varies properly at the correct power level A3A1A4 is working properly.

5. If the output level and frequency are not correct, perform the M/N loop adjustment procedure in Section V, before troubleshooting. If adjustment doesn't solve the problem continue with this procedure.

6. Measure the −40V power supply line as it enters A3A1A4. It should measure between −39 and −40.6 Vdc. If incorrect, turn to Service Sheet 13-A3 and continue troubleshooting.

7. Measure the bias voltages on Q2 as shown on the schematic. If correct, continue with this procedure. Otherwise troubleshoot Q2 and its associated components (Negative Resistance Oscillator). When measured with a high impedance probe, the power level at the emitter of Q2 should be approximately 0 dBm.

8. Measure the voltage at the pin labeled TUN. This should be the same voltage applied to A3A1A4TP1 TUNE test point.

SERVICE SHEET 4-A3 (Cont'd)

9. Measure the RF voltage at Q1 base. Use the HP Model 1121A high impedance spectrum analyzer probe or high frequency oscilloscope to avoid disturbing signal level.

10. If the results of steps 7 and 8 are correct and the output from the oscillator is missing or too low, the A3A1A4A1 VCO Resonator assembly is probably defective and should be replaced with a new A3A1A4 assembly. Recheck the adjustment of A3A1A4A1C5 before ordering a new assembly.

11. If the RF voltage at the base of Q1 is correct, check the dc bias voltages on Q1 to determine why the output isn't correct.

VCO Tune Voltage and Frequency

TUNE Voltage (TP1)	Frequency
−35.0 Vdc	395.0 MHz
−10.0 Vdc	375.0 MHz
−5.2 Vdc	365.0 MHz
−2.2 Vdc	355.0 MHz

NOTE

After repairing the A3A1A4 Assembly, perform the M/N Loop Adjustments in Section V.

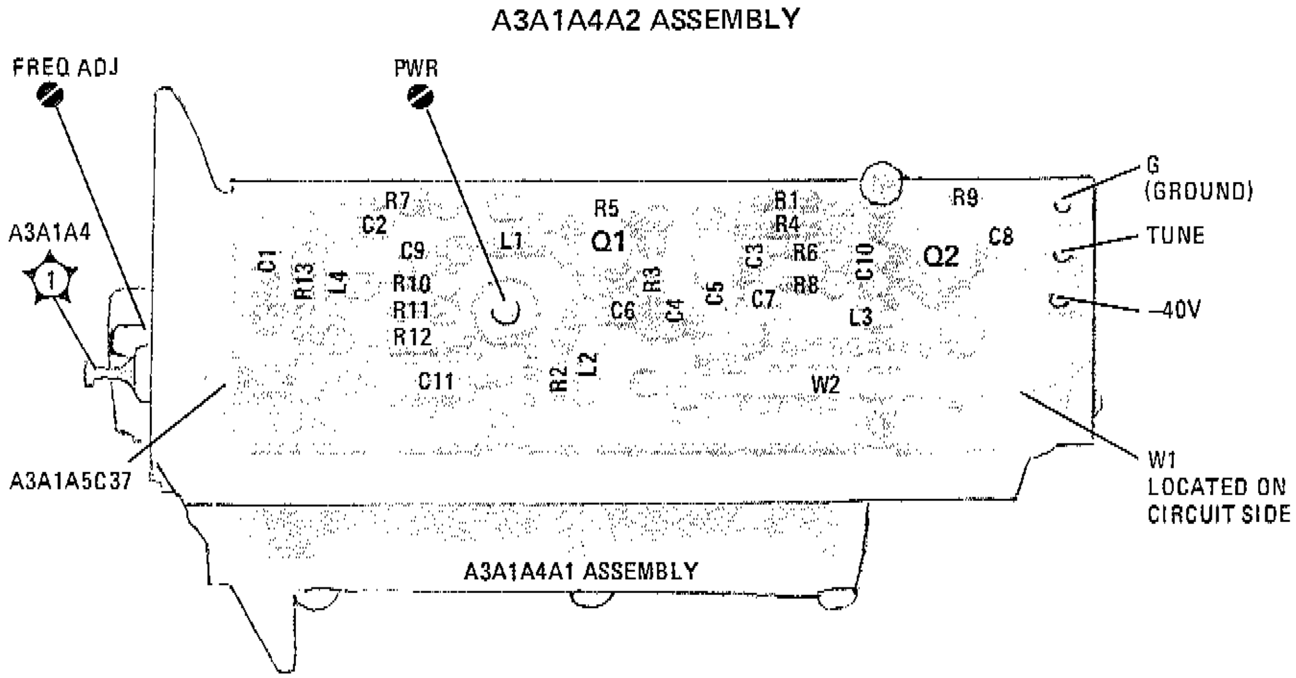
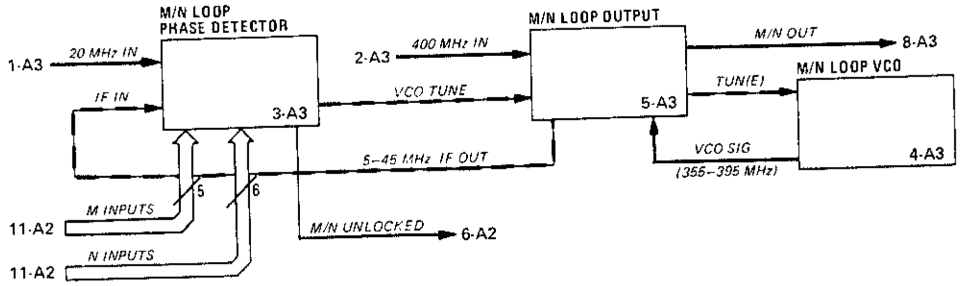


Figure 8-75. A3A1A4A2 M/N VCO Board Assembly Component, Adjustment, and Test Point Locations



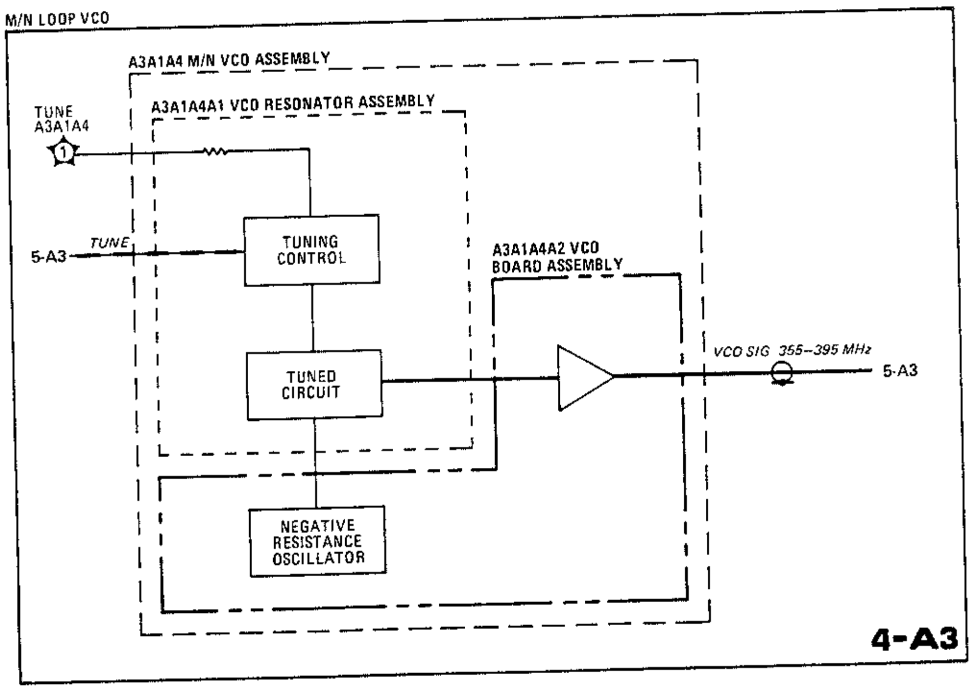


Figure 8-76. M/N VCO Block Diagrams

FIG. 8-77
Sht 1 of 2

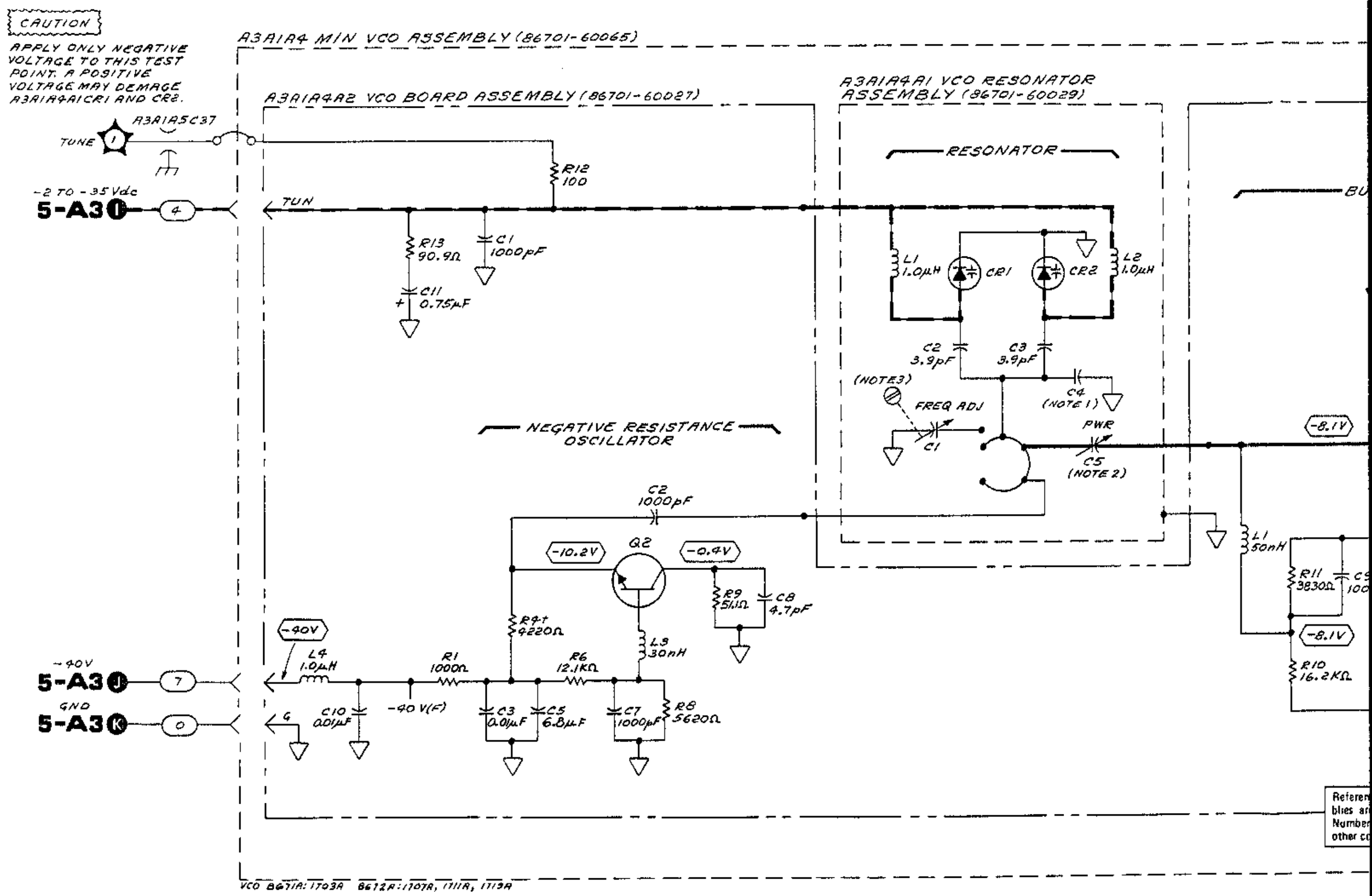
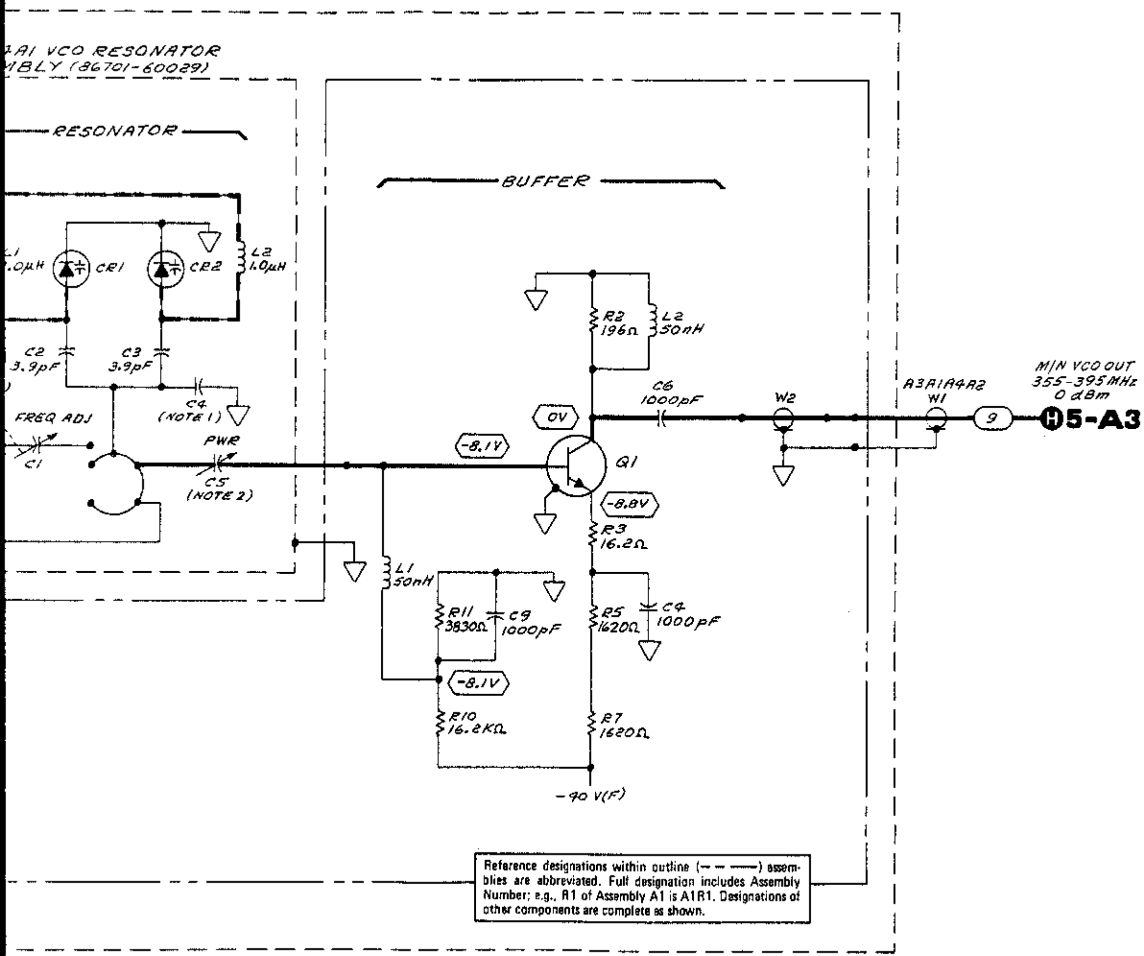


FIG. 8-77
Sht 2 of 2



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.

† BACKDATING INFORMATION IN SECTION VII

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 Q2	1854-0610 1854-0686

4-A3
A3A1A4

Figure 8-77. M/N VCO Assembly Schematic Diagram

SERVICE SHEET 5-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-28
• Performance tests	Refer to Table 5-3 on Page 5-3
• Adjustment procedures	Page 5-2

PRINCIPLES OF OPERATION

M/N Phase Lock Loop

The frequency output of the M/N loop 1) is dependent on the front panel frequency and 2) in part, controls the YTO output frequency. A digital equivalent (dependent on the front panel frequency's most significant digits; 10 MHz to 10 GHz) is input to the M/N 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 20/30 MHz loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N Loop, YTO pretuning and 20/30 MHz Loop are able to tune the YTO from 2000.000 to 6199.999 MHz in 1 kHz steps.

The M/N 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—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 loop is phase locked by comparing a subharmonic (fraction) of 20 MHz (20 MHz divided by the N number) to a subharmonic (fraction) of the IF signal (5 to 45 MHz divided by the M number) in the phase detector. The phase detector generates an error voltage that is integrated and input to the VCO as the VCO TUNE signal. The M and N numbers are determined by the A2 controller 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

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 8-4, M and N Numbers and Resulting Frequencies for a complete listing.

TROUBLESHOOTING

It is assumed that the troubleshooting information found on Service Sheets 1 and 2 was used to isolate a M/N loop malfunction. The following information will allow further isolation to circuits shown by one of the three M/N loop schematics 3-A3, 4-A3 or 5-A3. If the malfunction is on 5-A3, this information will also aid in isolating the defective component.

Test Equipment

Spectrum Analyzer . . . . HP 8555A/8552B/141T
Digital Voltmeter . . . . HP 3455A
Oscilloscope . . . . HP 180A/1801A/1821A

1. Turn the LINE switch OFF and install A3A1A5 on an extender board. Connect A3A4TP5 −5.2V to the A3A1A4TP1 TUNE test point. Measure the output of the M/N VCO to assure it is about 365 MHz at 0 dBm. If it is not correct turn to Service Sheet 4-A3 and continue troubleshooting. Otherwise continue with this procedure. (Be sure to reconnect the white coax).

2. Measure the IF OUT frequency and power. It should be 400 MHz minus the frequency measured in step 1 (about 35 MHz) at 0 dBm.

3. Measure M/N OUT frequency and power. It should be about 182.5 MHz at +3 dBm. If the results of both steps 2 and 3 are correct, proceed to step 8.

4. If step 2 results were correct but step 3 results were incorrect, troubleshoot the Divider Preamplifier, Divider and the Output Amplifier using the voltages on the schematic.

5. If the results of both steps 2 and 3 are incorrect, check the power supply voltages and input components on the M/N VCO IN line.

6. If the results of step 2 are incorrect and the step 3 results are correct, check the 400 MHz IN line. If correct, proceed with step 7. Otherwise turn to Service Sheet 2-A3 and continue troubleshooting.

7. Remove the RFI shield top cover and measure the RF voltage at the output of mixer U1 (the junction of C8 and L4) with an oscilloscope. There should be 0.07 Vp-p. If this signal is correct, troubleshoot the IF Amplifier. Otherwise troubleshoot the Mixer Amplifier and the mixer. Note that the LO input should be 1 Vp-p and the RF input 200 mVp-p.

8. Measure the VCO Tune voltage at the edge connector pin 1 and at the yellow wire leading to A3A1A4. If the measured voltages are different, remove the circuit board. Measure the resistance from A3A1A4TP1 TUNE to the edge connector pin 1. It should be 4.16K ohms. If the resistance is correct the tune filter is probably not defective. Resistance to ground should be almost infinite after A3A1A4A2C11 is charged.

NOTE

After the A3A1A5 Assembly is repaired, perform the M/N Loop Adjustments in Section V.

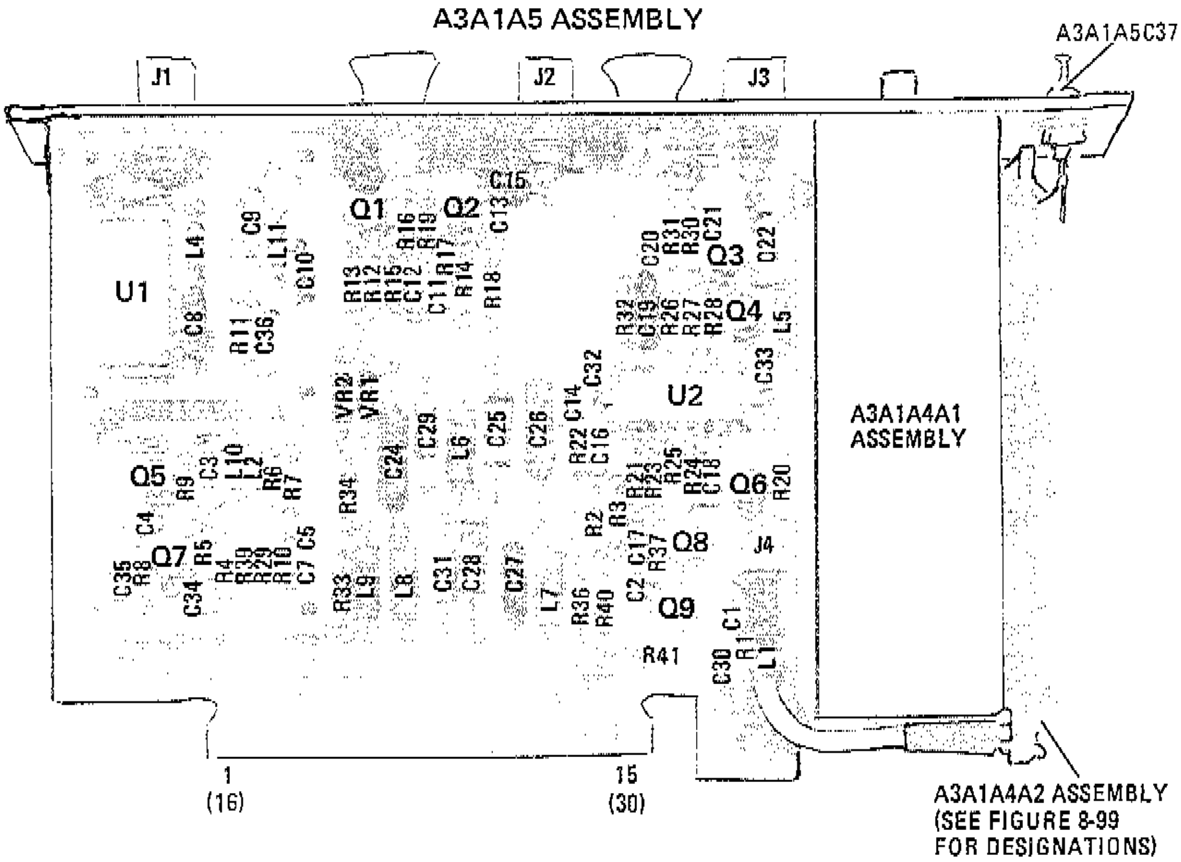
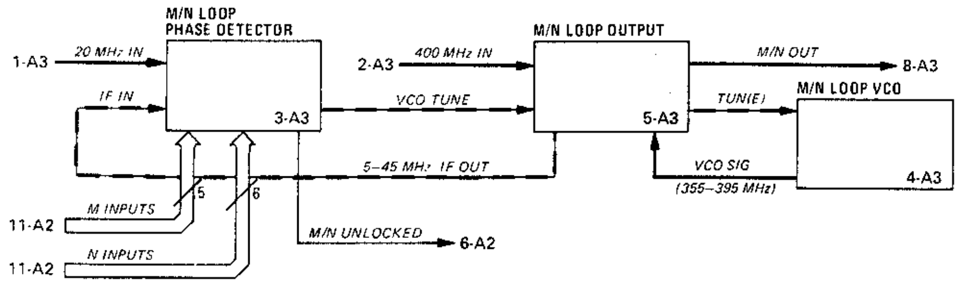


Figure 8-78. A3A1A5 M/N Output Assembly Component Locations



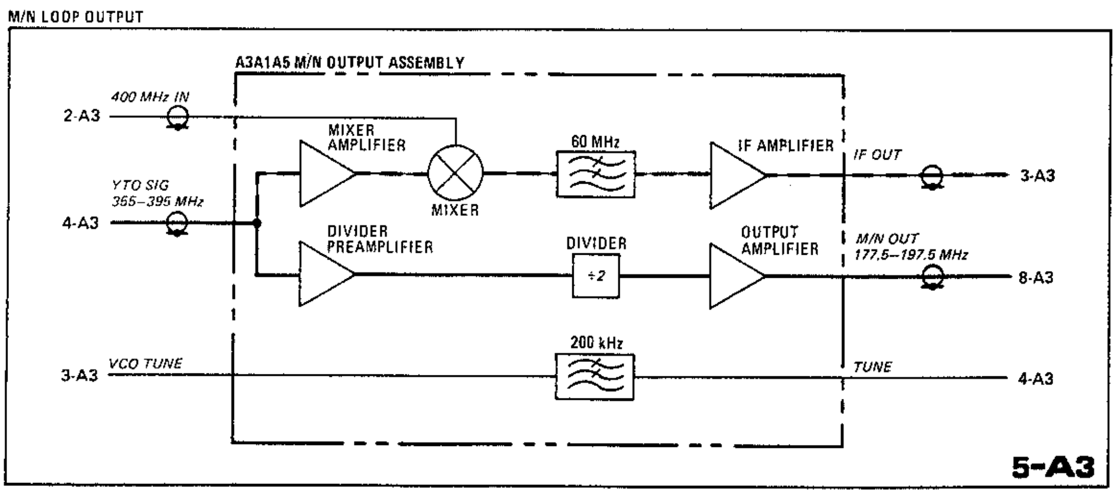


Figure 8-79. M/N Output Block Diagrams

FIG. 8-80
Sht 1 of 2

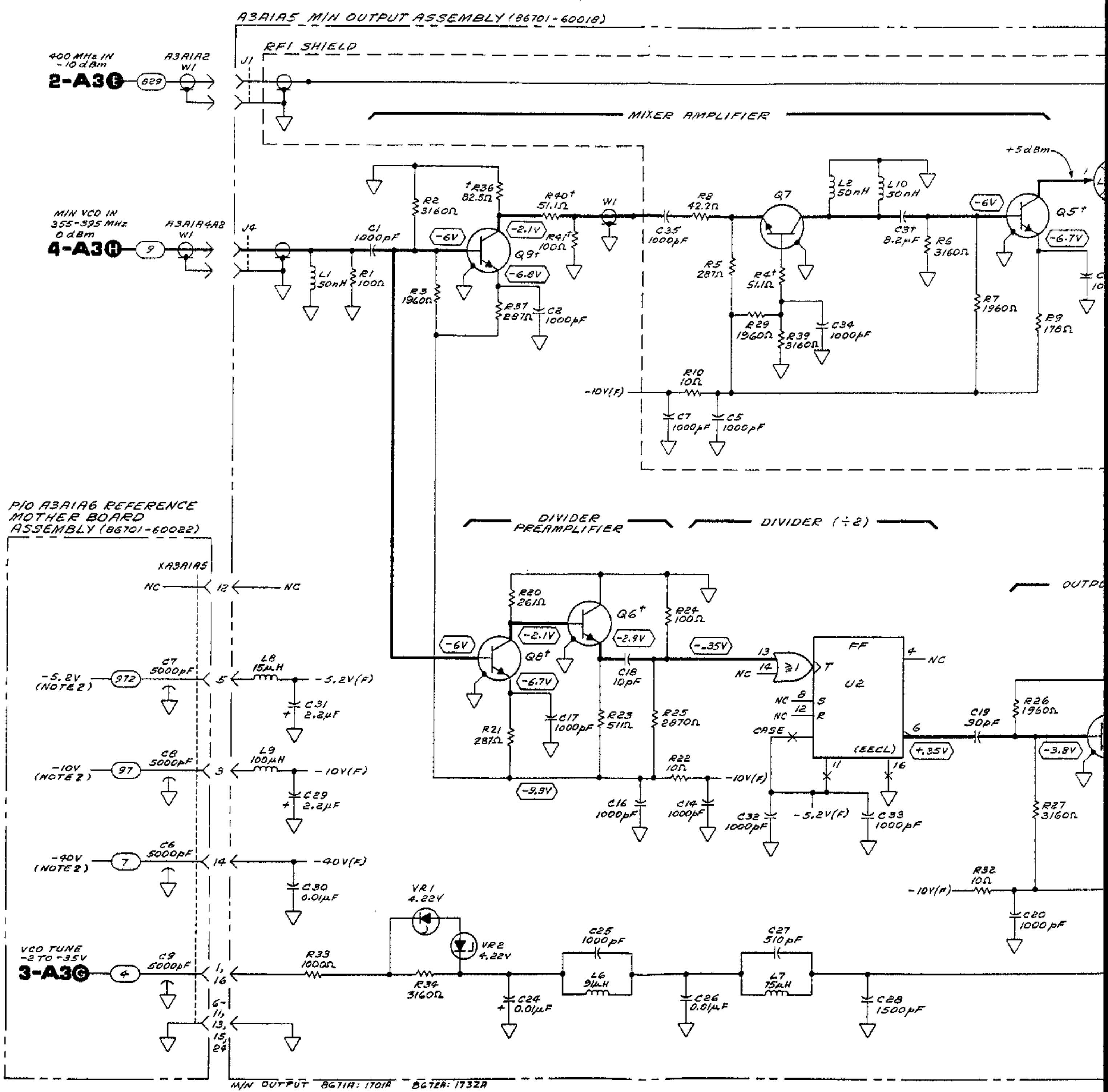
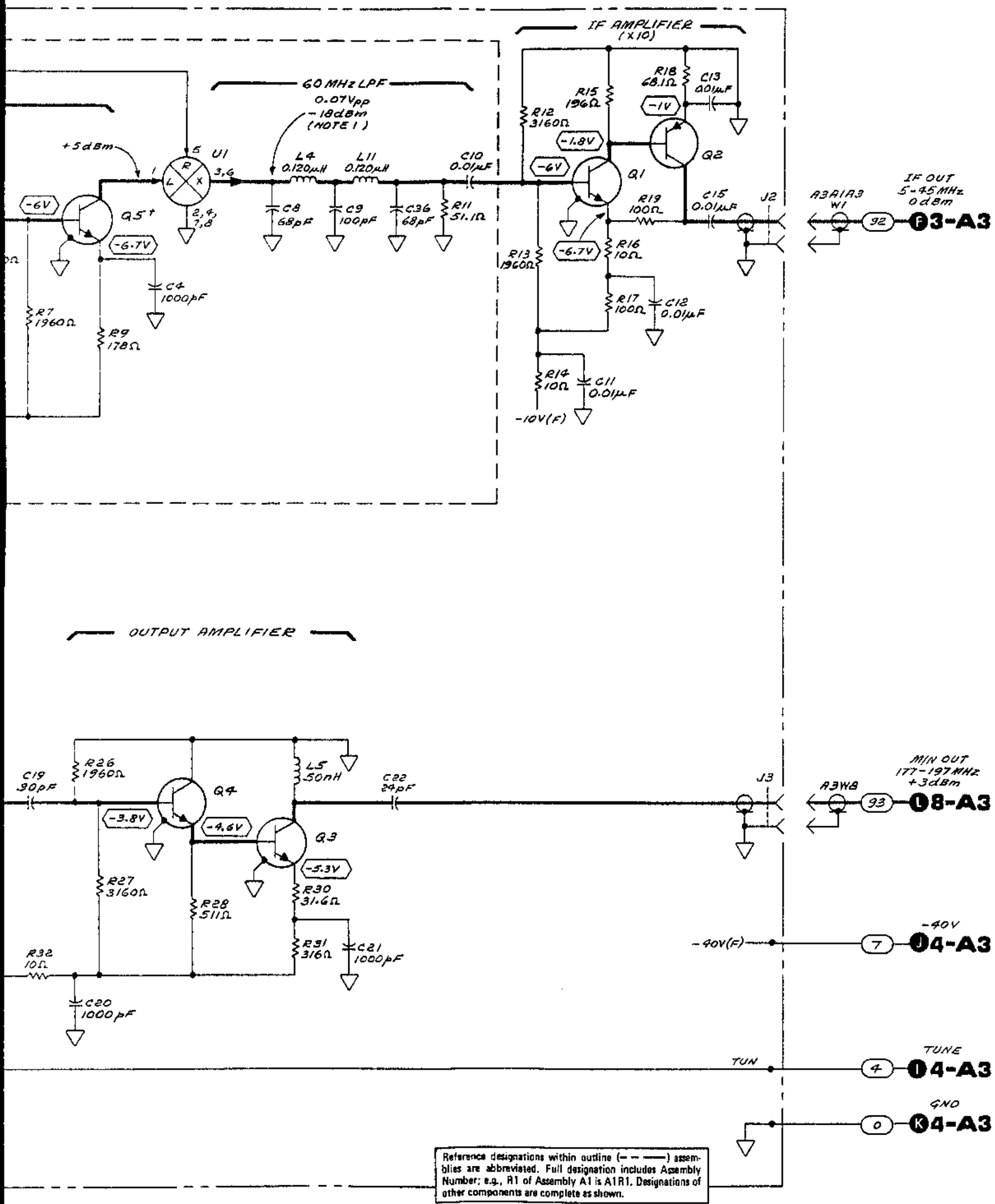


FIG. 8-80
Sht 2 of 2



NOTES

1. MEASURED WITH SPECTRUM ANALYZER HIGH IMPEDANCE PROBE.
2. POWER SUPPLY CONNECTIONS TO THE A3A1 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1-A3.

† BACDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

A3	A3A1A5
W8	C1-5, 7-22, 24-36
A3A1A2	J1-4
W1	L1, 2, 4-11
A3A1A3	Q1-9
W1	R1-34, 36, 37, 39-41
A3A1A4A2	U1, 2
W1	VR1, 2
	W1
	A3A1A6
	C6-9
	XA3A1A5

DELETED: A3A1A5C6, C38, C39, L3, L12

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, 3-9	1854-0546
Q2	1853-0015
U1	0955-0063
U2	1820-0736

5-A3
A3A1A5

Figure 8-80. M/N Output Assembly Schematic Diagram

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-34
• Performance tests	Refer to Table 5-3 on Page 5-3
• Adjustment procedures	Page 5-2

PRINCIPLES OF OPERATION

YTO Phase Lock 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 loop and 2) to the 20/30 MHz loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the DAC (Digital-toAnalog Converter) 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 20/30 MHz 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 20/30 loop frequency in the following manner:

$$f_o = (N)\,(f_{M/N} - f_{20/30})$$

where f_o = YTO output frequency (MHz)

N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)

$f_{M/N}$ = M/N loop output frequency (MHz)

$f_{20/30}$ = 20/30 loop output frequency (MHz)

f_{YTO} , N and $f_{M/N}$ OUT may be looked up on Table 8-4, M and N numbers and Resulting Frequencies.

Also, $f_{20/30} = (30.000 - D_4 . D_3 D_2 D_1)$ MHz

where D_4 = Front panel 1 MHz character

D_3 = front panel 100 kHz character

D_2 = front panel 10 kHz character

D_1 = front panel 1 kHz character

for YTO frequencies less than 6200 MHz. Refer to the Service Sheet 2 for a complete listing of pertinent formulas.

YTO Loop Pretune

The digital control inputs to the DAC from the A2 Controller Assembly select the pretuned 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 <6.2 GHz) then the pretune circuits are operating properly. Pretuning, however, does normally bring to YTO frequency to within 1 or 2 MHz of the desired YTO frequency.

NOTE

In order to check the pretuning, the YTO loop must be opened. Refer to the YTO pretune troubleshooting information on Service Sheet 2.

A3A5 DAC (Digital-to-Analog Converter) Assembly

The digital inputs to the DAC are in a 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 binary or 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 amplifier with a gain of −6.000 V/ma converts this summed current to a voltage (−3.000 V/GHz). Note that the Summing and Output Buffer Amplifier also has components (R59 and C12) which speed up the action of the amplifier during a frequency change.

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 those 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. The 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

It is assumed that the troubleshooting information on Service Sheets 1, 2, and 7-A3 was used to isolate a power supply malfunction to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter . . . . HP 3455A

NOTE

An accurate digital voltmeter is essential for troubleshooting the Digital-to-Analog Converter (DAC). The voltmeter must be capable of measuring −18 Vdc with a minimum resolution of 1 mV (0.1 mV resolution is preferred.

1. Connect the DVM to A3A5TP4. The voltage should be −6.50 ±0.06 Vdc. If it is not within tolerance, perform the complete DAC adjustment procedure in Section V before continuing. If the voltage can be adjusted within tolerance, proceed to step 4.

2. Measure the power supply inputs to the circuit board at pins 1, 2, 3, and 4. If correct, continue with step 3. Otherwise troubleshoot the power supply boards (A3A2, A3A3, and A3A4).

3. Measure the voltage at emitter Q1. It should be −20.9 Vdc. If correct, troubleshoot the Bias Buffer Amplifier. Otherwise, troubleshoot the Bias amplifier.

4. Measure the voltages at A3A5TP1 (+11 Vdc) and A3A5TP2 (+10 Vdc). If both are correct continue. Otherwise, troubleshoot the appropriate Reference Buffer amplifier (U3 or U4).

5. Tune the Synthesizer to 2000 MHz. Connect the DVM to A3A5TP3. The voltage should be −6.000 ±0.001 Vdc. If voltage is not correct, perform the DAC adjustment procedure. If the voltage can be adjusted within the tolerance, skip to step 8. Otherwise, continue with step 6.

6. Measure the voltages at U7 pins 9 and 4. Both should be 0.6V (high). Pins 1, 8 and 12 should be 0 Vdc. If correct, proceed to step 7. Otherwise, troubleshoot U10, U7 and their associated components.

7. Measure the voltage at the base of Q5A. It should be very nearly 0 Vdc (a virtual ground). If correct, the Summing and Output Buffer Amplifier is properly balanced and is probably working correctly (proceed to step 8). Otherwise, tune to 3000 MHz and troubleshoot the amplifier by using the voltages on the schematic.

8. Tune to the frequencies as shown in the following table. As before, compare the DVM reading to the voltages in the table.

Frequency	Voltage at A3A5TP3
2200 MHz	−6.600±0.001 Vdc
2800 MHz	−8.400±0.001 Vdc
3200 MHz	−9.600±0.001 Vdc
3600 MHz	−10.800±0.001 Vdc
4800 MHz	−14.400±0.001 Vdc

If all the voltages are correct, continue with this procedure. Otherwise, troubleshoot U10, U7, U4, Q4, and their associated components.

9. Tune the frequencies as shown in the following table. Compare the DVM reading to the voltages in the table.

Frequency	Voltage at A3A5TP3
2020 MHz	−6.060 ±0.001 Vdc
2040 MHz	−6.120 ±0.001 Vdc
2080 MHz	−6.240 ±0.001 Vdc
2100 MHz	−6.300 ±0.001 Vdc

If all voltages are correct continue with this procedure. Otherwise, perform the DAC adjustments. If the voltages cannot be adjusted within tolerance, troubleshoot U9, U6, Q3, and their associated components.

10. Tune the Synthesizer to the frequencies as shown in the following table and measure the voltages at A3A5TP3.

Frequency	Voltage at A3A5TP3
2001 MHz	−6.003 ±0.001 Vdc
2002 MHz	−6.006 ±0.001 Vdc
2004 MHz	−6.012 ±0.001 Vdc
2008 MHz	−6.024 ±0.001 Vdc
2010 MHz	−6.030 ±0.001 Vdc

If the voltages are correct, the DAC is working properly. If necessary, perform the DAC adjustment procedure. Otherwise, troubleshoot U5, U8, Q2, and their associated components.

NOTE

After the A3A5 assembly has been repaired, perform the Digital-to-Analog Converter Adjustments in Section V.

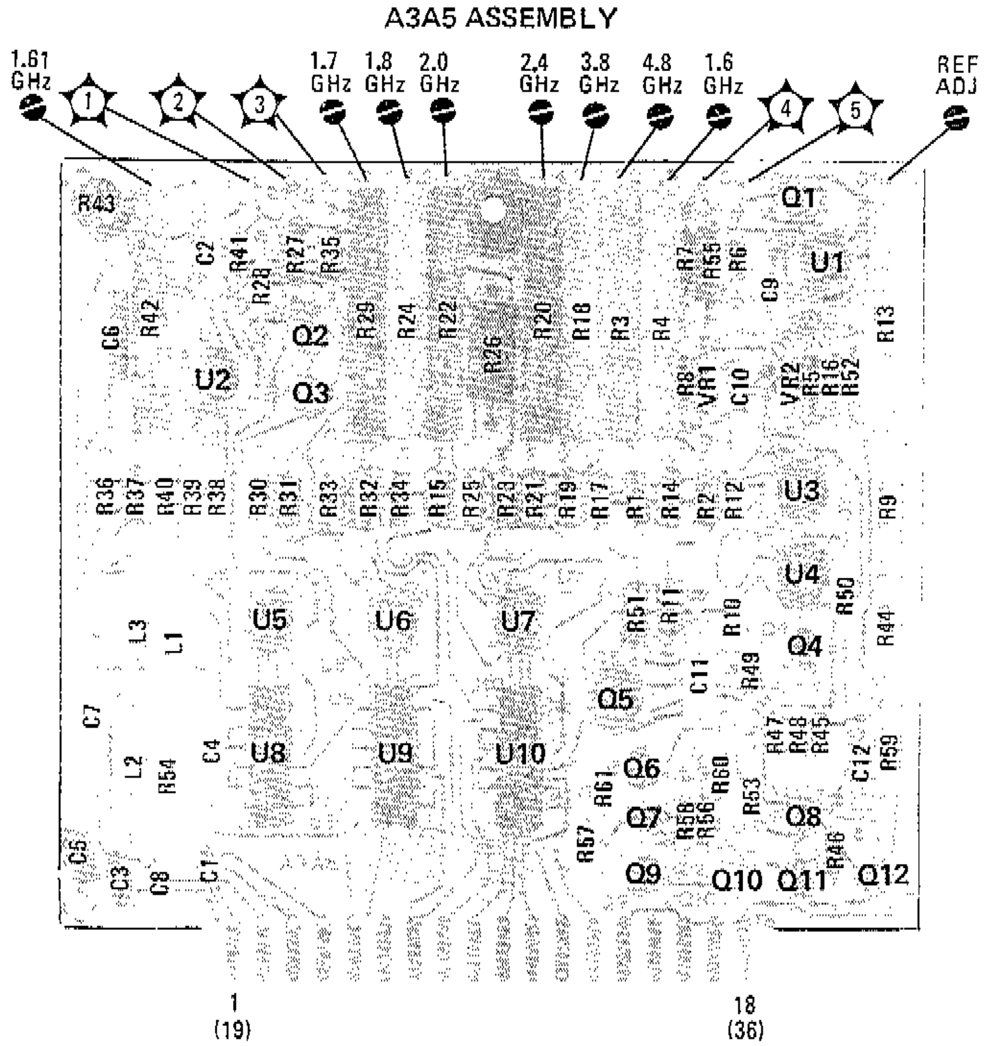
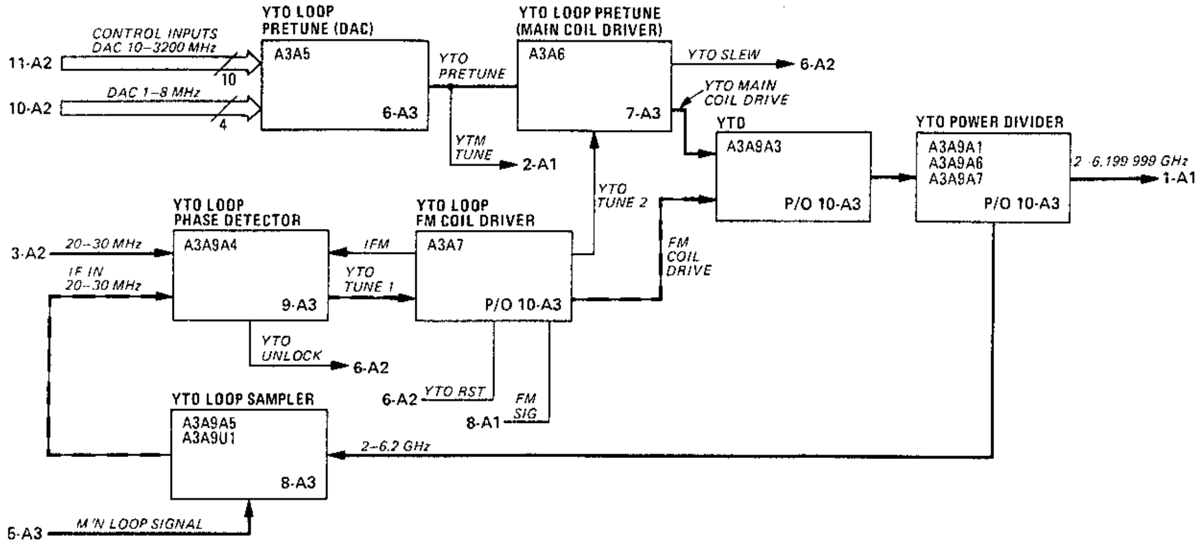


Figure 8-81. A3A5 DAC Assembly Component, Adjustment, and Test Point Locations



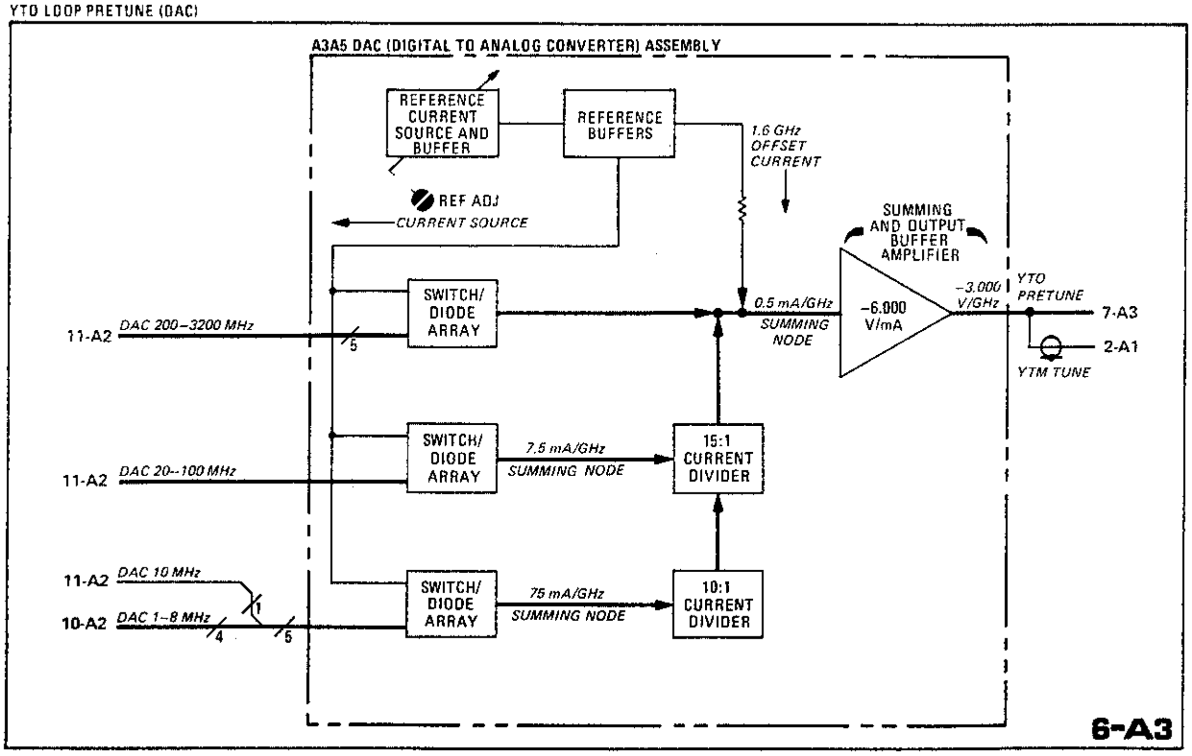


Figure 8-82. Digital-to-Analog Converter Block Diagrams

FIG. 8-83
Sht 1 of 3

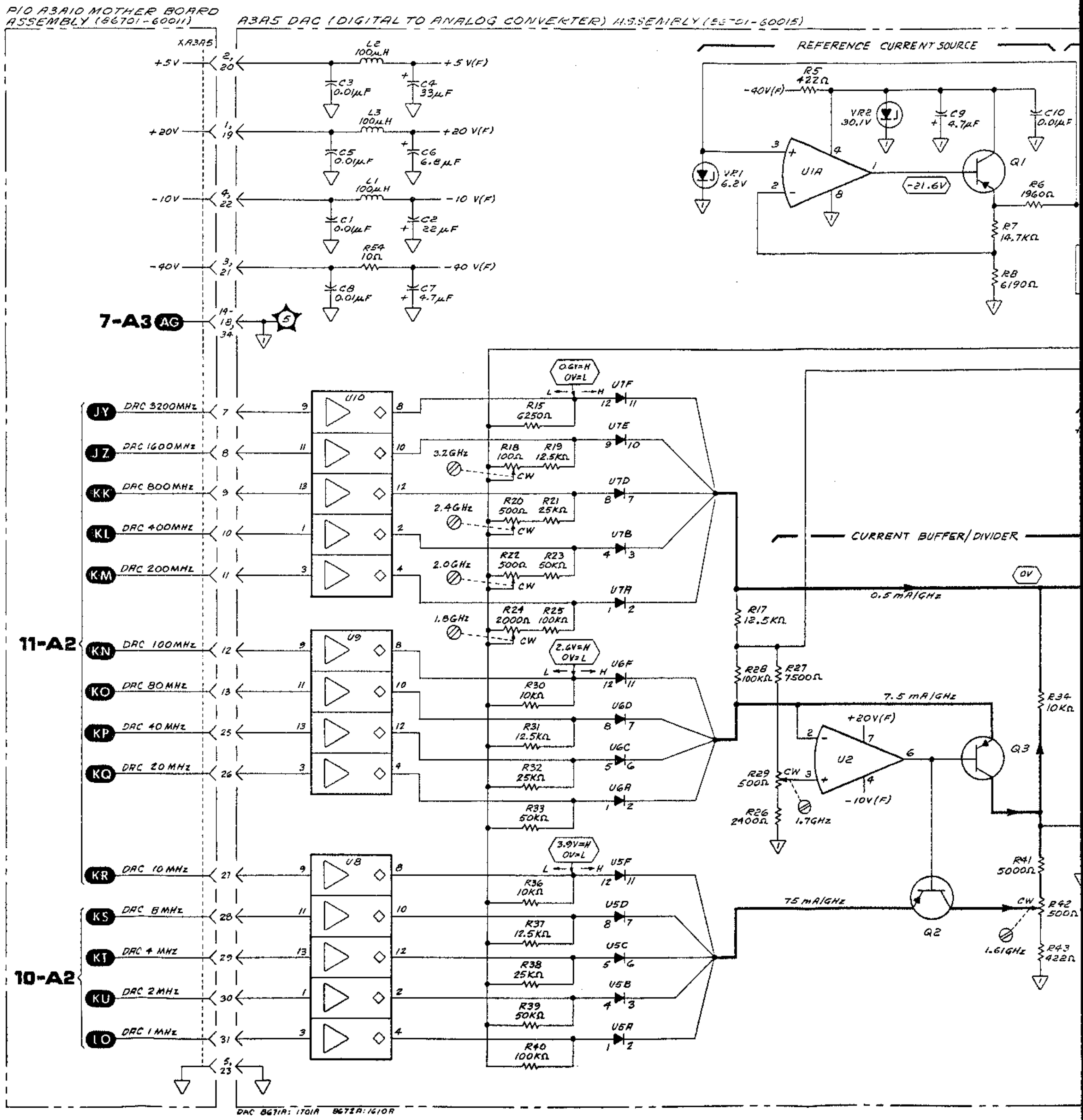


FIG. 8-83
Sht 2 of 3

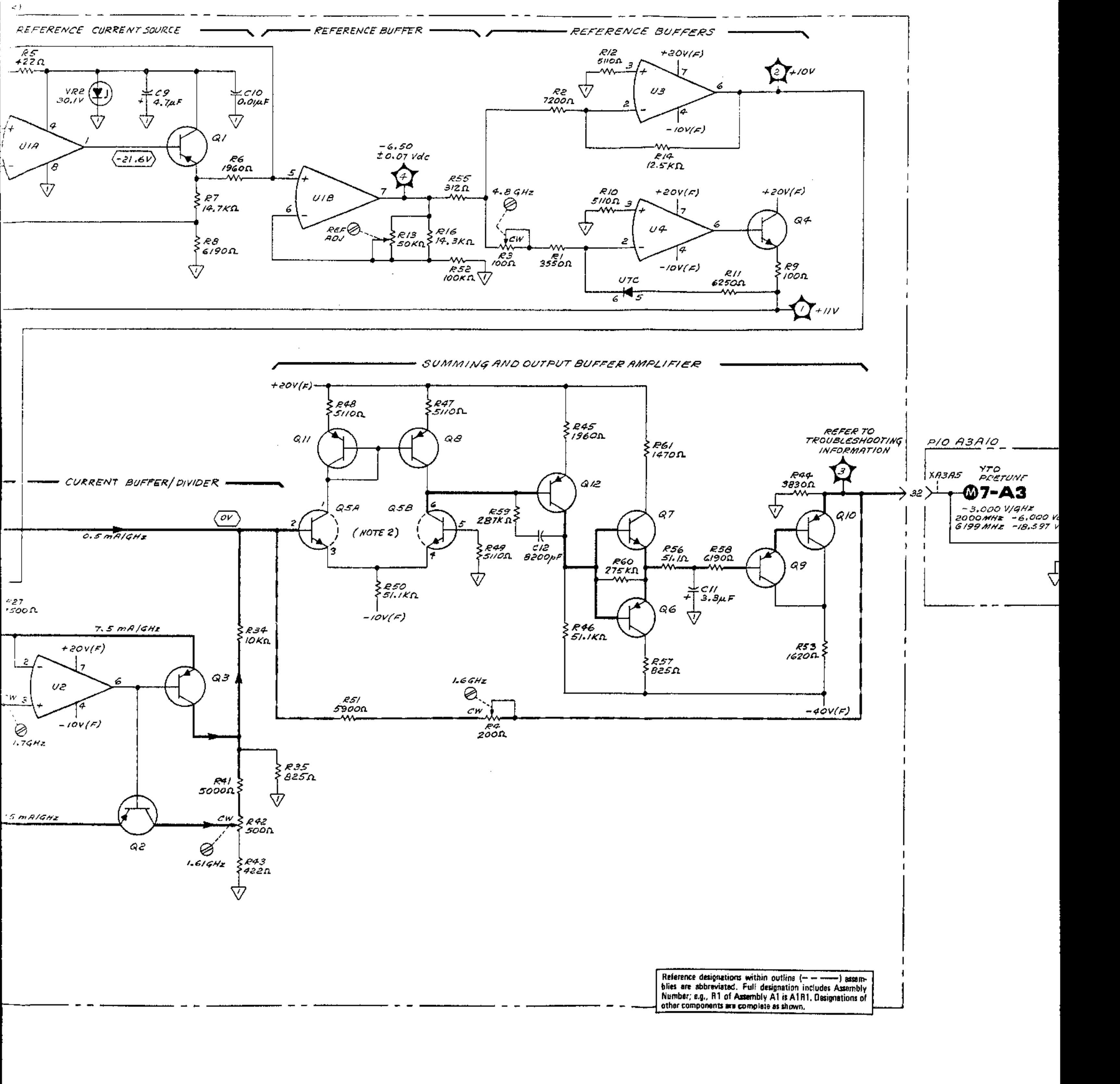
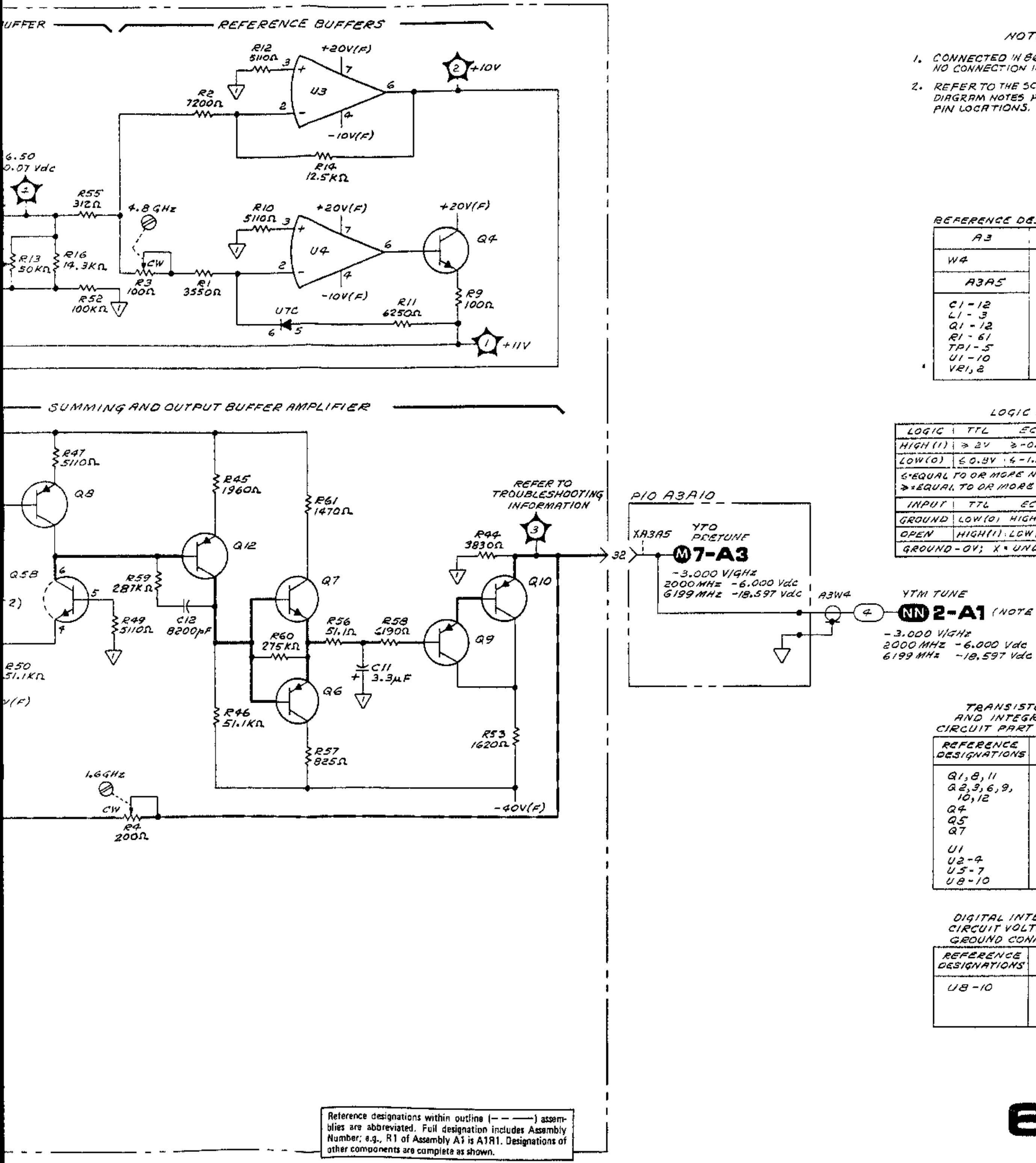


Figure 8-83. D

FIG. 8-83
Sht 3 of 3



NOTES

1. CONNECTED IN 8672A ONLY; NO CONNECTION IN 8671A
2. REFER TO THE SCHEMATIC DIAGRAM NOTES FOR PHYSICAL PIN LOCATIONS.

REFERENCE DESIGNATIONS

A3	A3A10
W4	XA3A5
A3A5	
C1-12 L1-3 Q1-12 R1-61 TP1-5 U1-10 VR1,2	

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
Q1,8,11	1853-0007
Q2,3,6,9,10,12	1853-0451
Q4	1854-0404
Q5	1854-0475
Q7	1854-0474
U1	1826-0092
U2-4	1826-0261
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

6-A3
A3A5

Figure 8-83. Digital-to-Analog Converter Schematic Diagram

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

- Block diagram — Page 8-33
- Motherboard wiring — Last 3 foldout pages
- Parts list — Page 6-36
- Performance tests — Refer to Table 5-3 on page 5-3
- Adjustment procedures — Page 5-2

PRINCIPLES OF OPERATION

YTO Phase Lock 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 loop and 2) to the 20/30 MHz loop.

The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the DAC (Digital-to-Analog Converter) 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 20/30 MHz 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 20/30 loop frequency in the following manner:

$$f_o = (N) \quad (f_{M/N} - f_{20/30})$$

where f_o = YTO output frequency (MHz)

N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)

$f_{M/N}$ = M/N loop output frequency (MHz)

$f_{20/30}$ = 20/30 loop output frequency (MHz)

f_{YTO}, N and $f_{M/N}$ OUT may be looked up on Table 8-4, M and N Numbers and Resulting Frequencies.

Also, $f_{20/30} = (30.000 - D_4 . D_3 D_2 D_1)$ MHz

where D_4 = front panel 1 MHz character

D_3 = front panel 100 kHz character

D_2 = front panel 10 kHz character

D_1 = front panel 1 kHz character

for YTO frequencies less than 6200 MHz. Refer to the Service Sheet 2 text for a complete listing of pertinent formulas.

YTO Loop Pretune

The digital control inputs to the DAC from the A2 Controller Assembly select the pretuned 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 <6.2 GHz) then the pretune circuits are operating properly. Pretuning, however, does normally bring the YTO frequency to within 1 or 2 MHz of the desired YTO frequency.

NOTE

In order to check the pretuning, the YTO loop must be opened. Refer to the YTO pretune troubleshooting information on Service Sheet 2.

A3A6 YTO Driver Assembly

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 and allows for variation in the frequency-to-voltage sensitivity of Yig Tuned Oscillators. Refer to the following figure.

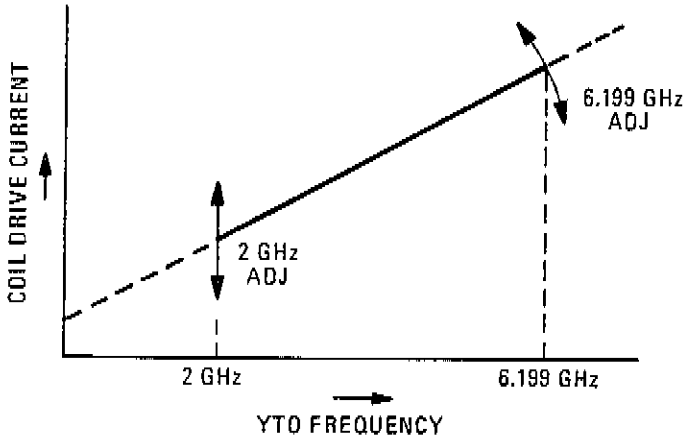
The Shaping Network (connected across the Sense Resistor) compensates for the non-linearity of the YTO frequency-to-voltage curve.

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 (125Ω) and that portion of R24 (15Ω) 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. Q8 and Q12 increase the slew rate of the amplifier by quickly charging or discharging C7 when large change occurs. The 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 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 volts. (Refer to the following figure.)



YTO Frequency versus Coil Drive Current

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1 and 2 was used to isolate a YTO pretune malfunction. The following information will allow further isolation to circuits shown by one of the two YTO pretune schematics 6-A3 or 7-A3. If the malfunction is on 7-A3, this information will also aid in isolating the defective component.

Test Equipment

Digital Voltmeter . . . . HP 3455A
Frequency Counter . . . . HP 5340A

1. Tune the Synthesizer to 2000 MHz. Measure the voltage at the edge connector XA3A6 pin 13. It should be −6.000 ± 0.001 Vdc. If correct, proceed to step 2. Otherwise, turn to Service Sheet 6-A3 and continue troubleshooting.

2. Ground A3A7TP2 to open the YTO loop.

3. Measure the voltage at A3A6TP2. It should be about −37.5 Vdc. Increase the frequency to 6199 MHz. The voltage at TP2 should drop to −32.5 Vdc. If the voltages are correct, proceed to step 6.

4. Set the frequency to 3000 MHz. Measure the voltage at the emitter of Q5. It should be −9.3 Vdc. If voltage is correct, use the voltages on schematic to troubleshoot the Coil Driver, Slewing Detector and the Coil Damping Network. Otherwise continue with step 5.

5. Measure the voltages at the inputs to the Input Amplifier. Compare them to the output voltage (measured at the emitter of Q8 and Q12). Since the Input Amplifier is a discrete operational amplifier, we can determine if the voltage change at the output follows the inputs. If the change does not follow the input, measure the voltages inside the amplifier to determine where the change occurs. If the output polarity follows the input polarity, measure voltages in the feedback path to find the defective component.

6. Remove the ground from A3A7TP2. Measure the voltage at A3A6TP1 and compare it to the voltage at A3A6TP4. $V_{TP4} = 2.9 + 0.64 (V_{TP1})$. If the voltage is correct, the phase lock amplifier is operating properly. Proceed to step 7. Otherwise, troubleshoot the Offset Reference and Phase Lock Amplifier.

7. Connect A3A7TP2 to ground. Connect the frequency counter to the RF OUTPUT connector. Tune to 2000 MHz. The counter should indicate 2000.0 + 1.0 MHz. Tune to 6199 MHz. The counter should indicate 6199.0 ±1.0 MHz. If the frequencies are correct, A3A6 is operating normally. Otherwise, perform the YTO Driver Adjustment in Section V.

NOTE

After the A3A6 assembly is repaired, perform the YTO Driver Adjustment in Section V.

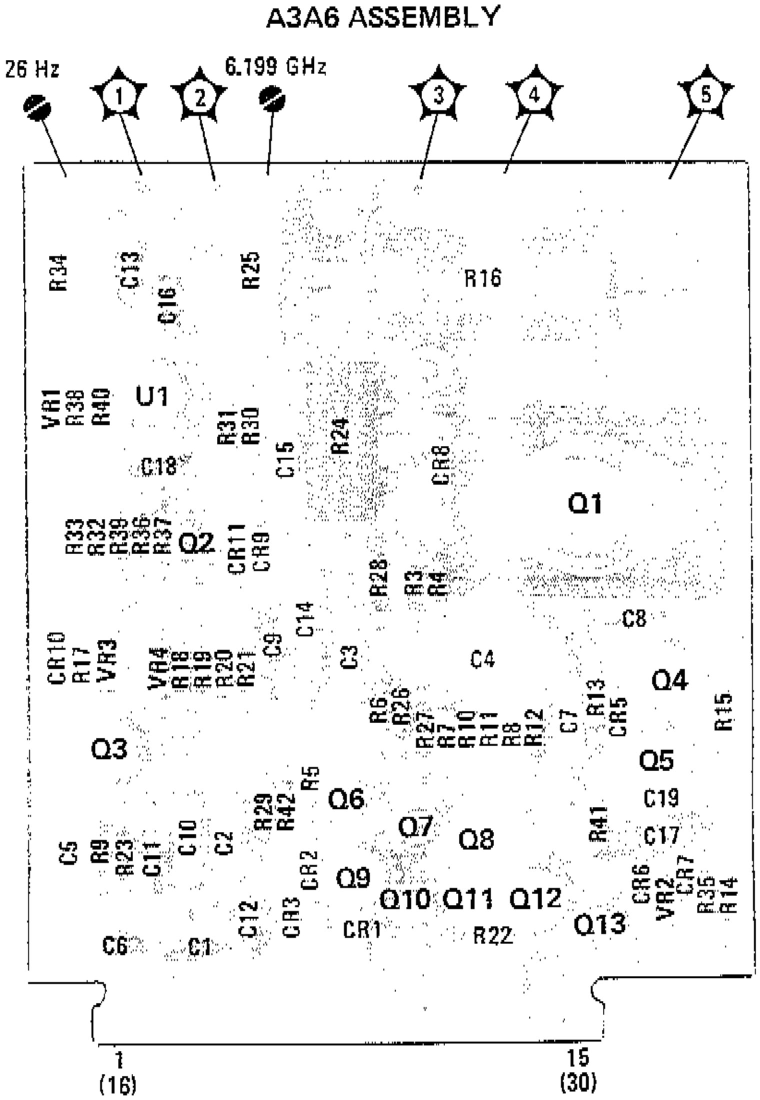
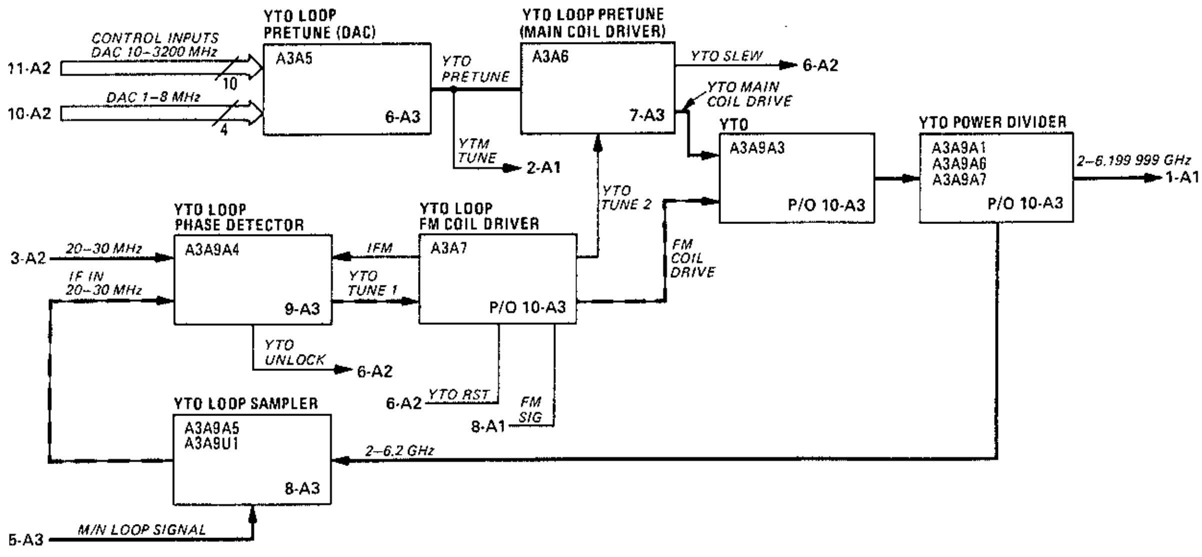


Figure 8-84. A3A6 YTO Main Coil Driver Assembly Component, Adjustment, and Test Point Locations



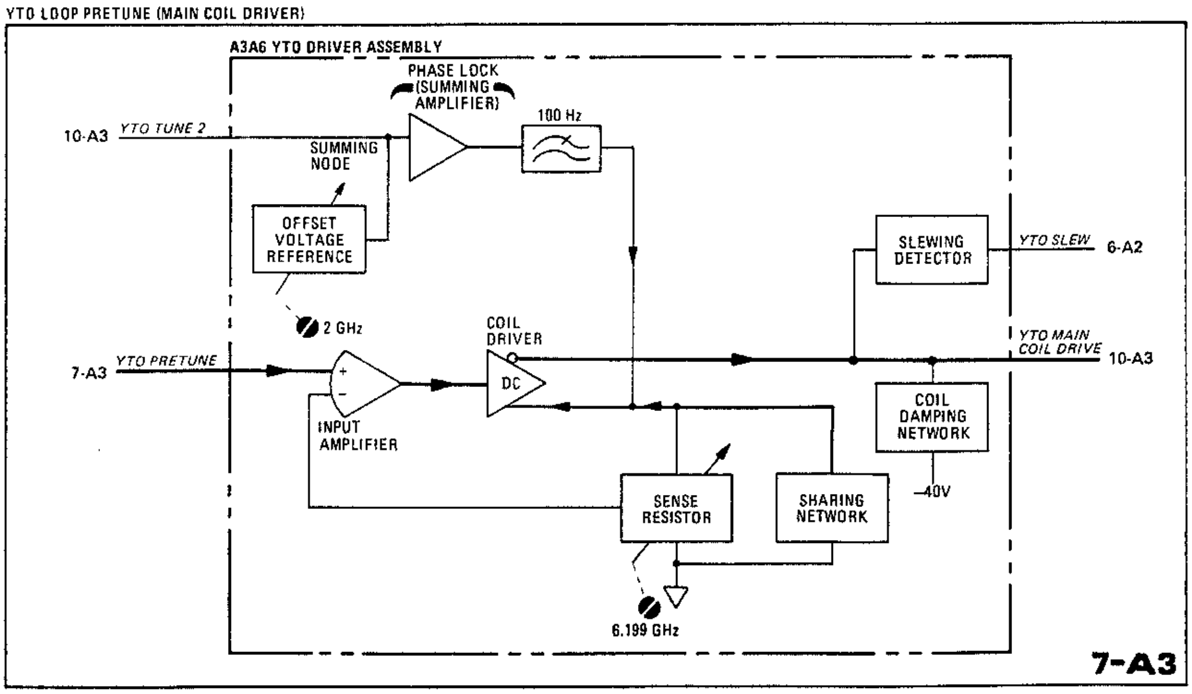


Figure 8-85. YTO Main Coil Driver Block Diagrams

FIG. 8-86
Sht 1 of 2

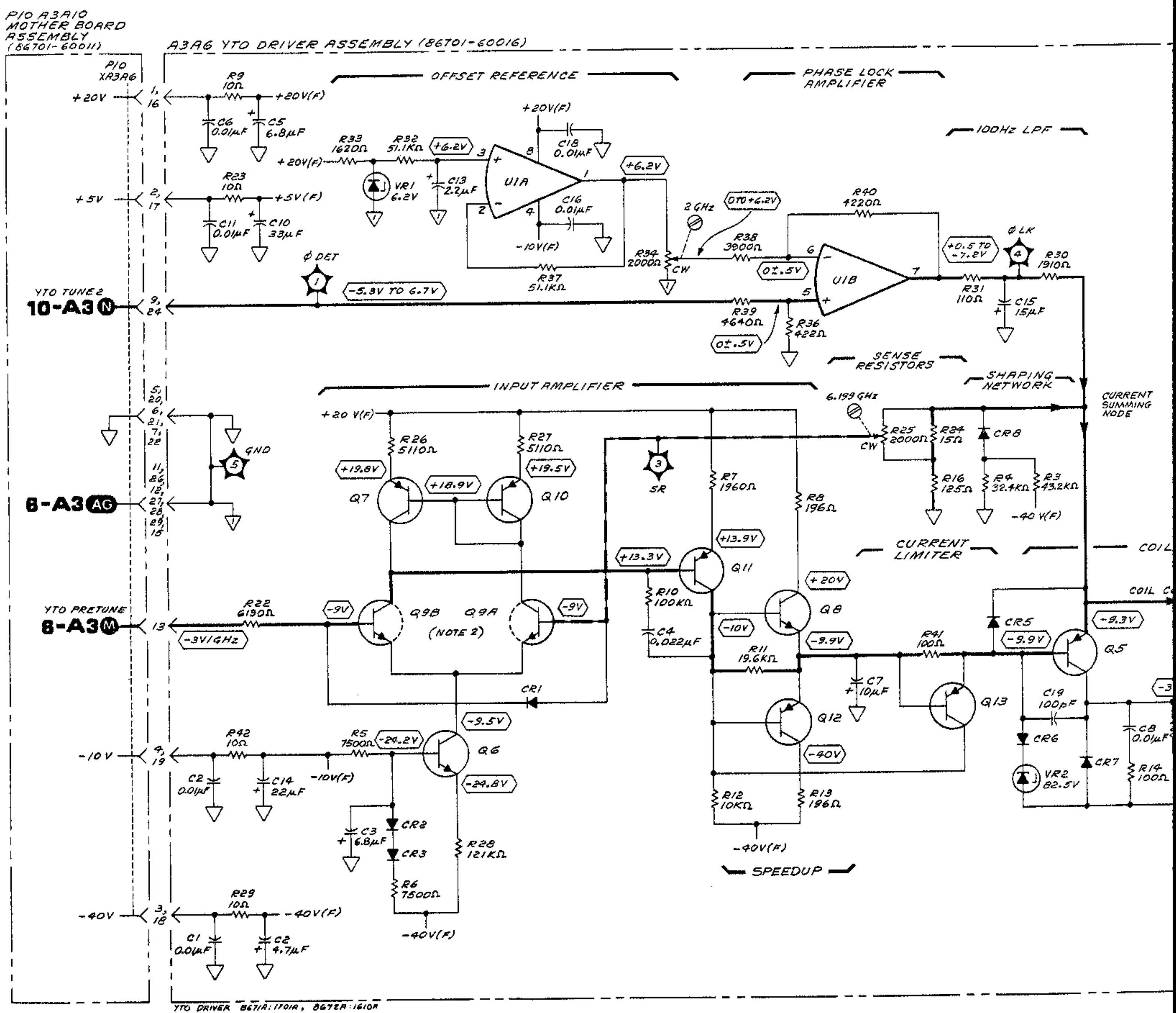
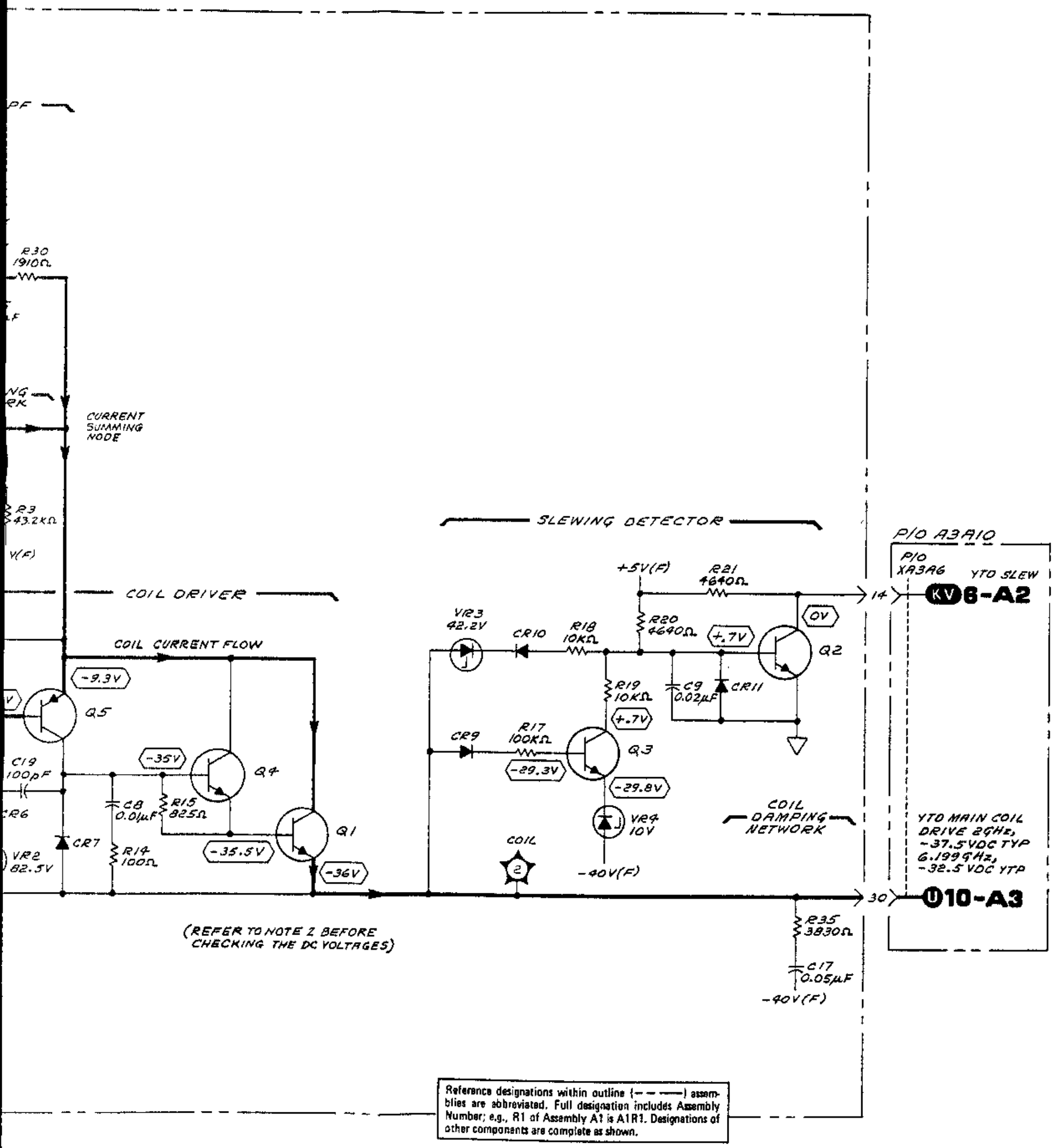


FIG. 8-86
Sht 2 of 2



NOTES

1. THE DC VOLTAGES SHOWN ARE FOR A CARRIER FREQUENCY OF 3 GHz.
2. REFER TO THE SCHEMATIC DIAGRAM NOTES FOR PHYSICAL PIN LOCATIONS.

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	1858-0007
Q9	1854-0475
Q11,13	1853-0451
Q12	1853-0012
U1	1826-0092

7-A3
A3A6

Figure 8-86. YTO Main Coil Driver Schematic Diagram

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-42
• Performance tests	Refer to Table 5-3 on page 5-3
• Adjustment proceudres	Page 5-2

PRINCIPLES OF OPERATION

YTO Phase Lock 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 loop and 2) to the 20/30 MHz loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the 20/30 MHz 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 20/30 loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{20/30})$$

where f_o = YTO output frequency (MHz)

N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned).

$f_{M/N}$ = M/N loop output frequency (MHz)

$f_{20/30}$ = 20/30 loop output frequency (MHz)

f_{YTO}, N and $f_{M/N}$ OUT may be looked up on Table 8-4, M and N Numbers and Resulting Frequencies.

Also, $f_{20/30} = (30.000 - D_4.D_3D_2D_1)$ MHz

where D_4 = front panel 1 MHz character

D_3 = front panel 100 kHz character

D_2 = front panel 10 kHz character

D_1 = front panel 1 kHz character

for YTO frequencies less than 6200 MHz. Refer to the Service Sheet 2 text for a complete listing of pertinent formulas.

NOTE

The RF INPUT is the same frequency as the YTO output f_o and the YTO IF signal is the same as $f_{20/30}$ if the YTO loop is locked. The M/N loop signal is the $f_{M/N}$ signal.

A3A9A5 Sampler Assembly

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 Loop Phase Detector where it is phase compared to the 20/30 MHz (LFS) Loop output.

The M/N 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 Harmonic 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 20/30 Loop signal in order to lock the YTO Loop.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1, 2 and 10-A3 was used to isolate a YTO loop malfunction to the circuits shown on this schematic. The following information will aid in isolating a defective component.

Test Equipment

Frequency Counter .... HP 5340
Oscilloscope .... HP 180C/1801A/1821A
Power Meter .... HP 436A/8481A
Spectrum Analyzer ....HP 8555A/8552B/141T
High Impedance Probe (Spectrum Analyzer)................. HP 1121A
Digital Voltmeter .... HP 3455A

1. Connect the IF OUT to a frequency counter using a coaxial tee to keep the YTO loop closed. Tune the Synthesizer's frequency to 3000.000 MHz. The IF OUT should be exactly 30 MHz. Change the frequency to 2999.999 MHz. The IF should be 20.001 MHz.

2. Disconnect the frequency counter and connect an oscilloscope to the coaxial tee. The output should be between 1.2 and 3 Volts peak-to-peak. If the results of steps 1 and 2 are correct, the A3A9A5 Assembly is operating properly. Otherwise, continue with this procedure.

3. Measure the M/N Loop Signal frequency and power using a power meter and the frequency counter. At 3 GHz the frequency should be 189.375 MHz. See the table on Service Sheet 2 for the other M/N Loop frequencies. If they are correct, continue. Otherwise troubleshoot the M/N loop.

4. Measure the coupled output of the A3A9A1 Directional Coupler. It should be about −15 dBm. If correct, continue. Otherwise troubleshoot the YTO and the A3A6 YTO Driver Assembly.

5. Install the A3A9 assembly in the service position. (Refer to the Assembly and Disassembly procedure which precede the Service Sheets.) Remove the A3A9A5 cover. Use a high impedance probe with a spectrum analyzer to measure the signal at gate 1 of Q4. The signal should be about 300 μVrms between 20 and 30 MHz. If the signal is correct, proceed to step 8. Otherwise, continue with step 6.

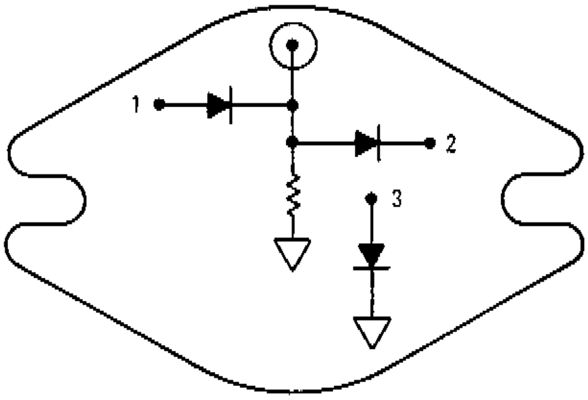
6. Check the Sampler Drive Amplifier at the junction of R9 and L9. It should deliver about +7 dBm into a 50 ohm load.

7. Measure the dc bias voltages to the Sampler at TP1. It should be +0.4 Vdc. If the drive signals are OK but the bias or output level is incorrect, the sampler A3A9U1 may be defective.

NOTE

The mixer (sampler) may be checked by measuring current flow and breakdown voltage of the diodes and internal resistance.

a. Remove the mixer from the board.
b. Make measurements across pin-1 (positive) and coaxial center pin (negative). $V_{BR} > 3V$ at 10 μA.
c. Measure across center pin (positive) and pin-2 negative. $V_{BR} > 3V$ at 10 μA.
d. Measure resistance from center pin to ground (about 50 ohms).
e. Measure pin-3 (positive) to ground (negative). $V_{BR} > 30V$ at 10 μA.



8. Measure the signal at base of Q6. The signal should be about the same level as measured in step 5. If correct, troubleshoot Q1, Q5, Q6 and their associated components. Otherwise, troubleshoot Q4, Q2, Q7 and their associated components.

NOTE

After the A3A9A5 Assembly has been repaired or when A3A9U1 is replaced, perform the YTO Loop Sampler Adjustments in Section V.

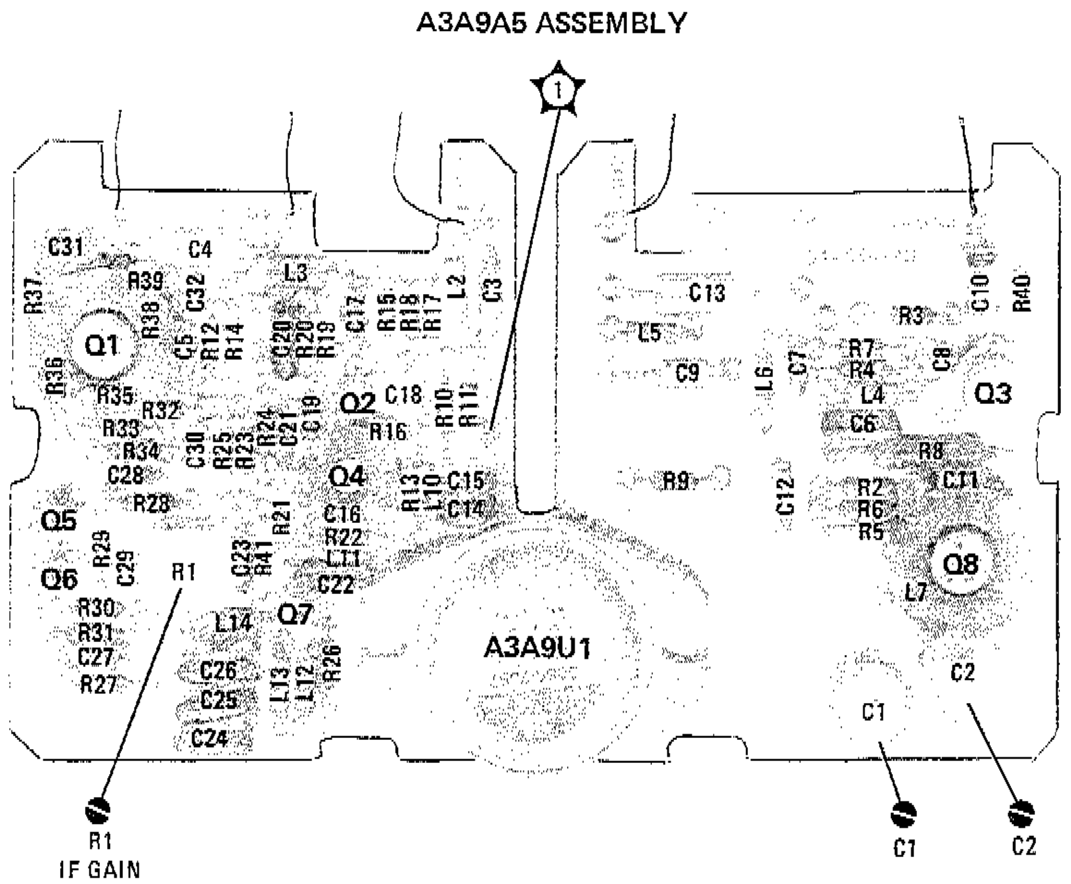


Figure 8-87. A3A9A5 YTO Sampler Assembly Component, Adjustment, and Test Point Locations

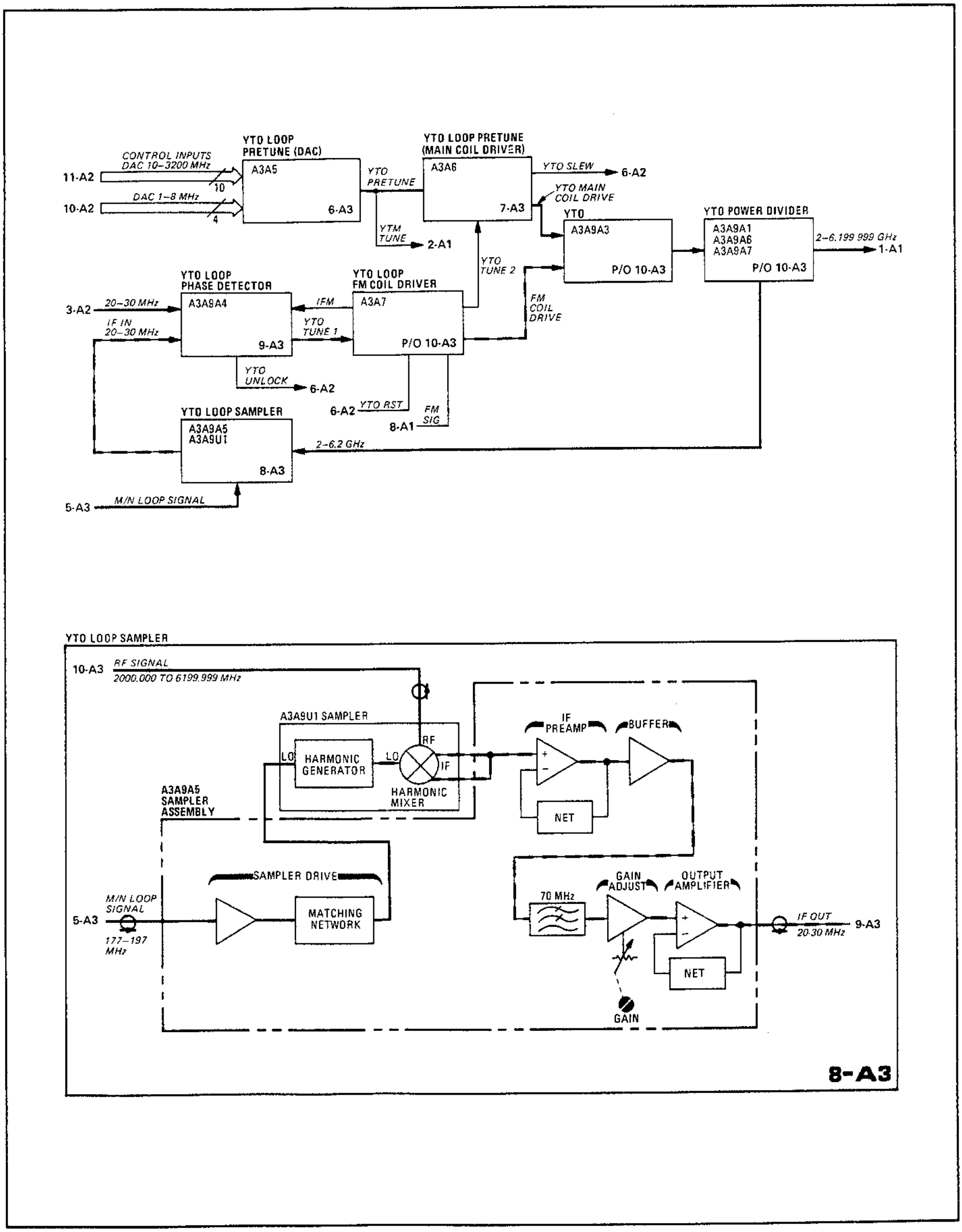


Figure 8-88. YTO Sampler Block Diagrams

FIG. 8-89
Sht 1 of 3

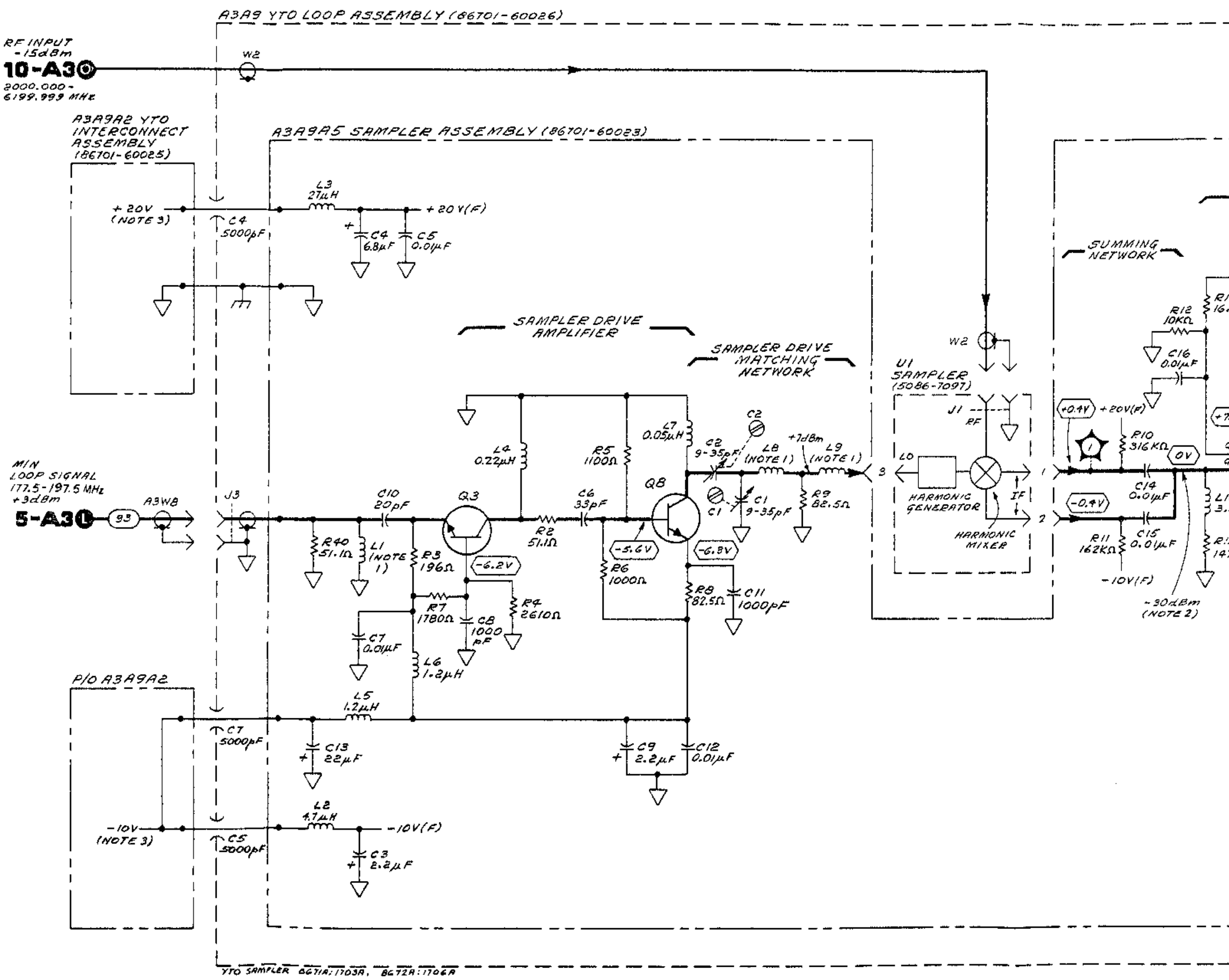
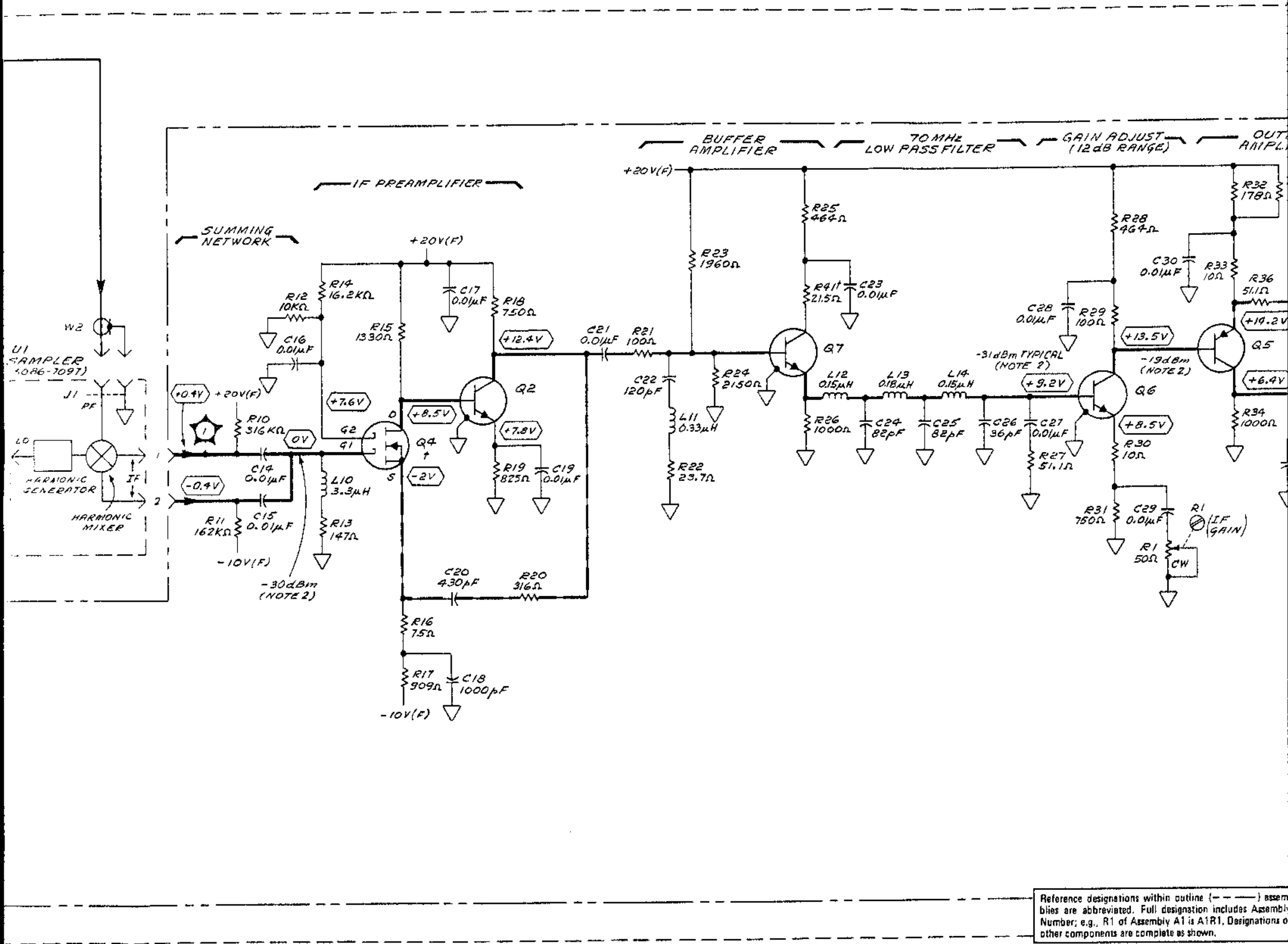
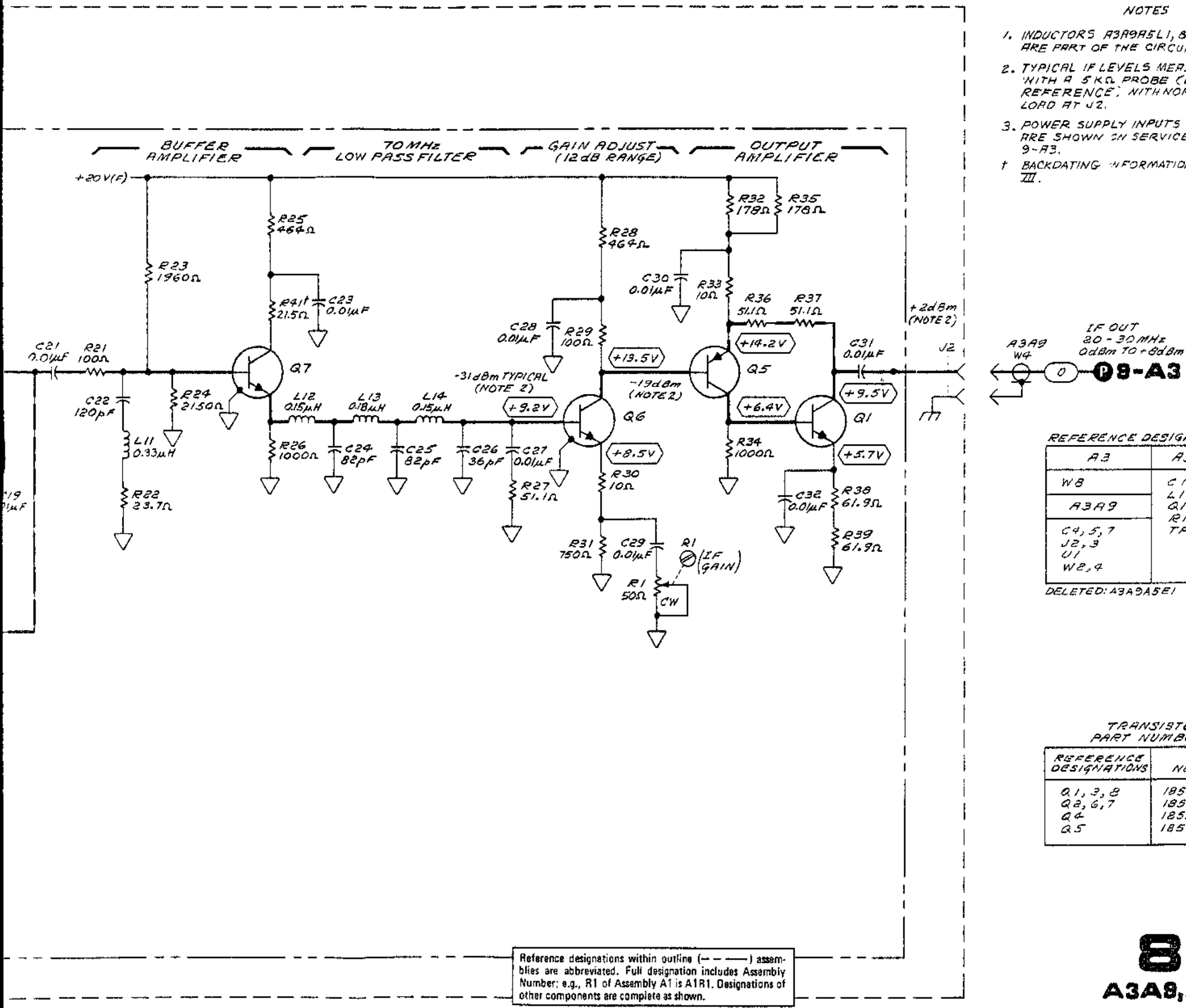


FIG. 8-89
Sht 2 of 3



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.

FIG. 8-89
Sht 3 of 3



NOTES

1. INDUCTORS A3A9A5L1, 8 AND 9 ARE PART OF THE CIRCUIT BOARD.
2. TYPICAL IF LEVELS MEASURED WITH A 5KΩ PROBE (50Ω REFERENCE) WITH NORMAL LOAD AT J2.
3. POWER SUPPLY INPUTS TO A3A9A2 ARE SHOWN ON SERVICE SHEET 9-A3.

† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

A3	A3A9,95
W8	C1 - 32 L1 - 14 Q1 - 8 R1 - 41 TP1
A3A9	
C4, 5, 7 J2, 3 U1 W2, 4	

DELETED: A3A9A5E1

TRANSISTOR PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1, 3, 8	1854 - 0247
Q2, 6, 7	1854 - 0345
Q4	1855 - 0254
Q5	1853 - 0015

8-A3
A3A9, A3A9A5, A3A9U1

Figure 8-89. YTO Sampler Assembly Schematic Diagram

SERVICE SHEET 9-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-40
• Performance tests	Refer to Table 5-3 on page 5-3
• Adjustment procedures	Page 5-2

PRINCIPLES OF OPERATION

YTO Phase Lock 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 loop and 2) to the 2/30 MHz loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the 20/30 MHz 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 20/30 loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{20/30})$$

where f_o = YTO output frequency (MHz)

N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)

$f_{M/N}$ = M/N Loop output frequency (MHz)

$f_{20/30}$ = 20/30 loop output frequency (MHz)

f_{YTO}, N and $f_{M/N}$ OUT may be looked up on Table 8-4, M and N Numbers and Resulting Frequencies.

Also, $f_{20/30} = (30.000 - D_4.D_3D_2D_1)$ MHz

where D_4 = front panel 1 MHz character

D_3 = front panel 100 kHz character

D_2 = front panel 10 kHz character

D_1 = front panel 1 kHz character
for YTO frequencies less than 6200 MHz. Refer to the Service Sheet 2 text for a complete listing of pertinent formulas.

YTO Loop FM Circuits

In the Synthesizer's CW mode of operation, the Phase Detector's error voltage is found to be proportional to the integral of the YTO frequency. In the FM mode, the error voltage is due to the sum of integrals of the YTO frequency and the frequency deviation. Since the deviation is directly proportional to the modulation drive voltage, the error voltage may be expressed as follows:

$$V_e = \int f_o(t)\,dt + \int V_{FM}(t)\,dt$$

where V_e = phase detector's error voltage

$f_o(t)$ = YTO frequency

$V_{FM}(t)$ = FM drive voltage.

SERVICE SHEET 9-A3 (Cont'd)

The result is a cancellation of modulation for FM rates inside the YTO loop bandwidth (20 kHz) and a partial cancellation at rates greater than 20 kHz and decreasing as the rate increases. In order to make the YTO loop response to FM essentially flat, a portion of the FM drive signal is integrated and subtracted from the error voltage output by the Phase Detector. This voltage is adjusted to just cancel the error voltage caused by the FM signal. Now the YTO loop effectively passes all specified rates to the YTO with little or no effect. Note that the FM drive signal is input after the Loop Integrator and the integrated FM is subtracted from the error voltage just before the Loop Integrator.

A3A9A4 YTO Phase Detector Assembly

The Phase/Frequency Detector compares the frequency and phase of the Sampler IF signal to the output of the 20/30 MHz 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.

During frequency modulation, the integrated FM signal from the A3A7 FM Driver Assembly is subtracted from the error signal. The net result is that the loop does not respond to the modulating signal and the YTO can be modulated at rates within the loop bandwidth.

Phase/Frequency Detector. The IF IN (from the Sampler) and the 20/30 MHz Loop signal are divided by two and to the Phase/Frequency Detector. If the phase of the IF signal leads that of the 20/30 MHz signal, a negative going pulse appears at U1 pin 12 (TP4). Pin 3 (TP3) remains at a steady dc level (about −0.6V). If the 20/30 Loop signal leads, a negative pulse appears at pin 3 (TP3). 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. The signal is then applied to the Loop Integrator. The output (YTO Tune 1) tunes the YTO frequency. When FM is applied to the YTO loop, the detector discriminates the FM signal. The following expression shows the relationship between modulation index (β), frequency deviation (f_{dev}) and rate of modulation (f_{mod}).

$$\beta = \frac{f_{dev}}{f_{mod}}$$

The detector's practical operating range is approximately 0.5 radians (β = 3.0). Because of the divider circuits which preceed the detector, β is effectively doubled to 6.0. Note that the specified modulation index is 5 minimum.

a. **Overmodulation Detector.** The active high outputs of the Phase/Frequency Detector are connected in a wired-or configuration to the Overmodulation Detector. When the present 0-MOD limit (2.5 minimum at phase detector output) is exceeded, the Divide Selector and the FM Status/Enable retriggerable monostable multivibrators are set.

b. **FM Status/Enable.** In the FM mode the FM ON input (high) turns the FM Switch on (Q3 off) which ungrounds the IFM IN (integrated FM input). When overmodulation occurs, and the FM Status/Enable monostable multivibrator is set, then the FM ON input is grounded (through Q1). The FM Switch however, remains ON due to the high from the FM Status/Enable multivibrator (through CR14 on to the base of Q2 which keeps Q3 off).

c. **Divide Selector.** During overmodulation, the Divide Selector monostable multivibrator is also set. The active low output causes the Dividers to divide-by-three. In the divide-by-two mode, the signal that triggered the overmodulation is normally about β = 6 (or at the Phase/Frequency Detector output,

$\beta = 3$). In the divide-by-three mode, the output beta is about 2. Therefore, the loop locks. Back in the normal divide-by-two mode, the Divide Selector will be set again if the loop has false locked on a transient or on an FM sideband, or it will simply remain as is if it has locked on the carrier.

NOTE

The YTO Loop can lock in either the divide-by-two or divide-by-three modes. In the divide-by-three mode, the loop bandwidth is reduced making it impossible to correctly adjust the YTO Phase Detector (refer to Section V).

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. Small ac transient provide unlock signal due to action of C12.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1 and 2 was used to isolate a YTO loop malfunction. The following information will aid in isolating the defective component.

NOTE

If the malfunction is FM related, skip directly to step 8. Otherwise go to step 1.

1. Connect an oscilloscope via a coaxial tee to the YTO Tune 1 connector (gray cable). The loop should remain closed (feedback path should not be broken) for this measurement. When the loop is locked, YTO Tune 1 should be 0 ±2 Vdc. When the loop is unlocked the voltage will be greater than ±6 Vdc depending on the direction of the phase error. Tune from 2000 to 6190 MHz in 100 MHz steps to check lock over the entire YTO range.

2. Make sure the YTO Unlock output tracks the YTO Tune 1 output (>±2.6V should indicate unlocked). If both steps 1 and 2 are correct, the YTO phase detector is working properly.

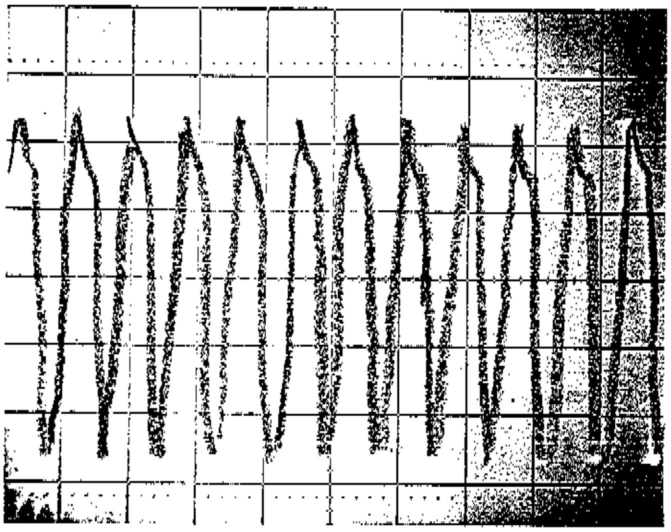
CAUTION

Disconnect the line (mains) power before installing the A3A9 Assembly in service position.

3. Install A3A9 in service position and remove A3A9A4 cover. Refer to the Disassembly and Reassembly Procedures which precede the service sheets.

4. Reconnect the Mains power and tune to 3000.000 MHz. Connect a dual channel oscilloscope to A3A9A4TP2 and TP5. The ECL pulses at these test points should be square waves of −1.0 to −1.5V amplitude between 10 and 15 MHz (66 to 100 ns period). Refer to following figure. If those signals are correct, proceed to step 7.

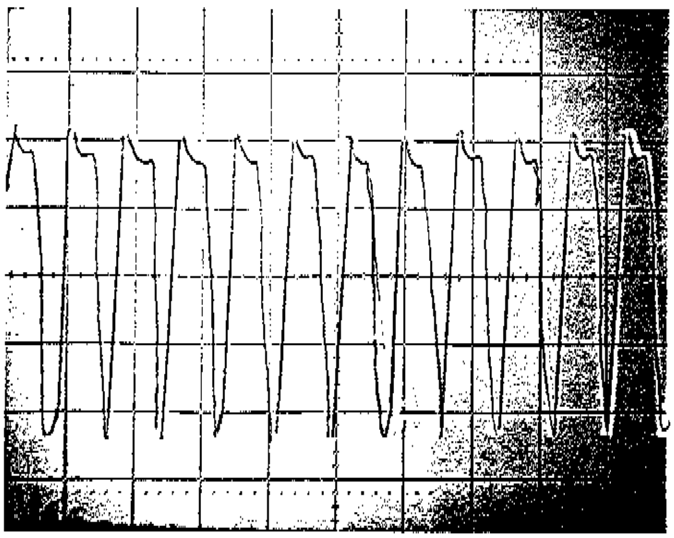
5. If the signals at TP2 or TP5 are not correct, measure the IF IN (black cable) and the 20/30 loop signal (green cable). These signals should both be about 0 dBm. When measuring the IF signal, ground A3A7TP2 to open the loop. If the 20/30 MHz loop signal (30.000 MHz) is incorrect, go to Service Sheet 1-A2. If the IF signal is incorrect (30.000 MHz plus or minus the pretune error) go to Service Sheet 8-A3. Otherwise proceed to step 6.



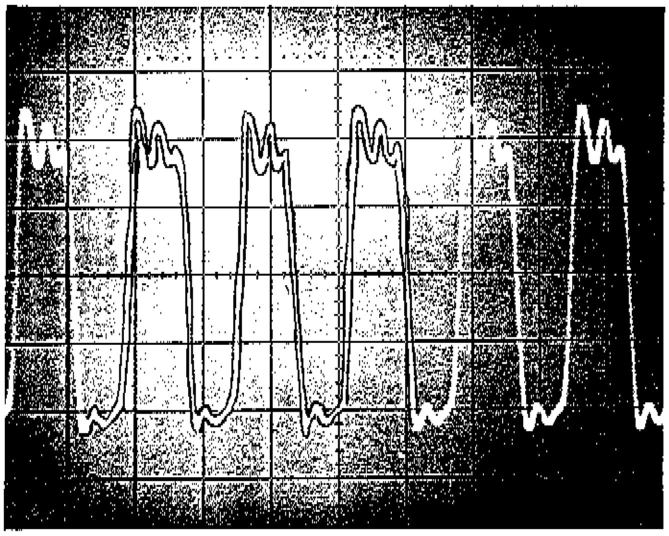
Oscilloscope Display of Signal at A3A9A4TP2 and TP5 (CW/AM Modes)
0.95 Vp-p at 12.5 MHz

6. Observe the 20/30 MHz pulses at pins 2 and 14 of U6; they should be as shown in figures below. If these signals are correct, throubleshoot U6 and its associated components.

7. Check the phase detector operation by observing the signal at U3 pin 6. The width of the pulse is determined by the phase difference between the IF and 20/30 MHz loop signals. (If the loop is phase locked, the signal is an extremely narrow pulse). If this signal is not correct, troubleshoot U5, Q4 and their associated components. Otherwise troubleshoot U3, U1 and their associated components.



Oscilloscope Display of Signal at A3A9A4U6 Pin 2 (CW/AM) Modes)
1.0 Vp-p at 30.6 MHz



Oscilloscope Display of Signal at A3A9A4U6 Pin 4 (CW/AM Modes)
0.9 Vp-p at 30.6 MHz

8. Set the Synthesizer's FM DEVIATION switch to OFF and the METER MODE switch to FM.

9. Tune the test oscillator to 2 MHz and connect the 50 ohms output to the Synthesizer's FM INPUT connector.

10. Measure the FM ON input. It should be about +0.1 Vdc. While observing the voltage, switch the FM Deviation switch through its range. In all FM positions the FM ON line should be high (about +4.4 Vdc). Leave the switch in the 10 MHz DEVIATION range. If the FM ON line does not respond correctly, turn to Service Sheet 8-A1 and continue troubleshooting. If the line is held low, consider the possibility of a short on A3A9A4.

11. Set the test oscillator's frequency to 100 kHz and output voltage to achieve a full scale reading on the Synthesizer's front panel meter (10 MHz deviation). The FM OVERMOD display should not be one.

12. Connect an oscilloscope to U2 pin 7. The level should be high. Increase the test oscillator's output voltage. The signal should pulse low (period about 5 ms) and the FM OVERMOD display should be on. If the output does not pulse low, check U2, U4B, U7B and U9B, U5 and their associated components.

13. Tune the test oscillator to 10 kHz. Measure the IFM signal at the drain of Q3. If the signal is not present or if the FM OVERMOD display is not lit, check U4A, Q1 and their associated components.

NOTE

After repairing the A3A9A4 assembly, perform the YTO Loop Phase Detector Adjustments, the YTO Loop Offset and the FM Overmodulation Adjustments.

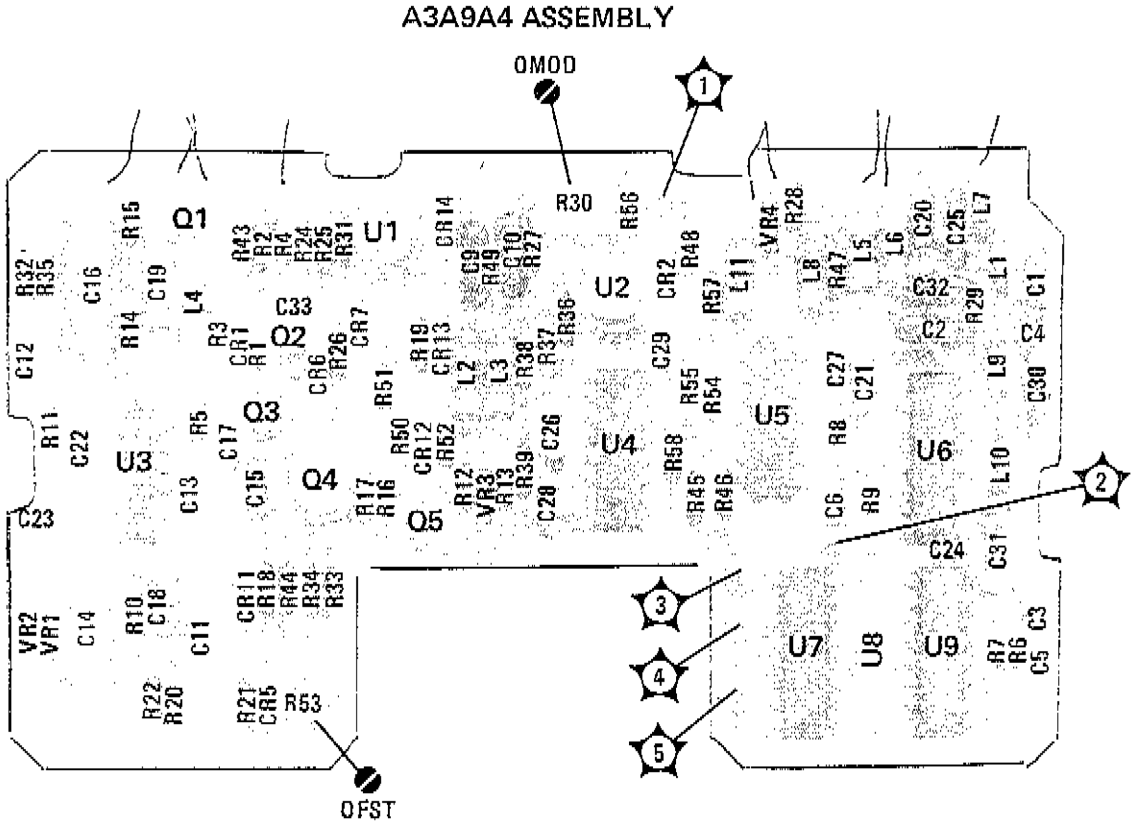


Figure 8-90. A3A9A4 YTO Phase Detector Assembly Component, Adjustment, and Test Point Locations

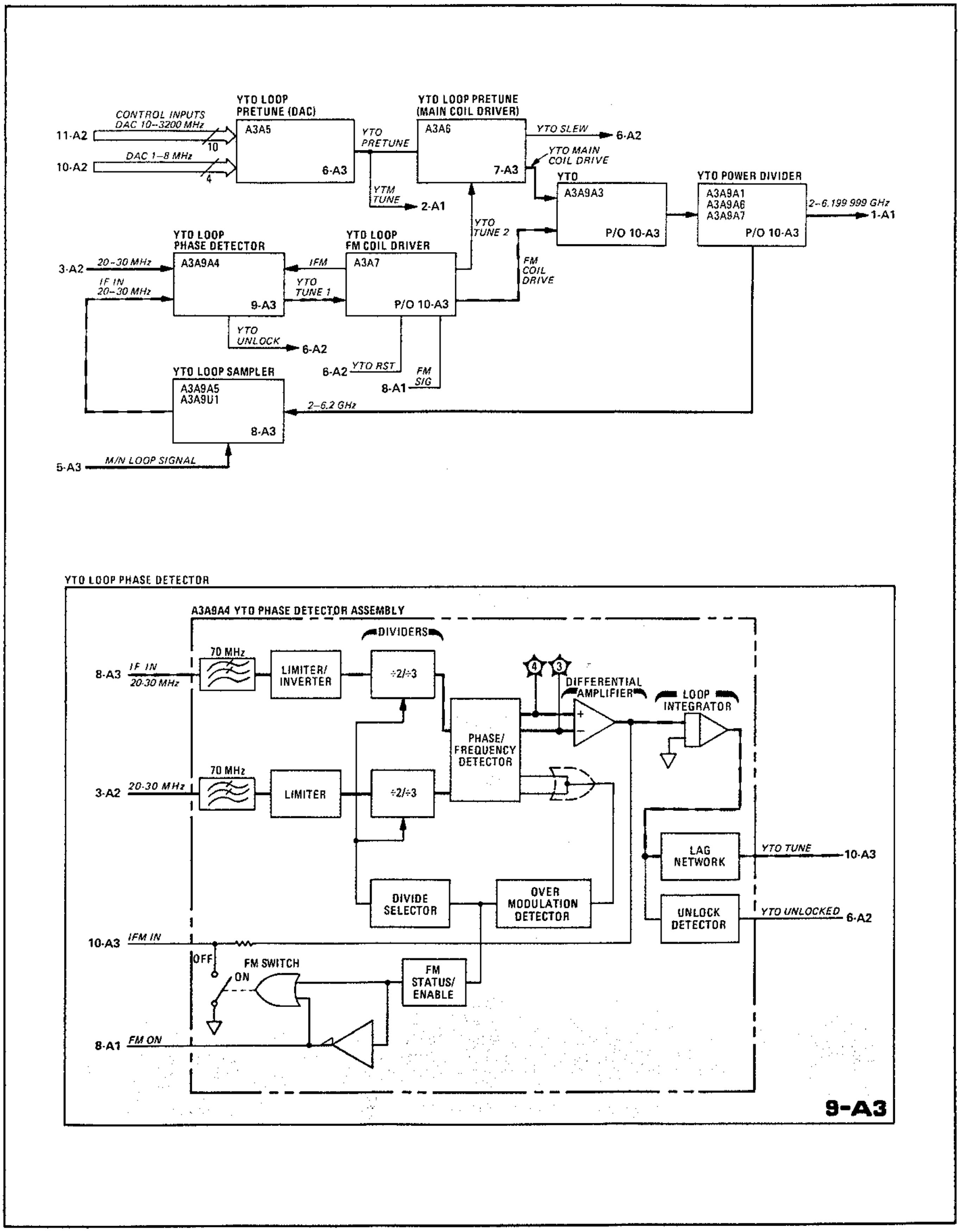


Figure 8-91. YTO Phase Detector Block Diagrams

FIG. 8-92
Sht 1 of 3

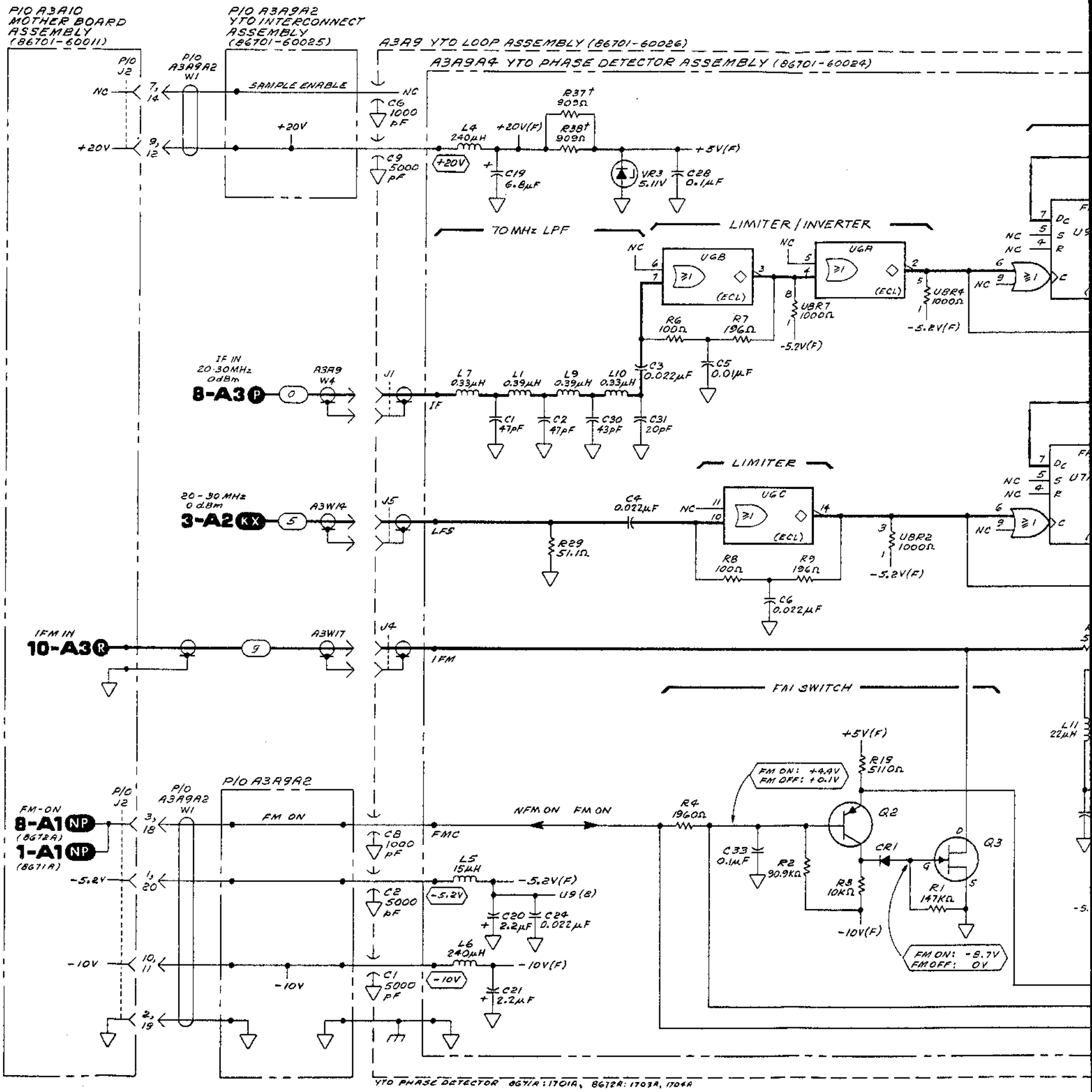


FIG. 8-92
Sht 2 of 3

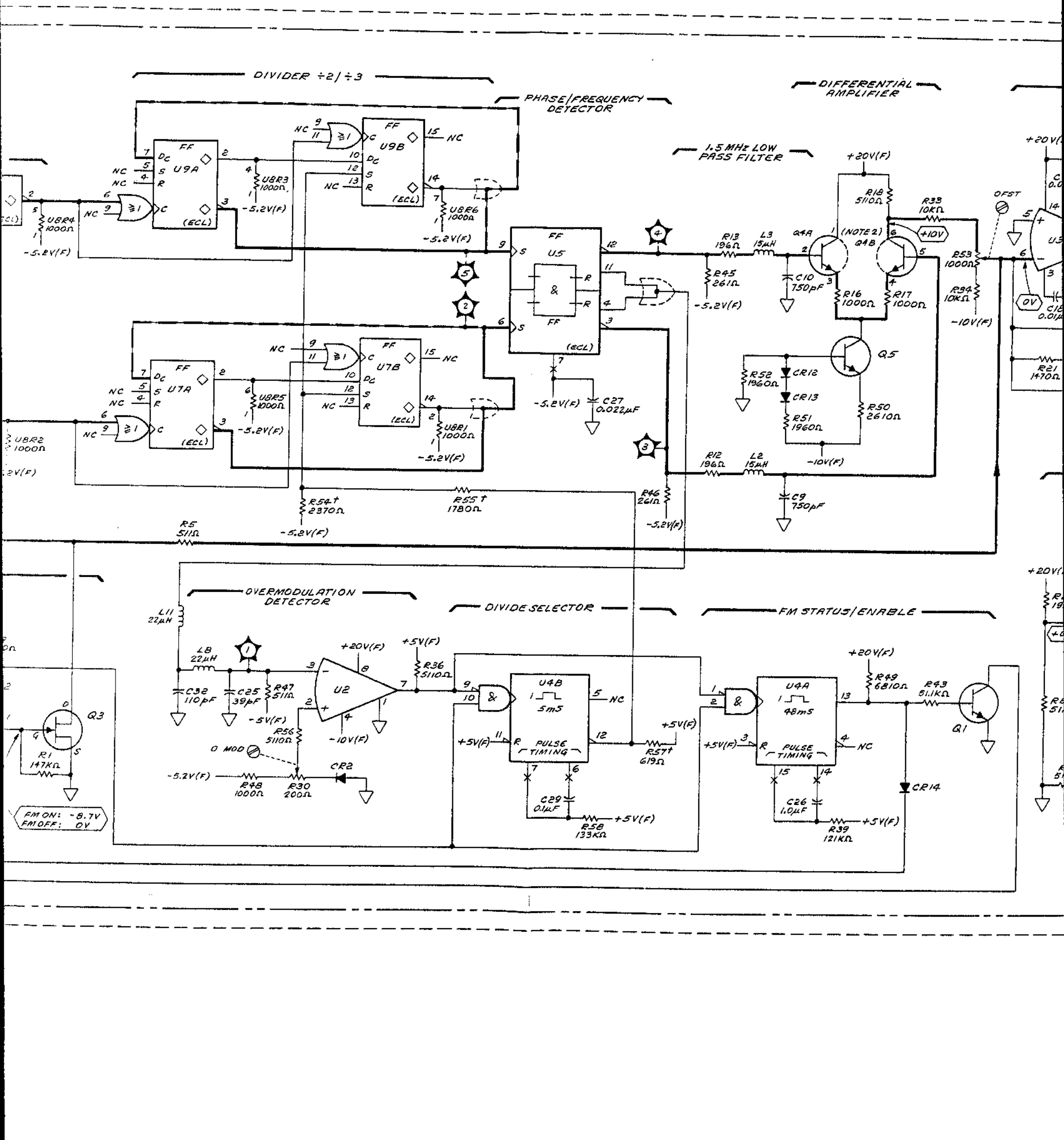
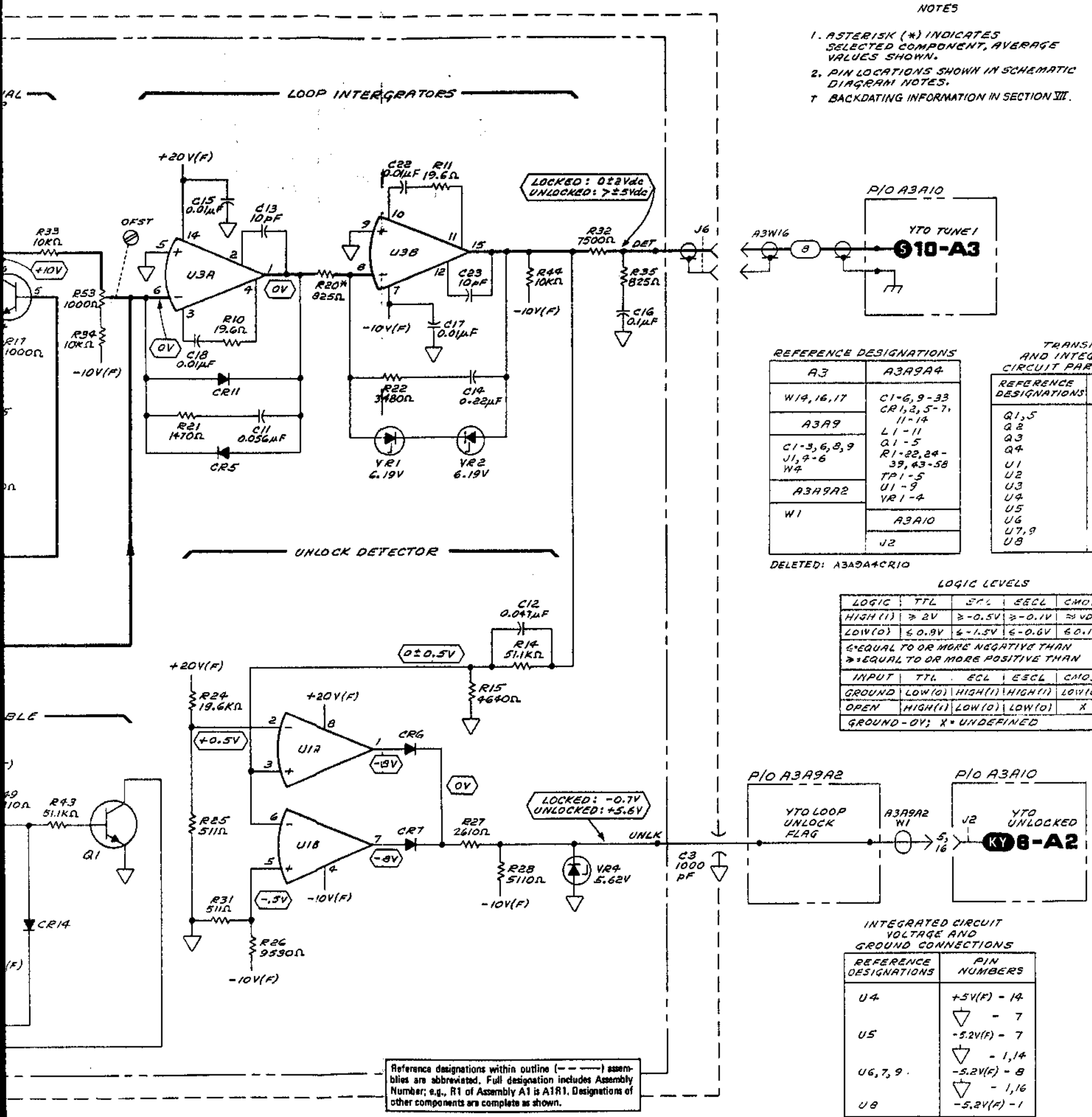


FIG. 8-92
Sht 3 of 3

NOTES

1. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
2. PIN LOCATIONS SHOWN IN SCHEMATIC DIAGRAM NOTES.
† BACKDATING INFORMATION IN SECTION VII.



REFERENCE DESIGNATIONS

A3	A3A9A4
W14,16,17	C1-6, 9-33 CR1,2,5-7, 11-14 L1-11 Q1-5 R1-22,24-39,43-58 TP1-5 U1-9 VR1-4
A3A9	
C1-3,6,8,9 J1,4-6 W4	
A3A9A2	
W1	**A3A10**
	J2

DELETED: A3A9A4CR10

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1,5	1854 - 0404
Q2	1853 - 0451
Q3	1855 - 0395
Q4	1854 - 0475
U1	1826 - 0092
U2	1826 - 0026
U3	1826 - 0044
U4	1820 - 1423
U5	1820 - 1344
U6	1820 - 0802
U7,9	1820 - 0817
U8	1810 - 0204

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH (1)	≥ 2V	≥ -0.5V	≥ -0.1V	≈ VDD
LOW (0)	≤ 0.9V	≤ -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 DESIGNATIONS	PIN NUMBERS
U4	+5V(F) - 14 ▽ - 7
U5	-5.2V(F) - 7 ▽ - 1,14
U6,7,9	-5.2V(F) - 8 ▽ - 1,16
U8	-5.2V(F) - 1

9-A3
A3A9, A3A9A2, A3A9A4

Figure 8-92. YTO Phase Detector Assembly Schematic Diagram

SERVICE SHEET 10-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-37
• Performance tests	Refer to Table 5-3 on Page 5-3
• Adjustment procedures	Page 5-2

PRINCIPLES OF OPERATION

YTO Phase Lock 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 loop and 2) to the 20/30 MHz loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the 20/30 MHz 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 20/30 loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{20/30})$$

where f_o = YTO output frequency (MHz)

N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)

$f_{M/N}$ = M/N loop output frequency (MHz)

$f_{20/30}$ = 20/30 Loop output frequency (MHz)

f_{YTO}, N and $f_{M/N}$ OUT may be looked up on Table 8-4, M and N Numbers and Resulting Frequencies.

Also, $f_{20/30} = (30.000 - D_4 . D_3 D_2 D_1)$ MHz

where D_4 = front panel 1 MHz character

D_3 = front panel 100 kHz character

D_2 = front panel 10 kHz character

D_1 = front panel 1 kHz character
for YTO frequencies less than 6200 MHz. Refer to the Service Sheet 2 text for a complete listing of pertinent formulas.

YTO Loop FM Circuits

In the Synthesizer's CW mode of operation, the Phase Detector's error voltage is found to be proportional to the integral of the YTO frequency. In the FM mode, the error voltage is due to the sum of integrals of the YTO frequency and the frequency deviation. Since the deviation is directly proportional to the modulation drive voltage, the error voltage may be expressed as follows:

$$V_e = \int f_o(t)\,dt + \int V_{FM}(t)\,dt$$

where V_e = phase detector's error voltage

$f_o(t)$ = YTO frequency

$V_{FM}(t)$ = FM drive voltage

SERVICE SHEET 10-A3 (Cont'd)

The result is a cancellation of modulation for FM rates inside the YTO loop bandwidth (20 kHz) and a partial cancellation at rates greater than 20 kHz and decreasing as the rate increases. In order to make the YTO loop response to FM essentially flat, a portion of the FM drive signal is integrated and subtracted from the error voltage output by the Phase Detector. This voltage is adjusted to just cancel the error voltage caused by the FM signal. Now the YTO loop effectively passes all specified rates to the YTO with little or no effect. Note that the FM drive signal is input after the Loop Integrator and the integrated FM is subtracted from the error voltage just before the Loop Integrator.

A3A7 FM Driver Assembly

The FM Driver Assembly performs three major functions. First, it combines and sums the FM drive signal with the high frequency component and the YTO Tune 1 signal. Then this combined signal is amplified, compensated (for frequency response) and converted to an FM coil drive current. The FM drive signal is integrated and coupled to the YTO Phase Detector Assembly, where it is summed with (subtracted from) the Phase Detector's error voltage output.

Two minor but extremely important functions 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) to divide YTO tuning voltage (YTO Tune 1) into its high and low frequency components.

Phase Lock and FM Drive Signals. The YTO 1's high frequency component and the FM drive signal are summed at the input to the FM Coil Driver. The combined signal is amplified and the drive current is applied to the FM coil through an impedance matching network. The Frequency Shaping Network, that is located in the coil driver's feedback loop and the main FM signal path, compensates for the gradual loss in sensitivity of the FM coil to higher frequencies. The 40 dB attenuator in the FM signal path allows switching between the most sensitive and least sensitive FM ranges. The other two attenuators (that allow switching between the six FM ranges) are located in the A1 Assembly.

Integrated FM Signal. The FM signal integrated by the FM integrator, U3A. R23 and C1 form the integrating network which operates at frequencies greater than 20 kHz while C3 operates below 20 kHz. Note the equivalent networks in the non-inverting input. These preserve the common mode rejection characteristics of the amplifier. U2A, the second FM integrator amplifier, includes an adjustable gain control. This allows adjustment of the IFM signal gain to exactly balance the FM signal discriminated by the YTO phase detector.

In the most sensitive FM ranges (1, 3 and 10 MHz/V), the gain of the first FM Integrator Amplifier (U3B) is 20 dB and the attenuation at the output of the second amplifier (U2A) is 0 dB. In the least sensitive ranges (0.03, 0.7 and 0.3 MHz/V), the gain of the first amplifier is reduced to Unity (0 dB) and the output of the second amplifier is attenuated by 20 dB. This, 40 dB change in level, in effect, keeps the gain consistant with FM drive signal applied to the YTO's FM coil.

Attenuating the integrated FM signal at the output of the amplifiers improves the signal-to-noise ratio of the FM system in the least sensitive ranges.

YTO Loop Reset. The YTO Loop Reset ensures that the YTO 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 RST does not effect the YTO Tune 1 input. If the loop does not achieve lock in less than 15 ms, the YTO UNLOCK causes YTO RST to momentarily go low. The YTO Tune 1 signal is

SERVICE SHEET 10-A3 (Cont'd)

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 RST to immediately go low. The YTO output is effectively frequency modulated and the IF signal passes through the loop capture range. If phase lock has not yet been achieved (after 15 ms), the YTO Tune 1 is pulsed to 0V sending the 20/30 MHz IF signal through the loops capture range to ensure locking.

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 (C12, R7 and R53) pass only those components of the signal greater than 100 Hz to the Coil Driver.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets 1 and 2 was used to isolate a YTO loop malfunction. The following information will allow further isolation to circuits shown by one of the three YTO loop schematics 8-A3, 9-A3 or 10-A3. If the malfunction is on 10-A3, this information will also aid in isolating the defective component.

Test Equipment

Digital Voltmeter . . . . HP 3455A
Test Oscillator . . . . HP 651B
Frequency Counter . . . . HP 5340A
Power Meter/Sensor . . . . HP 436A/8481A

1. Connect voltmeter to A3A7TP2. Set frequency to 3 GHz. Disconnect black IF jumper on A3A9. The phase detector should drive the test point to about −5.6 Vdc. Disconnect the green 20/30 MHz coax from its normal location and connect it to the IF IN connector. The voltage should go to about +5.9 Vdc. If either voltage is incorrect, go to Service Sheet 9-A3 to troubleshoot the dividers and phase detector.

2. Connect the voltmeter to A3A6TP1. The voltage should be +6.5 Vdc with the green coax connected to the IF IN connector or −5 Vdc with the green coax installed in its normal location and the IF jumper removed. If either voltage is incorrect, go to Step 5 to troubleshoot the FM Coil Driver on A3A7.

3. Reconnect the ground to A3A6TP1 and set the frequency to 3 GHz. Measure the IF OUT frequency and power. It should be 30 MHz ± pretuning error at 0 dBm. (Ideally the frequency should be the same as the output of the LFS loop). If the frequency is correct troubleshoot the main coil driver (Service Sheet 7-A3), especially the buffer amplifier fed by YTO TUNE 2.

4. If the frequency is incorrect or unmeasurable, isolate the malfunction by measuring the M/N loop output and the YTO signal at the input to the A3A9U1 Sampler to isolate the malfunction.

5. Make sure the RF switch on front panel is ON. Measure the voltage at A3A7TP2 (YTO TUNE 1). This voltage should be less than +2.6 Vdc if the loop is locked. If the loop appears to be locked, continue with step 2. Otherwise, proceed to step 6.

6. Measure the voltage at A3A7TP1. It should be about 0 Vdc. If the voltage is not zero, troubleshoot the Phase Lock Amplifier, the Bias Stabilizer and the FM Coil Driver. Otherwise, continue.

7. Connect the test oscillator's 50 ohm output to the FM INPUT connector. Tune the oscillator to 5 MHz with an output signal of about 0.7 Vrms (full scale on the Synthesizer's front panel meter). Connect a dual channel oscilloscope to A3A7TP1 and TP4. Set the FM DEVIATION switch to 10 MHz. The signal at TP1 should be about 9.6 Vp-p. If this signal is correct, the FM Amplifier (Q4 and Q6) and the FM Coil Drivers are OK. If the signal is not correct, check the FM INPUT at TP5 before troubleshooting the FM Amplifier and Coil Driver. The signal at TP4 should be an integrated sinewave.

8. Set FM DEVIATION switch to 0.1 MHz. The signals at TP1 and TP4 should decrease by 40 dB (1% of the original voltage). If the signals at TP1 and TP4 are correct, the FM portions of A3A7 are OK. If the malfunction is an FM problem, proceed to Service Sheet 9-A3.

9. Disconnect the test oscillator and set the FM DEVIATION switch to OFF. Tune the Synthesizer while measuring the dc voltage at A3A7TP2. The voltage at edge connector pins 8 and 23 should be 0.7V more positive than the voltage at TP2. If this voltage is correct, A3A7 is working properly. Otherwise, troubleshoot Q10. If the voltage is zero even when the frequency is tuned, troubleshoot the YTO LOOP RESET circuit. The YTO RST line should be a TTL high. It should pulse low when the loop is locked due to 1) excessive FM deviation, 2) a missing M/N loop signal, 3) RF OFF, and 4) the 20/30 MHz Loop Signal is missing.

10. Ground A3A7TP2 to open the loop and measure the pretune frequency at the A3A9A1 Directional coupler's main output with the Synthesizer tuned to 2 GHz. The frequency should be within ±5 MHz at +14 dBm nominal. If the frequency is correct, continue. Otherwise, go to Service Sheet 7-A3 to troubleshoot or adjust the YTO Driver or DAC. If the frequency cannot be measured, troubleshoot the A3A9A3 YTO Assembly and the A3A9A1 Directional Coupler.

11. Tune to 6199 MHz. The measured frequency should be within ±5 MHz. If the results of step 6 and 7 are correct, the DAC, YTO Driver and YTO main coil are OK. Otherwise troubleshoot the DAC, YTO Driver and YTO.

NOTE

After the A3A7 assembly is repaired, perform the FM Driver Adjustments in Section V. If A3A9A3 is replaced, perform the Power Supply, DAC, YTO Driver, YTO Loop, FM Driver, FM Modulation Meter and the YTO Loop Offset and Overmodulation Adjustments.

Voltages for 100 kHz FM at full scale deviation (1 Vpk input):

TP1	3.39 Vrms
TP5	0.95 Vrms

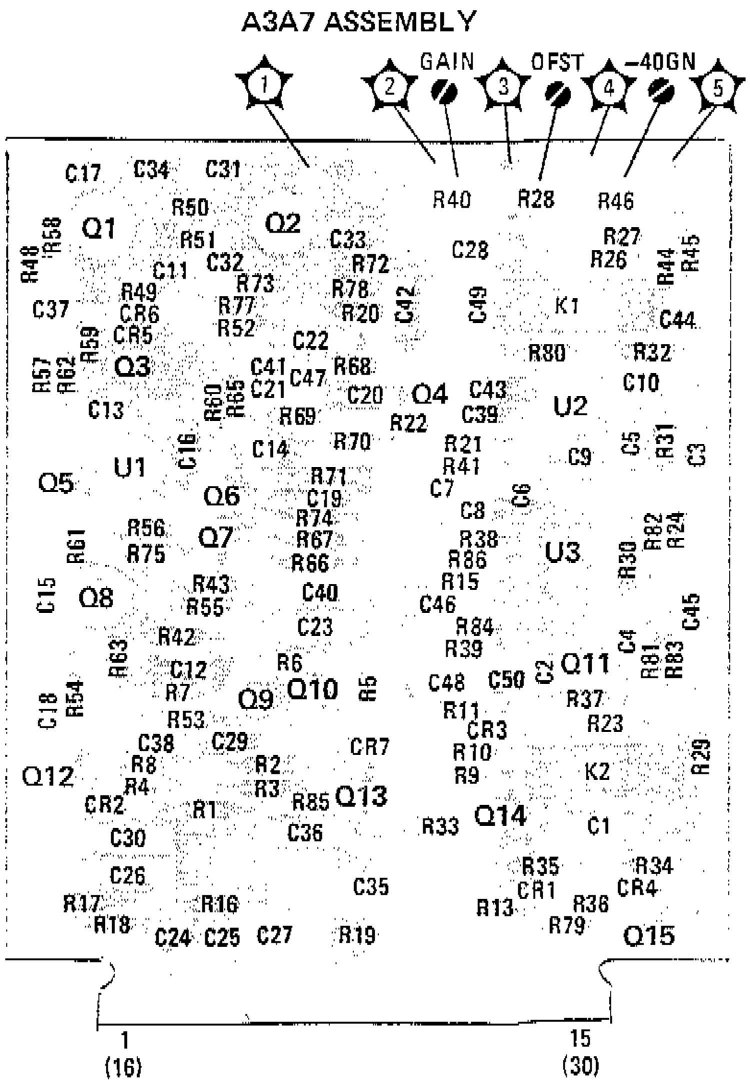


Figure 8-93. A3A7 FM Driver Assembly Component, Adjustment, and Test Point Locations

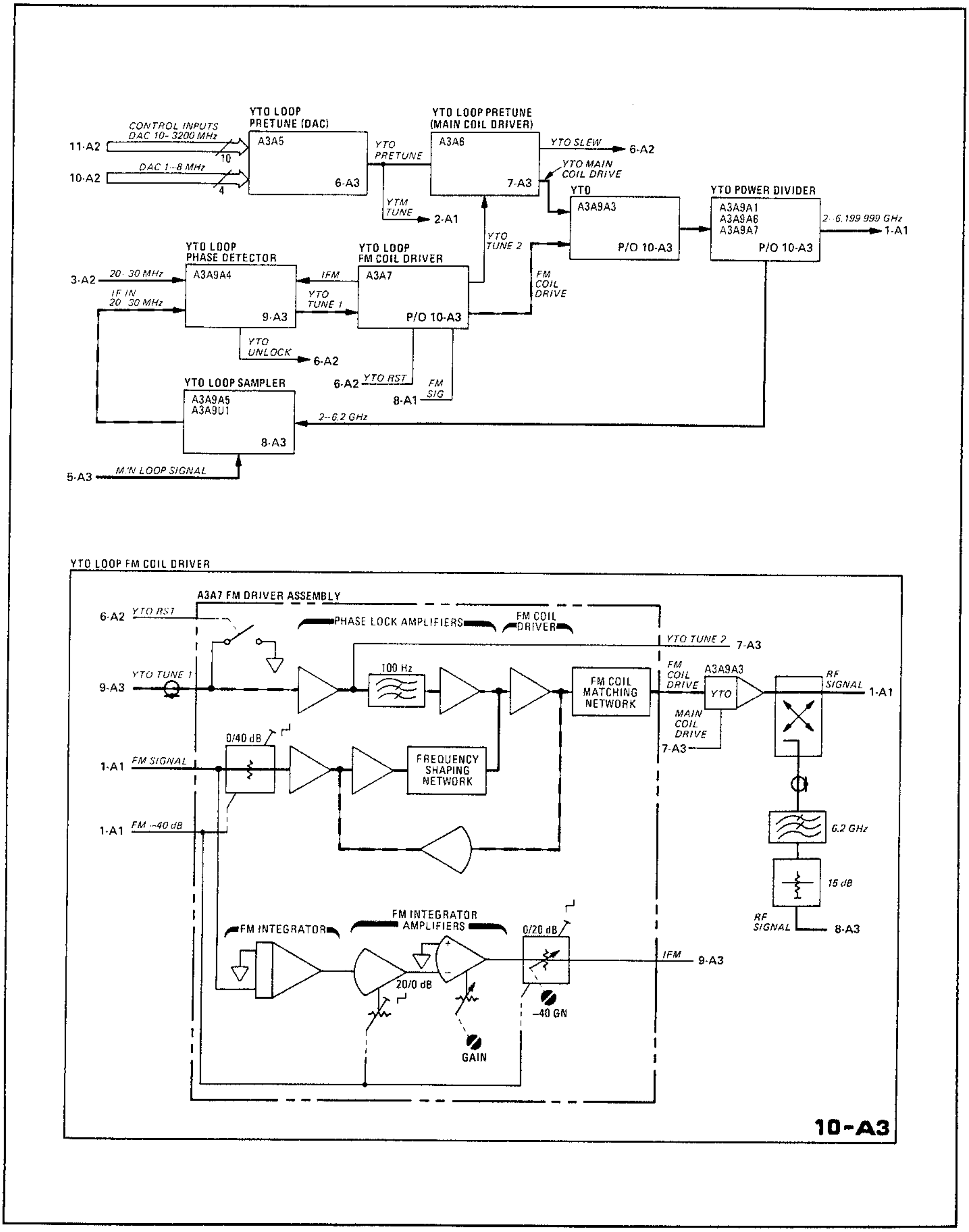


Figure 8-94. FM Driver Block Diagrams

FIG. 8-95
Sht 1 of 3

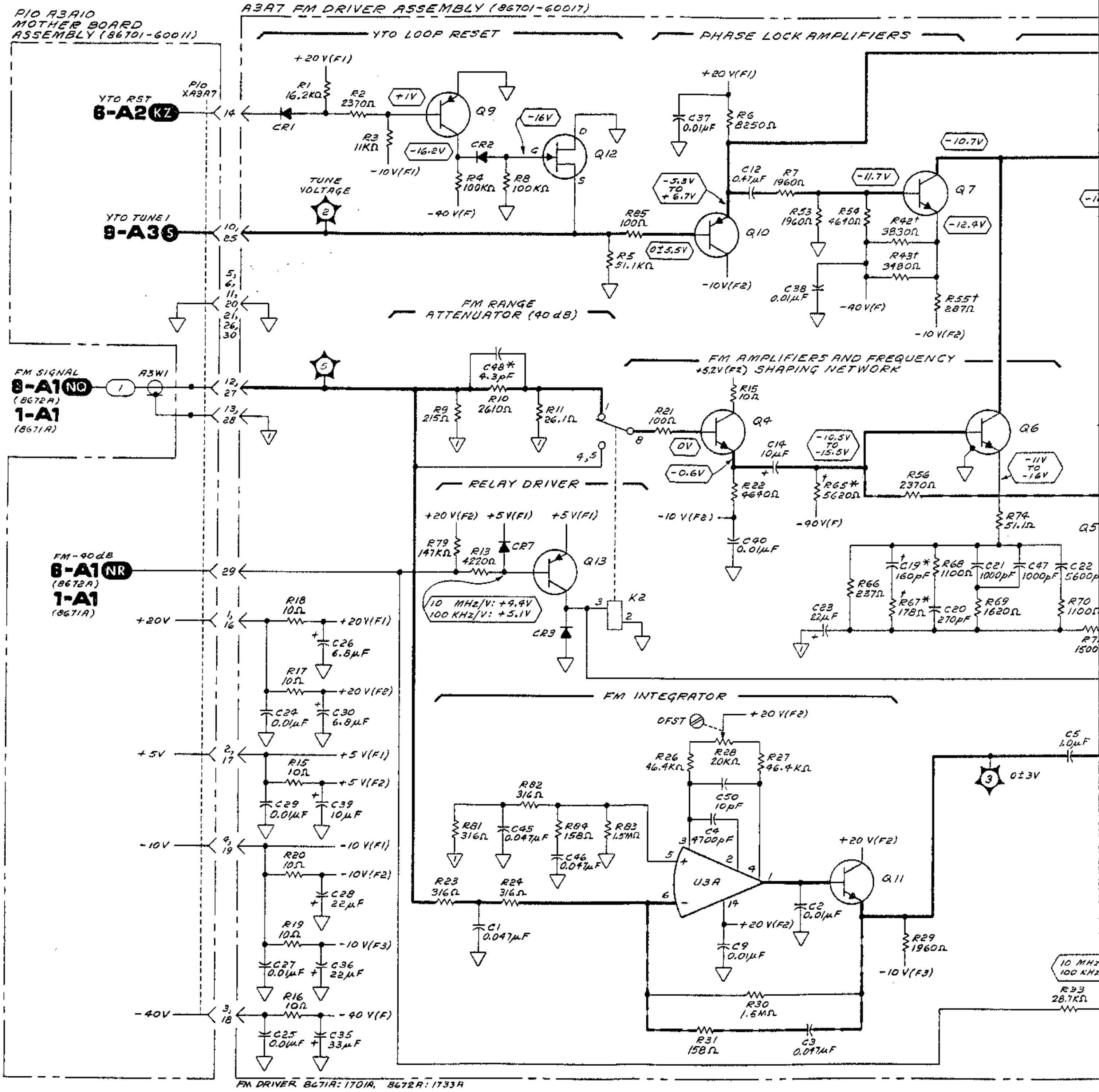


FIG. 8-95
Sht 2 of 3

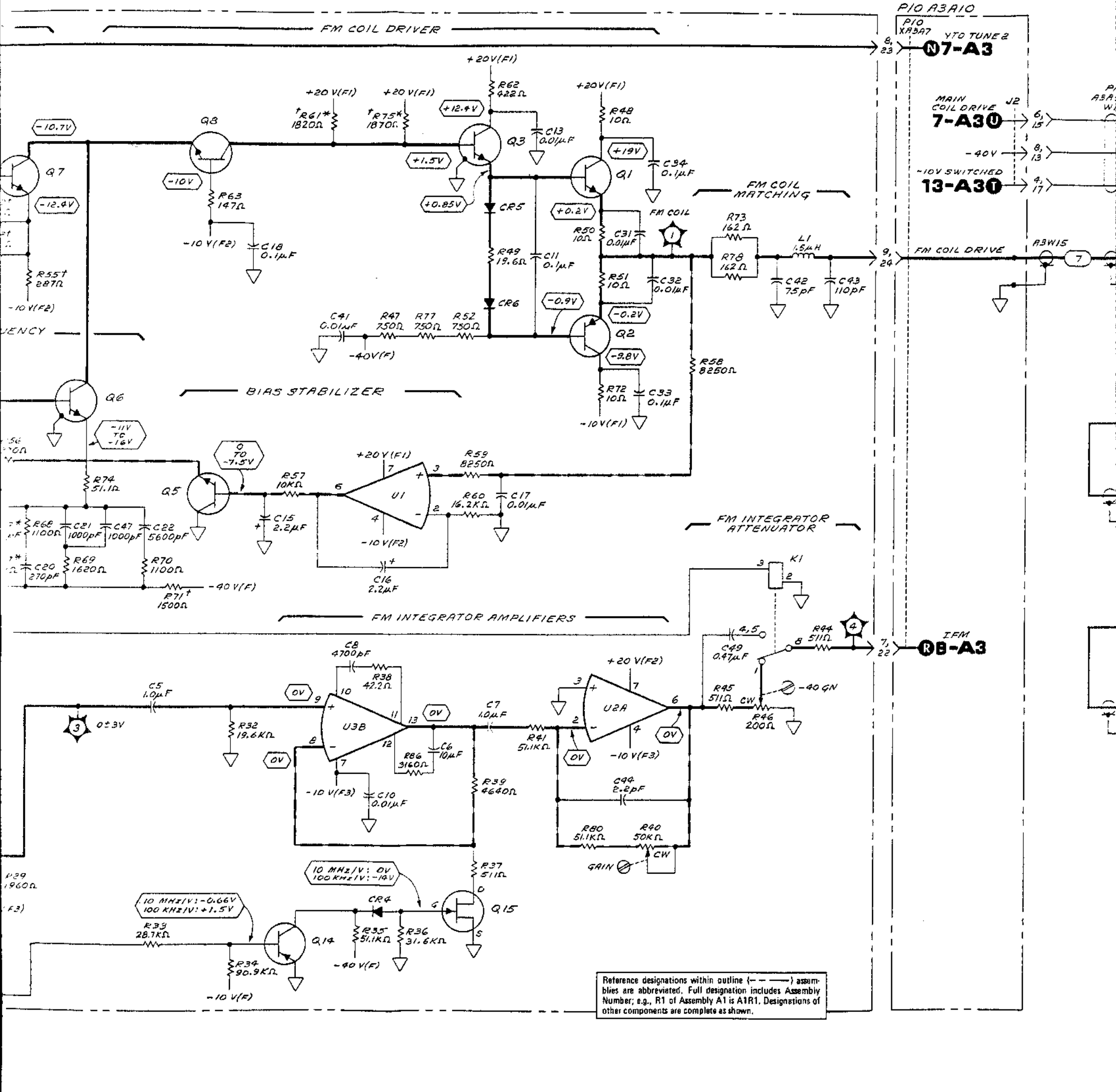
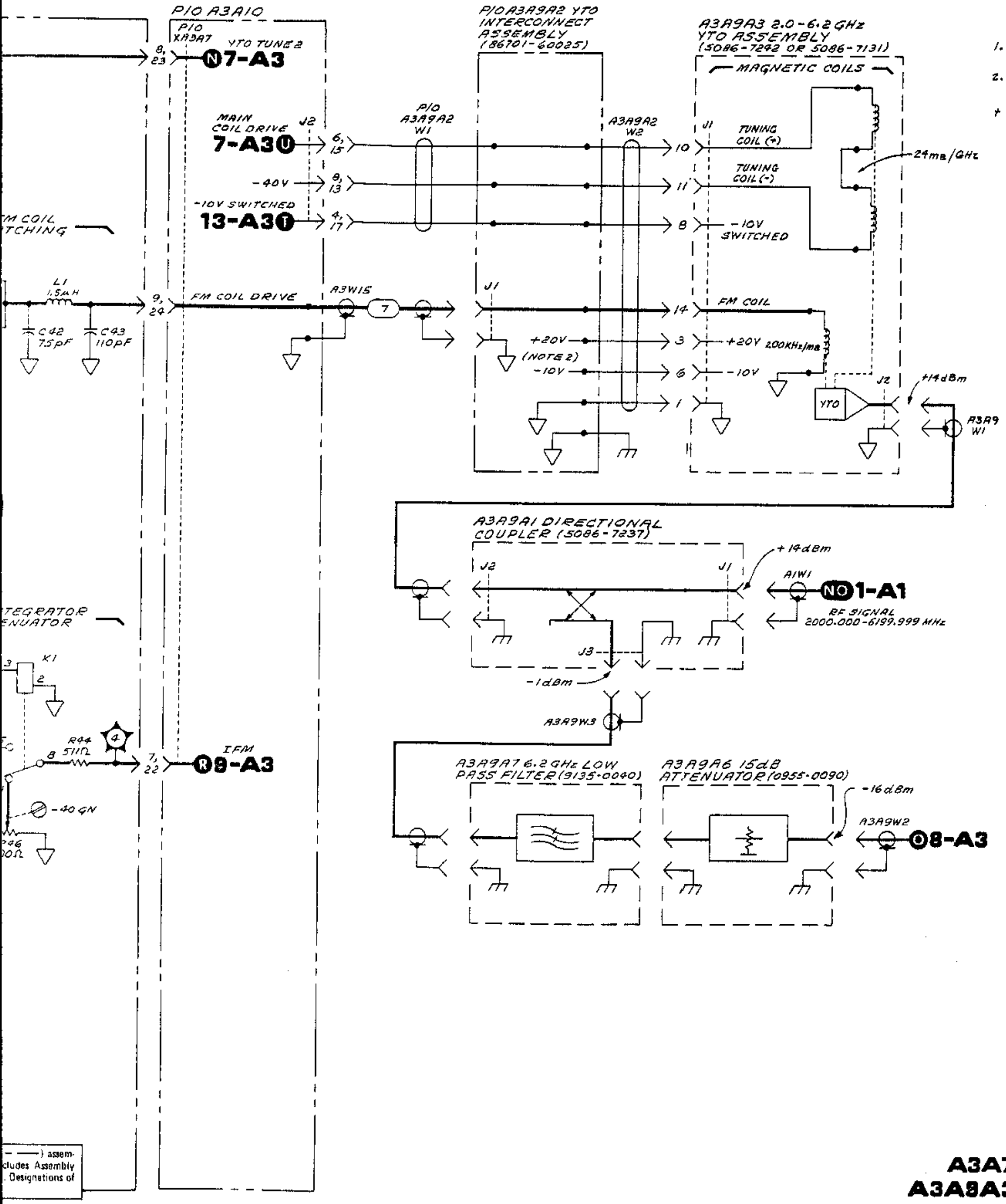


FIG. 8-95
Sht 3 of 3



NOTES

1. ASTERISK (*) INDICATES SELECTED COMPONENT; AVERAGE VALUES SHOWN.
2. POWER SUPPLY INPUTS TO A3A9A2 ARE SHOWN ON SERVICE SHEET 8-A3.

† BACKDATING INFORMATION IN SECTION VII.

WARNING

A VOLTAGE DIFFERENTIAL OF 60Vdc MAY BE FOUND ON THE YTO AND INTERFACE BOARD. THIS VOLTAGE COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING ON THE YTO WITH POWER SUPPLIED TO THE INSTRUMENT.

REFERENCE DESIGNATIONS

A1	A3A9
W1	W1-3
A3	A3A9A1
W1,15	J1,2
A3A7	A3A9A2
C1-50, CR1-7, K1,2, L1, Q1-15, R1-11, 13, 15-24, 26-63, 65-75, 77-86, TP1-5, U1-3	J1, W1,2
	A3A9A3
	J1,2
	A3A10
	J2, XA3A7

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0019
Q2	1853-0012
Q3	1854-0238
Q4,5,11	1854-0404
Q6	1854-0345
Q7	1854-0023
Q8	1854-0247
Q9,10,14	1853-0451
Q12	1855-0020
Q13	1853-0281
Q15	1855-0417
U1	1826-0261
U2	1826-0081
U3	1826-0044

10-A3
A3A7, A3A9A1, A3A9A2, A3A9A3, A3A9A6, A3A9A7

Figure 8-95. FM Driver Assembly Schematic Diagram

SERVICE SHEET 11-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-30
• Performance tests	Refer to Table 5-3 on Page 5-3
• Adjustment procedures	Page 5-2

PRINCIPLES OF OPERATION

General

If power cable W1 is connected between the line (Mains) power outlet and the A3A11 Line Module, primary ac power is connected to transformerA3T1 and fan relay A3A10K1. Line Voltage Selector A3A11TB1 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.

A3A2 Rectifier Assembly

The secondary ac voltages from the transformer are always present on the rectifier circuit board if the line voltage is connected to the Synthesizer. The four inputs are rectified and filtered before being output to the regulator circuits.

+22 Volt Regulator. The primary purpose of the +22V Regulator is to supply power to the internal reference oscillator's heater circuit any time the instrument is connected to the line voltage. The oscillator is maintained at operating temperature. Therefore, the instrument is 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. A3A2U1 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 current limit. This action effectively turns the Synthesizer off. If the primary power fuse A3F1 does not burn out, the instrument must be disconnected from 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 Line Voltage Selector A3A11TB1 set for 100 or 120 Vac. If this occurs, change the fuse to the 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 Sheets 1, 2 and 12-A3 was used to isolate a power supply malfunction to the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter . . . . HP 3455A
or
Oscilloscope . . . . HP 180C/1801A/1821A

1. Connect the Synthesizer to the line (Mains) power.
2. LED A3A2CR15 should be on.
3. Verify that the voltage at A3A2TP1 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 Synthesizer to the line power.

CAUTION

To prevent damage to the power supplies, measure the following voltages with a voltmeter that has a floating common.

6. Measure voltages between edge connector pins as shown below.

Positive Pin	Negative Pin	Voltage
6	5	27—35 Vdc
17	15	15—21 Vdc
3	1	48—60 Vdc
10	7	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 A3A2 assembly.

NOTE

With A3A2 removed the fan will run continuously in both STANDBY and ON. After repairing the A3A2 assembly, perform the Power Supply Adjustments in Section V. Also, perform the performance tests (if any) that led to the power supply repair.

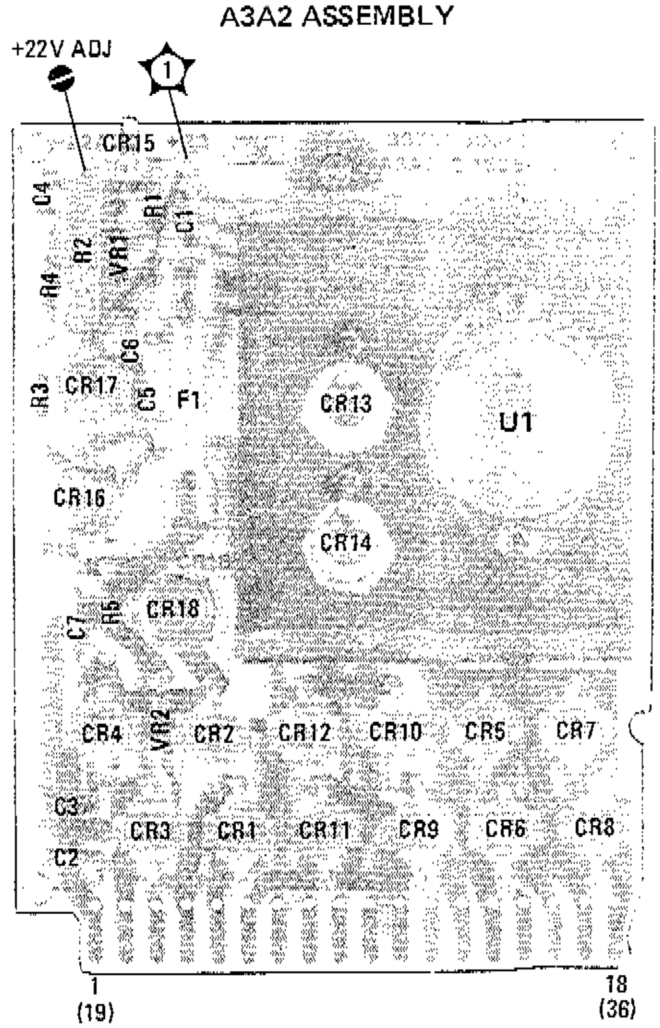
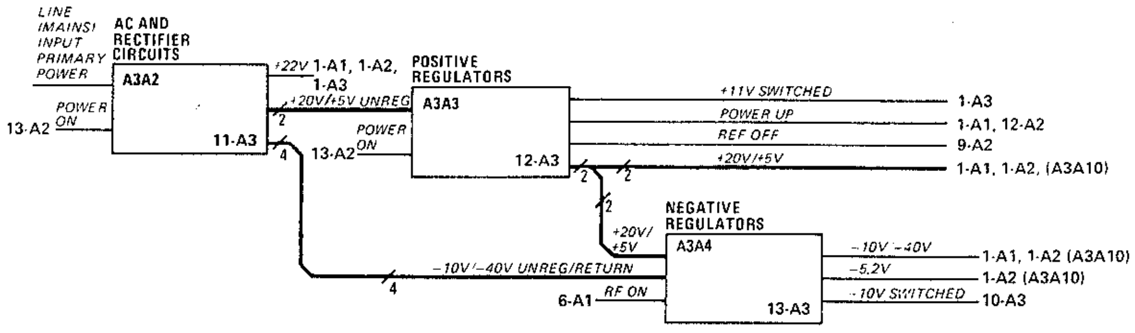


Figure 8-96. A3A2 Rectifier Assembly Component, Adjustment, and Test Point Locations



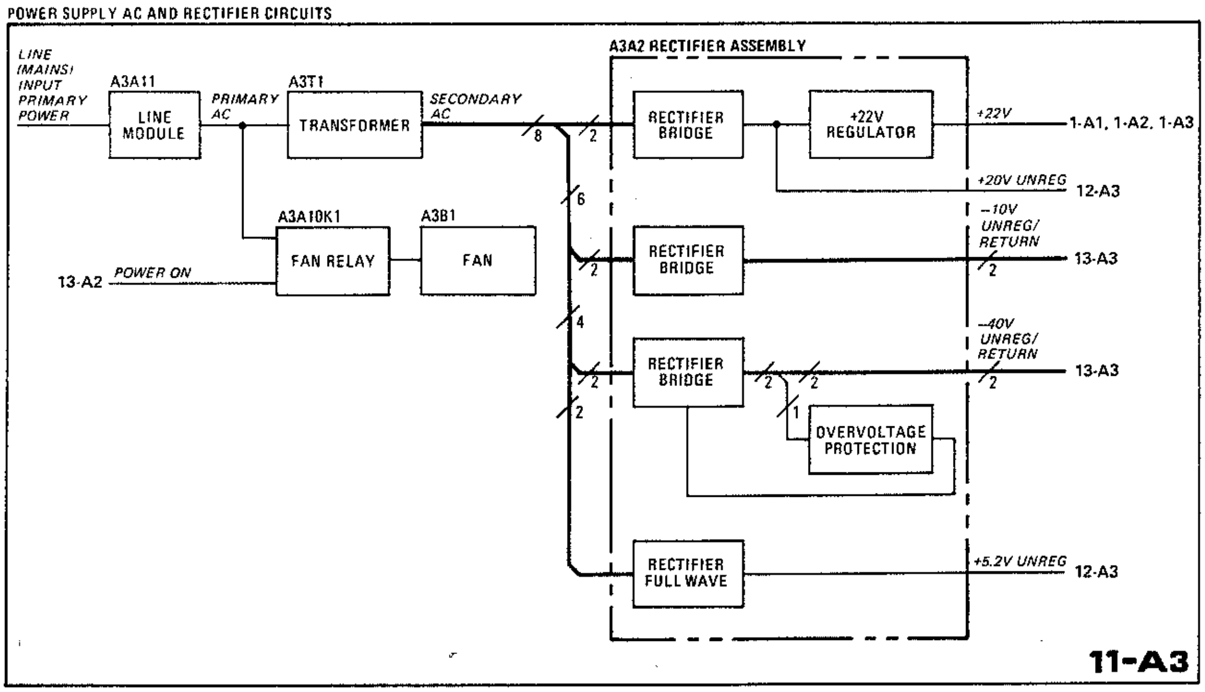


Figure 8-97. Rectifier Block Diagrams

FIG. 8-98
Sht 1 of 3

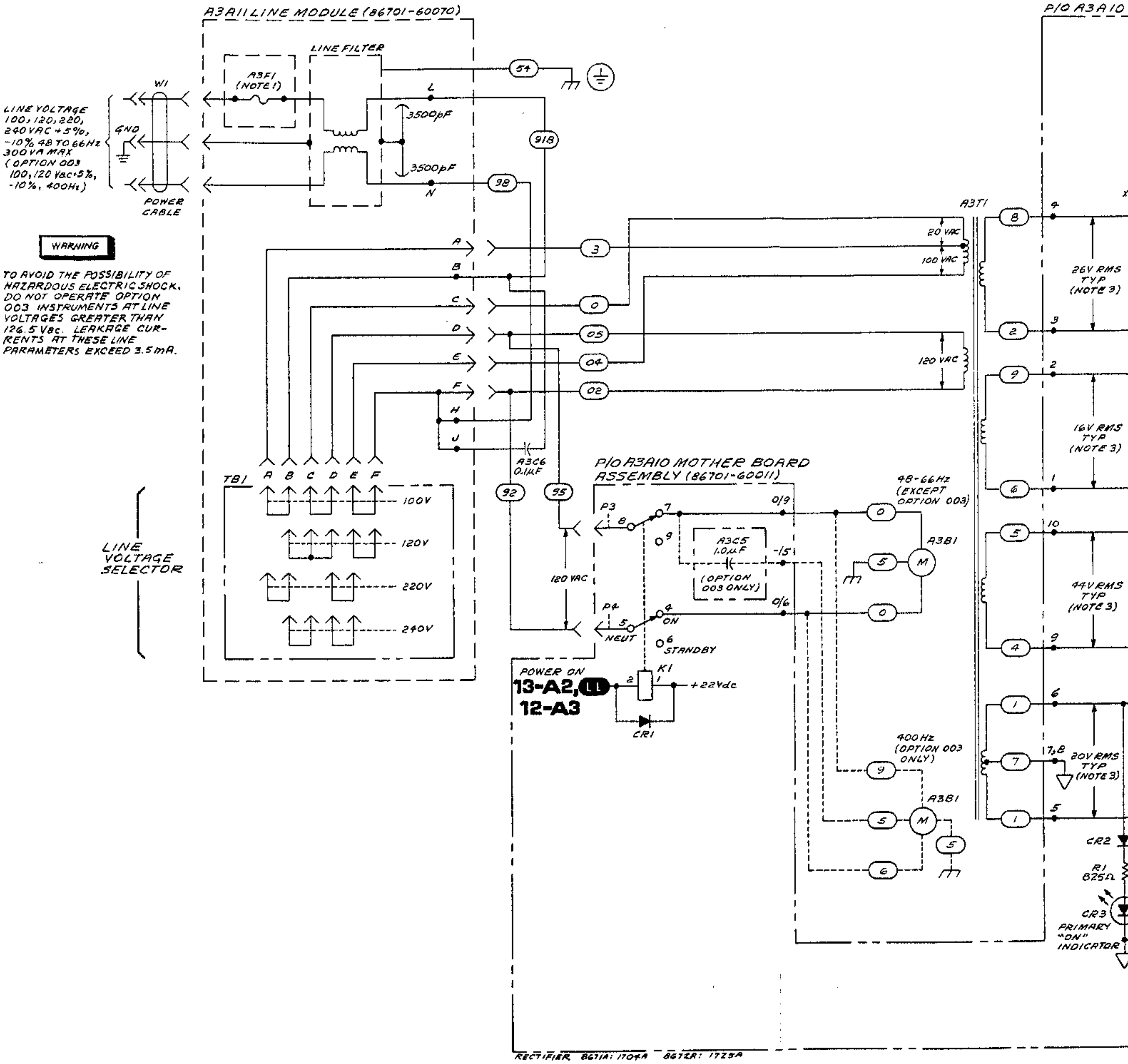
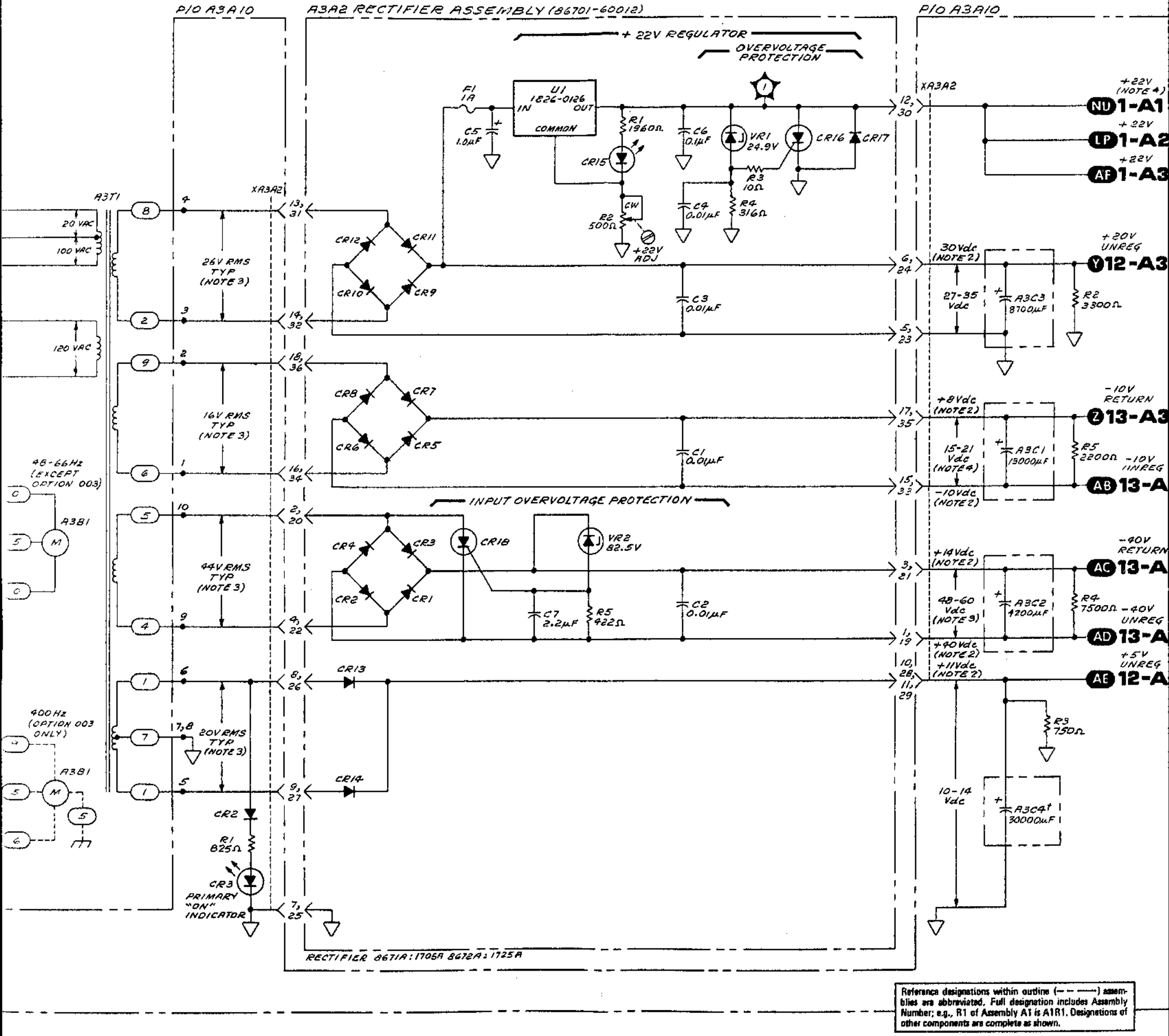


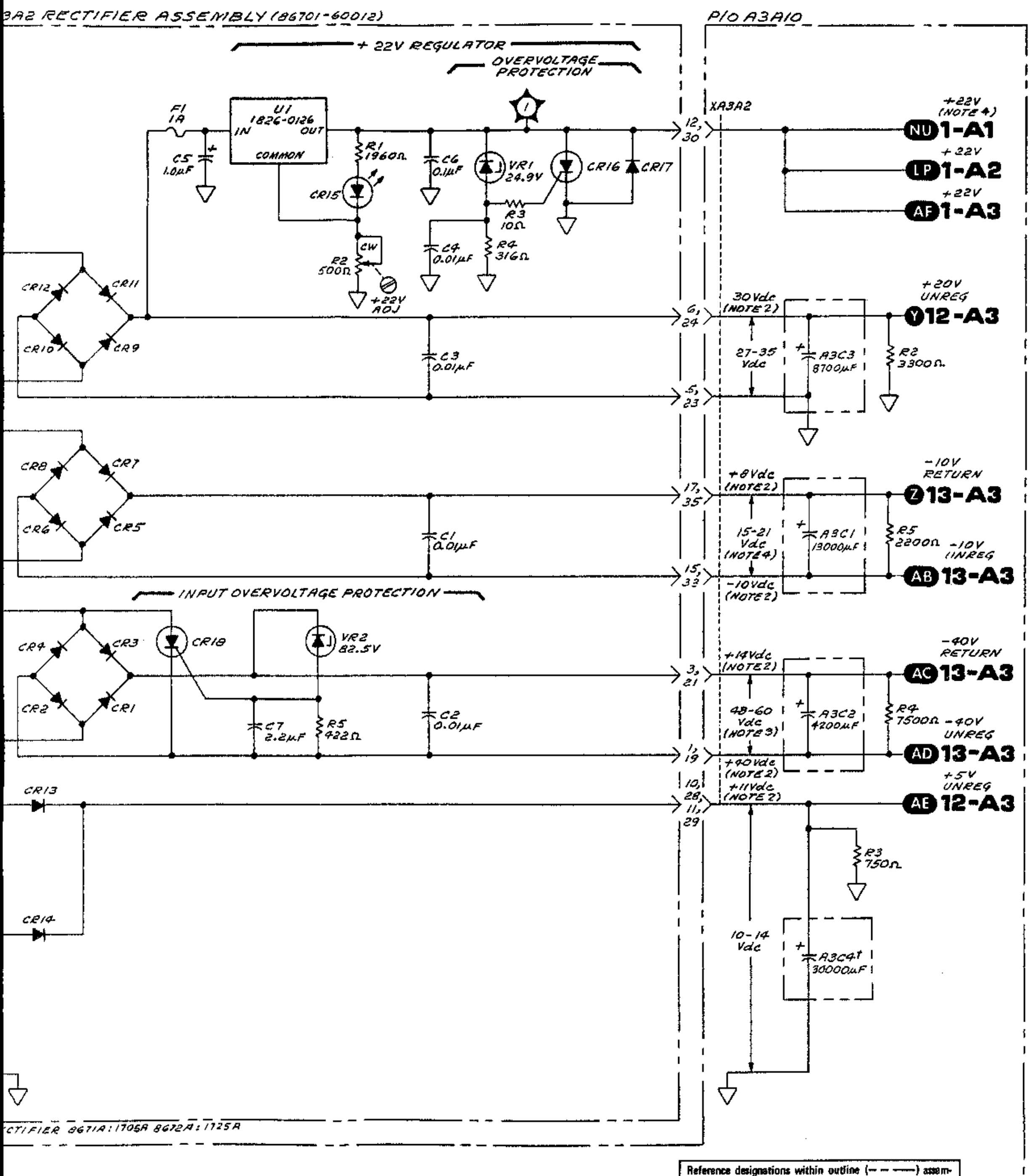
FIG. 8-98
Sht 2 of 3



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.

Figure 8-98. Rectifi

FIG. 8-98
Sht 3 of 3



WARNING

SECONDARY ac VOLTAGES OF GREATER THAN 30Vac AND RECTIFIED dc VOLTAGES OF GREATER THAN 60Vdc 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 (>30Vac) OR RECTIFIED dc VOLTAGES (>60Vdc) 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.
4. CONNECTED IN 8672A ONLY; NO CONNECTION 8671A.

† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

NO PREFIX	A3A10
W1	CR1-3 K1 P3,4 R1-5 XA3A2
A3	**A3A11**
B1 C1-6 F1 T1	TB1
A3A2	
C1-7 CR1-18 F1 R1-5 TP1 U1 VR1,2	

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.

11-A3
A3A2,A3A11

Figure 8-98. Rectifier Assembly Schematic Diagram

SERVICE SHEET 12-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-31
• Performance tests	Refer to Table 5-3 on Page 5-3
• Adjustment procedures	Page 5-2

PRINCIPLES OF OPERATION

Power Supplies

The +20V Regulator provides a reference voltage for all regulated supplies other than the +22V supply. If, or 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.

A3A3 Positive Regulator Assembly

+20V Regulator. A3A3Q2 and Q3 form a current source for A3Q3. When the Synthesizer is turned on, the +20V output increases and supplies current to the non-inverting input of A3A3U3 through the voltage reference A3A3VR2. The output voltage is also divided by A3A3R9, R50 and R10 and coupled to the inverting input of A3A3U3. This divided voltage is adjustable and sets the output voltage level.

At some level of current flow through the +20V Regulator, the voltage drop across A3A3R3 will equal that across A3A3R4 and A3A3Q4 begins to conduct. The output of A3A3U3 goes more positive which turns the current limiter on harder. The +20V Regulator is completely turned off. The regulator will remain off until the cause of the excess current drain is removed.

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 STANDBY position causes the Power On input to A3A3U1A to be 0V. This causes A3A3Q3 to saturate 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.

+5V 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.

SERVICE SHEET 12-A3 (Cont'd)

Power Up/Down Detector. This circuit outputs a Power Up/Down voltage (+5 or 0 Vdc) when the instrument is turned on or off. This lets the last frequency displayed before turnoff 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 A3S1 is set to INT, the Reference Oscillator Power Supply circuit is turned on. It reduces the +20 Vdc input to approximately +11 Vdc.

Troubleshooting

It is assumed that the troubleshooting information on Service Sheets 1 and 2 were used to isolate a power supply malfunction. The following procedure will allow further isolation to circuits shown by one of the three power supply schematics 11-A3, 12-A3 or 13-A3. If the malfunction is on 12-A3, this information will also aid in isolating the defective components.

Test Equipment

Digital Voltmeter . . . . HP 3455A

1. Connect the line (Mains) power to the Synthesizer and set the LINE switch to ON. Set rear panel FREQUENCY STANDARD INT/EXT switch to INT.

2. Observe the LED's on the A3A3 Assembly. The two red LED's (+20V and +5.2V indicators) should be on and the yellow LED (Thermal Shutdown indicator) should be off.

3. Set line switch to STANDBY. 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	+11.0 ±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 also 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.

CAUTION

To avoid damage to the Synthesizer's power supplies, measure the following voltages with a voltmeter that has a floating common.

6. If the output voltages are incorrect, measure the input voltages.

Input Voltage	Test Point	LINE Switch Position	
		ON	STANDBY
+20V UNREG +5.2 UNREG	A3A3TP4 A3A3TP1	~32 Vdc ~12.2 Vdc	~35.5 Vdc ~14.5 Vdc

If the input voltages are incorrect, go to Service Sheet 11-A3.

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-pin 13. The yellow LED (Thermal Shutdown indicator) should light and the 5 red LED's 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 13-A3.

Troubleshooting Line Related Spurious

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 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 +20V, +5.2V, and —5.2V should have ripple less than 1 millivolt. 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 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 contacts 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 100 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, stop the fan with a pencil or other insulated tool to see if the spurious signals go away.

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 assemblies are fully seated on their connectors and that all coax cables and circuit boards are properly seated on their connectors.

NOTE

After repairing the A3A3 assembly, perform the Power Supply Adjustments in Section V. Also, perform the performance tests (if an) that led to the power supply repair.

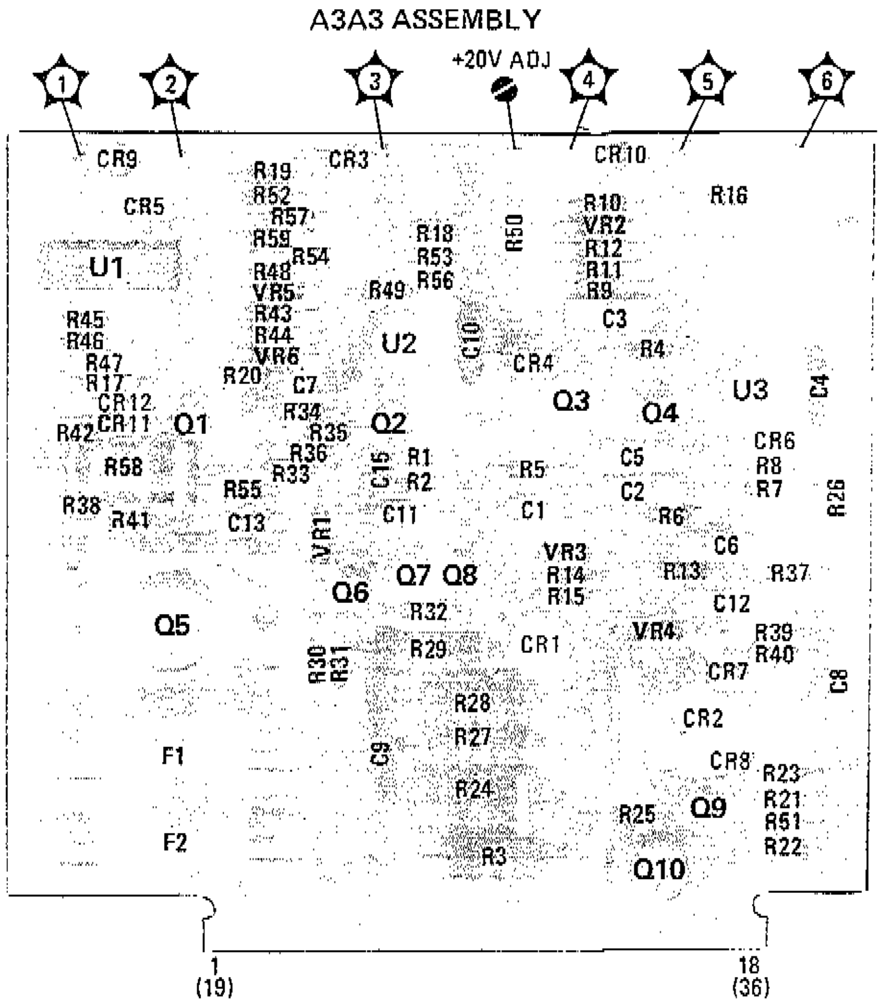


Figure 8-99. A3A3 Positive Regulator Assembly, Component, Adjustment, and Test Point Locations

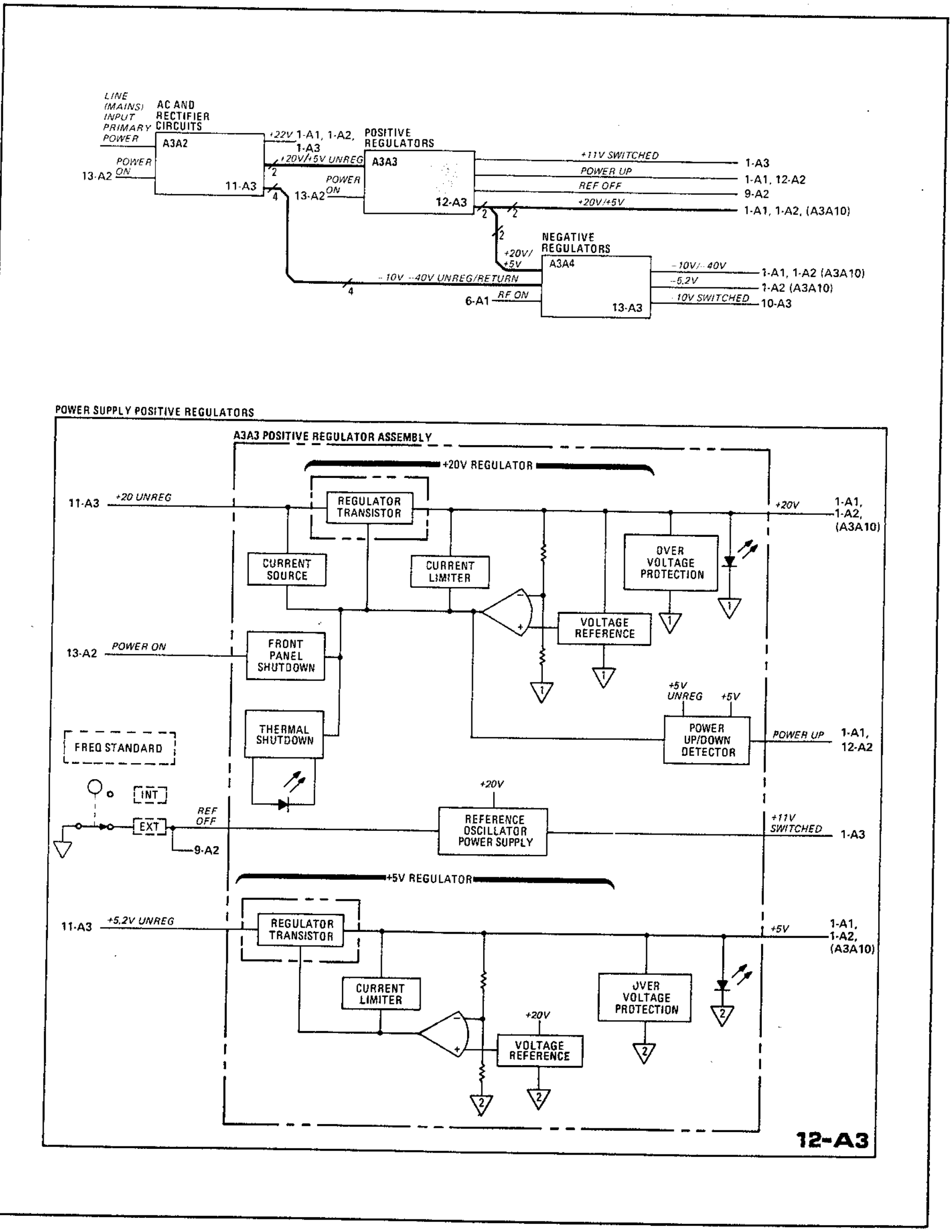


Figure 8-100. Positive Regulator Block Diagrams

FIG. 8-101
Sht 1 of 3

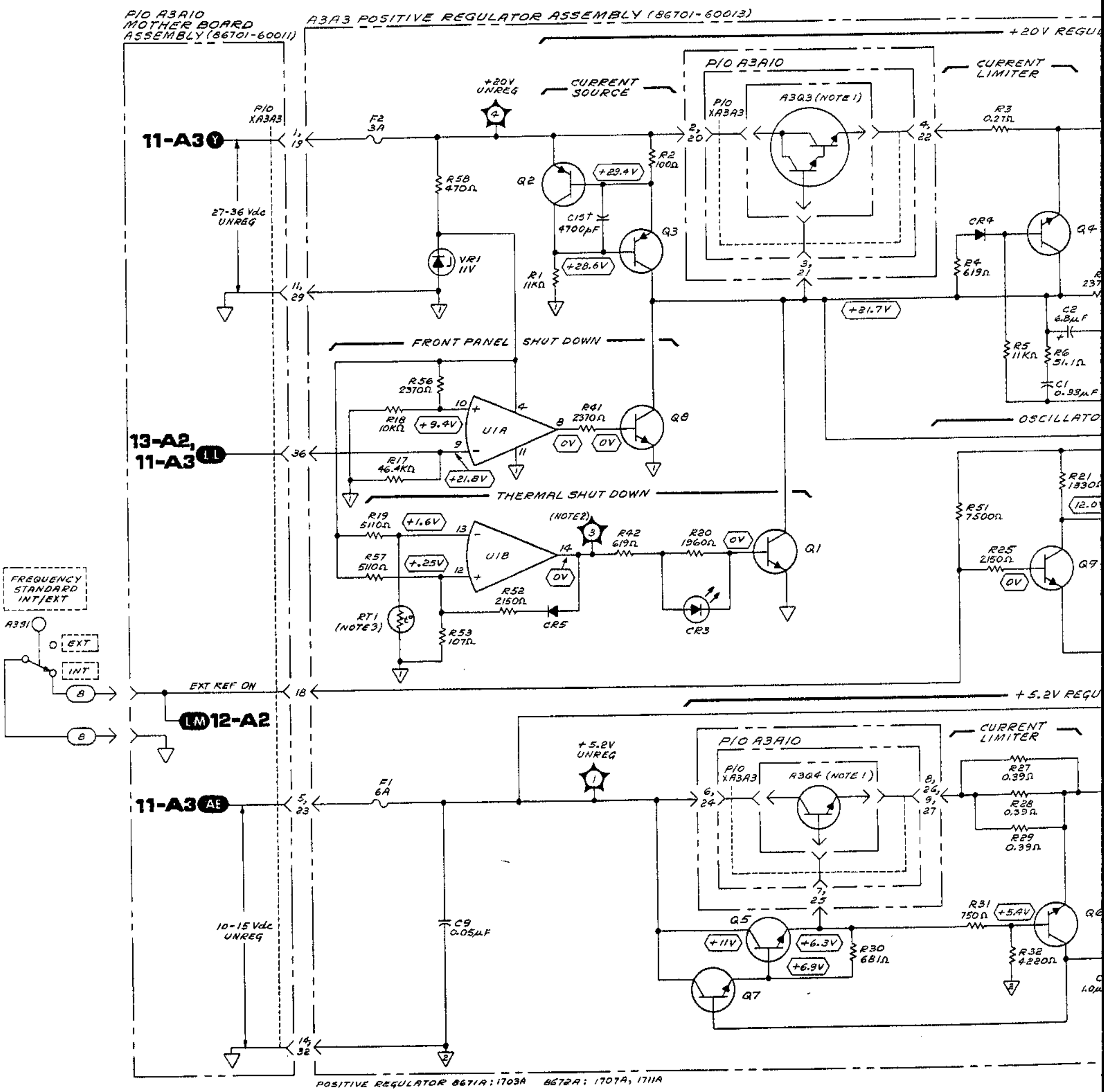


FIG. 8-101
Sht 2 of 3

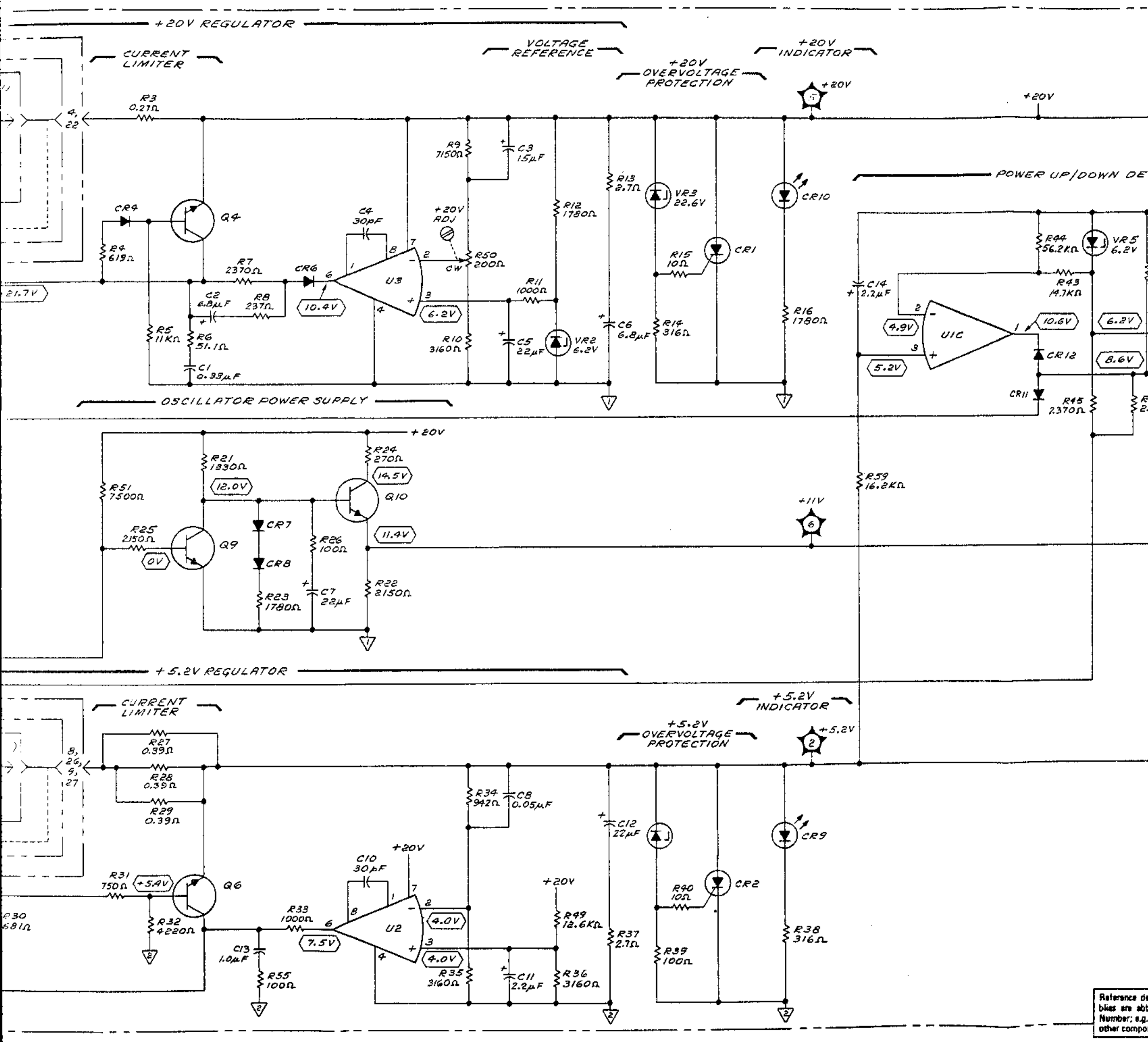
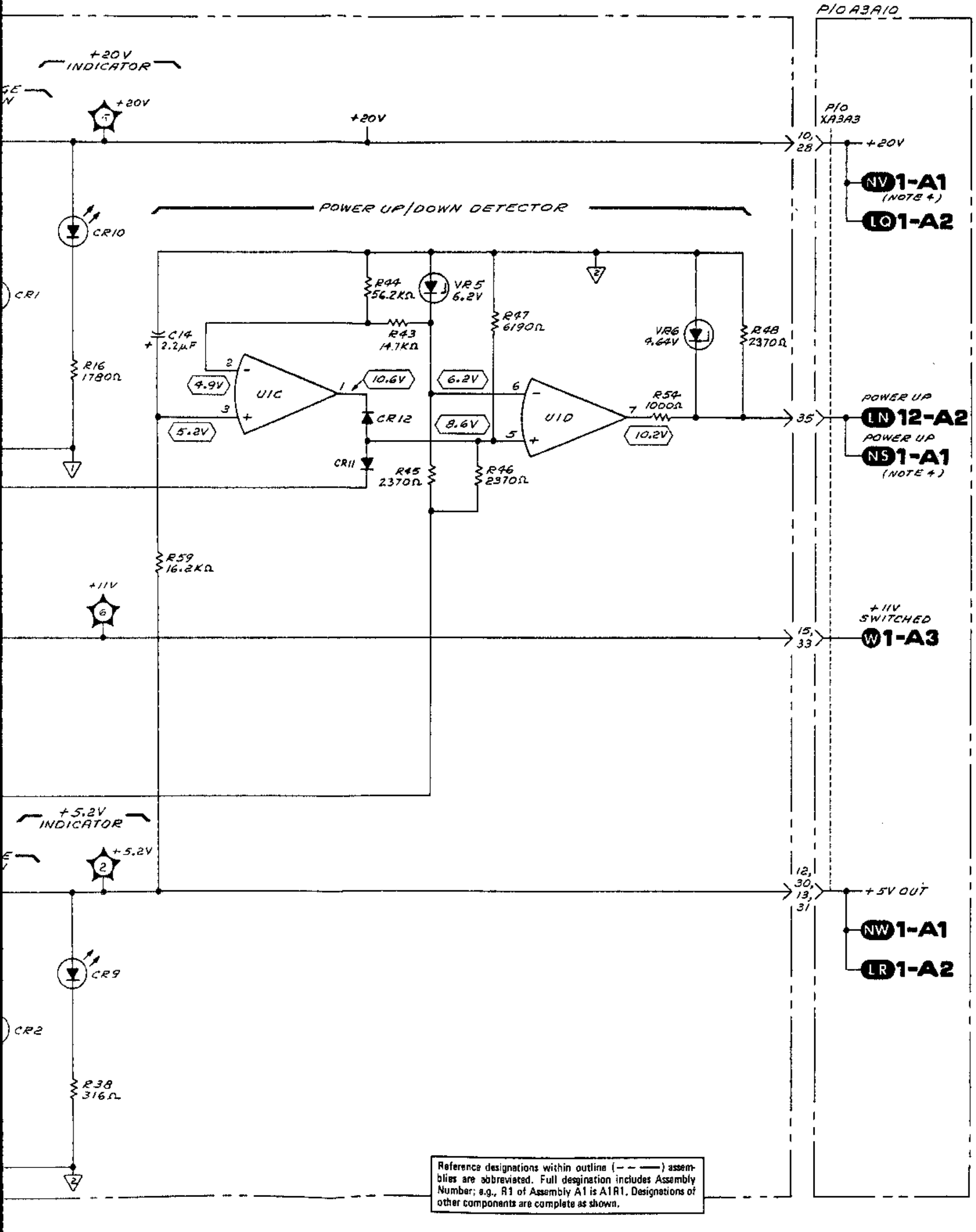


FIG. 8-101
Sht 3 of 3



WARNING

VOLTAGES OF GREATER THAN 60Vdc DIFFERENTIAL ARE 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 BOARD WITH POWER SUPPLIED TO THE INSTRUMENT.

CAUTION

DO NOT REMOVE OR INSERT POWER SUPPLY BOARDS WITH THE POWER CABLE CONNECTED. DAMAGE TO THE INSTRUMEN MAY OCCUR.

NOTES

1. A3Q3 AND A3Q4 ARE SEPARATE ASSEMBLIES MOUNTED ON THE REAR PANEL HEAT SINK AND A3A10 MOTHER BOARD ASSEMBLY.
2. DURING NORMAL OPERATION THE VOLTAGE AT TP3 IS <12 Vdc (CR7 IS OFF). IN THE THERMAL SHUT DOWN MODE THE VOLTAGE AT TP3 IS <6 Vdc (CR7 IS ON).
3. RT1 RESISTANCE IS ABOUT 1000 Ω AT 25°C; 107 Ω AT 85°C.
4. CONNECTED IN 8672A ONLY; NO CONNECTION IN 8671A.
† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

A3	A3A3
Q3, 4 S1 A3A10 XA3A3	C1-15 CR1-12 F1, 2 Q1-10 R1-59 RT1 TP1-6 U1-3 VR1-6

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1, 4, 6-8	1854-0404
Q2	1853-0451
Q3	1853-0012
Q5	1854-0441
Q9	1854-0005
Q10	1854-0039
U1	1826-0161
U2, 3	1820-0223

12-A3
A3A3

Figure 8-101. Positive Regulator Assembly Schematic Diagram

SERVICE SHEET 13-A3

TROUBLESHOOTING HELP: In addition to this service sheet refer to:

• Block diagram	Page 8-33
• Motherboard wiring	Last 3 foldout pages
• Parts list	Page 6-33
• Performance tests	Refer to Table 5-3 on Page 5-3
• Adjustment procedures	Page 5-2

PRINCIPLES OF OPERATION

Negative Power Supplies

The negative regulators are all controlled by the +20V Regulator output. The −10V Regulator and the −40V Regulator operate exactly 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.

A3A4 Negative Regulator Assembly

−10V Regulator. When the Synthesizer is turned on, +20V is applied across the voltage divider. The −10V output goes more negative until the divided voltage (at the non-inverting input of U2) is 0 Vdc.

At some level of current flow through the −10V Regulator, the voltage drop across R1 and R23 equals that across R2 and CR1 and Q1 begins to conduct. The output of U2 goes more positive, which then turns the current limiter on harder. The −10V Regulator is completely turned off and will remain in this condition until the cause of excess current drain is removed.

−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 feed-back voltage of the opposite sense to control regulation, the +20V to −5.2V voltage divider output 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.

RF Switch. The RF ON switch (on the front panel of the A1 RF Output Assembly) controls the −10V switch. This voltage is the supply voltage for the A3A9A3 YIG Tuned Oscillator Assembly.

Troubleshooting

It is assumed that the troubleshooting information on Service Sheets 2 and 12-A3 was used to isolate a power supply malfunction of the circuits shown on this schematic. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter . . . . HP 3455A

CAUTION

DO NOT remove or install power supply boards with the power cable connected. Damage to the instrument's internal circuitry may occur.

1. Connect the line (Mains) power to the Synthesizer and set the LINE switch to ON.

2. Observe the three red LED's on the A3A4 Assembly. All should be on unless the Synthesizer 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, remove the A3A4 Assembly and place it on an extender board. If all the voltages are incorrect, measure the +20V input at pin 9 of the edge connector.

Regulator	Test Point	Output Voltage
−40V	A3A4TP1	−40.0 +0.6 − 1.0 Vdc
−10V	A3A4TP4	−10.0 ± 0.2 Vdc
−5.2V	A3A4TP5	−5.2 ± 0.1 Vdc

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 appropriate fuse and measure the input voltages.

Input Voltage	Positive Pin	Negative Pin	LINE Switch Position	
			ON	OFF
−10V UNREG	7 (A3A4TP3)	6	~ 18.8 Vdc	~21.9 Vdc
−40V UNREG	2 (A3A4TP2)	3	~ 57 Vdc	~ 63 Vdc

5. Measure the output voltage at edge connector pin 14. With the front panel RF switch ON the voltage should measure −10 Vdc; with the switch OFF it 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.

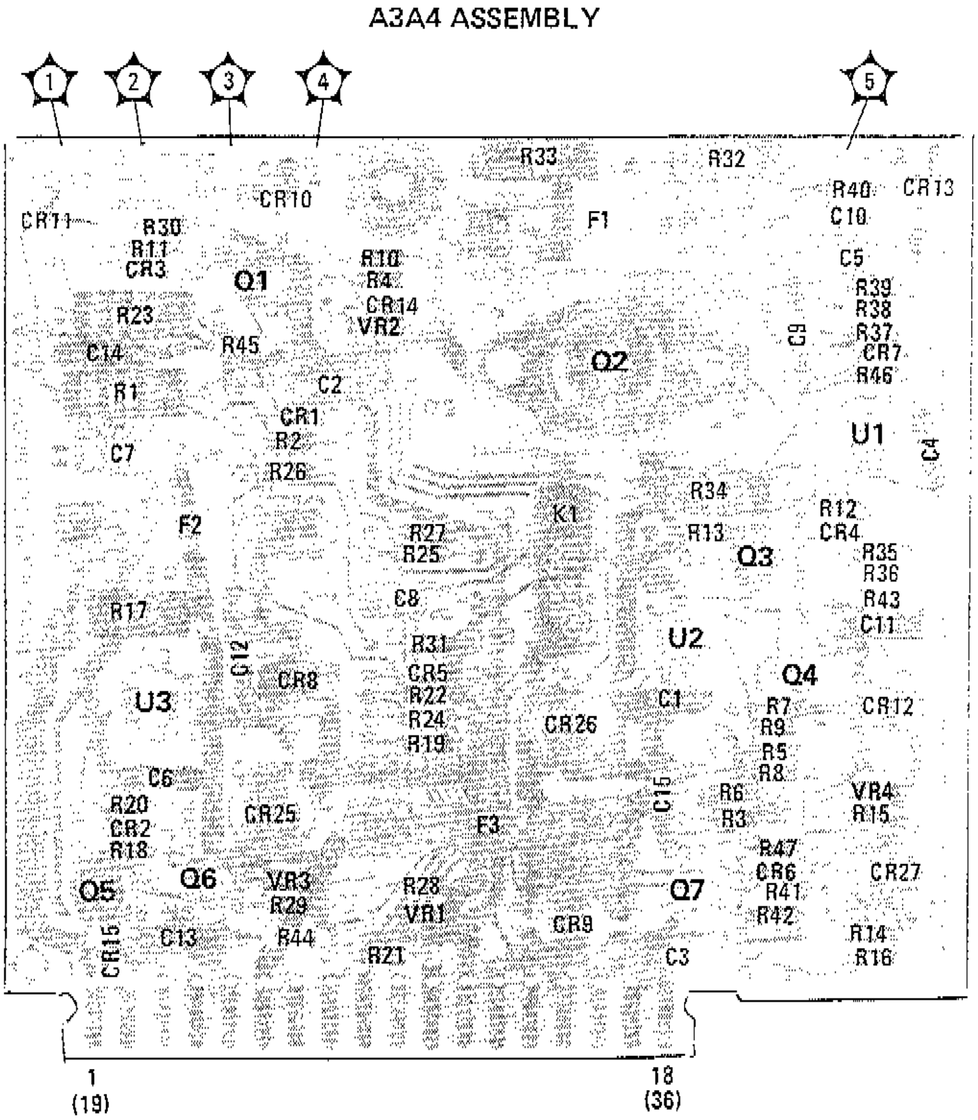


Figure 8-102. A3A4 Negative Regulator Assembly Component and Test Point Locations

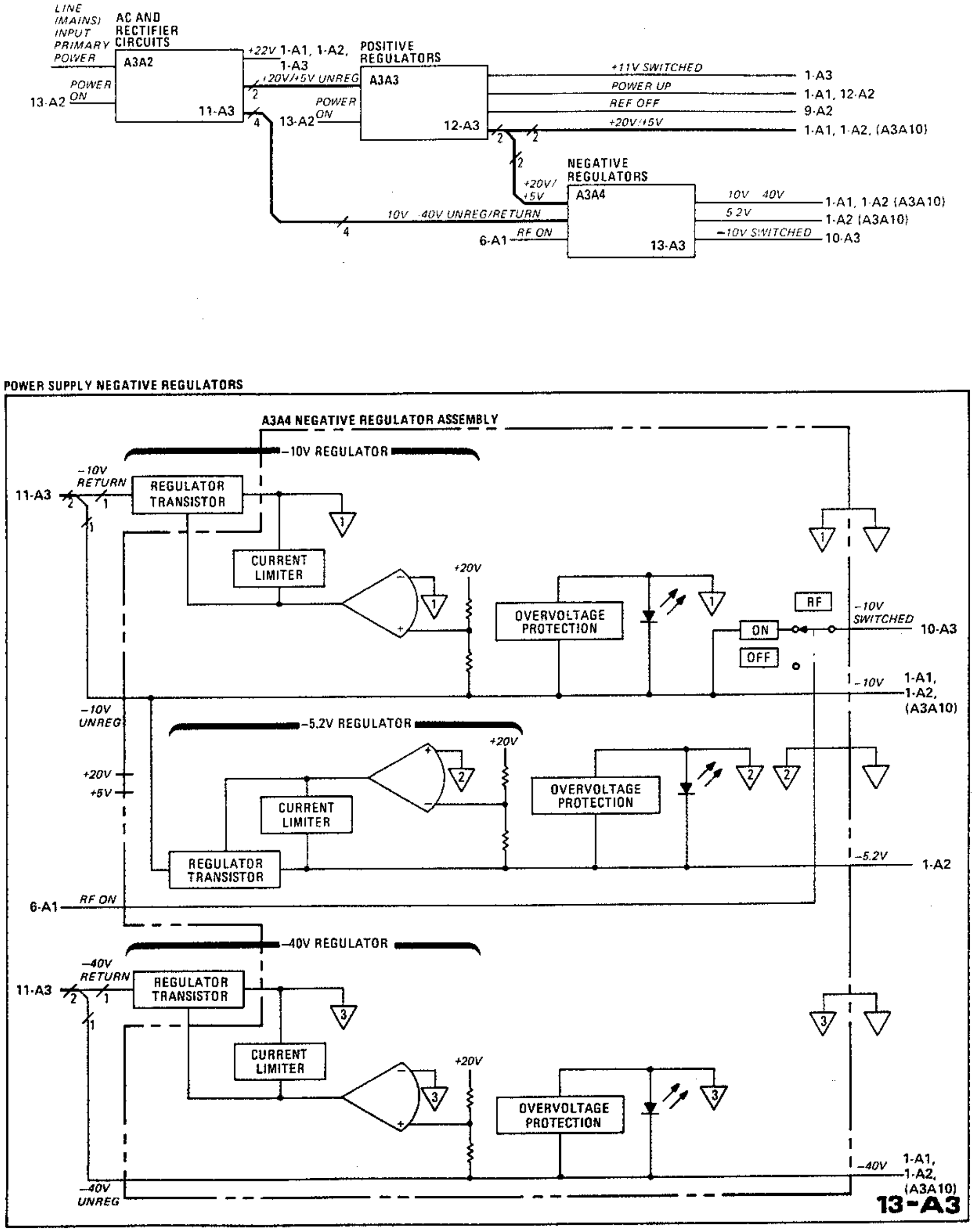


Figure 8-103. Negative Regulator Block Diagrams

FIG. 8-104
Sht 1 of 2

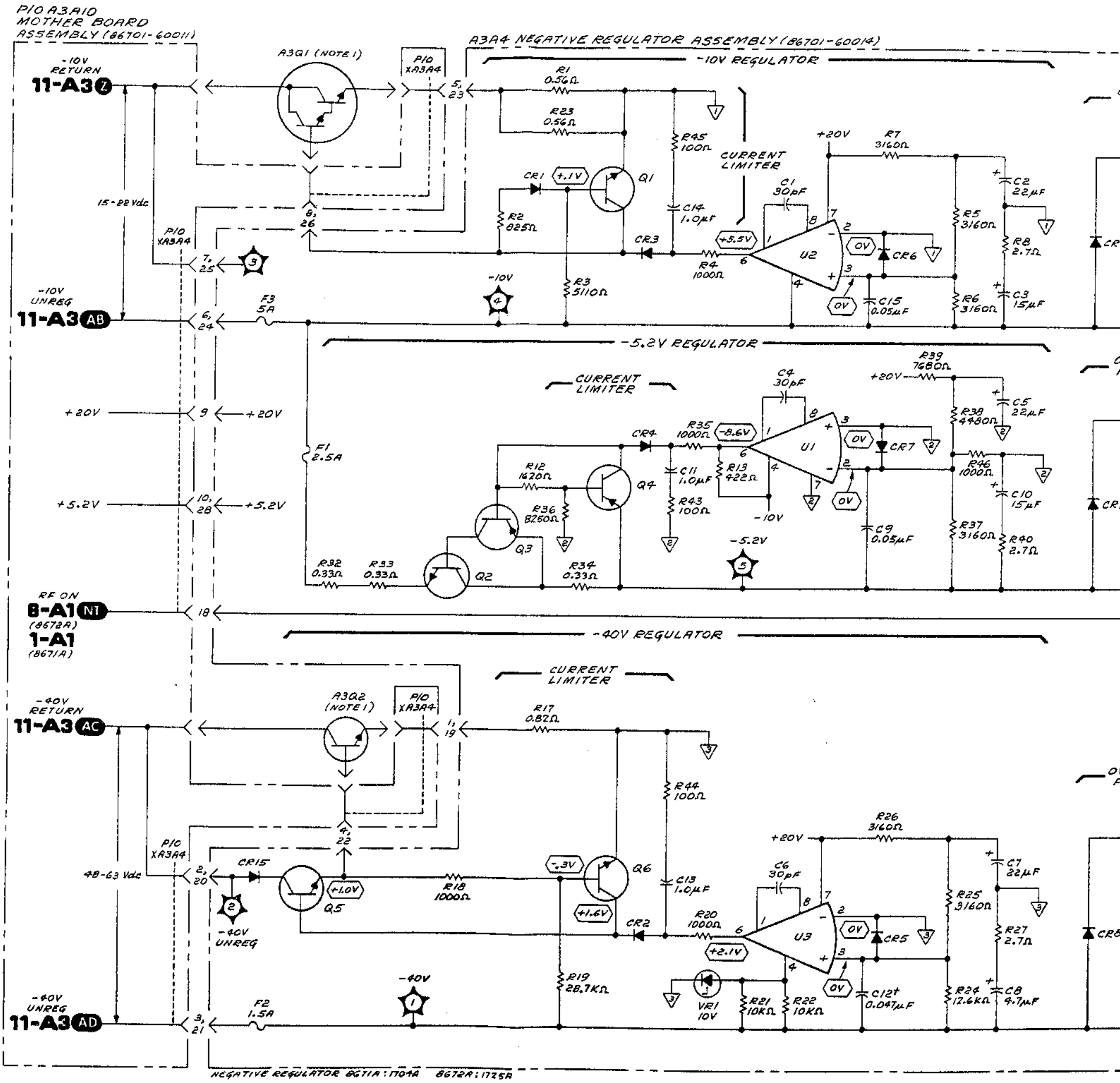
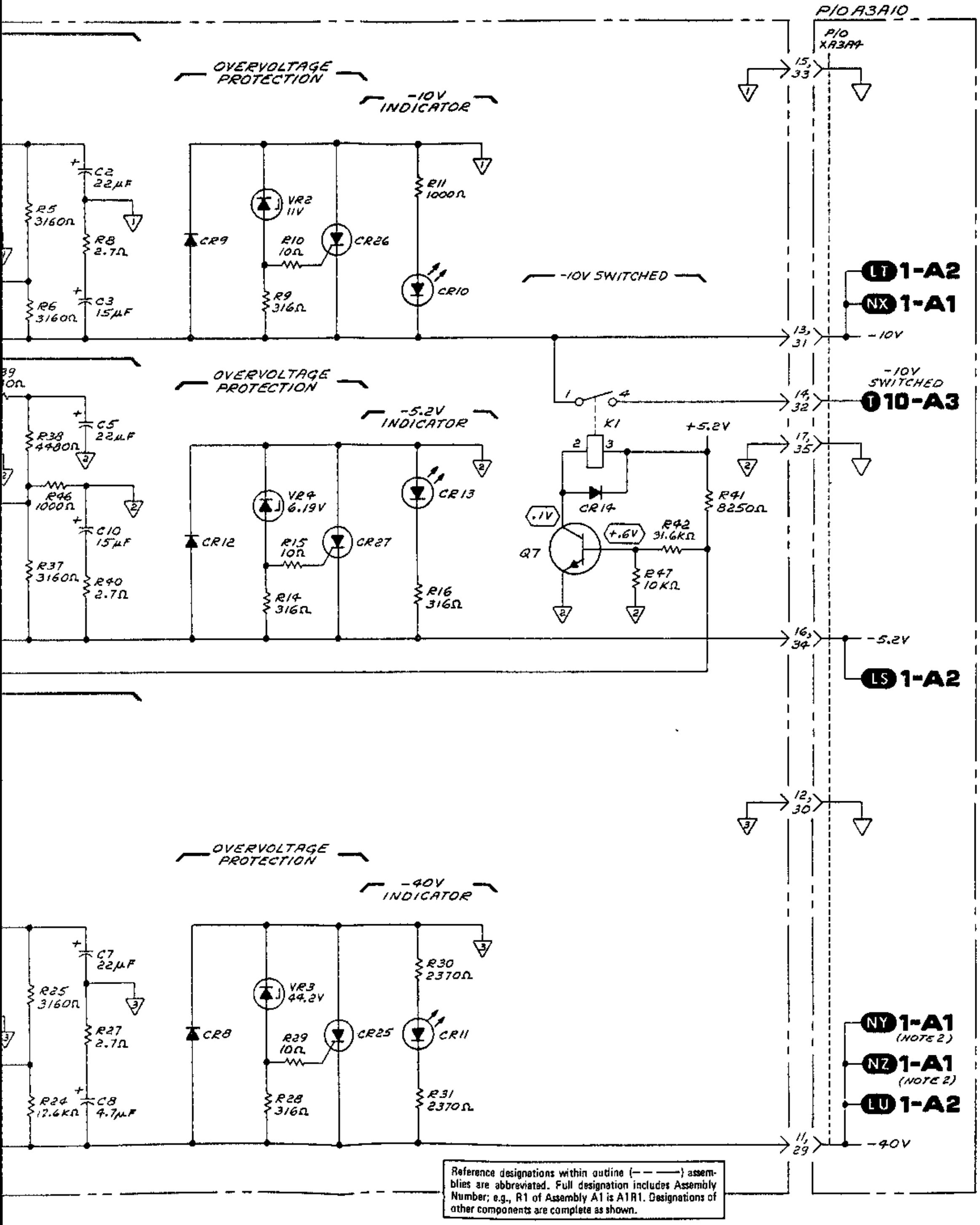


FIG. 8-104
Sht 2 of 2



WARNING

DC VOLTAGES OF >60Vdc 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 60Vdc 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 POWE 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.
2. CONNECTED IN 8672A ONLY; NO CONNECTION IN 8671A.

† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

A3	A3A4
Q1, 2	C1-15 CR1-15, 25-27 F1-3 K1 Q1-7 R1-47 TP1-5 U1-3 VR1-4
A3A10	
XA3A4	

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

13-A3
A3A4

Figure 8-104. Negative Regulator Assembly Schematic Diagram

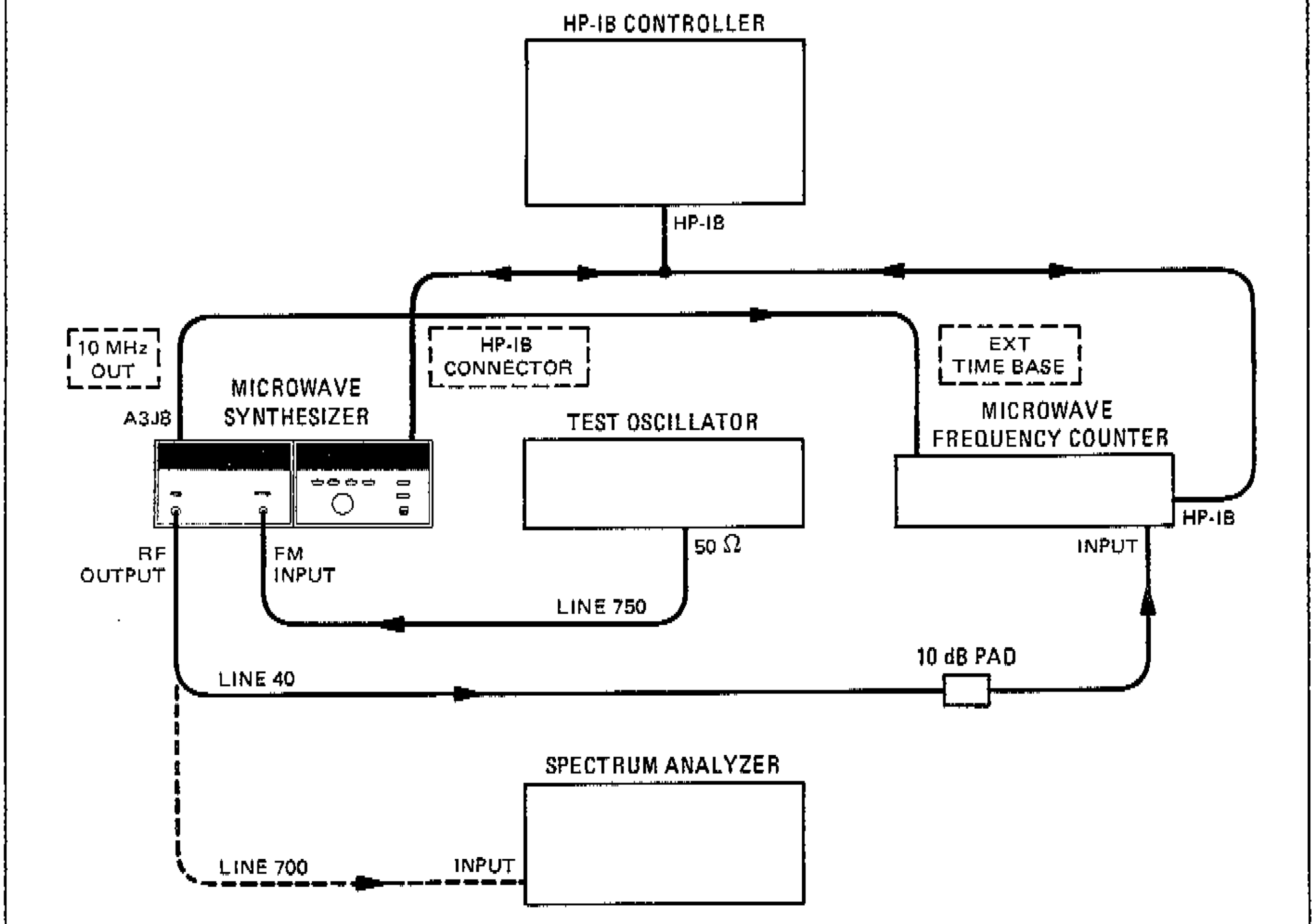


Figure 105. Remote Operator's Checks Test Setup

8-90a

Table 8-5. Remote Operator's Check (1 of 2)

```
10 PRINT "REMOTE OPERATOR'S CHECK"
20 PRINT "SET 5340A ADDRESSABLE AND SWITCHES TO 10010"
30 PRINT "SET 8671 ADDRESS SWITCHES TO 23"
40 PRINT "CONNECT COUNTER THRU 10DB PAD";
50 PRINT " TO 8671A RF OUTPUT AND 10MHZ OUTPUT"LIN2
60 DISP "PRESS CONT EXECUTE WHEN SET"
70 STOP
80 DIM V[16]
90 REM ENABLE REMOTE
100 CMD "?U"
110 FORMAT 2B
120 D=9
130 OUTPUT (13,110)1280,768;
140 N=M=0
150 F=2000000
160 REM INITIALIZE 8671 WITH FM OFF AND RF ON
170 CMD "?U3","N01"
180 REM FREQUENCY PROGRAMMING TEST
190 FOR Y=1 TO 7
200 IF Y#7 THEN 220
210 D=3
220 FOR Z=0 TO D
230 IF Z>0 THEN 250
240 IF M=1 THEN 400
250 CMD "?U3","@"
260 R=F
270 G=R/10000000
280 OUTPUT (13,290)G;
290 FORMAT F1000.7,"Z1"
300 REM INITIALIZE 5340A
310 CMD "?U2","3KM@TOHII","?R5"
320 REM THE FIRST TWO 5340A CHARACTERS ARE IGNORED. FREQ IS A
330 ENTER (13,340)A
340 FORMAT 2X,E14.0
350 A=A/1000
360 REM RESULTS ARE CHECKED FOR + OR - ONE COUNT ACCURACY
370 IF A=R OR A=R+1 OR A=R-1 THEN 410
380 PRINT "PROG. FREQ. ";R/1000;"MHZ. ACTUAL FREQ. ";A/1000;"MHZ"
390 N=N+1
400 REM FREQUENCY IS INCREMENTED
410 F=F+(10↑(Y-1))
420 NEXT Z
430 M=1
440 IF N THEN 480
450 OUTPUT (15,460)10↑(Y-1)/1000
460 FORMAT F9.3,X,"MHZ DIGIT ALL OK"
470 GOTO 490
480 PRINT N;" ERRORS IN";10↑(Y-1)/1000;" MHZ DIGIT"
490 N=0
500 NEXT Y
510 B=0
```

Table 8-5. Remote Operator's Check (2 of 2)

```
520 PRINT "FREQUENCY TUNING TEST COMPLETE"
530 CMD "?U3"
540 OUTPUT (13,550)256,1,512;
550 FORMAT 3B
560 DISP "PRESS PRESET BUTTON ON 8671"
570 WAIT 7000
580 CMD "?U2","3KL@TOHII","?R5"
590 ENTER (13,340)B
600 B=B/1000
610 Y=3000000
620 IF B=Y OR B=Y+1 OR B=Y-1 THEN 670
630 PRINT "ERROR IN PRESET FREQUENCY"B
640 PRINT "CHECK PRESET BUTTON OPERATION"
650 WAIT 3000
660 GOTO 560
670 PRINT "PRESET BUTTON OPERATION OK"LIN2
680 CMD "?U"
690 REM CYCLE FM AND RF
700 PRINT "CONNECT SPECTRUM ANALYZER TO 8671 RF OUTPUT."
710 PRINT "TUNE ANALYZER TO 3GHZ"
720 PRINT "SET TO 10KHZ BANDWIDTH AND .2MHZ SCAN WIDTH."
730 PRINT "SET 10 DBM LOG REF. LEVEL"
740 PRINT "SET 100KHZ AT ABOUT 0.2V(RMS) ON TEST OSCILLATOR."
750 PRINT "CONNECT TEST OSC. 50 OHM OUTPUT TO 8671 FM INPUT"
760 PRINT "PRESS CONT EXECUTE WHEN SET."LIN2
770 STOP
780 CMD "?U3"
790 DISP "WATCH SPECTRUM FOR FM"
800 WAIT 1500
810 CMD "","N1"
820 DISP "FM 100KHZ DEVIATION RANGE"
830 WAIT 2000
840 CMD "","N2"
850 DISP "FM 10MHZ DEVIATION RANGE"
860 WAIT 2000
870 CMD "","N0"
880 DISP "FM OFF"
890 WAIT 1500
900 PRINT "FM TEST COMPLETE"
910 REM  RF ON OFF TEST
920 DISP "OBSERVE RF OUTPUT"
930 WAIT 1000
940 CMD "?U3","O0"
950 DISP "RF OFF."
960 WAIT 2000
970 CMD "","O1"
980 DISP "RF ON."
990 WAIT 2000
1000 PRINT "8671 TEST COMPLETE"LIN2
1010 END
```

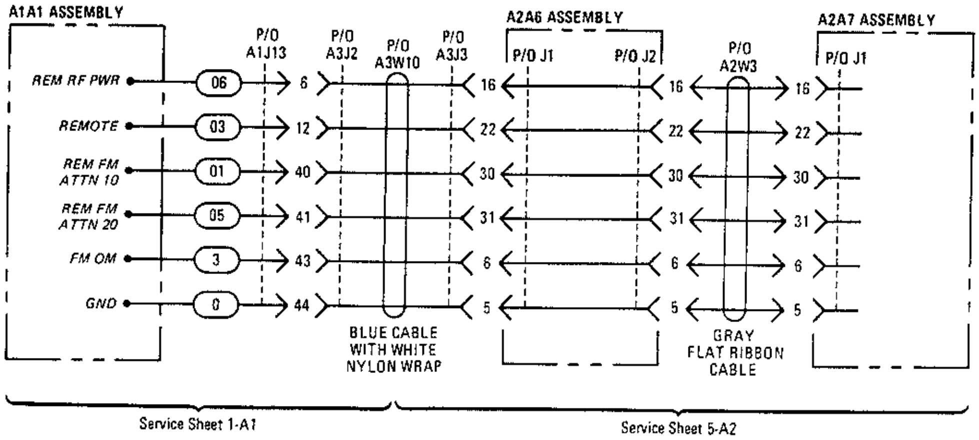


Figure 8-106. A1 to A2 Interconnections

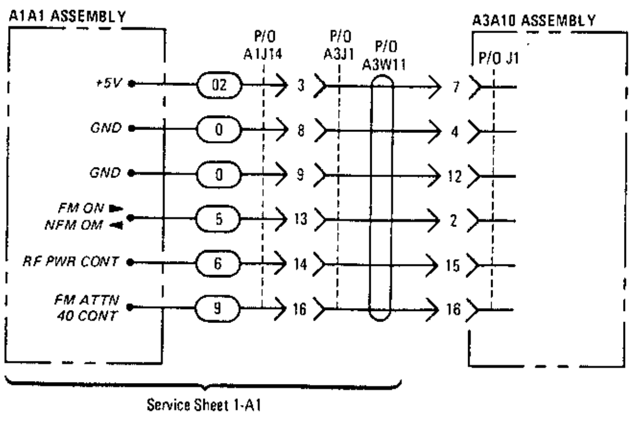


Figure 8-107. A1 to A3 Interconnections

Table 8-6. Controller Assembly (A2) Interconnections (1 of 3)

Signal Line Menmonic	Board Edge Connectors XA2																	
	A3	A4	A5	A7 A	A7 B	A7 C	A8 A	A8 B	A8 C	A9	A10 B	A10 C	A11 A	A11 B	A11 C	J4	W3	J1
ATN						25				25								
CLK 1						21						21	27					17
CLK 2								12							6			
CLK PRTCT												18		17				
CYCLE													19					20
DAC 10 MHz							13									57		
DAC 20 MHz								3								28		
DAC 40 MHz								8								58		
DAC 80 MHz								24								27		
DAC 100 MHz									3							26		
DAC 200 MHz									5							25		
DAC 400 MHz									19							24		
DAC 800 MHz									2							23		
DAC 1600 MHz								29								22		
DAC 3200 MHz								13								52		
DAC 1 MHz			14				30									53		
DAC 2 MHz			13					18								54		
DAC 4 MHz			12					23								55		
DAC 8 MHz			11					10								56		
DC						23				23								
DCU BZY						27				27								
DI 1						30				30								
DI 2						15				15								
DI 3						14				14								
DI 4						29				29								
DI 5						12				12								
DI 6						28				28								
DI 7						13				13								
DINTF 1					3						17							
DINTF 2					7						22							
DINTF 4					10						26							
DINTF 8					12						13							
DINTF 10					20						18							
DINTF 20					24						24							
DINTF 40					28						14							
DINTF 80					13						29							
DINTF 100					5						20							
DINTF 200					22						21							
DINTF 400					11						27							
DINTF 800				29	29						30							
DINTF 1000				21	21						19							
DINTF 2000				9	9						25							
DINTF 4000				27	27						28							
DINTF 8000				26	26						11							
DR2I1								5							2			
DR2I2								20						29				
DR2I4								4						27				
DR2I8								19						26				
DR1I1												16			17			26

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Table 8-6. Controller Assembly (A2) Interconnections (2 of 3)

Signal Line Mnemonic	Board Edge Connectors XA2																	
	A3	A4	A5	A7 A	A7 B	A7 C	A8 A	A8 B	A8 C	A9	A10 B	A10 C	A11 A	A11 B	A11 C	J4	W3	J1
DR1I2												2			16			25
DR1I4												17			18			21
DR1I8												1			19			23
DR101												9			27			
DR102												24			26			
DR104												23			23			
DR108												22			22			
ERR$										11				1				7
EXT REF ON																13		8
FMOM						19				19							6	
GO												19	20		1			2
HET				22								10			5,20		3	
HN1					4			6			23	13			13		1	
HN2					18			21			6	12			12		2	
INTF CLK GO				29									29					
INTF CLK 1					23						10							
INTF CLK 2					2						16							
LFS 1 kHz			32				3											
LFS 2 kHz			30				23											
LFS 4 kHz			31				26											
LFS 8 kHz			29				15											
LFS 10 kHz			36				17											
LFS 20 kHz			34				6											
LFS 40 kHz			35				10											
LFS 80 kHz			33				29											
LFS 100 kHz			18				14											
LFS 200 kHz			16				2											
LFS 400 kHz			17				7											
LFS 800 kHz			15				25											
LEFT								9				11		30				
LEV UNCAL																	5	
LFS 1 MHz			14				30									53		
LFS 2 MHz			12				18									54		
LFS 4 MHz			13				23									55		
LFS 8 MHz			11				10									56		
LFS UNLOCKED		11		15														
LOCAL					17									2				18
LO LTM											8							19
MØ									26							10		
M1									12							40		
M2									27							11		
M3									25							41		
M4									10							12		
M/N UNLOCKED					2											6		
NØ								28								7		
N1								27								37		
N2									4							8		
N3									6							38		
N4								26								9		

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Table 8-6. Controller Assembly (A2) Interconnections (3 of 3)

Signal Line Mnemonic	Board Edge Connectors XA2																	
	A3	A4	A5	A7 A	A7 B	A7 C	A8 A	A8 B	A8 C	A9	A10 B	A10 C	A11 A	A11 B	A11 C	J4	W3	J1	
N5							14									39			
NCLK2								17							7				
NCLK3								22					30						
NDAV						7				7									
NERR												20		6					
NHET											2					36			
NLSDR													26					16	
NRMDR								11						5					
NRSTOR						20				20									
NYTM											3					35			
ON/STBY																5		6	
OVEN MON																33		15	
OVN OK										4								13	
OVR RNG						22				22									
PRESET					8						9			7				10	
PWR ON				25		10				10			17					14	
REF UNLOCKED				3												16			
REMOTE						24				24									
RF OFF						26				26									
RPG1														3				11	
RPG2														16				9	
SYNTH												25			21				
SYNTH P											4					34			
UNLOCK				13		5				5								12	
UNLVL						9				9									
VCO TUNE	17,35	17																	
YTO RST				9												51			
YTO SLEW				1												29			
YTO UNLOCKED				8												21			
+22V																43		4	
+20V	1,20	2,20	2,20													44			
+5V		3,21	3,21		1,16			1,16		3	1			22		15, 45		22,24	
−5V	5,23		5,23													20, 50			
−10V	6,24	6,24														17, 47			
−40V	7,25															46			
±1 BIT													22					1	
+5V (P)											4		15						
10 MHz REF			19											24					J2
80 kHz REF		27	9																
÷N1 80 kHz		28	10																

8-91a/8-92c

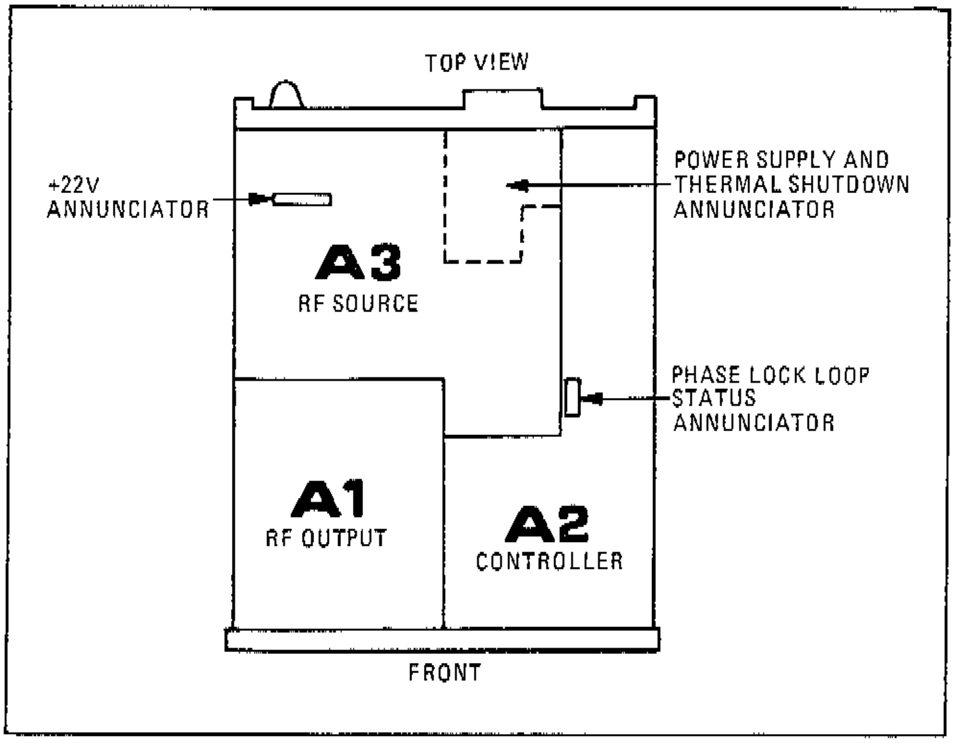

Figure 8-108. Major Assembly Locations

8-91/8-92d

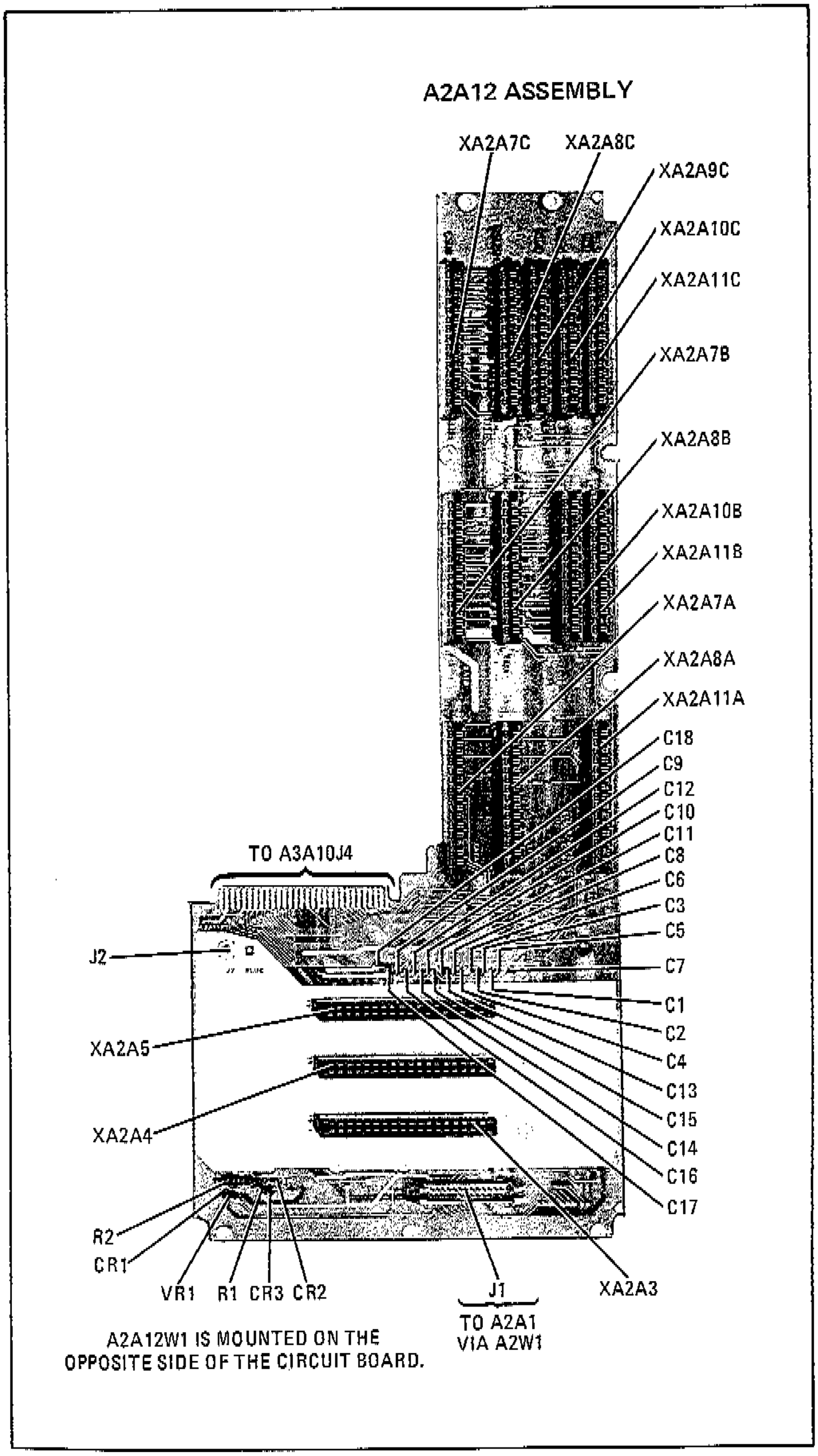

Figure 8-109. A2A12 Motherboard Assembly Component Locations

Table 8-7. Motherboard Assembly (A3A10) Interconnections (1 of 2)

Signal Line Mnemonic	Board Edge Connectors XA3A10													
	A1 A	A1 B	A2	A3	A4	A5	A6	A7	A8	J1	J2	J3	J4	
DAC 1 MHz						31							53	
DAC 2 MHz						30							54	
DAC 4 MHz						29							55	
DAC 8 MHz						28							56	
DAC 10 MHz						27							57	
DAC 20 MHz						26							28	
DAC 40 MHz						25							58	
DAC 80 MHz						13							27	
DAC 100 MHz						12							26	
DAC 200 MHz						11							25	
DAC 400 MHz						10							24	
DAC 800 MHz						9							23	
DAC 1600 MHz						8							22	
DAC 3200 MHz						7							52	
EXT REF ON				18									13	P1
FM COIL INPUT								9,24						W27
FM INPUT								12, 27						W1
FM ON								15		2	3,18			
FM −40 dB								29		16				
INTEGRATED FM								7, 22						W29
M/N UNLOCKED	8												6	
MØ	5												10	
M1	6												40	
M2	3												11	
M3	4												41	
M4	1												12	
M5	2												42	
NØ	15												7	
N1	14												37	
N2	13												8	
N3	12												38	
N4	11												9	
N5	10												39	
NHET										14			36	
NYTM										3			35	
ON STBY				36									5	K1
OVEN MON												4	33	
Q1 E					3,23									
B					8,26									
C			17, 35		7, 25									
Q2 E					1,19									
B					4,22									
C			3,21		2,20									
Q3 E				4,22										
B				3,21										
C				2,20										

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Table 8-7. Motherboard Assembly (A3A10) Interconnections (2 of 2)

Signal Line Mnemonic	Board Edge Connectors XA3A10												
	A1 A	A1 B	A2	A3	A4	A5	A6	A7	A8	J1	J2	J3	J4
Q4 E				8,26									
				9,27									
B				7,25									
C				6,24									
REF UN-LOCKED		14											16
SYNTH P										13			54
YTO RST								14					51
YTO SLEW							14						29
YTO TUNE 1								10, 25					
YTO TUNE 2							9,24 10,25	8,23					
YTO UN-LOCKED											5,16		21
+20V UNREG			6,24	1,19									
+5V UNREG.			10,28 11,29	5,23									
−10V UNREG			15,33		6,24								
−40V UNREG			1,14		3,21								
+20V WINDING (RED)			14,32										
+20V WINDING (GREY)			13,31										
+5.2V WINDING (BROWN)			9,27										
+5.2V WINDING (BROWN)			8,26										
−10V WINDING (BLUE)			16,34										
−10V WINDING (WHITE)			18,36										
−40V WINDING (YELLOW)			4,22										
−40V WINDING (GREEN)			2,20										
10V SWITCHED					14,32						4,17		
+22V												6	43
+20V		2,3		10,28	9,27	1,19	1,16	1,16			9,12		44
+11V				15,33								1	15,45
+5V		4,5		12,30	10,28	2,20	2,17	2,17					
				13,31							1,20		20,50
−5V		12,13			16,34						1,20		20,50
−10V		8,9				4,22		4,19			10,11		17,47
−20V					13,31								
−40V			6,7		11,29	3,21		3,18	3,18	46	8,13		

8-93/8-94b

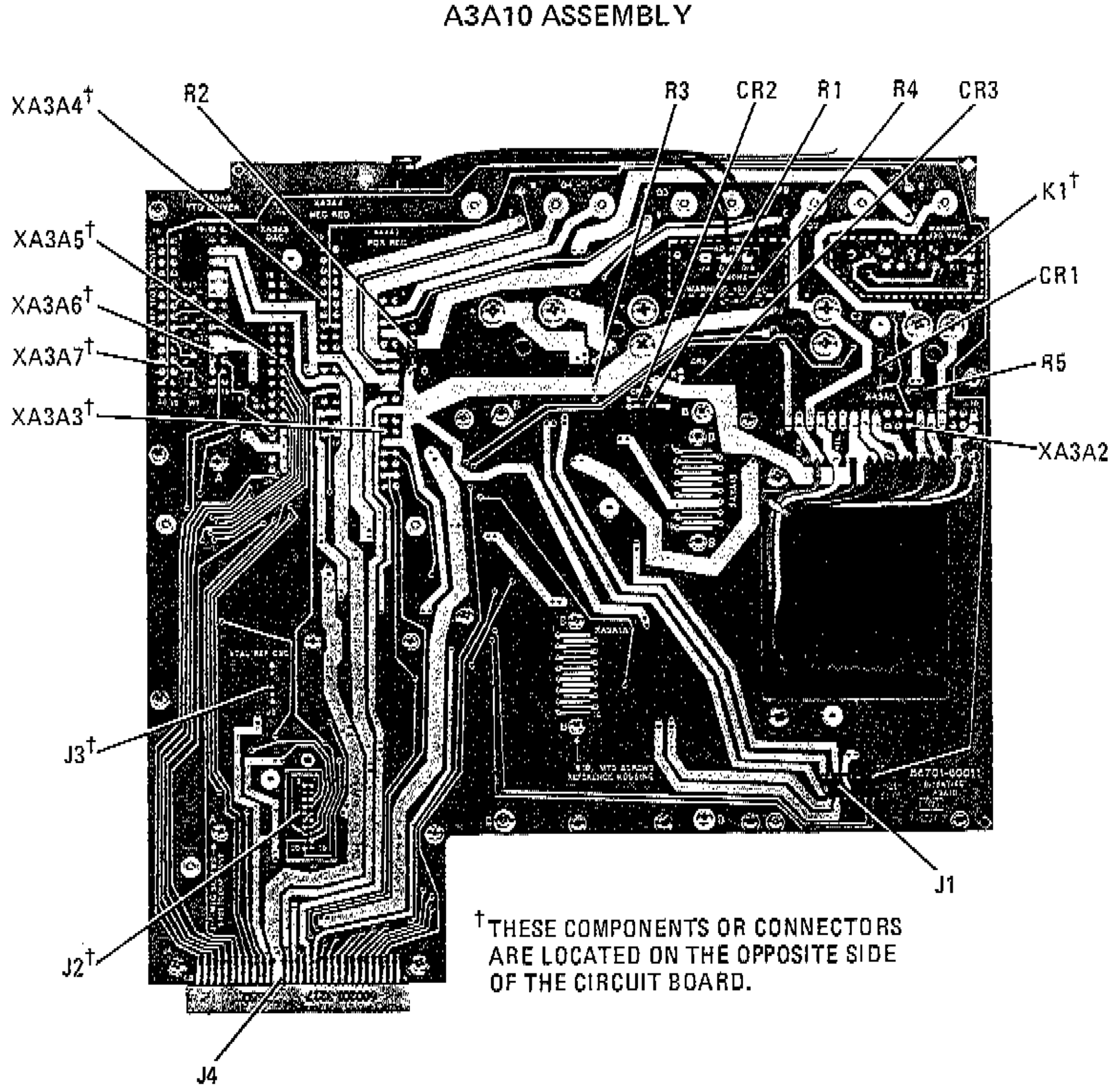

Figure 8-110. A3A10 RF Source Motherboard Component Locations

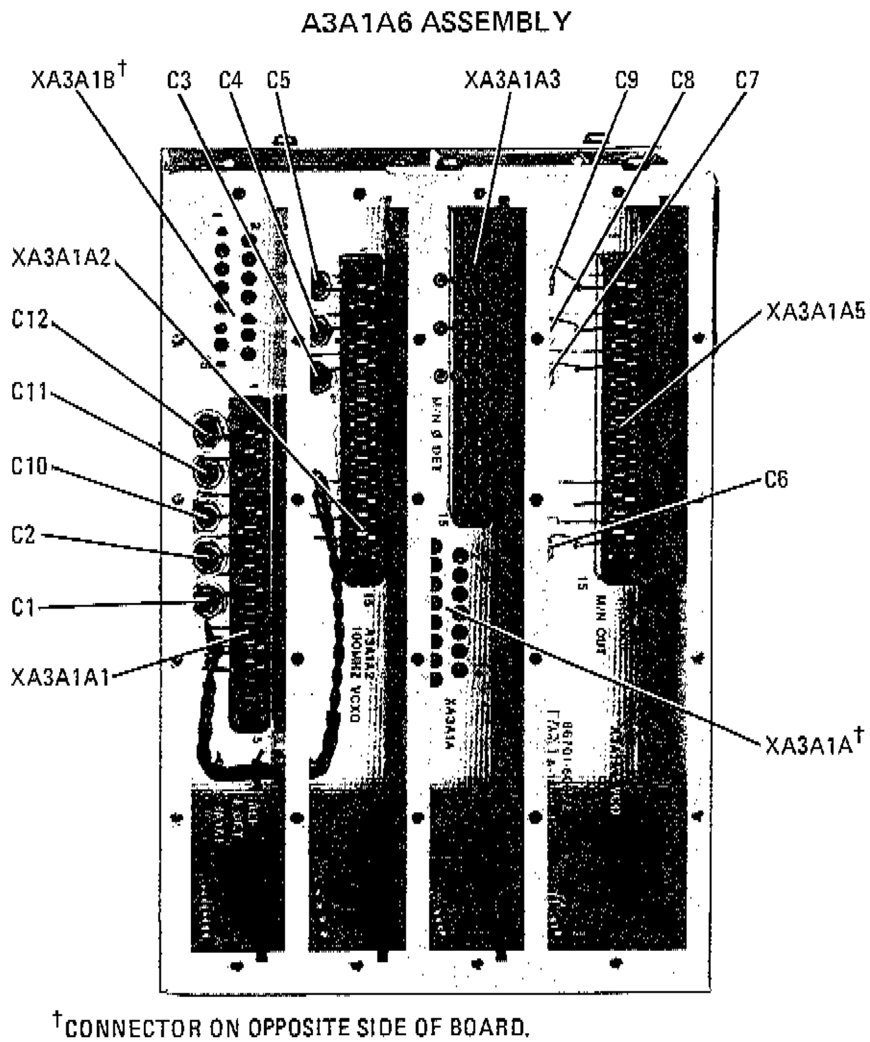

Figure 8-111. A3A1A6 Reference and M/N Motherboard Assembly Component and Connector Locations

8-93/8-94d

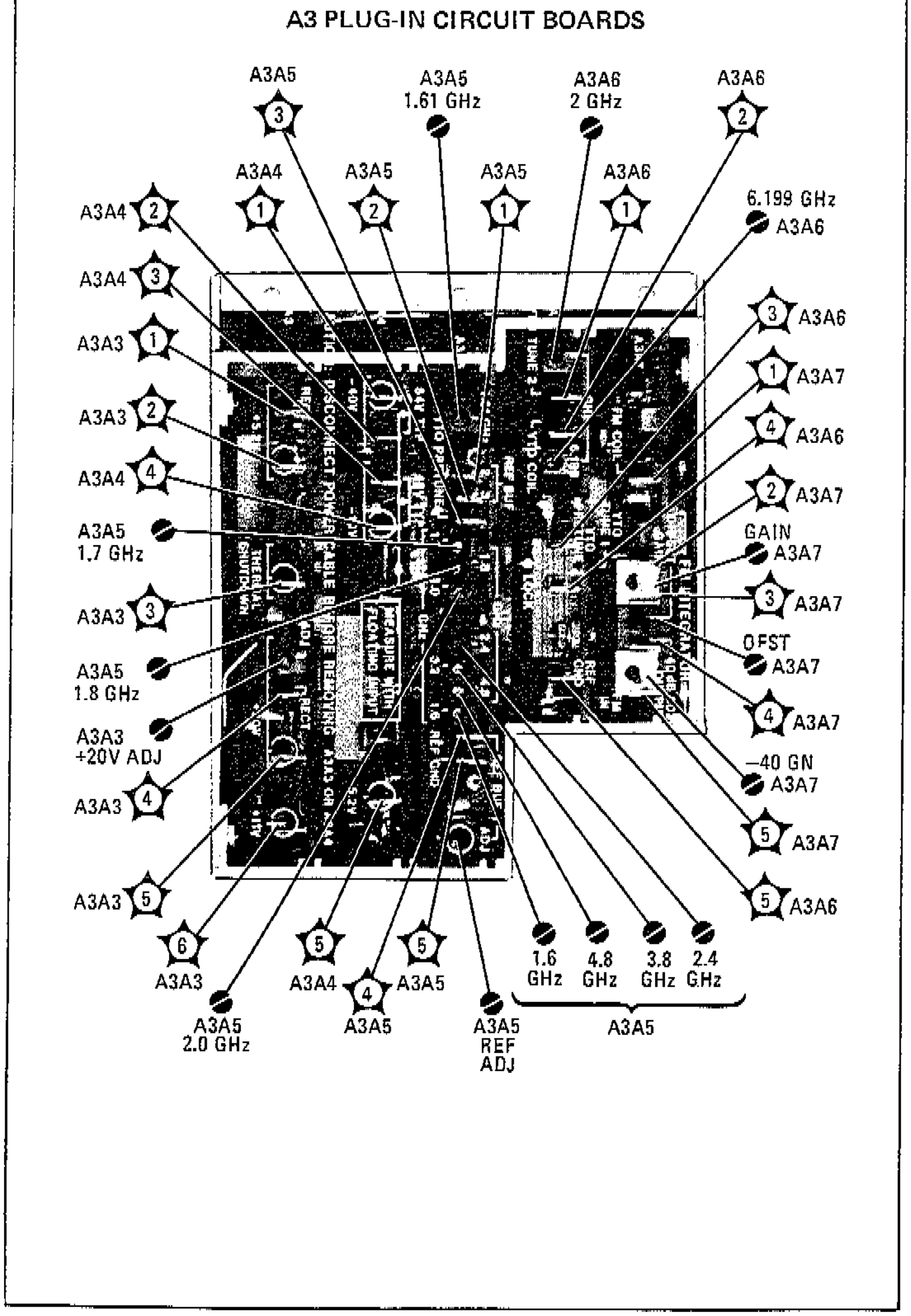

Figure 8-112. A3 Plug-in Circuit Board Adjustment and Test Point Locations

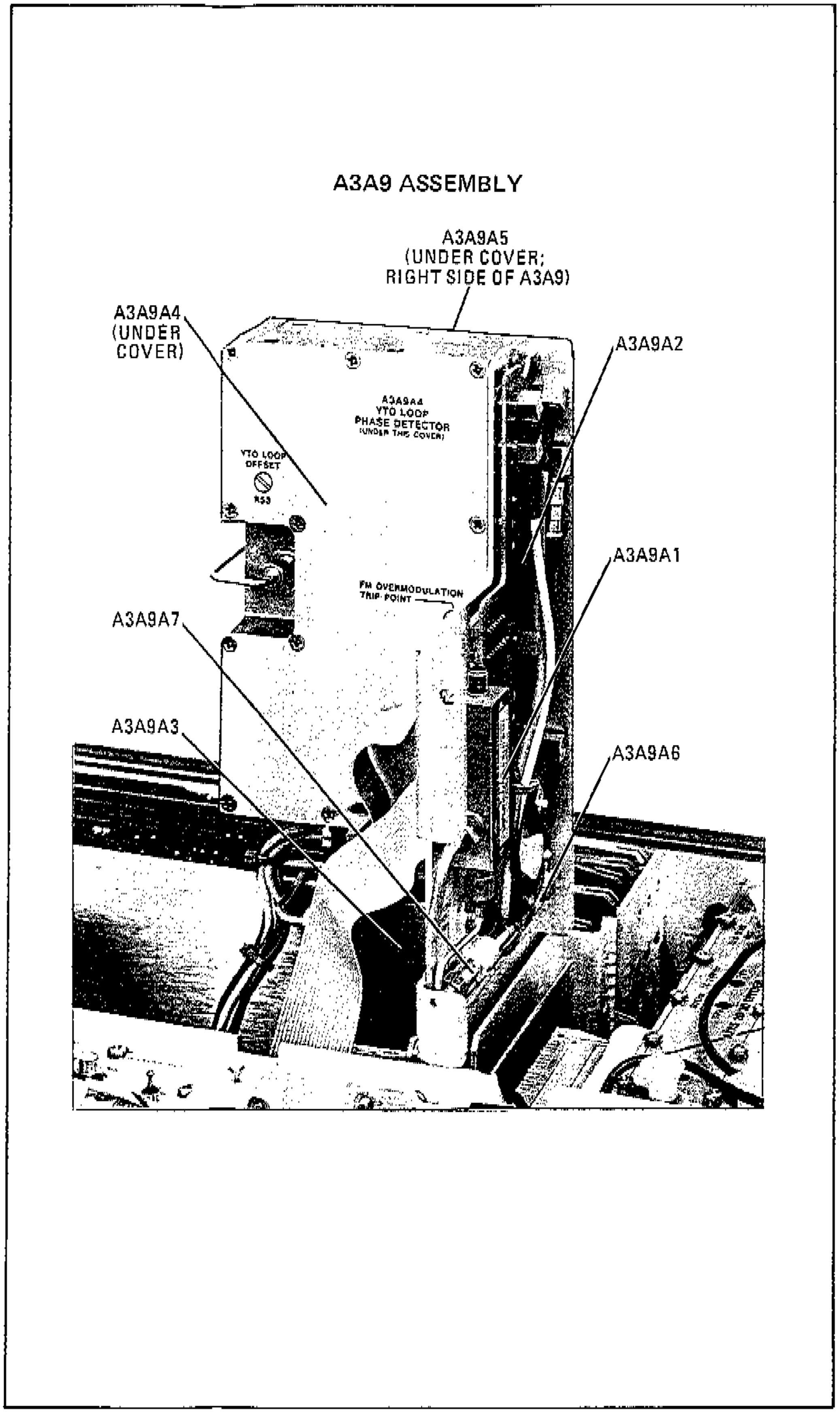

Figure 8-113. A3A9 Assembly Locations

8-95/8-96a

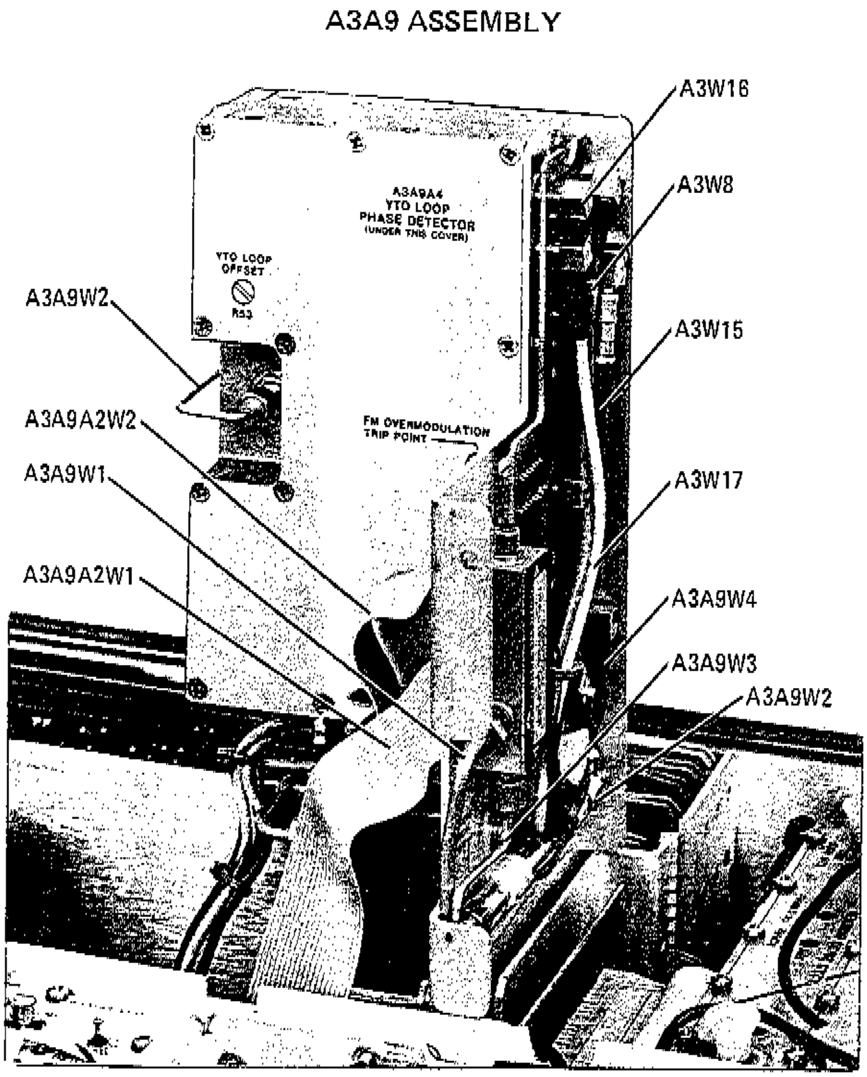

Figure 8-114. A3A9 Cable Connections

8-95/8-96b

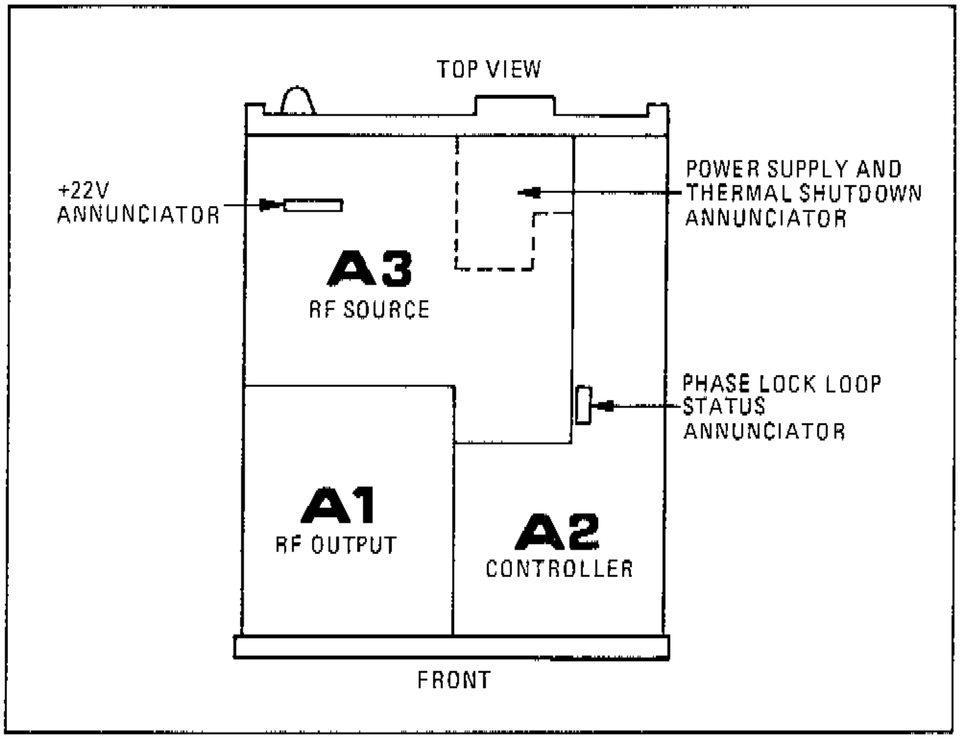

Figure 8-115. Major Assembly Locations

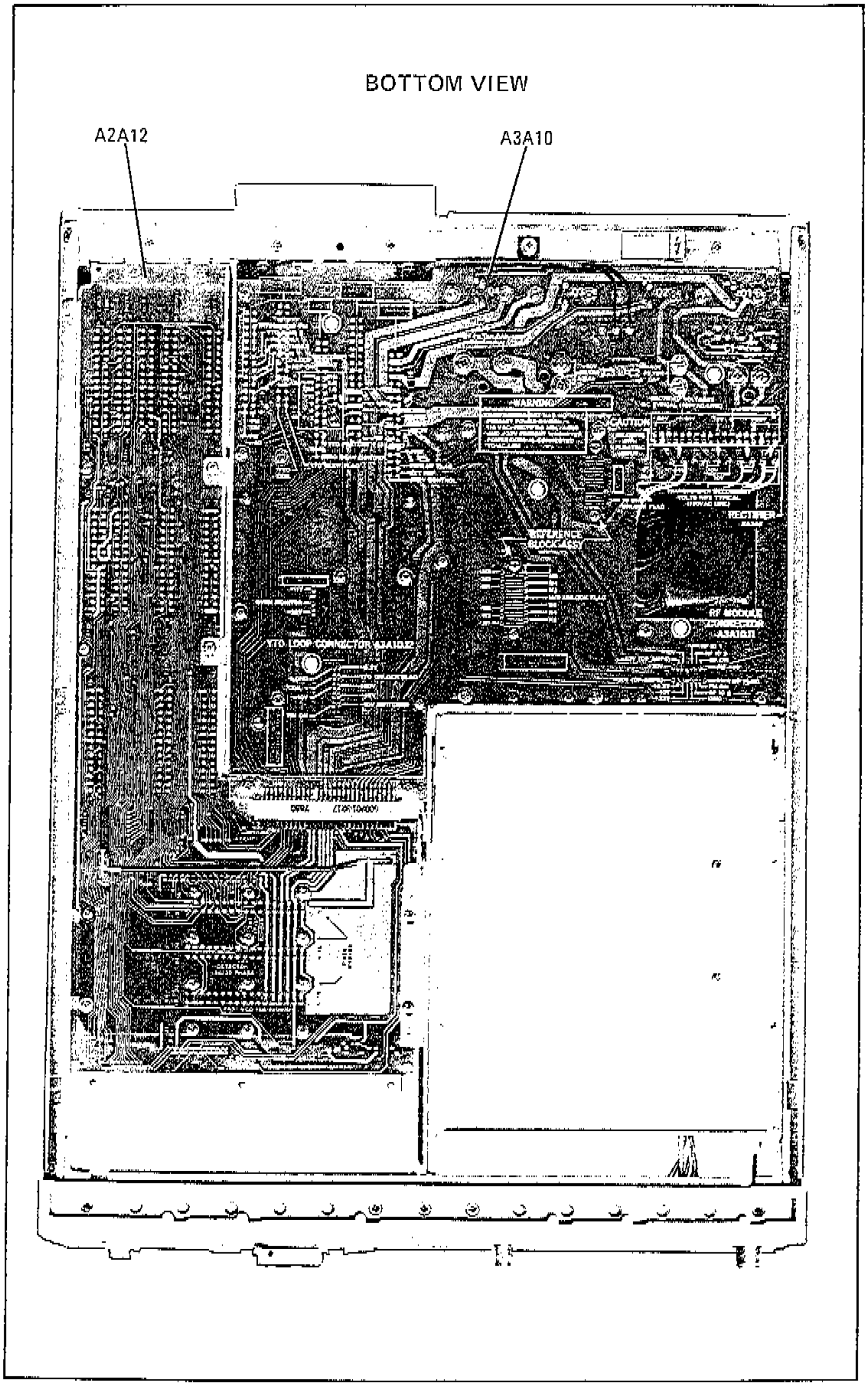

Figure 8-116. Bottom View Assembly Locations

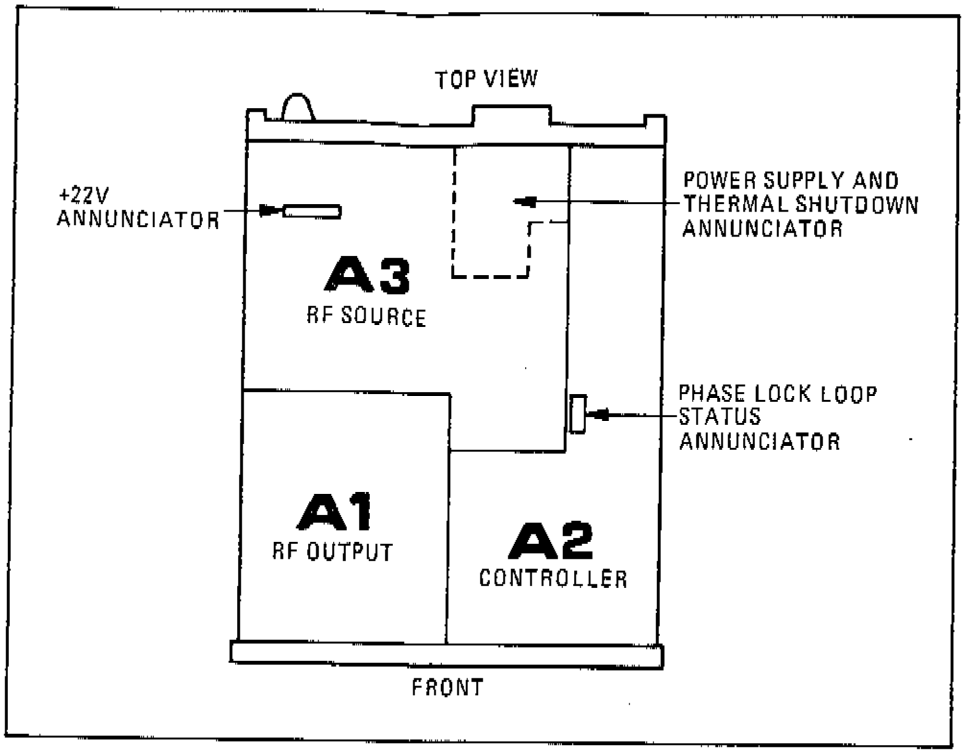

Figure 8-117. Major Assembly Locations

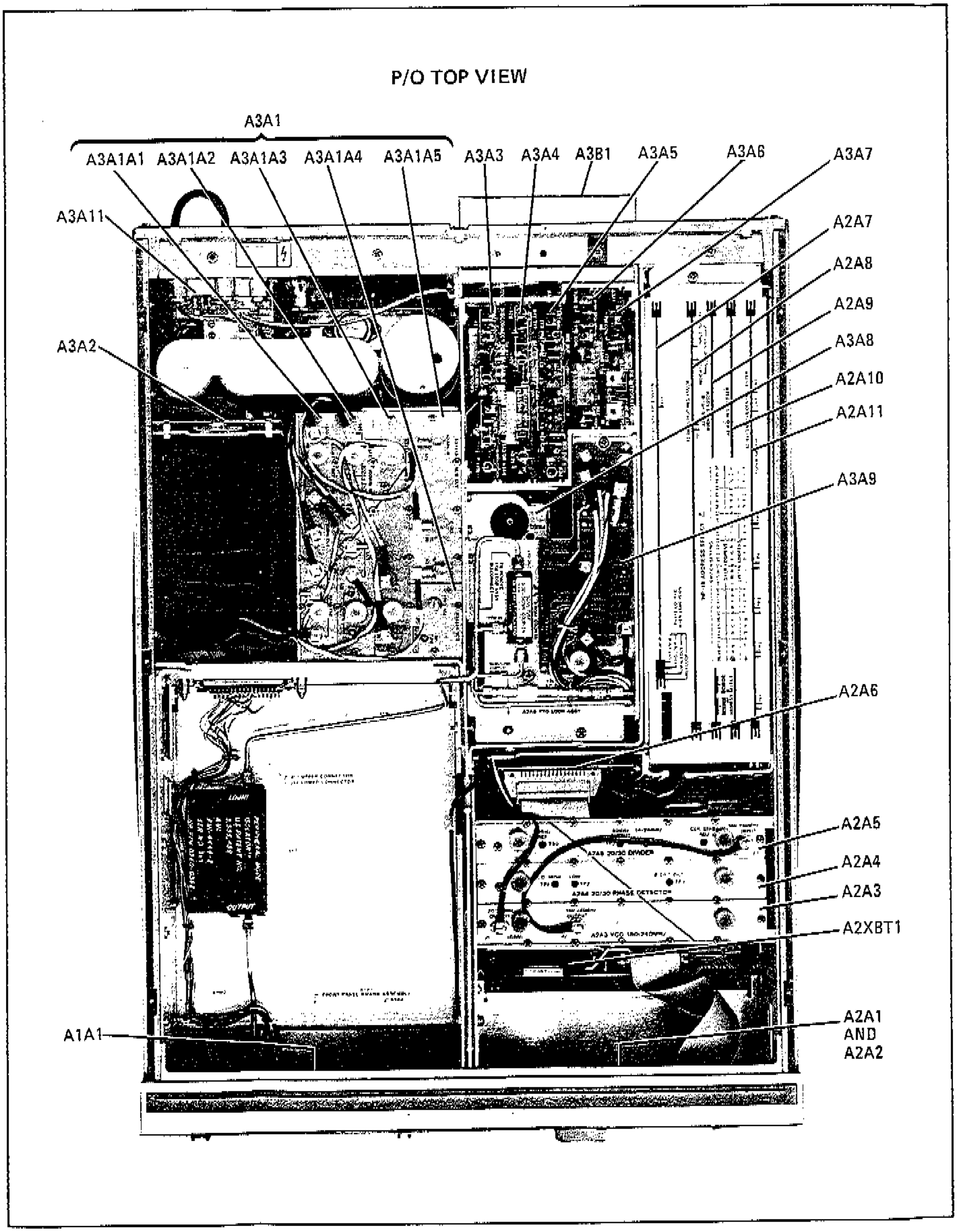

Figure 8-118. Top View Assembly Locations

8-97/8-98b

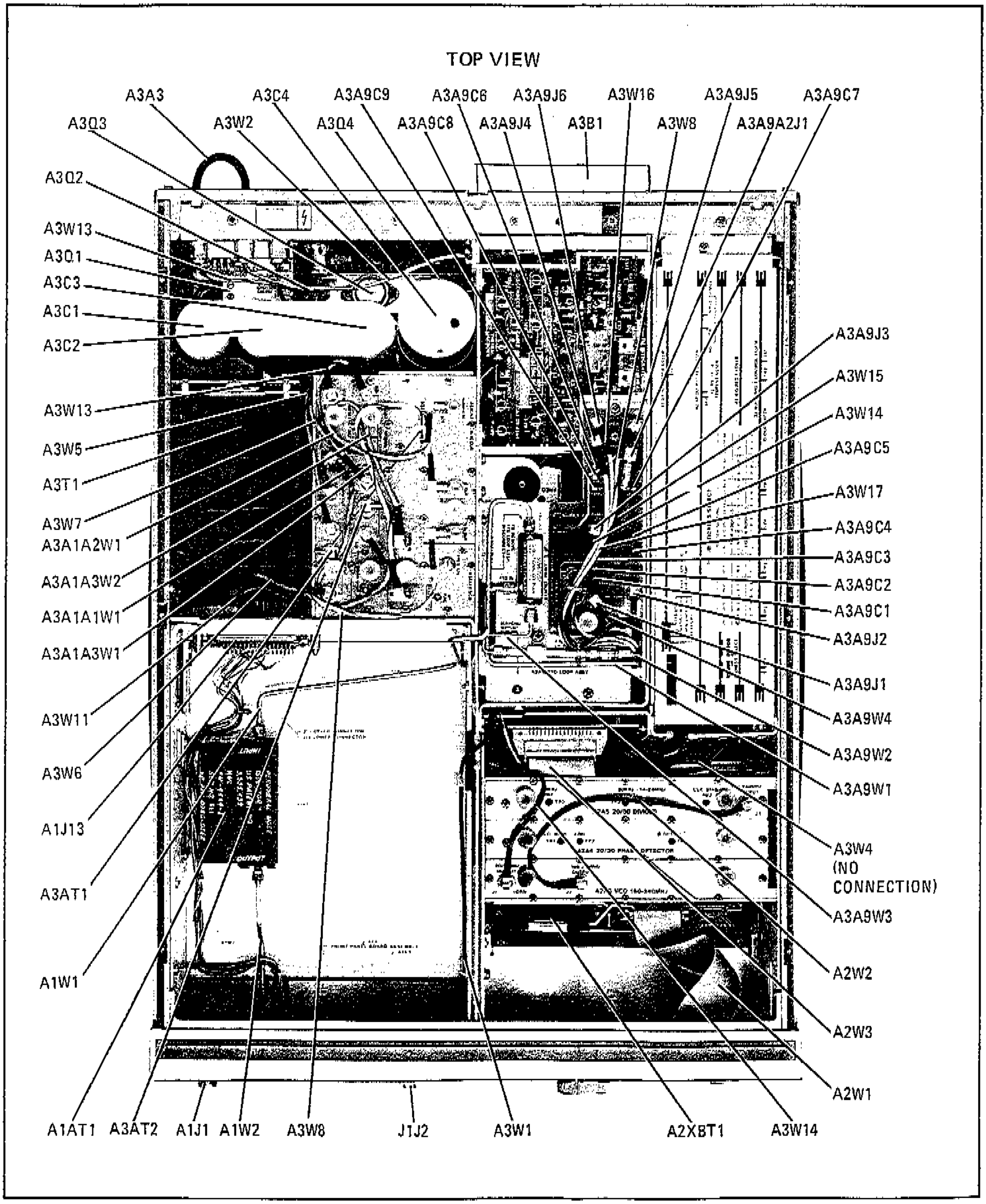

Figure 8-119. Top View Chassis Mounted Parts and Assembly Locations

8-97/8-98a

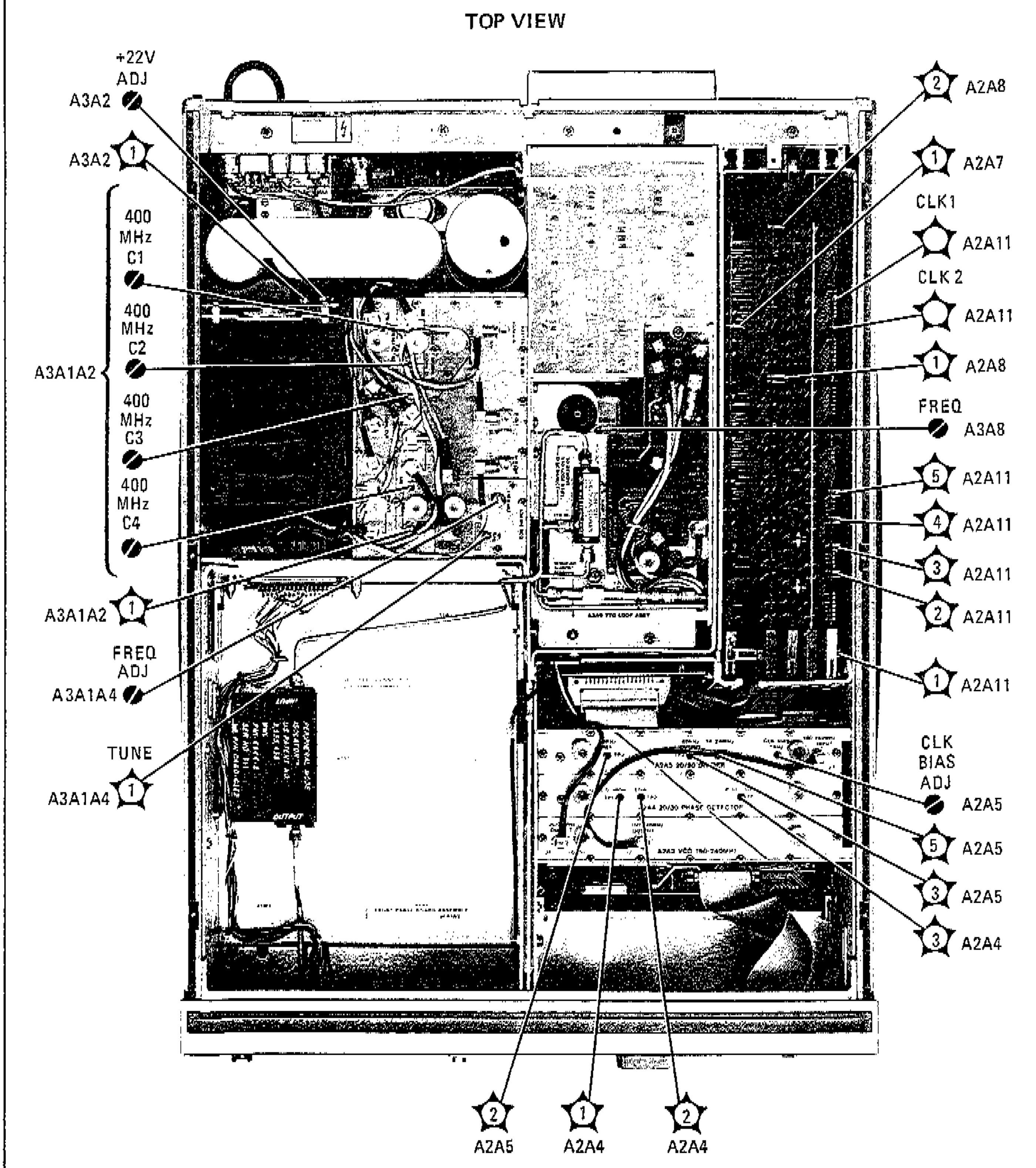

Figure 8-120. Top View A2 and A3 Assemblies Adjustments and Test Point Locations