Hewlett-Packard to Agilent Technologies Transition

This documentation supports a product that previously shipped under the Hewlett-Packard company brand name. The brand name has now been changed to Agilent Technologies. The two products are functionally identical, only our name has changed. The document still includes references to Hewlett-Packard products, some of which have been transitioned to Agilent Technologies.

Transition de Hewlett-Packard vers Agilent Technologies

La présente documentation se réfère à un produit qui était auparavant livré sous la marque Hewlett-Packard. Cette marque a été remplacée par Agilent Technologies. D'un point de vue fonctionnel, les deux produits sont identiques et seuls leurs noms les différencient. La documentation comprend toujours des références aux produits Hewlett-Packard, même si certains possèdent déjà l'appelation Agilent Technologies.

Umbenennung Hewlett-Packard in Agilent Technologies

Diese Dokumentation gehört zu einem Produkt, das früher unter dem Markennamen Hewlett-Packard ausgeliefert wurde. Der Markenname lautet in der Zwischenzeit Agilent Technologies. Die Funktionalität der beiden Produkte ist identisch, nur der Name hat sich geändert. Im Dokument wird zum Teil immer noch auf Hewlett-Packard verwiesen. An anderer Stelle wurde die Marke in Agilent Technologies umbenannt.

Hewlett-Packard e la transizione ad Agilent Technologies

La presente documentazione è fornita a supporto di un prodotto che in precedenza veniva commercializzato con il marchio Hewlett-Packard. Tale marchio è stato traformato in Agilent Technologies. I due prodotti sono identici dal punto di vista funzionale; il cambiamento ha riguardato soltanto il nome della società. Nella documentazione sono ancora presenti riferimenti ai prodotti Hewlett-Packard, alcuni dei quali tuttavia sono passati sotto il marchio Agilent Technologies.

Transición de Hewlett-Packard a Agilent Technologies

Esta documentación proporciona información técnica sobre un producto que anteriormente se distribuía bajo el nombre de marca de la compañía Hewlett-Packard. Dicho nombre de marca ha cambiado ahora a Agilent Technologies. Los dos productos son funcionalmente idénticos, sólo ha cambiado nuestro nombre. Este documento aún incluye referencias a productos de Hewlett-Packard, algunos de los cuales han pasado a Agilent Technologies.

Agilent Technologies

08901-90136

Printed in USA March 2000

Изменение торговой марки Hewlett–Packard на Agilent Technologies

Эта документация относится к продукту, который ранее поставлялся под торговой маркой Hewlett–Packard. Теперь торговая марка изменена на Agilent Technologies, при этом функциональные возможности продукта не изменились. В документе могут встречаться ссылки на продукты Hewlett–Packard, однако некоторые из них теперь являются продуктами Agilent Technologies.

Hewlett–Packard가 Agilent Technologies로 변경되었습니다.

본 설명서의 내용은 Hewlett–Packard 회사 이름으로 출시된 기존의 제품에도 적용됩니다. 상표명이 Agilent Technologies로 변경되었습니다. 제품명만 변경된 것일뿐 기능적인 면에서는 이전과 동일합니다. 설명서에는 Hewlett–Packard 제품에 적용되는 참조사항이 포함되어 있으며, 일부 제품명은 Agilent Technologies로 변경되어 있습니다.

Hewlett-PackardからAgilent Technologiesへの移行

この文書は、以前にHewlett-Packardの商標名で出荷された製品をサポートするものです。その商標名は現在、Agilent Technologiesに変更されています。2つの商標の製品は機能的に同じですが、当社の商標のみが変更されました。この文書にはHewlett-Packard製品に関する参照事項がまだ含まれていますが、その一部はAgilent Technologiesに移行されています。

关于惠普公司更名为安捷伦科技公司的事宜

此文档支持先前以惠普公司 (Hewlett-Packard) 商标名称交付的产品。此商标名称现已更名为安捷伦科技公司 (Agilent Technologies)。两个商标名称的产品在功能上完全相同，只是更改了名称。文档中仍然会提到惠普产品，但其中一些产品名称已改为安捷伦科技公司。

關於惠普公司更名爲安捷倫科技事宜

本資料支持先前以惠普公司 (Hewlett-Packard) 品牌交付的產品，而該品牌現已改名爲安捷倫科技 (Agilent Technologies)。兩個品牌的產品功能相同，僅名稱更換而已。本資料仍含有惠普公司產品參數，但其中的一些產品名稱已改爲安捷倫科技。

HP 8901A
MODULATION ANALYZER
Service Manual

SERIAL NUMBERS

This manual provides complete information for instruments with serial-number prefixes:

1836A to 2916A and all major change that occur to your instrument.

rev.06NOV92

For additional important information about serial numbers, refer to "INSTRUMENTS COVERED BY THIS MANUAL" in section 1.

Fourth Edition

EAST 24001 MISSION AVENUE, TAF C-34, SPOKANE, WASHINGTON, U.S.A. 99220

Service Manual HP Part 08901-90136

Other Documents Available:
Operation and Calibration Manual HP Part 08901-90135
Microfiche Operation and Calibration Manual HP Part 08901-90137
Microfiche Service Manual HP Part 08901-90138

Printed in U.S.A. : March 1993

HEWLETT PACKARD

CERTIFICATION

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

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to the Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

SAFETY CONSIDERATIONS

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

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

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

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

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 (refer to Table of Contents.)

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.

WARNING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could resulting personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection).

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

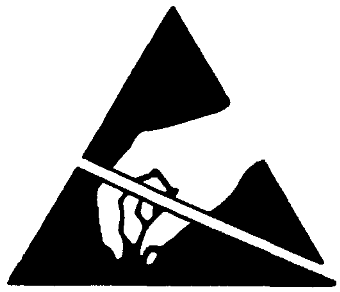
If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

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

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

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

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



ATTENTION
Static Sensitive Devices

This instrument was constructed in an ESD (electro-static discharge) protected environment. This is because most of the semi-conductor devices used in this instrument are susceptible to damage by static discharge.

Depending on the magnitude of the charge, device substrates can be punctured or destroyed by contact or mere proximity of a static charge. The results can cause degradation of device performance, early failure, or immediate destruction.

These charges are generated in numerous ways such as simple contact, separation of materials, and normal motions of persons working with static sensitive devices.

When handling or servicing equipment containing static sensitive devices, adequate precautions must be taken to prevent device damage or destruction.

Only those who are thoroughly familiar with industry accepted techniques for handling static sensitive devices should attempt to service circuitry with these devices.

In all instances, measures must be taken to prevent static charge build-up on work surfaces and persons handling the devices.

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Section 6
REPLACEABLE PARTS

6-1. INTRODUCTION TO THIS SECTION

This section contains information for ordering parts. Table 6-1 lists reference designations, and Table 6-2 lists abbreviations that are used in the Replaceable Parts List. Table 6-3 lists all replaceable parts in the instrument. Table 6-4 contains the names and addresses that correspond to the manufacturer's code numbers listed in Table 6-3. Also included in this section are photographs and drawings to aid in identifying and ordering chassis mounted parts and mechanical parts.

6-2. REFERENCE DESIGNATIONS AND ABBREVIATIONS USED IN THIS MANUAL

Table 6-1 lists the reference designation letters for electrical parts in the instrument. The letter designations found in Table 6-1 are coupled with numeric designations to provide a unique reference designation for each part in the instrument. For example A17R1 is the reference designation of a particular resistor R1 on assembly A17.

Table 6-2 lists abbreviations used in the parts list and on schematics.

6-3. MECHANICAL AND CHASSIS PART LOCATIONS AND REFERENCE DESIGNATIONS

Most mechanical parts are identified in Figures 6-1 to 6-5. These figures are located at the end of this section. Major mechanical parts have reference designations that begin with the letters MP. To find the part number and description of a mechanical part, find the part in one of the photographs or drawings, and then look up the reference designation in Table 6-3. Mechanical hardware not shown in the figures, such as screws, are listed under the part which they attach. For example, the screws that attach the fan (B1) to the rear panel are listed under B1.

6-4. RECOMMENDED SPARES LIST

Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has prepared a "Recommended Spares" list for this instrument. The contents of the list are based on failure reports and repair data. Quantities given are for one year of parts support. You can request a complimentary copy of the "Recommended Spares" list from your nearest Hewlett-Packard office.

When stocking parts to support more than one instrument or to support a variety of Hewlett-Packard instruments, it may be more economical to work from one consolidated list rather than simply adding together stocking quantities from the individual instrument lists. Hewlett-Packard will prepare consolidated "Recommended Spares" lists for any number or combination of instruments. Contact your nearest Hewlett-Packard office for details.

6-5. REPLACEABLE PARTS LIST

Table 6-3 is a list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components with reference designations in alphanumeric order.

b. Chassis-Mounted parts with reference designations in alphanumeric order.

c. Mechanical parts with reference designations in alphanumeric order.

Ordering Parts.

Instrument Serial Numbers.

Attached to the rear of the instrument is a serial-number plate. The first four digits and the letter are the instrument serial-number prefix. The last five digits (serial-number suffix) are unique to each instrument. When parts in the instrument are changed, the serial-number prefix of the instrument may also change. This means that sometimes a part will be listed more than once in the the replaceable parts list along with a serial-number prefix or range of serial-number prefixes. Find the serial-number prefix on the serial plate of your instrument and order the part listed under the corresponding prefix in the table. If no serial prefix information is listed, the part is compatible in instruments of all serial numbers.

NOTE

It is possible that some assemblies in your instrument have been updated (through service or retrofitting) to reflect changes made to instruments with serial-number prefixes later than that shown on your instrument serial-number tag. Be sure to note the board number of the assembly being repaired or replaced when ordering parts for your instrument.

How to Order

To order a part in the Replaceable Parts List, call or write the nearest Hewlett-Packard Sales Office. Have the following information ready to speed the ordering process:

1. The Hewlett-Packard part number with the check digit. (The check digit will ensure accurate and timely processing of your order.)
2. The quantity required.
3. An approved purchase order number. (Sometimes required.)

NOTE

Within the USA, it is better to order directly from the HP Support Materials Organization, Roseville, California. Ask your nearest HP office for information and forms for the "Direct Order System".

Replaceable Parts List Updating (Manual Updates)

A "MANUAL UPDATES" packet is shipped with the manual, when necessary, to provide the most current information available at the time of shipment. These packets consist of replacement and addition pages which should be incorporated into the manual to bring it up to date.

Hewlett-Packard offers a Documentation Update Service that will provide you with further updates as they become available. If you operate or service instruments of different serial prefixes, we strongly recommend that you join this service immediately to ensure that you manual is kept current. For more information, refer to the Documentation Update Service reply card included in this manal, or call: Learning Products Department (509) 921-4001,

or write:

Hewlett-Packard Company
Learning Products Department
24001 E. Mission – TAF C-34
Spokane, WA 99220

Table 6-1. Reference Designations

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; FET
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

Table 6-2. Abbreviations (1 of 2)

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
BECU	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	incandescent
INCL	include(s)
INP	input
INS	insulation
INT	internal
kg	kilogram
kHz	kilohertz
k	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)
LK WASH	lock washer
LO	low; local oscillator
LOG	logarithmic taper (used in parts list)
log	logarithm(ic)
LPF	low pass filter
LV	low voltage
m	meter (distance)
mA	milliampere
MAX	maximum
M	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	minute (time)
...′	minute (plane angle)
MINAT	miniature
mm	millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-2. 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
SS	Service Sheet
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
UNDEF	undefined
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-tune 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						
1933A to 2443A						
A1	08901-60034	8	1	KEYBOARD AND DISPLAY ASSEMBLY (EXCEPT OPTION 010)-DOES NOT INCL A1W1	28480	08901-60034
A1	08901-60001	9	1	KEYBOARD AND DISPLAY ASSEMBLY (OPT. 010 ONLY)- DOES NOT INCL A1W1	28480	08901-60001
2447A and above						
A1	08901-60275	9	1	KEYBOARD AND DISPLAY ASSEMBLY (EXCEPT OPTION 010)-DOES NOT INCL A1W1	28480	08901-60275
A1	08901-60261	3	1	KEYBOARD AND DISPLAY ASSEMBLY (OPT. 010 ONLY)- DOES NOT INCL A1W1	28480	08901-60261
A1C1	0180-0229	7	5	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
1933A to 2443A						
A1C2	0160-2055	9	71	CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
2447A and above						
A1C2	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C3	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C4	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C5	0160-2291	5	1	CAPACITOR-FXD .18UF +-10% 80VDC POLYE	19701	706D1MV184PK800AX
1933A to 2443A						
A1C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
2447A and above						
A1C6	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C7	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C8	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C9	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C10	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C11	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C12	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C13	0160-4832	4	3	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
1933A to 2443A						
A1C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A1C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
2447A and above						
A1C14-C24				NOT ASSIGNED		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A1CR1 Δ	1901-1098	1	4	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A1CR2 Δ	1901-1098	1	4	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A1CR3 Δ	1901-1098	1	4	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A1CR4 Δ	1901-1098	1	4	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A1DS1 Δ	1990-0547	0	33	LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS2 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS3 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS4 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
1933A to 2201A						
*A1DS5*Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
2212A and above						
A1DS5				NOT ASSIGNED		
A1DS6 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS7 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS8 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS9 Δ	1990-0547	0	24	LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS10 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS11 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS12 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS13 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS14 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS15 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS16 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS17 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS18 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS19 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS20 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS21 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS22 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS23 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS24 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS25 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS26 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS27 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS28 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS29 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS30 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS31 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS32 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS33 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1DS34 Δ	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684, SEL IV
A1J1	1251-5169	6	4	CONN-POST TYPE .156-PIN-SPCG 6-CONT	28480	1251-5169
	1251-4460	8	7	CLIP-CABLE PLUG RTNG-DUAL INLINE 16 CONT	06776	RC-74
A1J2	1200-0507	9	10	SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
	1251-4460	8		CLIP-CABLE PLUG RTNG-DUAL INLINE 16-CONT	06776	RC-74

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A1MP1	5041-0386	8	5	KEY CAP, FULL, DARK, LED	28480	5041-0386
A1MP2	5041-0386	8		KEY CAP, FULL, DARK, LED	28480	5041-0386
A1MP3	5041-0287	8	1	KEY CAP, FULL, GREY, LED	28480	5041-0287
A1MP4	5041-0319	7	7	KEY CAP, HALF, GREY, LED	28480	5041-0319
A1MP5	5041-0836	3	1	KEY CAP, "8"	28480	5041-0836
A1MP6	5041-0832	9	1	KEY CAP,"4"	28480	5041-0832
A1MP7	5041-0838	5	1	KEY CAP,"0"	28480	5041-0838
A1MP8	5041-0386	8		KEY CAP, FULL, DARK, LED	28480	5041-0386
A1MP9	5041-0319	7		KEY CAP, HALF, GREY, LED	28480	5041-0319
A1MP10	5041-0747	5	2	KEY CAP,FULL, ARROW	28480	5041-0747
A1MP11	5041-1671	6	1	KEY CAP, FULL, "MHZ"	28480	5041-1671
A1MP12	5041-0319	7		KEY CAP, HALF, GREY, LED	28480	5041-0319
A1MP13	5041-0837	4	1	KEY CAP, FULL,"9"	28480	5041-0837
A1MP14	5041-0833	0	1	KEY CAP, FULL,"5"	28480	5041-0833
A1MP15	5041-0829	4	1	KEY CAP,FULL,"1"	28480	5041-0829
A1MP16	5041-0386	8		KEY CAP, FULL, DARK, LED	28480	5041-0386
A1MP17	5041-0252	7	11	KEY CAP, QUARTER, LED	28480	5041-0252
A1MP18	5041-0839	6	1	KEY CAP, FULL, DECIMAL	28480	5041-0839
A1MP19	5041-0747	5		KEY CAP, FULL, ARROW	28480	5041-0747
A1MP20	5041-0319	7		KEY CAP, HALF, GREY, LED	28480	5041-0319
A1MP21	5041-0319	7		KEY CAP, HALF, GREY, LED	28480	5041-0319
A1MP22	5041-0834	1	1	KEY CAP, FULL, "6"	28480	5041-0834
A1MP23	5041-0830	7	1	KEY CAP, FULL, "2"	28480	5041-0830
A1MP24	5041-0386	8		KEY CAP, FULL, DARK, LED	28480	5041-0386
A1MP25	5041-0508	6	1	KEY CAP, HALF, GREEN	28480	5041-0508
A1MP26	5041-1672	7	1	KEY CAP, FULL,"CLEAR"	28480	5041-1672
A1MP27	5041-0319	7		KEY CAP, HALF, GREY, LED	28480	5041-0319
A1MP28	5041-0319	7		KEY CAP, HALF, GREY, LED	28480	5041-0319
A1MP29	5041-0835	2	1	KEY CAP, FULL, "7"	28480	5041-0835
A1MP30	5041-0831	8	1	KEY CAP, FULL,"3"	28480	5041-0831
A1MP31	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP32	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP33	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP34	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP35	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP36	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP37	5041-1665	8	1	KEY CAP, QUARTER, "LCL"	28480	5041-1665
A1MP38	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP39	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP40	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1MP41	5041-0252	7		KEY CAP, QUARTER, LED	28480	5041-0252
A1R1	1810-0208	0	2	NETWORK-RES 8-SIP 68.0K OHM X 7	C1433	750-81
A1R2	1810-0205	7	2	NETWORK-RES 8-SIP 4.7K OHM X 7	C1433	750-81
A1R3	1810-0205	7		NETWORK-RES 8-SIP 4.7K OHM X 7	C1433	750-81
A1R4	1810-0207	9	1	NETWORK-RES 8-SIP 22.0K OHM X 7	C1433	750-81
A1R5	0757-0199	3	14	RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A1R6				NOT ASSIGNED		
A1R7				NOT ASSIGNED		
A1R8	1810-0208	0		NETWORK-RES 8-SIP 68.0K OHM X 7	C1433	750-81
A1R9	0698-0082	7	23	RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A1R10	0698-3453	2	2	RESISTOR 196K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1963-F
A1R11	0757-0447	4	2	RESISTOR 16.2K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1622-F
A1R12	0698-3441	8	19	RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A1R13	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A1R14	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A1R15	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A1R16	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A1R17	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A1R18	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A1R19	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A1R20 △	1810-0229	5	5	NETWORK-RES 8-SIP 330 OHM X 7	28480	1810-0229
1933A to 2201A						
A1R21 △	0698-3445	2	3	RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
2212A and above						
A1R21				NOT ASSIGNED		
A1R22 △	1810-0229	5	5	NETWORK-RES 8-SIP 330 OHM X 7	28480	1810-0229
A1R23 △	1810-0229	5	5	NETWORK-RES 8-SIP 330 OHM X 7	28480	1810-0229
A1R24 △	0698-3445	2	3	RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
A1R25 △	0698-3445	2	3	RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
A1R26 △	1810-0229	5	5	NETWORK-RES 8-SIP 330 OHM X 7	28480	1810-0229
A1R27 △	1810-0229	5	5	NETWORK-RES 8-SIP 330 OHM X 7	28480	1810-0229
1933A to 2443A						
A1R28-R35				NOT ASSIGNED		
2447A and above						
A1R28	1810-0402	6	8	NETWORK-RES 16-DIP330.0 OHM X 8	28480	1810-0402
A1R29	1810-0402	6	8	NETWORK-RES 16-DIP330.0 OHM X 8	28480	1810-0402
A1R30	1810-0402	6	8	NETWORK-RES 16-DIP330.0 OHM X 8	28480	1810-0402
A1R31	1810-0402	6	8	NETWORK-RES 16-DIP330.0 OHM X 8	28480	1810-0402
A1R32	1810-0402	6	8	NETWORK-RES 16-DIP330.0 OHM X 8	28480	1810-0402
A1R33	1810-0402	6	8	NETWORK-RES 16-DIP330.0 OHM X 8	28480	1810-0402
A1R34	1810-0402	6	8	NETWORK-RES 16-DIP330.0 OHM X 8	28480	1810-0402
A1R35	1810-0402	6	8	NETWORK-RES 16-DIP330.0 OHM X 8	28480	1810-0402
A1S1	5060-9436	7	41	PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S2	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S3	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S4	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S5	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S6	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S7	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S8	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S9	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S10	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A1S11	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S12	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S13	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S14	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S15	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S16	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S17	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S18	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S19	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S20	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S21	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S22	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S23	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S24	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S25	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S26	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S27	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S28	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S29	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S30	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S31	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S32	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S33	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S34	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S35	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S36	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S37	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S38	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S39	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S40	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1S41	5060-9436	7		PUSHBUTTON SWITCH, PC MOUNT	28480	5060-9436
A1TP1	1251-0600	0	83	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A1TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A1TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A1TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A1TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
1933A to 2443A						
A1U1-U8	1990-0437	7	8	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7751
	1200-0803	8	8	SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2
2447A and above						
A1U1	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	1990-0574
	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2
A1U2	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	1990-0574
	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2
A1U3	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	1990-0574
	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2
A1U4	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	1990-0574
	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2
A1U5	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	1990-0574
	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2
A1U6	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	1990-0574
	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2
A1U7	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	1990-0574
	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2
A1U8	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	1990-0574
	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	06776	ICN-143-S2

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A1U9	1820-0839	4	2	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN74175N
A1U10	1820-1361	9	8	IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U11	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U12	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U13	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U14	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U15	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U16	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U17	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U18	1820-0839	4		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN74175N
A1U19	1820-1411	0	20	IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U20	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U21	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A1U22	1820-1198	0	10	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A1U23	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A1U24	1820-1216	3	13	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A1U25	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A1U26	1820-1199	1	7	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A1U27	1820-1287	8	2	IC BFR TTL LS NAND QUAD 2-INP	01295	SN74LS37N
A1U28	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A1U29	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U30	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U31	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U32	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U33	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U34	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U35	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U36	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A1U37	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A1U38	1820-1427	8	1	IC DCDR TTL LS 2-TO-4-LINE DUAL 2-INP	01295	SN74LS156N
A1U39	1826-0412	1	2	IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
	8150-0447	6		WIRE 24AWG BK 300V PVC 7X32 80C	28480	8150-0447
	0362-0227	1	2	CONNECTOR-SGL CONT SKT 1.14-MM-BSC-SZ	27264	02-05-5216
1933A to 2443A						
A1U40-U48				NOT ASSIGNED		
2447A and above						
A1U40	08901-80074	8	1	PROGRAMMED ROM	28480	08901-80074
A1U41	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74LS574N
A1U42	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74LS574N
A1U43	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74LS574N
A1U44	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74LS574N
A1U45	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74LS574N
A1U46	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74LS574N
A1U47	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74LS574N
A1U48	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74LS574N

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A2						
A2	08901-60008	6	1	AUDIO FILTER ASSEMBLY	28480	08901-60008
A2C1	0180-1746	5	23	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2C2	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2C3	0160-4650	4	2	CAPACITOR-FXD 1380PF +-1% 500VDC MICA	28480	0160-4650
A2C4	0160-4650	4		CAPACITOR-FXD 1380PF +-1% 500VDC MICA	28480	0160-4650
A2C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A2C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A2C7	0160-4648	0	2	CAPACITOR-FXD 1650PF +-1% 500VDC MICA	28480	0160-4648
A2C8	0160-4648	0		CAPACITOR-FXD 1650PF +-1% 500VDC MICA	28480	0160-4648
A2C9	0160-0134	1	4	CAPACITOR-FXD 220PF +-5% 300VDC MICA	28480	0160-0134
A2C10	0160-4649	1	1	CAPACITOR-FXD 214PF +-1% 500VDC MICA	28480	0160-4649
A2C12	0140-0200	0	1	CAPACITOR-FXD 390PF +-5% 300VDC MICA	28480	0140-0200
A2C13	0180-2206	4	10	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A2C14△	0160-3539	6	1	CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-3539
A2C15	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A2C16	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A2C17	0140-0194	1	1	CAPACITOR-FXD 110PF +-5% 300VDC MICA	28480	0140-0194
A2C18				NOT ASSIGNED		
A2C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A2C20	0180-2141	6	2	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A2C21	0160-4084	8	37	CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A2C22				NOT ASSIGNED		
A2C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A2C24				NOT ASSIGNED		
A2C25	0180-1714	7	1	CAPACITOR-FXD 330UF+-10% 6VDC TA	56289	150D337X9006S2
A2C26	0160-4849	3	1	CAPACITOR-FXD 9100PF +-1% 100VDC	84411	HEW-517
A2C27	0160-2302	9	3	CAPACITOR-FXD 4000PF +-1% 100VDC MICA	28480	0160-2302
A2C28				NOT ASSIGNED		
A2C29△	0160-6606	4	1	CAP-FXD 0.02UF +-1% POLY-MET	28480	0160-6606
A2C30	0140-0154	3	1	CAPACITOR-FXD 1300PF +-5% 500VDC MICA	28480	0140-0154
A2C31	0160-4759	4	1	CAPACITOR-FXD 6800PF +-1% 200VDC	84411	HEW-592
1933A to 1935A						
A2C32	0160-0945	2	1	CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0160-0945
A2C33	0160-3539	6	2	CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-3539
2009A and above						
A2C32	0160-3538	5	1	CAPACITOR-FXD 750PF +-5% 100VDC MICA	28480	0160-3538
A2C33	0160-3536	3	1	CAPACITOR-FXD 620PF +-5% 100VDC MICA	28480	0160-3536
A2C34	0140-0198	5	4	CAPACITOR-FXD 200PF +-5% 300VDC MICA	28480	0140-0198
A2C35				NOT ASSIGNED		
A2C36	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A2C37	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A2C38△	0160-3068	6	1	CAPACITOR-FXD 1500PF +-5% 300VDC MICA	28480	0160-3068
A2CR1	1901-0040	1	38	DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A2J1	1250-1220	0	26	CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4	32	WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9	32	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A2J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A2L1	9140-0137	1	6	INDUCTOR RF-CH-MLD 1MH +-5%	91637	IM6-1000uH 5%
A2L2	9140-0137	1		INDUCTOR RF-CH-MLD 1MH +-5%	91637	IM6-1000uH 5%
A2L3	9140-0293	0	2	INDUCTOR RF-CH-MLD 906UH +-2%	24226	19M903G-1
A2L4	9140-0293	0		INDUCTOR RF-CH-MLD 906UH +-2%	24226	19M903G-1
A2L5△	9100-1653	4	1	INDUCTOR RF-CH-MLD 910UH +-5%	24226	19M913J
A2L6	9140-0291	8	1	INDUCTOR RF-CH-MLD 824UH +-2%	32159	6-02739
A2L7	9100-1645	4	1	INDUCTOR RF-CH-MLD 390UH +-5%	91637	IM-6 390UH 5%
A2L8	9140-0292	9	1	INDUCTOR RF-CH-MLD 375UH +-2%	24226	19M373G-1
A2L9	9140-0280	5	1	INDUCTOR 13MH +-2% .25D-INX.7LG-IN	06560	10247-4G
1933A to 1935A						
A2L10	9100-1654	5	1	INDUCTOR RF-CH-MLD 1.1MH +-5%	32159	911000M-5%
2009A and above						
A2L10	9100-1660	3	1	INDUCTOR RF-CH-MLD 2 MH +-5% .2DX.57LG.	28480	9100-1660
A2L11	9140-0281	6	1	INDUCTOR 16MH +-2% .25D-INX.7LG-IN	28480	9140-0281
1933A to 1935A						
A2L12	9140-0137	1		INDUCTOR RF-CH-MLD 1MH +-5%	91637	IM6-1000uH 5%
A2L13	9140-0137	1		INDUCTOR RF-CH-MLD 1MH +-5%	91637	IM6-1000uH 5%
A2L14	9100-1650	1	1	INDUCTOR RF-CH-MLD 680UH +-5%	91637	IM-6 680UH 5%
2009A and above						
A2L12	9100-1654	5	1	INDUCTOR RF-CH-MLD 1.1MH +-5%	32159	911000M-5%
A2L13	9100-1651	2		INDUCTOR RF-CH-MLD 750 UH +-5% .2DX.57LG.	28480	9100-1651
A2L14	9100-1648	7		INDUCTOR RF-CH-MLD 560 UH +-5% .2DX.45LG.	28480	9100-1648
A2MP1	08901-00022	8	1	COVER, AUDIO FILTER (INCLUDES EXTRACTOR)	28480	08901-00022
	2360-0113	2	28	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2MP2	08901-00014	8	1	DIVIDER, ENCLOSED SHIELD	28480	08901-00014
A2MP3	08901-00015	9	1	COVER, ENCLOSED SHIELD	28480	08901-00015
A2MP4	08901-00050	2	1	SPACER, #1 (FOR L2, 3, 5)	28480	08901-00050
A2MP5	08901-00051	3	1	SPACER, #2 (FOR L4, 6, 8)	28480	08901-00051
A2MP6	08901-00052	4	1	SPACER, #3 (FOR L10, 12-14)	28480	08901-00052
A2MP7	08901-00053	5	1	SPACER, #4 (FOR L9, 11)	28480	08901-00053
A2MP8	5021-0817	8	6	P.C. BOARD EXTRACTOR	28480	5021-0817

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A2Q1△	1854-0830	6	1	TRANSISTOR-DUAL NPN PD=500MW X-ND LM394-05	28480	1854-0830
A2Q2	1854-0071	7	29	TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2Q3	1853-0007	7	24	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A2Q4	1854-0477	7	16	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q5	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A2Q6	1853-0012	4	5	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	04713	2N2904A
A2Q7	1854-0013	7	6	TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	07263	2N2218A
1933A to 2421A						
A2R1	0757-0442	9	50	RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A2R2	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
2426A and above						
A2R1	0757-0290	5		RESISTOR 6.19K +-1% .125W F TC=0+-100	19701	MF4 C1/8-TO-6191-F
A2R2	0757-0290	5		RESISTOR 6.19K +-1% .125W F TC=0+-100	19701	MF4 C1/8-TO-6191-F
A2R3	0699-0140	0	2	RESISTOR 524 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A2R4	0699-0139	7	2	RESISTOR 660 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A2R5	0698-8556	6	2	RESISTOR 1.62K +-0.1% .125W TF TC=0+-10	09464	PR1/8
1933A to 2051A						
A2R6	2100-0552	3	4	RESISTOR-TRMR 50 10% TKF SIDE-ADJ 1-TRN	28480	2100-0552
2052A AND ABOVE						
A2R6	2100-3052	4	1	RESISTOR-TRMR 50 10% C SIDE-ADJ 17-TRN	28480	2100-3052
A2R7	0699-0140	0		RESISTOR 524 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A2R8	0699-0144	4	3	RESISTOR 10K +-0.01% .1W TF TC=0+-5	09464	PR1/10
A2R9	0699-0145	5	4	RESISTOR 1.1174K +-0.01% .1W TF TC=0+-5	09464	PR1/10
A2R10	0698-3451	0	2	RESISTOR 133K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1333-F
A2R11	0698-7219	6	4	RESISTOR 196 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-196R-F
A2R12	0698-7244	7	4	RESISTOR 2.15K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-2151-F
A2R13	0698-7244	7		RESISTOR 2.15K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-2151-F
A2R14	0698-7244	7		RESISTOR 2.15K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-2151-F
A2R15	0698-7244	7		RESISTOR 2.15K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-2151-F
A2R16	0698-3457	6	1	RESISTOR 316K +-1% .125W TF TC=0+-100	12498	CT4
A2R17	0698-7260	7	19	RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A2R18				NOT ASSIGNED		
A2R19	0698-8823	0	1	RESISTOR 8.25 +-1% .125W TF TC=0+-100	12498	L04D
A2R20	0698-3451	0		RESISTOR 133K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1333-F
A2R21				NOT ASSIGNED		
A2R22	0698-6414	1	2	RESISTOR 1K +-0.1% .1W TF TC=0+-5	09464	PR1/10
A2R23	0699-0176	2	1	RESISTOR 415 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A2R24	0698-3444	1	6	RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A2R25				NOT ASSIGNED		
A2R26	0757-0280	3	74	RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A2R27	0698-8475	8	3	RESISTOR 1.799K +-0.1% .1W TF TC=0+-5	09464	PR1/10
A2R28	0698-3430	5	9	RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A2R29	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A2R30	0698-8556	6		RESISTOR 1.62K +-0.1% .125W TF TC=0+-10	09464	PR1/8

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A2R31	0699-0161	5	1	RESISTOR 580 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A2R32	0699-0143	3	2	RESISTOR 825 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A2R33	0757-0394	0	13	RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A2R34	0757-0180	2	1	RESISTOR 31.6 +-1% .125W TF TC=0+-100	D8439	MK2
A2R35	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A2R36	0698-8475	8		RESISTOR 1.799K +-0.1% .1W TF TC=0+-5	09464	PR1/10
A2R37	0699-0144	4		RESISTOR 10K +-0.01% .1W TF TC=0+-5	09464	PR1/10
A2R38	0699-0145	5		RESISTOR 1.1174K +-0.01% .1W TF TC=0+-5	09464	PR1/10
A2R39	0757-0400	9	4	RESISTOR 90.9 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-90R9-F
A2R40	2100-0552	3		RESISTOR-TRMR 50 10% TKF SIDE-ADJ 1-TRN	28480	2100-0552
A2R41	0699-0159	1	1	RESISTOR 860 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A2R42	0698-8475	8		RESISTOR 1.799K +-0.1% .1W TF TC=0+-5	09464	PR1/10
A2R43	0698-3434	9	2	RESISTOR 34.8 +-1% .125W TF TC=0+-100	D8439	MK2
A2R44	2100-0552	3		RESISTOR-TRMR 50 10% TKF SIDE-ADJ 1-TRN	28480	2100-0552
A2R45	0699-0160	4	1	RESISTOR 940 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A2R46	0698-3136	8	3	RESISTOR 17.8K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1782-F
A2R47	0698-3243	8	2	RESISTOR 178K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1783-F
A2R48	0698-6414	1		RESISTOR 1K +-0.1% .1W TF TC=0+-5	09464	PR1/10
A2R49	0699-0144	4		RESISTOR 10K +-0.01% .1W TF TC=0+-5	09464	PR1/10
A2R50	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
1933A to 2629A						
A2R51	0757-0399	5	2	RESISTOR 82.5 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-82R5-F
2705A and above						
A2R51	0757-0401	0	1	RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-100R-F
A2RT1	0837-0027	6	2	THERMISTOR DISC 30-OHM TC=-3.9%/C-DEG	83186	13E30
A2RT2	0839-0011	2	1	THERMISTOR DISC 100-OHM TC=-3.8%/C-DEG	83186	21E23
A2RT3	0837-0027	6		THERMISTOR DISC 30-OHM TC=-3.9%/C-DEG	83186	13E30
A2TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A2TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A2TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A2TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A2U1	1826-0582	6	7	ANALOG SWITCH 4 SPST 16 -CBRZ/SDR	27014	LF13201D
A2U2	1826-0582	6		ANALOG SWITCH 4 SPST 16 -CBRZ/SDR	27014	LF13201D
A2U3	1826-0413	2	5	IC OP AMP LOW-BIAS-H-IMPD 8-TO-99 PKG	34371	HA2-2605-5
A2U4	1826-0582	6		ANALOG SWITCH 4 SPST 16 -CBRZ/SDR	27014	LF13201D
A2U5	1826-0109	3	1	IC OP AMP WB 8-TO-99 PKG	34371	HA2-2625-5 (SELECTED)
A2W1	08901-20096	8	1	CABLE, SEMI RIGID (AM INPUT)	28480	08901-20096
A2W2	08901-20095	7	1	CABLE, SEMI RIGID (FM INPUT)	28480	08901-20095

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3						
A3	08901-60009	7	1	AUDIO DE-EMPHASIS AND OUTPUT ASSEMBLY	28480	08901-60009
A3C1	0180-0058	0	7	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C2	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
1933A to 2251A						
A3C3	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
2302A and above						
A3C3	0180-2929	8	6	CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
1933A to 2505A						
A3C4	0160-3858	2	2	CAPACITOR-FXD .039UF +-2% 200VDC	84411	HEW-249
2518A and above						
A3C4	0160-5340	1	2	CAPACITOR-FXD .03UF +-1% 200VDC	28480	0160-5340
A3C5	0160-4613	9	2	CAPACITOR-FXD .1UF +-1% 50VDC POLYSTY	27735	PSO
1933A to 2505A						
A3C6	0160-3858	2		CAPACITOR-FXD .039UF +-2% 200VDC	84411	HEW-249
2518A and above						
A3C6	0160-5340	1	2	CAPACITOR-FXD .03UF +-1% 200VDC	28480	0160-5340
A3C7	0160-4613	9		CAPACITOR-FXD .1UF +-1% 50VDC POLYSTY	27735	PSO
A3C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A3C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A3C10	0160-3879	7	71	CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A3C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A3C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C22	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C24Δ	0160-6606	4	1	CAP-FXD 0.02UF +-1% POLY-MET	28480	0160-6606
A3C25	0160-4317	0	1	CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-4317
A3C26	0140-0213	5	2	CAPACITOR-FXD 2000PF +-1% 300VDC MICA	28480	0140-0213
A3C27	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C28	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C29	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C30	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3C31	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C32	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C33	0140-0213	5		CAPACITOR-FXD 2000PF +-1% 300VDC MICA	28480	0140-0213
A3C24△	0160-6606	4	1	CAP-FXD 0.02UF +-1% POLY-MET	28480	0160-6606
A3C35				NOT ASSIGNED		
A3C36	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	28480	0140-0196
A3C37	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A3C38				NOT ASSIGNED		
A3C39	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C40	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C41	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C42	0160-2204	0	6	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3C43	0160-2201	7	2	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A3C44	0180-0291	3	6	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C45				NOT ASSIGNED		
A3C46				NOT ASSIGNED		
1933A to 2505A						
A3C47	0160-3165	4	1	CAPACITOR-FXD .047UF +-2% 50VDC POLYE	84411	HEW-163
A3C48	0160-2302	9		CAPACITOR-FXD 4000PF +-1% 100VDC MICA	28480	0160-2302
2518A and above						
A347	0160-5340	1	2	CAPACITOR-FXD .03UF +-1% 200VDC	28480	0160-5340
A3C48	0160-4217	9		CAPACITOR-FXD 3900PF +-1% MICA	28480	0160-4217
1933A to 2251A						
A3C49	0160-4357	8	2	CAPACITOR-FXD .01UF +-2% 100VDC	84411	X1263UW
2302A and above						
A3C49	0160-5201	3	2	CAPACITOR-FXD .01UF +-1% 100VDC	28480	0160-5201
A3C50	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C51	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
1933A to 2251A						
A3C52	0160-4357	8		CAPACITOR-FXD .01UF +-2% 100VDC	84411	X1263UW
2302A and above						
A3C52	0160-5201	3	2	CAPACITOR-FXD .01UF +-1% 100VDC	28480	0160-5201
1933A to 2505A						
A3C53	0160-2302	9		CAPACITOR-FXD 4000PF +-1% 100VDC MICA	28480	0160-2302
2518A and above						
A3C53	0160-4217	9		CAPACITOR-FXD 3900PF +-1% MICA	28480	0160-4217
A3C54				NOT ASSIGNED		
A3C55	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C56	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C57	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C58	0180-0116	1	2	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C59	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C60	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C61	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C62	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C63				NOT ASSIGNED		
A3C64	0180-0228	6	5	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3C65	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3C66				NOT ASSIGNED		
A3C67				NOT ASSIGNED		
A3C68	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C69	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C70	0160-0134	1		CAPACITOR-FXD 220PF +-5% 300VDC MICA	28480	0160-0134
A3C71				NOT ASSIGNED		
A3C72	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C73	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A3C74	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A3C75	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A3C76	0180-0197	8	52	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C77	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3CR3△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A3CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A3CR8				NOT ASSIGNED		
A3CR9△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A3L1	9140-0137	1		INDUCTOR RF-CH-MLD 1MH +-5%	91637	IM6-1000uH 5%
A3L2	9100-1633	0	1	INDUCTOR RF-CH-MLD 68UH +-5%	91637	IM-4 68UH 5%
A3L3	9140-0137	1		INDUCTOR RF-CH-MLD 1MH +-5%	91637	IM6-1000uH 5%
A3MP1	08901-00021	7	1	COVER, AUDIO DE-EMPHASIS	28480	08901-00021
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP2	5021-0817	6		P.C. BOARD EXTRACTOR	28480	5021-0817
A3Q1	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
1933A to 2238A						
A3R1	0698-7062	7	1	RESISTOR 19.6K +-0.5% .125W TF TC=0+-50	12498	NC55
2239A to 2505A						
A3R1	0698-7353	9	1	RESISTOR 19K +-1% .125W F TC=0+-100	28480	0698-7353
2518A and above						
A3R1	0698-6942	0	1	RESISTOR 25K +-.1% .125W F TC=0+-50	28480	0698-6942
A3R2	0698-5091	8	1	RESISTOR 45K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4502-F
A3R3	0757-0349	5	1	RESISTOR 22.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2262-F
1933A to 2238A						
A3R4	0699-0027	2	1	RESISTOR 9.474K +-0.25% .125W TF	12498	NC55
2239A to 2505A						
A3R4	0698-6343	5	1	RESISTOR 9K +-.1% .125W F TC=0+-25	28480	0698-6343
2518A and above						
A3R4	0698-8191	5	1	RESISTOR 12.5K +-0.1% .125W FF TC=0+-25	19701	5033R-1/8-T9-1252-B
A3R5	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3R6				NOT ASSIGNED		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3R7	0698-0085	0	7	RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A3R8	0698-3159	5	2	RESISTOR 26.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2612-F
A3R9	0698-3161	9	2	RESISTOR 38.3K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3832-F
A3R10				NOT ASSIGNED		
A3R11	0757-0441	8	6	RESISTOR 8.25K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8251-F
A3R12	0757-0441	8		RESISTOR 8.25K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8251-F
A3R13	0757-0438	3	20	RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A3R14	0757-0441	8		RESISTOR 8.25K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8251-F
A3R15				NOT ASSIGNED		
A3R16	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R17	0757-0465	6	23	RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A3R18	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A3R19	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R20	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A3R21	0683-2265	1	5	RESISTOR 22M +-5% .25W CC TC=-900/+1200	01121	CB2265
A3R22	0757-0279	0	16	RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A3R23	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A3R24				NOT ASSIGNED		
A3R25	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R26	0698-7236	7	25	RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A3R27	2100-3273	1	2	RESISTOR-TRMR 2K 10% TKF SIDE-ADJ 1-TRN	28480	2100-3273
A3R28	0698-3156	2	5	RESISTOR 14.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1472-F
1933A to 2505A						
A3R29	0698-8046	9	1	RESISTOR 16K +-0.1% .125W FF TC=0+-25	19701	5033R-1/8-T9-1602-B
2518A and above						
A3R29	0698-6942	0	1	RESISTOR 25K +-.1% .125W F TC=0+-50	28480	0698-6942
A3R30	0698-7264	1	6	RESISTOR 14.7K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1472-F
A3R31	0698-8191	5	1	RESISTOR 12.5K +-0.1% .125W FF TC=0+-25	19701	5033R-1/8-T9-1252-B
A3R32	0698-7643	0	2	RESISTOR 6.25K +-0.1% .125W FF TC=0+-25	19701	5033R-1/8-T9-6251-B
A3R33	0699-0069	2	1	RESISTOR 2.15M +-1% .125W TF TC=0+-100	19701	5033R
A3R34	0698-8642	1	1	RESISTOR 56.2K +-0.1% .125W FF TC=0+-25	12498	NE55
A3R35	0698-8731	9	12	RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
1933A to 2505A						
A3R36	0698-6614	3	1	RESISTOR 7.5K +-0.1% .125W FF TC=0+-25	12498	NE55
2518A and above						
A3R36	0698-8307	5	1	RESISTOR 7.4K +-.25% .25W F TC=0+-50	28480	0698-8307
A3R37	0698-7643	0		RESISTOR 6.25K +-0.1% .125W FF TC=0+-25	19701	5033R-1/8-T9-6251-B
A3R38	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A3R39	0698-7251	6	4	RESISTOR 4.22K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-4221-F
A3R40	0698-7224	3	2	RESISTOR 316 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-316R-F
A3R41	0698-3157	3	8	RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
A3R42				NOT ASSIGNED		
A3R43	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A3R44	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A3R45	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A3R46	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3R47	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A3R48	0757-1094	9	8	RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1471-F
1933A to 2052A						
A3R49	0698-3455	4	1	RESISTOR 261K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2613-F
2105A and above						
A3R49	0698-3159	5	2	RESISTOR 26.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2612-F
A3R50	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A3R51△	0698-6414	1		RESISTOR 1K +-0.1% .1W TF TC=0+-5	28480	0698-6414
A3R52	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3R53	0757-1094	9		RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1471-F
A3R54	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A3R55△	0698-6414	1		RESISTOR 1K +-0.1% .1W TF TC=0+-5	28480	0698-6414
A3R56	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3R57	0757-0439	4	5	RESISTOR 6.81K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6811-F
A3R58				NOT ASSIGNED		
A3R59	0757-0401	0	40	RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A3R60	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A3R61	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R62	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R63	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3R64	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3R65	0698-7272	1	2	RESISTOR 31.6K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-3162-F
A3TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A3U1	1826-0413	2		IC OP AMP LOW-BIAS-H-IMPD 8-TO-99 PKG	34371	HA2-2605-5
A3U2	1826-0413	2		IC OP AMP LOW-BIAS-H-IMPD 8-TO-99 PKG	34371	HA2-2605-5
A3U3	1826-0413	2		IC OP AMP LOW-BIAS-H-IMPD 8-TO-99 PKG	34371	HA2-2605-5
1933A to 2313A						
A3U4△	1826-0522	3	2	IC OP AMP LOW-BIAS-HIGH-IMPD QUAD 14-DIP-P	01295	TLO74CN
2324A and above						
A3U4△	1826-0753	3	2	IC OP AMP LOW-BIAS-HIGH-IMPD QUAD 14-DIP-C	28480	1826-0753
A3U5	1826-0371	1	2	IC OP AMP LOW-BIAS-H-IMPD 8-TO-99 PKG	27014	LF256H
A3U6	1826-0059	2	5	IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
1933A to 2052A						
A3U7				IF A3U7 FAILS, REPLACE IT WITH THE PART NUMBER LISTED FOR SERIAL PREFIXES 2105A AND ABOVE. ALSO REPLACE U8, U10, U11, AND R49.		
A3U8				IF A3U8 FAILS, REPLACE IT WITH THE PART NUMBER LISTED FOR SERIAL PREFIXES 2105A AND ABOVE. ALSO REPLACE U7, U10, U11, AND R49.		
2105A and above						
A3U7	1826-0783	9	4	IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN
A3U8	1826-0783	9	4	IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2313A						
A3U9△	1826-0522	3	2	IC OP AMP LOW-BIAS-HIGH-IMPD QUAD 14-DIP-P	01295	TL074CN
2324A and above						
A3U9△	1826-0753	3	2	IC OP AMP LOW-BIAS-HIGH-IMPD QUAD 14-DIP-C	28480	1826-0753
1933A to 2052A						
A3U10				IF A3U10 FAILS, REPLACE IT WITH THE PART NUMBER LISTED FOR SERIAL PREFIXES 2105A AND ABOVE. ALSO REPLACE U7, U8, U11, AND R49.		
A3U11				IF A3U11 FAILS, REPLACE IT WITH THE PART NUMBER LISTED FOR SERIAL PREFIXES 2105A AND ABOVE. ALSO REPLACE U7, U8, U10, AND R49.		
2105A and above						
A3U10	1826-0783	9	4	IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN
A3U11	1826-0783	9	4	IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN
1933A to 2421A						
A3U12	1826-0582	6		ANALOG SWITCH 4 SPST 16 -CBRZ/SDR	27014	LF13201D
A3U13	1826-0582	6		ANALOG SWITCH 4 SPST 16 -CBRZ/SDR	27014	LF13201D
A3U14	1826-0582	6		ANALOG SWITCH 4 SPST 16 -CBRZ/SDR	27014	LF13201D
A3U15	1826-0582	6		ANALOG SWITCH 4 SPST 16 -CBRZ/SDR	27014	LF13201D
2426A and above						
A3U12	1826-0606	5		IC SWITCH ANLG QUAD 16-DIP-PKG	17856	DG201BK
A3U13	1826-0606	5		IC SWITCH ANLG QUAD 16-DIP-PKG	17856	DG201BK
A3U14	1826-0606	5		IC SWITCH ANLG QUAD 16-DIP-PKG	17856	DG201BK
A3U15	1826-0606	5		IC SWITCH ANLG QUAD 16-DIP-PKG	17856	DG201BK
A3U16	1820-1195	7	6	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A3U17	1820-1418	7	1	IC DCDR TTL LS BCD-TO-DEC 4-TO-10-LINE	01295	SN74LS42N
A3U18	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A3U19	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A3U20	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A3U21	1820-1272	1	1	IC BFR TTL LS NOR QUAD 2-INP	01295	SN74LS33N
A3U22	1820-1112	8	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U23	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A3VR1	1902-0041	4	9	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A3VR2	1902-0048	1	2	DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A3VR3	1902-0048	1		DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A3VR4	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A3VR5	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A4						
1933A to 2424A						
A4	08901-60006	4	1	FM DEMODULATOR ASSEMBLY	28480	08901-60006
2426A and above						
A4	08901-60184	9	1	FM DEMODULATOR ASSEMBLY	28480	08901-60184
A4C1	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A4C2	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A4C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
1933A to 2424A						
A4C6	0160-2263	1	2	CAPACITOR-FXD 18PF +-5% 500VDC CER 0+-30	09535	301-000-COG0-180J
2426A and above						
A4C6	0160-4492	2	2	CAPACITOR-FXD 18PF +-5% 200VDC CER 0+-30	28480	0160-4492
A4C7	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A4C8	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A4C9	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A4C10	0160-2263	1		CAPACITOR-FXD 18PF +-5% 500VDC CER 0+-30	09535	301-000-COG0-180J
A4C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C13	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A4C14	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
1933A to 2424A						
A4C15	0140-0190	7	1	CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0140-0190
2426A and above						
A4C15	0160-4806	2	1	CAPACITOR-FXD 39PF +-5% 100VDC CER 0+-30	28480	0160-4806
A4C16	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C17	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
1933A to 2424A						
A4C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
2426A and above						
A4C18	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C19	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
1933A to 2424A						
A4C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
2426A and above						
A4C20	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C21	0180-0094	4	7	CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A4C22	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C23	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A4C24	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A4C25	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A4C26	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
1933A to 2424A						
A4C27	0160-2264	2	3	CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	09535	301-000-COG0-200J
2426A and above						
A4C27	0160-5699	3	3	CAPACITOR-FXD 20PF +-5% 100VDC CER 0+-30	28480	0160-5699
A4C28	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	09535	301-000-COG0-200J
A4C29	0160-0162	5	1	CAPACITOR-FXD .022UF +-10% 200VDC POLYE	19701	708D1HH223PK201AX
A4C30	0160-0153	4	2	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	19701	708D1AA102PK201AX
1933A to 2424A						
A4C31	0160-2307	4	1	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A4C32	0160-3533	0	1	CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0160-3533
A4C33	0140-0222	6	1	CAPACITOR-FXD 240PF +-1% 300VDC MICA	28480	0140-0222
2426A and above						
A4C31	0160-4805	1	1	CAPACITOR-FXD 47PF +-5% 100VDC MICA	28480	0160-4805
A4C32	0160-4808	4	1	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A4C33	0160-5491	3	1	CAPACITOR-FXD 240PF +-5% 100VDC CER	28480	0160-5491
A4C34				NOT ASSIGNED		
1933A to 2424A						
A4C35	0160-2241	5	1	CAPACITOR-FXD 2.2PF +-.25PF 500VDC CER	09535	301-000-COJ0-229C
2426A and above						
A4C35	0160-4799	2	1	CAPACITOR-FXD 2.2PF +-.25PF 100VDC CER	28480	0160-4799C
A4C36	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A4C37	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
1933A to 2424A						
A4C38	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
2426A and above						
A4C38	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A4C39	0160-3501	2	3	CAPACITOR-FXD 4UF +-10% 50VDC MET-POLYC	84411	HEW-249
A4C40				NOT ASSIGNED		
A4C41	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
1933A to 2424A						
A4C42	0160-0134	1		CAPACITOR-FXD 220PF +-5% 300VDC MICA	28480	0160-0134
A4C43	0160-2257	3	2	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	09535	301-000-C0H-100D
A4C44	0160-2249	3	3	CAPACITOR-FXD 4.7PF +-.25PF 500VDC CER	09535	301-000-COH0-479C
A4C45	0160-3536	3	2	CAPACITOR-FXD 620PF +-5% 100VDC MICA	28480	0160-3536
A4C46	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A4C47	0160-3456	6	5	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	06383	CK45XE3A102K-H
2426A and above						
A4C42	0160-4812	0		CAPACITOR-FXD 220PF +-5% 100VDC	28480	0160-4812
A4C43	0160-4791	4	2	CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A4C44	0160-4795	8		CAPACITOR-FXD 4.7PF +-.5PF 100VDC CER	28480	0160-4795
A4C45	0160-5719	8		CAPACITOR-FXD 620PF +-5% 100VDC CER	28480	0160-5719
A4C46	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C47	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A4C48	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2424A						
A4C49	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A4C50	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
2426A and above						
A4C49	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C50	0160-4819	7		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4819
1933A to 2421A						
A4C51				NOT ASSIGNED		
2426A and above						
A4C51	0160-4819	7		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4819
A4CR1△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A4CR2△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A4CR3△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A4CR4△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A4CR5△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A4CR6△	08901-80037	3		MATCHED DIODE SET (REPLACE CR6-9)	28480	08901-80037
A4CR7△				SEE A4CR6 (REPLACE CR6-9)		
A4CR8△				SEE A4CR6 (REPLACE CR6-9)		
A4CR9△				SEE A4CR6 (REPLACE CR6-9)		
A4CR10	1901-0518	8	23	DIODE-SCHOTTKY SM SIG	12403	5082-2800
A4CR11	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A4CR12	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A4CR13	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A4CR14△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A4CR15△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A4CR16△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A4DS1	1990-0325	2	4	LED-LAMP LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A4DS2	1990-0325	2		LED-LAMP LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A4J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A4J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A4J3	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A4L1	9140-0098	3	2	INDUCTOR RF-CH-MLD 2.2UH +-10%	91637	IM-4 2.2UH 10%
A4L2	9140-0098	3		INDUCTOR RF-CH-MLD 2.2UH +-10%	91637	IM-4 2.2UH 10%
A4L3	9100-2272	5	2	INDUCTOR RF-CH-MLD 47UH +-10%	91637	IM-2 47UH 10%
A4L4	9100-2272	5		INDUCTOR RF-CH-MLD 47UH +-10%	91637	IM-2 47UH 10%
A4MP1	08901-00020	6	1	COVER, FM DEMODULATOR	28480	08901-00020
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A4MP2	5021-0817	8		P.C. BOARD EXTRACTOR	28480	5021-0817

†Refer to Section 7 for update information.   *Factory Selected Component (Refer to Section 5).   △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A4Q1	1854-0210	6	4	TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A4Q2	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A4Q3	1853-0020	4	29	TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A4Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A4Q5	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A4Q6	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4Q7	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A4Q8	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A4Q9	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A4Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A4Q11	1858-0032	8	4	TRANSISTOR ARRAY 14-PIN PLSTC DIP	27014	LM3146
A4Q12	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4Q13	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4Q14	1854-0210	6		TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A4Q15	1854-0210	6		TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A4Q16	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A4Q17	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4Q18Δ	1854-0830	6		TRANSISTOR-DUAL NPN PD=500MW	27014	LM394
A4Q19	1858-0032	8		TRANSISTOR ARRAY 14-PIN PLSTC DIP	27014	LM3146
A4Q20	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A4Q21	1855-0020	8	5	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A4Q22	1855-0049	1	2	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
1933A to 2421A						
A4Q23	1854-0013	7		TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	07263	2N2218A
2426A and above						
A4Q23	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	07263	2N2219A
	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A4Q24	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A4Q25	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
1933A to 2421A						
A4Q26	1854-0013	7		TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	07263	2N2218A
2426A and above						
A4Q26	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	07263	2N2219A
	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A4Q27	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
1933A to 2421A						
A4Q28	1854-0013	7		TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	07263	2N2218A
2426A and above						
A4Q28	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	07263	2N2219A
	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
	1205-0361	3		HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0361
A4Q29	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A4Q30	1858-0032	8		TRANSISTOR ARRAY 14-PIN PLSTC DIP	27014	LM3146
A4Q31	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A4Q32	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
1933A to 2421A						
A4Q33	1854-0013	7		TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	07263	2N2218A
2426A and above						
A4Q33	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	07263	2N2219A
	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
	1205-0361	3		HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0361
A4Q34	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
1933A to 2421A						
A4Q35				NOT ASSIGNED		
2426A and above						
A4Q35	1855-0020	8	5	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A4R1	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A4R2	0698-3430	5		RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A4R3	0698-3155	1	21	RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R4	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A4R5	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A4R6	0757-1094	9		RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1471-F
A4R7	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R8	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R9	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R10	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R11	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R12	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R13	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A4R14	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A4R15	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R16	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R17	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R18	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A4R19	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R20	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R21	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R22	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R23	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R24	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A4R25	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R26	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R27	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R28	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A4R29	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R30	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R31	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R32	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R33	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R34	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R35	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A4R36	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R37	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A4R38	0698-0084	9	7	RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A4R39	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A4R40	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A4R41	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R42	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A4R43				NOT ASSIGNED		
A4R44				NOT ASSIGNED		
A4R45	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A4R46	0698-3160	8	3	RESISTOR 31.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3162-F
A4R47	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A4R48	0757-0403	2	5	RESISTOR 121 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-121R-F
A4R49	0698-8833	2	1	RESISTOR 10K +-0.1% .125W TF TC=0+-10	09464	PR1/8
A4R50	2100-3273	1		RESISTOR-TRMR 2K 10% TKF SIDE-ADJ 1-TRN	28480	2100-3273
A4R51△	0698-3904	8	1	RESISTOR 14.7K +-0.1% .1W TF TC=0+-10	19701	5023Z1/8-T13-1472-F
A4R52	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A4R53	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A4R54	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A4R55	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A4R56	0698-3430	5		RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A4R57	0698-3430	5		RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A4R58	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A4R59	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A4R60	0757-0400	9		RESISTOR 90.9 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-90R9-F
A4R61	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A4R62	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A4R63	0757-0346	2	13	RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A4R64	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A4R65	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A4R66	0698-3430	5		RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A4R67	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A4R68	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A4R69	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A4R70	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R71	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A4R72	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R73	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R74	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A4R75	0698-8821	8	2	RESISTOR 5.62 +-1% .125W TF TC=0+-100	12498	L04D
A4R76	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R77	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A4R78	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A4R79	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2421A						
A4R80	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A4R81	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
2426A and above						
A4R80	0698-3432	7		RESISTOR 26.1 +-1% .125W F TC=0+-100	28480	0698-3432
A4R81	0698-3432	7		RESISTOR 26.1 +-1% .125W F TC=0+-100	28480	0698-3432
A4R82	0698-3160	8		RESISTOR 31.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3162-F
A4R83	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A4R84	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A4R85	2100-3352	7	1	RESISTOR-TRMR 1K 10% TKF SIDE-ADJ 1-TRN	28480	2100-3352
A4R86	0698-3454	3	3	RESISTOR 215K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2153-F
A4R87	0698-0083	8	13	RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A4R88	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A4R89	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A4R90	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R91	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A4R92	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A4R93	0698-8549	7	3	RESISTOR 2.1K +-0.5% .1W TF TC=0+-5	09464	PR1/10
A4R94	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R95	0698-8731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A4R96	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R97	0698-3438	3	6	RESISTOR 147 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-147R-F
A4R98	0757-0395	1	2	RESISTOR 56.2 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-56R2-F
A4R99	0699-0139	7		RESISTOR 660 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A4R100	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R101	0698-8827	4	10	RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1004-F
A4R102	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A4R103	0698-3160	8		RESISTOR 31.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3162-F
A4R104	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
1933A to 2421A						
A4R105				NOT ASSIGNED		
A4R106				NOT ASSIGNED		
2426A and above						
A4R105	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A4R106	0698-3446	3	1	RESISTOR 383 +-1% .125W F TC=0+-100	12498	CT4-1/8-T0-383R-F
A4TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A4TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A4TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A4TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A4TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A4TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A4VR1	1902-0680	7	4	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60010 – SERIAL PREFIX 1933A TO 2545A**		
A5	08901-60010	0	1	VOLTMETER ASSEMBLY	28480	08901-60010
A5C1	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
1933A to 2251A						
A5C2	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
2302A to 2545A						
A5C2	0180-2929	8	6	CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
A5C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
1933A to 2251A						
A5C4	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A5C5	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
2302A to 2545A						
A5C4	0180-2929	8	6	CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
A5C5	0180-2929	8	6	CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
A5C6	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A5C7	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
1933A to 2142A						
A5C8	0160-2199	2	9	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A5C9	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	28480	0140-0196
2201A to 2545A						
A5C8	0160-2202	0	1	CAPACITOR-FXD 75PF +-5% 300VDC	28480	0160-2202
A5C9				NOT ASSIGNED		
A5C10	0180-0374	3	5	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
1933A to 2142A						
A5C11	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
2201A to 2545A						
A5C11				NOT ASSIGNED		
A5C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A5C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A5C14	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A5C15	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A5C16	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A5C17	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A5C18	0160-3876	4	7	CAPACITOR-FXD 47PF +-20% 200VDC CER	09969	RPE121-105X7R470M200V
A5C19	0160-3451	1	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB305Y5V103Z100V
A5C20	0180-1704	5	1	CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A5C21	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A5C22	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A5C23	0160-3501	2		CAPACITOR-FXD 4UF +-10% 50VDC MET-POLYC	84411	HEW-249
A5C24	0160-0970	3	1	CAPACITOR-FXD .47UF +-10% 80VDC POLYE	19701	708D1HV474PK800AX
A5C25	0160-0575	4	5	CAPACITOR-FXD .047UF +-20% 50VDC CER	12474	SR205C473MAA
A5C26	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	12474	SR205C473MAA
A5C27	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	12474	SR205C473MAA
A5C28	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	12474	SR205C473MAA

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A5 08901-60010 – SERIAL PREFIX 1933A TO 2545A

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2251A						
A5C29	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
2302A to 2545A						
A5C29	0180-2929	8	6	CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
A5C30	0160-4397	6	1	CAPACITOR-FXD .1UF +-1% 100VDC POLYSTY	84411	HEW-451
A5C31	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A5C32	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A5C33	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A5C34	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A5CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A5CR2Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR3Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR4Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A5CR6	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A5CR7	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A5CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A5CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A5CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A5CR11Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR12	1906-0074	1	2	DIODE-ARRAY 50V 400MA	07263	FSA3157P
A5CR13	1906-0074	1		DIODE-ARRAY 50V 400MA	07263	FSA3157P
A5CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A5CR15Δ	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A5CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A5DS1	1990-0325	2		LED-LAMP LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A5L1	9140-0210	1	4	INDUCTOR RF-CH-MLD 100UH +-5%	91637	IM-4 100UH 5%
A5MP1	08901-00019	3	1	COVER-VOLTMETER (INCLUDES EXTRACTOR)	28480	08901-00019
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A5MP2	5021-0817	8		P.C. BOARD EXTRACTOR	28480	5021-0817
A5Q1	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A5Q2	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A5Q3	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A5Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A5Q5	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A5Q6	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A5Q7	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A5Q8	1855-0414	4	1	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	17856	2N4393
A5Q9	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A5Q10	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60010 – SERIAL PREFIX 1933A TO 2545A**		
A5R1	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A5R2	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R3	0757-1094	9		RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1471-F
A5R4	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A5R5	1810-0126	1	3	NETWORK-RES 14-DIP 10.0K OHM X 13	11236	760-1-R10K
A5R6	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A5R7	2100-3358	3	3	RESISTOR-TRMR 1M 20% TKF SIDE-ADJ 1-TRN	28480	2100-3358
A5R8	0698-8549	7		RESISTOR 2.1K +-0.5% .1W TF TC=0+-5	09464	PR1/10
1933A to 2142A						
A5R9	0683-2265	1		RESISTOR 22M +-5% .25W CC TC=-900/+1200	01121	CB2265
2201A to 2447A						
A5R9	0683-1565	2		RESISTOR 15M +-5% .25W FC	28480	0683-1565
2450A to 2545A						
A5R9	0699-0073	8		RESISTOR 10M +-1% .125W F TC=0+-150	28480	0699-0073
A5R10	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A5R11	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R12	0698-8549	7		RESISTOR 2.1K +-0.5% .1W TF TC=0+-5	09464	PR1/10
A5R13	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A5R14	0757-0461	2	1	RESISTOR 68.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6812-F
A5R15	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A5R16	0757-0416	7	40	RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A5R17	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R18	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A5R19	0698-3154	0	8	RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A5R20	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A5R21	0757-0428	1	3	RESISTOR 1.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1621-F
A5R22	0757-0288	1	2	RESISTOR 9.09K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-9091-F
A5R23	0698-6731	9		RESISTOR 4.8K +-0.1% .1W TF TC=0+-15	09464	PR1/10
1933A to 2142A						
A5R24	0683-2265	1		RESISTOR 22M +-5% .25W CC TC=-900/+1200	01121	CB2265
2201A to 2447A						
A5R24	0683-1565	2		RESISTOR 15M +-5% .25W FC	28480	0683-1565
2450A to 2545A						
A5R24	0699-0073	8		RESISTOR 10M +-1% .125W F TC=0+-150	28480	0699-0073
A5R25	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A5R26	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
1933A TO 2009A						
A5R27	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
2012A to 2545A						
A5R27				NOT ASSIGNED		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60010 – SERIAL PREFIX 1933A TO 2545A**		
A5R28	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A5R29	2100-3358	3		RESISTOR-TRMR 1M 20% TKF SIDE-ADJ 1-TRN	28480	2100-3358
A5R30	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A5R31	0698-3150	6	2	RESISTOR 2.37K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2371-F
A5R32	0699-0222	9	1	RESISTOR 10.5K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A5R33	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A5R34	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A5R35	2100-3351	6	2	RESISTOR-TRMR 500 10% TKF SIDE-ADJ 1-TRN	28480	2100-3351
A5R36	0757-0458	7	3	RESISTOR 51.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5112-F
A5R37	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A5R38	0757-0439	4		RESISTOR 6.81K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6811-F
A5R39	0698-3430	5		RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A5R40	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R41	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A5R42	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A5R43	0698-6286	5	1	RESISTOR 100M +-10% .25W CC	01121	CB1071
A5R44	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A5R45	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A5R46	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A5R47	0757-0458	7		RESISTOR 51.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5112-F
A5R48	0683-1055	5	1	RESISTOR 1M +-5% .25W CF TC=0-800	19701	(CR-25) 1-4-5P-1M
1933A to 2032A						
A5R49	2100-3358	3		RESISTOR-TRMR 1M 20% TKF SIDE-ADJ 1-TRN	28480	2100-3358
2051A to 2545A						
A5R49	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A5R50	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R51	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R52	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A5R53	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R54	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A5R55	1810-0037	3	2	NETWORK-RES 16-DIP 1.0K OHM X 8	11236	761-3-R1K
A5R56	0698-3157	3		RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
A5R57	0698-3157	3		RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
A5R58	1810-0037	3		NETWORK-RES 16-DIP 1.0K OHM X 8	11236	761-3-R1K
1933A TO 2009A						
A5R59	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
2012A to 2545A						
A5R59	0698-6360	6		RESISTOR 10K +-.1% .125W TF TC=0+-25	28480	0698-6360
A5R60	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A5R61	0757-0463	4	2	RESISTOR 82.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8252-F
A5R62	0757-0467	8	4	RESISTOR 121K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1213-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60010 – SERIAL PREFIX 1933A TO 2545A**		
1933A TO 2009A						
A5R63	0698-3159	5		RESISTOR 26.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2612-F
2012A to 2021A						
A5R63	0698-6631	4		RESISTOR 2.5K +-.1% .125W TF TC=0+-25	28480	0698-6631
2026A to 2545A						
*A5R63**	0757-0276	7	2	RESISTOR 61.9 +-1% .125W F TC=0+-100	12498	CT4-1/8-T0-61R9-F
A5R64	0698-3156	2		RESISTOR 14.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1472-F
A5R65	0698-3243	8		RESISTOR 178K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1783-F
A5R66	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A5R67	0757-0467	8		RESISTOR 121K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1213-F
A5R68	0757-0421	4	11	RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A5R69	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A5R70	0698-3443	0	3	RESISTOR 287 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-287R-F
A5R71	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A5R72	0757-0419	0	2	RESISTOR 681 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-681R-F
1933A to 2021A						
A5R73	0698-3157	3		RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
2026A to 2545A						
A5R73	0757-0419	0		RESISTOR 681 +-1% .125W F TC=0+-100	12498	CT4-1/8-T0-681R-F
A5R74	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
1933A to 2021A						
A5R75	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
2026A to 2545A						
A5R75	0757-0405	4		RESISTOR 162 +-1% .125W F TC=0+-100	12498	CT4-1/8-T0-162R-F
A5R76	2100-3103	6	1	RESISTOR-TRMR 10K 10% TKF SIDE-ADJ	73138	89PR10K
A5R77	0699-0239	8	1	RESISTOR 59K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A5R78	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R79	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A5R80	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A5R81	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A5R82	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A5R83	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
1933A to 2032A						
A5R84				NOT ASSIGNED		
A5R85				NOT ASSIGNED		
2051A to 2545A						
A5R84	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A5R85	0698-3452	1		RESISTOR 147K +-1% .125W F TC=0+-100	24546	CT4-1/8-TO-1473-F
A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A5TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60010 – SERIAL PREFIX 1933A TO 2545A**		
A5TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A5TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A5TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
1933A to 2138A						
A5U1	1826-0574	6	1	IC OP AMP LOW-DRIFT 8-TO-99 PKG	07263	UA714LHC
2142A to 2545A						
A5U1	1826-0471	2	1	IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
1933A to 2142A						
A5U2	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
2201A to 2545A						
A5U2	1826-0371	1		IC OP AMP TO-99 PKG	28480	1826-0371
A5U3	1826-0096	9	3	IC COMPARATOR PRCN 8-TO-99 PKG	27014	LM211H
A5U4	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
1933A to 2032A						
A5U5	1826-0371	1		IC OP AMP LOW-BIAS-H-IMPD 8-TO-99 PKG	27014	LF256H
2051A to 2545A						
A5U5	1826-0266	3		IC OP AMP LOW DRIFT TO-99 PKG	06665	OP-05EJ
A5U6	1826-0096	9		IC COMPARATOR PRCN 8-TO-99 PKG	27014	LM211H
A5U7	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	18324	NE555N
A5U8	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A5U9	1820-1211	8	1	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86AN
A5U10△	1820-1547	3	1	IC MULTIPLXR 8-CHAN-ANL 16-DIP-C PKG	04713	MC14051
A5U11△	1820-1547	3	1	IC MULTIPLXR 8-CHAN-ANL 16-DIP-C PKG	04713	MC14051
A5U12△	1820-1547	3	1	IC MULTIPLXR 8-CHAN-ANL 16-DIP-C PKG	04713	MC14051
A5U13	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A5U14	1820-1196	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A5U15	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A5VR1	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A5VR2				NOT ASSIGNED		
A5VR3	1902-3024	9	1	DIODE-ZNR 2.87V 5% DO-7 PD=.4W TC=-.07%	28480	1902-3024
A5VR4	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A5VR5	1902-3082	9	1	DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
1933A TO 2009A						
A5VR6				NOT ASSIGNED		
2012A to 2545A						
A5VR6	1902-0946	8	1	DIODE-ZNR 3.3V 5% DO-35 PD=.4W TC=-.039%	28480	1902-0946

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60293 – SERIAL PREFIX 2606A AND ABOVE**		
A5	08901-60293	1	1	VOLTMETER ASSEMBLY	28480	08901-60293
A5C1	0180-2929	8		CAPACITOR-FXD 68UF+-10% 10VDC TA	28480	0180-2929
A5C2	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A5C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A5C4	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A5C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A5C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A5C7	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A5C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A5C9	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A5C10	0180-0374	3	6	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A5C11	0160-4387	4	3	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A5C12	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A5C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C14	0180-1704	5	1	CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A5C15	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A5C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A5C17	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A5C18	0160-3501	2		CAPACITOR-FXD 4UF +-10% 50VDC MET-POLYC	28480	0160-3501
A5C19	0160-0970	3	1	CAPACITOR-FXD .47UF +-10% 80VDC POLYE	28480	0160-0970
A5C20	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
2606A to 2623A						
A5C21	0160-3878	6	51	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C22	0160-3402	2	3	CAPACITOR-FXD 1UF +-5% 50VDC MET-POLYC	28480	0160-3402
A5C23	0160-3501	2		CAPACITOR-FXD 4UF +-10% 50VDC MET-POLYC	28480	0160-3501
A5C24	0160-3501	2		CAPACITOR-FXD 4UF +-10% 50VDC MET-POLYC	28480	0160-3501
A5C25	0160-3402	2		CAPACITOR-FXD 1UF +-5% 50VDC MET-POLYC	28480	0160-3402
2629A and above						
A5C21-C25				NOT ASSIGNED		
A5C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C27	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C28	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C29	0180-2929	8		CAPACITOR-FXD 68UF+-10% 10VDC TA	28480	0180-2929
A5C30	0160-4807	3	4	CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A5C31	0160-4397	6	1	CAPACITOR-FXD .1UF +-1% 100VDC POLYSTY	28480	0160-4397
A5C32	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C33	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C34	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A5C35	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A5CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR2	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR3	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR4	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR5	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60293 – SERIAL PREFIX 2606A AND ABOVE**		
A5CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR8	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A5CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR11	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR14	1901-0880	7	9	DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A5CR15	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5CR16	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A5L1	9140-0210	1	8	INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A5MP1	08901-00019	3	1	COVER VOLT MTR	28480	08901-00019
	2190-0006	3		WASHER-LK EXT T NO. 6 .141-IN-ID	28480	2190-0006
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A5Q1	1854-0810	2	7	TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A5Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A5Q3	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A5Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A5Q5	1855-0414	4	2	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q6	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A5Q7	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A5R1	1810-0126	1	1	NETWORK-RES 14-DIP10.0K OHM X 13	11236	760-1-R10K
A5R2	2100-3358	3	2	RESISTOR-TRMR 1M 20% C SIDE-ADJ 1-TRN	28480	2100-3358
A5R3	0698-8549	7		RESISTOR 2.1K .5% .1W F TC=0+-5	28480	0698-8549
A5R4	0699-0073	8		RESISTOR 10M 1% .125W F TC=0+-150	28480	0699-0073
A5R5	0757-0288	1	3	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A5R6	0698-8549	7		RESISTOR 2.1K .5% .1W F TC=0+-5	28480	0698-8549
A5R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R8	0698-8731	9		RESISTOR 4.8K .1% .1W F TC=0+-15	28480	0698-8731
A5R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R11	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A5R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R13	0698-3154	0	12	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A5R14	0698-3132	4	11	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A5R15	0699-0073	8		RESISTOR 10M 1% .125W F TC=0+-150	28480	0699-0073
A5R16	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R17	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A5R18	2100-3358	3		RESISTOR-TRMR 1M 20% C SIDE-ADJ 1-TRN	28480	2100-3358
A5R19	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A5R20	0698-3150	6	7	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60293 – SERIAL PREFIX 2606A AND ABOVE**		
A5R21	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R22	0699-0222	9	1	RESISTOR 10.5K .1% .1W F TC=0+-15	28480	0699-0222
A5R23	2100-3351	6	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A5R24	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A5R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R26	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A5R27	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R28	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R29	0757-0458	7	8	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A5R30	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A5R31	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R32	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R33	0698-6286	5	1	RESISTOR 100M 10% .25W FC TC=-900/+1200	01121	CB1071
A5R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R35	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R36	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A5R37	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A5R38	2100-3353	8	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A5R39	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-2153-F
A5R40	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A5R41	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A5R42	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R43	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R44	0757-0420	3	9	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A5R45	0698-3152	8	7	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A5R46	0698-6360	6	3	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A5R47	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A5R48	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A5R49	0699-0847	4	3	RESISTOR 1.96K .1% .125W F TC=0+-50	28480	0699-0847
A5R50	0699-0847	4		RESISTOR 1.96K .1% .125W F TC=0+-50	28480	0699-0847
A5R51	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R52	0698-6631	4	1	RESISTOR 2.5K .1% .125W F TC=0+-25	28480	0698-6631
A5R53	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R54	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A5R55	0698-6362	8	1	RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A5R56	0699-0847	4		RESISTOR 1.96K .1% .125W F TC=0+-50	28480	0699-0847
A5R57	0757-0467	8	3	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A5R58	0757-0463	4	3	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A5R59	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A5R60	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A5R61	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A5R62	0757-0467	8		RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A5R63	0698-3243	8		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A5R64	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A5R65	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60293 – SERIAL PREFIX 2606A AND ABOVE**		
A5R66	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R67	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R68	0698-3443	0	5	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A5R69	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A5R70	0757-0419	0	7	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A5R71	0757-0405	4	4	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A5R72	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A5R73	2100-3103	6	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A5R74	0699-0239	8	1	RESISTOR 59K .1% .1W F TC=0+-15	28480	0699-0239
A5R75	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R76	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R77	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R78	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A5R79	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R80	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A5R81	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5U1	1826-0471	2	2	IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
2606A to 2623A						
A5U2	1826-0969	3	1	RMS/DC 10-METAL BPLR	28480	1826-0969
2629A and above						
A5U2				NOT ASSIGNED		
A5U3	1826-0371	1		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF256H
A5U4	1826-0098	9	3	IC COMPARATOR PRCN TO-99 PKG	27014	LM211H
A5U5	1826-0098	9		IC COMPARATOR PRCN TO-99 PKG	27014	LM211H
A5U6	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
2606A to 2623A						
A5U7	1826-0783	9		IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN
2629A and above						
A5U7				NOT ASSIGNED		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A5				**08901-60293 – SERIAL PREFIX 2606A AND ABOVE**		
A5U8	1826-0371	1		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF256H
A5U9	1826-0180	0	2	IC TIMER TTL MONO/ASTBL	01295	NE555P
A5U10	1826-0605	4	3	IC MULTIPLXR 8-CHAN-ANLG 16-DIP-C PKG	17856	DG508BK
A5U11	1826-0605	4		IC MULTIPLXR 8-CHAN-ANLG 16-DIP-C PKG	17856	DG508BK
A5U12	1826-0605	4		IC MULTIPLXR 8-CHAN-ANLG 16-DIP-C PKG	17856	DG508BK
A5U13	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A5U14	1820-1211	8	1	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
A5U15	1820-1411	0	13	IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A5U16	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A5U17	1826-0371	1		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF256H
A5U18	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A5VR1	1902-0946	8	1	DIODE-ZNR 3.3V 5% DO-35 PD=.4W TC=-.039%	28480	1902-0946
A5VR2	1902-3062	9	1	DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3062
A5VR3	1902-3024	9	1	DIODE-ZNR 2.87V 5% DO-7 PD=.4W TC=-.07%	28480	1902-3024
A5VR4	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	24046	1N827
2606A to 2623A						
A5W1				NOT ASSIGNED		
2629A and above						
W1	8159-0005	6		RESISTOR ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A6 08901-60114 – SERIAL PREFIX 1933A TO 2308A

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6	08901-60114	5	1	AM DEMODULATOR ASSEMBLY	28480	08901-60114
A6C1	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A6C2	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A6C3	0160-4636	6	1	CAPACITOR-FXD 255PF +-1% 100VDC MICA	28480	0160-4636
A6C4	0160-2660	2	1	CAPACITOR-FXD 20PF +-2% 500VDC CER 0+-30	09535	301-000-COG0-200G
A6C5	0160-4635	5	1	CAPACITOR-FXD 212PF +-1% 100VDC MICA	28480	0160-4635
A6C6	0160-2249	3		CAPACITOR-FXD 4.7PF +-.25PF 500VDC CER	09535	301-000-COH0-479C
A6C7	0160-2150	5	1	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A6C8	0121-0105	4	2	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A6C9	0160-0574	3	3	CAPACITOR-FXD .022UF +-20% 100VDC CER	06383	FD12X7R2A223M
A6C10				NOT ASSIGNED		
A6C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C12				NOT ASSIGNED		
A6C13				NOT ASSIGNED		
A6C14	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C15	0180-2618	2	5	CAPACITOR-FXD 33UF+-10% 10VDC TA	12344	T355F336K010AS
A6C16	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A6C17	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A6C18	0170-0040	9	1	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	19701	708D1HP473PK201AX
A6C19	0160-0302	5	1	CAPACITOR-FXD .018UF +-10% 200VDC POLYE	19701	708D1HH183PK201AX
A6C20	0160-2249	3		CAPACITOR-FXD 4.7PF +-.25PF 500VDC CER	09535	301-000-COH0-479C
A6C21	0160-0155	6	1	CAPACITOR-FXD 3300PF +-10% 200VDC POLYE	19701	708D1AC332PK201AX
A6C22	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C23	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A6C24	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C25	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A6C26	0160-0299	9	1	CAPACITOR-FXD 1800PF +-10% 200VDC POLYE	19701	708D1AC182PK201AX
A6C27				NOT ASSIGNED		
A6C28	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A6C29	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A6C30	0180-1743	2	1	CAPACITOR-FXD .1UF+-10% 35VDC TA	56289	150D104X9035A2
A6C31	0160-3501	2		CAPACITOR-FXD 4UF +-10% 50VDC MET-POLYC	84411	HEW-249
A6C32	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C33				NOT ASSIGNED		
A6C34	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C35				NOT ASSIGNED		
A6C36	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A6C37	0160-4261	3	1	CAPACITOR-FXD .22UF +-10% 50VDC	84411	HEW 249
A6C38	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C39	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C40	0160-3539	6		CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-3539
A6C41	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C42	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A6C43*Δ	0160-2208	4	1	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A6C44	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C45	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A6 08901-60114 – SERIAL PREFIX 1933A TO 2308A

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6C46	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A6C47	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A6C48				NOT ASSIGNED		
A6C49				NOT ASSIGNED		
A6C50	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	06383	CK45XE3A102K-H
1933A to 2238A						
A6C51	0160-3536	3		CAPACITOR-FXD 620PF +-5% 100VDC MICA	28480	0160-3536
2239A to 2308A						
A6C51	0160-3535	2		CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A6C52	0180-2613	7	1	CAPACITOR-FXD 390UF+-10% 6VDC TA	56289	152D397X9006R2-DJB
A6C53	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C54	0160-3459	9	13	CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A6C55Δ	0160-5469	5	1	CAPACITOR-FXD 1UF +-10% 50VDC MPE	28480	0160-5469
A6C56	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A6C57	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A6C58	0160-3535	2	3	CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A6C59	0160-3535	2		CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A6C60	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A6C61	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C62	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C63	0160-0134	1		CAPACITOR-FXD 220PF +-5% 300VDC MICA	28480	0160-0134
A6C64	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A6C65	0180-0376	5	2	CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A6C66	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	06383	CK45XE3A102K-H
A6C67	0160-0166	9	1	CAPACITOR-FXD .068UF +-10% 200VDC POLYE	19701	708D1MP683PK201AX
A6C68	0160-2262	0	1	CAPACITOR-FXD 16PF +-5% 500VDC CER 0+-30	09535	301-000-COG0-160J
A6C69	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C70	0160-4509	2	1	CAPACITOR-FXD .033UF +-5% 50VDC	84411	HEW-246
A6CR1				?????????? NOT ASSIGNED ??????????		
A6CR1Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR2Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR3Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR4				?????????? NOT ASSIGNED ??????????		
A6CR4Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR5Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR6Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR7Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR8Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR9	1901-0539	3	3	DIODE-SCHOTTKY SM SIG	28480	1901-0539
A6CR10	1901-0539	3		DIODE-SCHOTTKY SM SIG	28480	1901-0539
A6CR11				NOT ASSIGNED		
A6CR12				NOT ASSIGNED		
A6CR13	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A6CR14	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A6CR15	08901-80024	8	2	DIODE, MATCHED	28480	08901-80024

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**08901-60114 – SERIAL PREFIX 1933A TO 2308A**		
A6CR16	08901-80024	8		DIODE, MATCHED	28480	08901-80024
A6CR17	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A6CR18△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR19△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR20	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A6CR21	1901-0539	3		DIODE-SCHOTTKY SM SIG	28480	1901-0539
A6DS1	1990-0325	2		LED-LAMP LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A6J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A6J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A6J3	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A6J4	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A6L1	9100-1635	2	2	INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A6L2	9100-1635	2		INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A6L3	9140-0271	4	1	INDUCTOR RF-CH-MLD 13.3UH +-2%	32159	6-02738
A6L4	9140-0272	5	1	INDUCTOR RF-CH-MLD 32UH +-2%	24226	15M322G-1
A6L5	9140-0273	6	1	INDUCTOR RF-CH-MLD 47.6UH +-2%	24226	15M472G-1
A6L6	9100-1666	9	2	INDUCTOR RF-CH-MLD 3.6MH +-5%	32159	936000M-5%
A6L7	9100-1652	3	1	INDUCTOR RF-CH-MLD 820UH +-5%	91637	IM-6 820UH 5%
A6L8*△	9100-1633	0	1	INDUCTOR RF-CH-MLD 68UH +-5% .166DX.385LG	28480	9100-1633
A6L9	9100-1666	9		INDUCTOR RF-CH-MLD 3.6MH +-5%	32159	936000M-5%
A6L10	9140-0131	5	4	INDUCTOR RF-CH-MLD 10MH +-5%	91637	IM-10 10000UH 5%
A6MP1	08901-00018	2	1	COVER, AM DEMODULATOR	28480	08901-00018
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A6MP2	5021-0817	8		P.C. BOARD EXTRACTOR	28480	5021-0817
A6Q1	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q2	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A6Q3	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A6Q4	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A6Q5	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A6Q6	1855-0265	3		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0265
A6Q7				NOT ASSIGNED		
A6Q8	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A6Q9	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A6Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**08901-60114 – SERIAL PREFIX 1933A TO 2308A**		
A6Q11	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q12	1854-0215	1	2	TRANSISTOR NPN SI TO-92 PD=350MW	04713	2N3904
A6Q13	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q14	1854-0013	7		TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	07263	2N2218A
A6Q15	1854-0404	0	5	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A6Q16	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A6Q17Δ	1855-0597	4	1	TRANSISTOR J-FET P-CHAN D-MODE TO-92 SI	28480	1855-0597
A6Q18	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A6Q19	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A6Q20	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q21	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A6Q22	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q23	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q24	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q25	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A6Q26	1854-0215	1		TRANSISTOR NPN SI TO-92 PD=350MW	04713	2N3904
A6Q27	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A6Q28	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A6Q29	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A6Q30	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A6Q31	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A6R1	0757-1108	6	1	RESISTOR 300 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-301-F
A6R2	0698-3157	3		RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
A6R3	0698-3446	3	5	RESISTOR 383 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-383R-F
A6R4	0698-3447	4	4	RESISTOR 422 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-422R-F
A6R5	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A6R6	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A6R7	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A6R8-R12				NOT ASSIGNED		
A6R13	0757-0418	9	2	RESISTOR 619 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-619R-F
A6R14	0698-3226	7	1	RESISTOR 6.49K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6491-F
A6R15	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A6R16	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A6R17	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A6R18	0757-0437	2	1	RESISTOR 4.75K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4751-F
A6R19				NOT ASSIGNED		
A6R20	0757-0458	7		RESISTOR 51.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5112-F
A6R21	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A6R22	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A6R23	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A6R24	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A6R25	0757-0290	5	4	RESISTOR 6.19K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-6191-F
A6R26	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A6R27	0757-0462	3	2	RESISTOR 75K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7502-F
A6R28	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A6R29	0698-3446	3		RESISTOR 383 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-383R-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A6 08901-60114 – SERIAL PREFIX 1933A TO 2308A

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6R30	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A6R31	0698-3158	4	3	RESISTOR 23.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2372-F
A6R32	0698-3157	3		RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
A6R33	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A6R34	0698-3439	4	3	RESISTOR 178 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-178R-F
A6R35	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A6R36	0698-3440	7	5	RESISTOR 196 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-196R-F
A6R37	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A6R38	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A6R39	0757-0443	0	2	RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1102-F
A6R40				NOT ASSIGNED		
A6R41	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A6R42	0757-0338	2	3	RESISTOR 1K +-1% .25W TF TC=0+-100	12498	NA5-1/4-TO-1001-F
A6R43				NOT ASSIGNED		
A6R44	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A6R45	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A6R46	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A6R47				NOT ASSIGNED		
A6R48	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A6R49	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A6R50	0698-3152	8	4	RESISTOR 3.48K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3481-F
A6R51	0698-4488	5	1	RESISTOR 26.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2672-F
A6R52	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A6R53	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A6R54	0698-4472	7	1	RESISTOR 7.68K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7681-F
A6R55	0757-0431	6	1	RESISTOR 2.43K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2431-F
A6R56	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A6R57	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A6R58	0698-3432	7	2	RESISTOR 26.1 +-1% .125W TF TC=0+-100	D8439	MK2
A6R59				NOT ASSIGNED		
A6R60	0699-0148	8	2	RESISTOR 31.6K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A6R61	0757-0200	7	2	RESISTOR 5.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5621-F
A6R62	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A6R63	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A6R64	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A6R65	2100-3207	1	1	RESISTOR-TRMR 5K 10% TKF SIDE-ADJ 1-TRN	28480	2100-3207
A6R66	0698-8955	9	1	RESISTOR 13.5K +-0.1% .1W TF TC=0+-10	09464	PR1/10
A6R67	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A6R68	0757-0419	0		RESISTOR 681 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-681R-F
A6R69	0699-0149	9	1	RESISTOR 28.7K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A6R70	0698-3447	4		RESISTOR 422 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-422R-F
A6R71	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A6R72	0699-0096	5	2	RESISTOR 12K +-0.1% .1W TF TC=0+-10	09464	PR1/10
A6R73	0698-4454	5	3	RESISTOR 523 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-523R-F
A6R74	0698-4454	5		RESISTOR 523 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-523R-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**08901-60114 – SERIAL PREFIX 1933A TO 2308A**		
A6R75	0699-0096	5		RESISTOR 12K +-0.1% .1W TF TC=0+-10	09464	PR1/10
A6R76	0698-4454	5		RESISTOR 523 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-523R-F
A6R77	0757-0444	1	1	RESISTOR 12.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1212-F
A6R78	0757-0443	0		RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1102-F
A6R79	0699-0148	8		RESISTOR 31.6K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A6R80	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A6R81	0698-4626	3	1	RESISTOR 1.47K +-1% .25W TF TC=0+-100	12498	NA5-1/4-TO-1471-F
A6R82	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A6R83-R86				NOT ASSIGNED		
A6R87	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A6R88	0699-0143	3		RESISTOR 825 +-0.1% .1W TF TC=0+-15	09464	PR1/10
A6R89	0757-0400	9		RESISTOR 90.9 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-90R9-F
A6R90	0757-0447	4		RESISTOR 16.2K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1622-F
A6R91	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A6R92	0757-0417	8	1	RESISTOR 562 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-562R-F
A6R93	0698-3442	9	1	RESISTOR 237 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-237R-F
A6R94	0757-0338	2		RESISTOR 1K +-1% .25W TF TC=0+-100	12498	NA5-1/4-TO-1001-F
A6R95	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A6R96	0698-8979	7	1	RESISTOR 11.6K +-1% .125W TF TC=0+-100	12498	CT4
A6R97	0698-3153	9	3	RESISTOR 3.83K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3831-F
A6R98	0757-0440	7	4	RESISTOR 7.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7501-F
A6R99	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A6R100	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A6R101	0757-1094	9		RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1471-F
A6R102	0698-3433	8	1	RESISTOR 28.7 +-1% .125W TF TC=0+-100	D8439	MK2
A6R103	0698-3152	8		RESISTOR 3.48K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3481-F
A6R104	0698-3454	3		RESISTOR 215K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2153-F
A6R105	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A6R106				NOT ASSIGNED		
A6R107	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A6R108	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A6R109	0698-8825	2	1	RESISTOR 681K +-1% .125W TF TC=0+-100	12498	CT4
A6R110	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A6R111				NOT ASSIGNED		
A6R112	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A6R113	0683-2265	1		RESISTOR 22M +-5% .25W CC TC=-900/+1200	01121	CB2265
A6R114	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A6R115	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A6R116	1901-0050	3		NOT ASSIGNED	9N171	1N4150
A6R117	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A6R118	0698-3152	8		RESISTOR 3.48K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3481-F
A6R119	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A6R120	0757-0317	7	2	RESISTOR 1.33K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1331-F
A6R121	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A6R122	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**08901-60114 - SERIAL PREFIX 1933A TO 2308A**		
A6R123	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A6R124	0698-3440	7		RESISTOR 196 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-196R-F
A6R125	0683-2265	1		RESISTOR 22M +-5% .25W CC TC=-900/+1200	01121	CB2265
A6R126	0698-3440	7		RESISTOR 196 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-196R-F
A6R127				NOT ASSIGNED		
A6R128	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A6U1	1826-0035	4	2	IC OP AMP LOW-DRIFT 8-TO-99 PKG	27014	LM308AH
A6U2Δ	1826-0989	7		IC OP AMP GP 8-DIP-C PKG LM307J	28480	1826-0989
A6U3	1826-0035	4		IC OP AMP LOW-DRIFT 8-TO-99 PKG	27014	LM308AH
A6U4Δ	08901-80075	9	1	OPTO ISOLATOR LED P	28480	08901-80075
A6U5	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
A6U6	1826-0102	6	1	IC OP AMP LOW-BIAS-H-IMPD 8-TO-99 PKG	27014	LM312H
A6U7Δ	1826-0065	0	1	IC COMPARATOR PRCN 8-DIP-C PKG LM311N	28480	1826-0065
A6U8	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A6U9	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A6U10	1820-1197	9	4	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6VR1				NOT ASSIGNED		
A6VR2	1902-0072	1	1	DIODE-ZNR 7.87V 2% DO-35 PD=.4W	28480	1902-0072
A6VR3	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A6VR4	1902-3059	0	1	DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**SERIAL PREFIX 2309A AND ABOVE**		
2309A to 2312A						
A6	08901-60240	8	1	AM DEMODULATOR ASSEMBLY	28480	08901-60240
2313A and above						
A6	08901-60246	4	1	AM DEMODULATOR ASSEMBLY	28480	08901-60246
A6C1	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A6C2	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A6C3	0160-4636	6	1	CAPACITOR-FXD 255PF +-1% 100VDC MICA	28480	0160-4636
A6C4	0160-2660	2	1	CAPACITOR-FXD 20PF +-2% 500VDC CER 0+-30	28480	0160-2660
A6C5	0160-4635	5	1	CAPACITOR-FXD 212PF +-1% 100VDC MICA	28480	0160-4635
A6C6	0160-4795	8		CAPACITOR-FXD 4.7PF +-.5PF 100VDC CER	28480	0160-4795
A6C7	0160-4807	3		CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A6C8	0121-0105	4	2	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A6C9	0160-4833	5	7	CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A6C10				NOT ASSIGNED		
A6C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C12				NOT ASSIGNED		
A6C13				NOT ASSIGNED		
A6C14	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A6C15	0160-4835	7	8	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A6C16	0160-4812	0		CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A6C17	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A6C18	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A6C19	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A6C20	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A6C21	0160-4833	5		CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A6C22	0160-4833	5		CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A6C23	0160-4812	0		CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A6C24	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C25	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C26	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A6C27				NOT ASSIGNED		
A6C28				NOT ASSIGNED		
A6C29	0160-4807	3		CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A6C30	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A6C31	0160-3501	2		CAPACITOR-FXD 4UF +-10% 50VDC MET-POLYC	28480	0160-3501
A6C32	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C33				NOT ASSIGNED		
A6C34	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C35				NOT ASSIGNED		
A6C36	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A6C37	0160-5528	7	1	CAPACITOR-FXD .22UF +-5% 100VDC	28480	0160-5528
A6C38	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C39	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C40	0160-3539	6	1	CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-3539

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A6 SERIAL PREFIX 2309A AND ABOVE

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6C41	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C42	0160-4807	3		CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
2309A to 2312A						
*A6C43**	0160-4334	1	1	CAPACITOR-FXD 290PF +-1% 300VDC MICA	28480	0160-4334
2313A and above						
*A6C43**	0160-2208	4	1	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A6C44	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C45	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C46	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A6C47	0180-2929	8		CAPACITOR-FXD 68UF+-10% 10VDC TA	28480	0180-2929
A6C48				NOT ASSIGNED		
A6C49				NOT ASSIGNED		
A6C50	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
2309A to 2324A						
A6C51	0160-0340	1	1	CAPACITOR-FXD 600PF +-1% 300VDC MICA	28480	0160-0340
2342A and above						
A6C51	0160-4678	6		CAPACITOR-FXD 560PF +-1% 100VDC MICA	28480	0160-4678
A6C52	0180-2613	7	1	CAPACITOR-FXD 390UF+-10% 6VDC TA	56289	150D397X9006R2-DJB
A6C53	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C54	0160-4833	5		CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
2309A to 2312A						
A6C55	0160-4535	4	1	CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
2313A and above						
A6C55	0160-5469	5	1	CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-5469
A6C56	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A6C57	0160-4833	5		CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A6C58	0160-4825	5	2	CAPACITOR-FXD 560PF +-5% 100VDC CER	28480	0160-4825
A6C59	0160-4825	5		CAPACITOR-FXD 560PF +-5% 100VDC CER	28480	0160-4825
A6C60	0160-4810	8	1	CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4810
A6C61	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6C62	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C63	0160-4812	0		CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A6C64	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A6C65	0180-0376	5	2	CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A6C66	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
2309A to 2312A						
A6C67	0160-0166	9	1	CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
2313A and above						
A6C67	0160-5714	3	1	CAPACITOR-FXD .68UF +-10% 100VDC CER	28480	0160-5714
A6C68	0160-4789	0	1	CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A6C69	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C70	0160-4509	2	1	CAPACITOR-FXD .033UF +-5% 50VDC	28480	0160-4509

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**SERIAL PREFIX 2309A AND ABOVE**		
A6CR1-CR4				NOT ASSIGNED		
A6CR5	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR6	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR7	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR8	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR9	1901-0539	3	3	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A6CR10	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A6CR11				NOT ASSIGNED		
A6CR12				NOT ASSIGNED		
A6CR13	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR14	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR15	08901-80024	8	2	DET DIODES-MATCH	28480	08901-80024
A6CR16	08901-80024	8		DET DIODES-MATCH	28480	08901-80024
A6CR17	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR18	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR19	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A6CR20	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR21	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
2309A to 2312A						
A6CR22				NOT ASSIGNED		
2313A and above						
A6CR22	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A6J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A6J3	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A6J4	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A6L1	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A6L2	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A6L3	9140-0271	4	1	INDUCTOR RF-CH-MLD 13.3UH 2%	28480	9140-0271
A6L4	9140-0272	5	1	INDUCTOR RF-CH-MLD 32UH 2% .166DX.385LG	28480	9140-0272
A6L5	9140-0273	6	1	INDUCTOR RF-CH-MLD 47.6UH 2%	28480	9140-0273
A6L6				NOT ASSIGNED		
A6L7	9100-1652	3	1	INDUCTOR RF-CH-MLD 820UH 5% .2DX.45LG	28480	9100-1652
A6L8∆	9100-1633	8	1	INDUCTOR RF-CH-MLD 27UH 5% .166DX.385LG	28480	9100-1633

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). ∆ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**SERIAL PREFIX 2309A AND ABOVE**		
A6L9	9100-1666	9	1	INDUCTOR RF-CH-MLD 3.6MH 5% .23DX.57LG	28480	9100-1666
A6L10	9140-0131	5	4	INDUCTOR RF-CH-MLD 10MH 5% .25DX.75LG	28480	9140-0131
A6MP1	08901-00018	2	1	COVER AM DEMOD	28480	08901-00018
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A6Q1	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q2	1858-0010	2	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	04713	MPQ2906
A6Q3				NOT ASSIGNED		
A6Q4	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q5	1854-0404	0	13	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
2309A to 2426A						
A6Q6	1855-0420	2	5	TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
2432A and above						
A6Q6	1855-0265	3		TRANSISTOR J-FET N-CHAN D-MODE T0-18 SI		
A6Q7	1855-0421	3	1	TRANSISTOR J-FET 2N5114 P-CHAN D-MODE	17856	2N5114
A6Q8	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A6Q9	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A6Q10	1853-0281	9	13	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A6Q11	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q12	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A6Q13	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q14	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q15	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A6Q16	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
2309A to 2312A						
A6Q17	1855-0082	2	1	TRANSISTOR J-FET P-CHAN D-MODE SI	28480	1855-0082
2313A and above						
A6Q17	1855-0597	4	1	TRANSISTOR J-FET P-CHAN D-MODE T0-92 SI	28480	1855-0597
A6Q18	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A6Q19	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A6Q20	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A6Q22-Q28				NOT ASSIGNED		
A6Q29	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A6Q30	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A6Q31	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A6R1	0757-1108	6	1	RESISTOR 300 1% .125W F TC=0+-100	24546	C4-1/8-T0-301-F
A6R2	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A6R3	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A6R4	0698-3447	4	6	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6R5	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A6 SERIAL PREFIX 2309A AND ABOVE

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R8	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A6R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R11				NOT ASSIGNED		
A6R12				NOT ASSIGNED		
A6R13	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A6R14	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A6R15	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A6R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R17	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R18	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R19	0698-3445	2	8	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A6R20	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A6R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R22	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A6R23	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R24	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R25	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A6R26	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R27	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R28	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A6R29	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A6R30	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R31	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A6R32	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A6R33	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R34	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A6R35	0757-0338	2	4	RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-TO-1001-F
A6R36	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R37	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R38	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R39	0757-0443	0	3	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A6R40				NOT ASSIGNED		
A6R41	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R42	0757-0338	2		RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-TO-1001-F
A6R43				NOT ASSIGNED		
A6R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R45				NOT ASSIGNED		
A6R46	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R47				NOT ASSIGNED		
A6R48				NOT ASSIGNED		
A6R49	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R50	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**SERIAL PREFIX 2309A AND ABOVE**		
A6R51	0698-4488	5	1	RESISTOR 26.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2672-F
2309A to 2312A						
A6R52	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
2313A and above						
A6R52	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A6R53				NOT ASSIGNED		
A6R54	0698-4472	7	1	RESISTOR 7.68K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7681-F
A6R55	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A6R56	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R57	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R58	0698-3432	7		RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
A6R59				NOT ASSIGNED		
A6R60	0699-0148	8	2	RESISTOR 31.6K .1% .1W F TC=0+-15	28480	0699-0148
A6R61	0757-0200	7	5	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A6R62	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R63	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A6R64	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R65	2100-3207	1	2	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	28480	2100-3207
A6R66	0698-8955	9	1	RESISTOR 13.5K .1% .1W F TC=0+-10	28480	0698-8955
A6R67	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A6R68	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A6R69	0699-0149	9	1	RESISTOR 28.7K .1% .1W F TC=0+-15	28480	0699-0149
A6R70	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6R71	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A6R72	0699-0096	5	2	RESISTOR 12K .1% .1W F TC=0+-10	28480	0699-0096
A6R73	0698-4454	5	3	RESISTOR 523 1% .125W F TC=0+-100	24546	C4-1/8-T0-523R-F
A6R74	0698-4454	5		RESISTOR 523 1% .125W F TC=0+-100	24546	C4-1/8-T0-523R-F
2309A to 2312A						
A6R75	0699-0096	5		RESISTOR 12K .1% .1W F TC=0+-10	28480	0699-0096
2313A and above						
A6R75	0698-6191	5		RESISTOR 12.5K .1% .125W F TC=0+-25	19701	MF4C1/8-TO-1252-B
A6R76	0698-4454	5		RESISTOR 523 1% .125W F TC=0+-100	24546	C4-1/8-T0-523R-F
A6R77	0757-0444	1	4	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A6R78	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A6R79	0699-0148	8		RESISTOR 31.6K .1% .1W F TC=0+-15	28480	0699-0148
A6R80	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A6R81	0698-4626	3	1	RESISTOR 1.47K 1% .25W F TC=0+-100	24546	C5-1/4-TO-1471-F
A6R82	0698-3440	7	7	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R83-R86				NOT ASSIGNED		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

A6 SERIAL PREFIX 2309A AND ABOVE

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6R87	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R88	0699-0143	3		RESISTOR 825 .1% .1W F TC=0+-15	28480	0699-0143
A6R89	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R90	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A6R91	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R92	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A6R93	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R94	0757-0338	2		RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-TO-1001-F
A6R95	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6R96	0698-8979	7	1	RESISTOR 11.6K 1% .125W F TC=0+-100	28480	0698-8979
A6R97	0698-3153	9	7	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A6R98	0757-0440	7	6	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R99	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R100	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A6R101	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A6R102	0698-3432	7		RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
A6R103	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A6R104	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A6R105	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A6R106				NOT ASSIGNED		
A6R107	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A6R108	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A6R109	0698-8825	2	1	RESISTOR 681K 1% .125W F TC=0+-100	28480	0698-8825
A6R110	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R111				NOT ASSIGNED		
A6R112	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A6R113	0683-2265	1		RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A6R114	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R115	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R116				NOT ASSIGNED		
A6R117	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R118	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A6R119	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R120	0757-0317	7	2	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A6R121	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R122	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R123				NOT ASSIGNED		
A6R124	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R125	0683-2265	1		RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A6R126	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R127				NOT ASSIGNED		
A6R128	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R129	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A6				**SERIAL PREFIX 2309A AND ABOVE**		
A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6U1	1826-0035	4	2	IC OP AMP LOW-DRIFT TO-99 PKG	27014	LM308AH
2309A to 2312A						
A6U2	1826-0043	4	4	IC OP AMP GP TO-99 PKG	3L585	CA307T
2313A and above						
A6U2	1826-0989	7	4	IC OP AMP GP 8-DIP-P PKG	28480	1826-0989
A6U3	1826-0035	4		IC OP AMP LOW-DRIFT TO-99 PKG	27014	LM308AH
A6U4	1826-0716	8	1	IC OP AMP LOW-NOISE DUAL 8-DIP-C PKG	18324	NE5532AFE
A6U5	1826-0606	5	7	IC SWITCH ANLG QUAD 16-DIP-C PKG	17856	DG201BK
A6U6	1826-0102	6	1	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LM312H
2309A to 2312A						
A6U7	1826-0026	3	1	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
2313A and above						
A6U7	1826-0065	0	1	IC COMPARATOR PRCN 8-DIP-P PKG	S0545	UPC311C
A6U8	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A6U9	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A6U10	1820-1197	9	4	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6VR1				NOT ASSIGNED		
A6VR2	1902-0072	1	1	DIODE-ZNR 7.87V 2% DO-35 PD=.4W	28480	1902-0072
A6VR3	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	24046	1N827
A6VR4	1902-3059	0	5	DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A7 – A9				NOT ASSIGNED		
A10						
A10	08901-60115	6	1	POWER SUPPLY REGULATORS ASSEMBLY	28480	08901-60115
A10C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A10C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A10C3				NOT ASSIGNED		
A10C4	0180-2618	2		CAPACITOR-FXD 33UF+-10% 10VDC TA	12344	T355F336K010AS
A10C5	0180-2617	1	10	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A10C6				NOT ASSIGNED		
A10C7	0180-2620	6	11	CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A10C8	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
1933A to 2606A						
A10C9	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A10C10	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
2607A and above						
A10C9	0180-0491	5	1	CAPACITOR-FXD 10UF+-20% 25VDC TA	12344	T355E106M025AS
A10C10	0180-0491	5	1	CAPACITOR-FXD 10UF+-20% 25VDC TA	12344	T355E106M025AS
A10C11	0180-2854	8	1	CAPACITOR-FXD 68UF+-10% 100VDC TA	56289	109D686X9100T2
A10C12	0180-0491	5	1	CAPACITOR-FXD 10UF+-20% 25VDC TA	12344	T355E106M025AS
A10C13	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A10C14Δ	0180-3701	6		CAPACITOR-FXD 2.2UF 75VDC TA	28480	0180-3701
A10C15	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A10C16	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A10C17	0160-3535	2		CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A10C18	0160-0939	4	2	CAPACITOR-FXD 430PF +-5% 300VDC MICA	28480	0160-0939
A10C19	0180-2618	2		CAPACITOR-FXD 33UF+-10% 10VDC TA	12344	T355F336K010AS
A10C20	0180-2618	2		CAPACITOR-FXD 33UF+-10% 10VDC TA	12344	T355F336K010AS
1933A to 2606A						
A10C21	0160-0573	2	3	CAPACITOR-FXD 4700PF +-20% 100VDC CER	06383	FD12X7R2A472M
A10C22	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	06383	FD12X7R2A472M
2607A and above						
A10C21	0160-0574	3	2	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A10C22	0160-0574	3	2	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A10CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A10CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A10CR3	1901-0081	0	1	DIODE-SWITCHING 50V 75MA 10NS	9N171	1N4148
A10CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A10CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A10CR6	1901-0159	3	9	DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A10CR7	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A10CR8	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A10CR9Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A10CR10	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A10CR11△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A10CR12△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A10CR13△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A10CR14	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A10CR15△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A10CR16△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A10CR17	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A10CR18	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A10DS1	1990-0485	5	5	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	28480	HLMP-1503
A10DS2	1990-0485	5		LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	28480	HLMP-1503
A10DS3	1990-0485	5		LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	28480	HLMP-1503
A10DS4	1990-0485	5		LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	28480	HLMP-1503
A10DS5	1990-0485	5		LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	28480	HLMP-1503
A10F1	2110-0036	9	1	FUSE (INCH) 8A 125V NTD FE UL	75915	312 008
A10F2	2110-0083	6	3	FUSE (INCH) 2.5A 250V NTD FE UL	11870	04.025
A10F3	2110-0011	0	1	FUSE (INCH) .062A 250V NTD FE UL	16428	AGC 1/16
A10F4	2110-0083	6		FUSE (INCH) 2.5A 250V NTD FE UL	11870	04.025
A10F5	2110-0083	6		FUSE (INCH) 2.5A 250V NTD FE UL	11870	04.025
1933A to 2542A						
A10MP1	0380-0310	1	2	STANDOFF-RVT-ON .75-IN-LG 6-32-THD	28480	0380-0310
2543A and above						
A10MP1	5001-0178	2	2	ANGLE BRACKET	28480	5001-0178
	2190-0007	2		WASHER-LOCK INTL T NO.6 .141-ID	00000	ORDER BY DESCRIPTION
	2360-0191	6		SCREW-MACH 6-32 .188 PNPD	00000	ORDER BY DESCRIPTION
A10MP2	2110-0269	0	10	FUHLR-CLP-TYP	91506	6008-32CN
1933A to 2303A						
A10Q1	1884-0012	9	3	THYRISTOR-SCR 2N3528 TO-8 VRRM=200	28480	1884-0012
2308A to 2916A						
A10Q1	1884-0244	9	3	THYRISTOR-SCR VRRM=400	28480	1884-0244
	1205-0361	3	3	HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0361
2925A and above						
A10Q1	1884-0345	1	3	THYRISTOR-SCR VRRM=400	28480	1884-0345
	1205-0361	3	3	HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0361
A10Q2	1884-0005	0	1	THYRISTOR-SCR VRRM=50	04713	MCR649P-2
	2190-0006	1	18	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
	2360-0119	8	2	SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2420-0002	6	3	NUT-HEX-DBL-CHAM 6-32-THD .109-IN-THK	28480	2420-0002
A10Q3	1884-0073	2	1	THYRISTOR-SCR VRRM=100	9N171	CD1031
	3050-0016	8	1	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0016
A10Q4	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
1933A to 2303A						
A10Q5	1884-0012	9		THYRISTOR-SCR 2N3528 TO-8 VRRM=200	28480	1884-0012
2308A to 2916A						
A10Q5	1884-0244	9	3	THYRISTOR-SCR VRRM=400	28480	1884-0244
	1205-0361	3	3	HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0361
2925A and above						
A10Q5	1884-0345	1	3	THYRISTOR-SCR VRRM=400	28480	1884-0345
	1205-0361	3	3	HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0361

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A10Q6	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
1933A to 2009A						
A10Q7	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
2912A and above						
A10Q7	1854-0811	3		TRANSISTOR NPN SI PD=625MW FT=100 MHZ	28480	1854-0811
A10Q8	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
1933A to 2009A						
A10Q9	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
2912A and above						
A10Q9	1854-0811	3		TRANSISTOR NPN SI PD=625MW FT=100 MHZ	28480	1854-0811
A10Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
1933A to 2303A						
A10Q11	1884-0012	9		THYRISTOR-SCR 2N3528 TO-8 VRRM=200	28480	1884-0012
2308A to 2916A						
A10Q11	1884-0244	9	3	THYRISTOR-SCR VRRM=400	28480	1884-0244
	1205-0361	3	3	HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0361
2925A and above						
A10Q11	1884-0345	1	3	THYRISTOR-SCR VRRM=400	28480	1884-0345
	1205-0361	3	3	HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0361
A10Q12	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A10Q13	1853-0281	9	10	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A10Q14	1854-0474	4	3	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A10Q15	1853-0038	4	2	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
	1205-0095	0	1	HEAT SINK SGL TO-5/TO-39-CS	30161	3225B
A10Q16	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A10Q17	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A10Q18	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A10Q19	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A10Q20	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A10Q21	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A10R1	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A10R2	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
1933A to 2518A						
A10R3	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
2521A and above						
A10R3	0698-3447	4		RESISTOR 422 +-1% .125W F TC=0+-100	12498	CT4-1/8-T0-422R-F
A10R4	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A10R5	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A10R6	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
1933A to 2521A						
A10R7	0811-1552	0	1	RESISTOR .56 +-5% 2W PWI TC=0+-800	11502	SPH
2521A and above						
A10R7	0811-1662	3		RESISTOR .47 +-5% 2W PW TC=0+-800	28480	0811-1662

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A10R8	0811-1666	7	1	RESISTOR 1 +-5% 2W PWI TC=0+-800	11502	SPH
A10R9	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A10R10	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A10R11	0757-0274	5	4	RESISTOR 1.21K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1211-F
A10R12	0757-0440	7		RESISTOR 7.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7501-F
A10R13	0698-3152	8		RESISTOR 3.48K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3481-F
A10R14	0698-3161	9		RESISTOR 38.3K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3832-F
1933A to 2009A						
A10R15	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
2912A and above						
A10R15	0757-0280	3		RESISTOR 1K +-1% .125W F TC=0+-100	12498	CT4-1/8-T0-1001-F
A10R16	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
1933A to 2009A						
A10R17	0757-0428	1		RESISTOR 1.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1621-F
2912A and above						
A10R17	0757-0421	4		RESISTOR 825 +-1% .125W F TC=0+-100	12498	CT4-1/8-T0-825R-F
A10R18	0757-0440	7		RESISTOR 7.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7501-F
1933A to 2009A						
A10R19	0698-0085	0		RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
2912A and above						
A10R19	0757-0424	7		RESISTOR 1.1K +-1% .125W F TC=0+-100	12498	CT4-1/8-T0-1101-F
A10R20	0698-7246	9	1	RESISTOR 2.61K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-2611-F
A10R21	0698-0085	0		RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A10R22	0698-3156	2		RESISTOR 14.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1472-F
A10R23	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A10R24	2100-3351	6		RESISTOR-TRMR 500 10% TKF SIDE-ADJ 1-TRN	28480	2100-3351
A10R25	0698-3151	7	7	RESISTOR 2.87K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2871-F
A10R26	0698-7264	1		RESISTOR 14.7K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1472-F
A10R27	0698-3156	2		RESISTOR 14.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1472-F
A10R28				NOT ASSIGNED		
A10R29				NOT ASSIGNED		
A10R30	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A10R31	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A10R32	0698-7284	5	4	RESISTOR 100K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1003-F
A10R33	0698-3624	9	1	RESISTOR 150 +-5% 2W MO TC=0+-200	12498	FP-69
A10R34	0757-0290	5		RESISTOR 6.19K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-6191-F
A10R35	0698-7251	6		RESISTOR 4.22K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-4221-F
A10R36	0698-7253	8	4	RESISTOR 5.11K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-5111-F
A10R37	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A10R38	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A10R39	0698-7266	3	1	RESISTOR 17.8K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1782-F
A10R40	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A10R41	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A10R42	0698-7219	6		RESISTOR 196 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-196R-F
A10R43	0698-7219	6		RESISTOR 196 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-196R-F
A10R44	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A10R45	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A10R46	0698-7272	1		RESISTOR 31.6K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-3162-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A10R47	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A10R48	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A10R49	0757-0816	1	1	RESISTOR 681 +-1% .5W TF TC=0+-100	K8479	H2
A10R50	0698-3136	8		RESISTOR 17.8K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1782-F
A10R51	0698-6205	8	1	RESISTOR 9.65K +-1% .125W TF TC=0+-50	12498	NC4-1/8-T2-9651-F
A10R52	0698-7216	3	3	RESISTOR 147 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-147R-F
A10R53	0698-7264	1		RESISTOR 14.7K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1472-F
A10R54	0698-7264	1		RESISTOR 14.7K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1472-F
A10R55	0698-7240	3	2	RESISTOR 1.47K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1471-F
A10R56	0698-3453	2		RESISTOR 196K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1963-F
A10R57	0757-0467	8		RESISTOR 121K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1213-F
A10R58	8110-0180	0	1	RIBBON-RES .157-OHM/FT .0253X.0625	9B253	NEUTROLOY
A10R59	0811-1659	8	1	RESISTOR .27 +-5% 2W PWI TC=0+-800	11502	SPH
A10R60	0757-0290	5		RESISTOR 6.19K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-6191-F
A10R61	0698-7264	1		RESISTOR 14.7K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1472-F
A10R62	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A10R63				NOT ASSIGNED		
A10R64				NOT ASSIGNED		
A10R65	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A10R66	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A10R67-R69				NOT ASSIGNED		
A10R67	0698-7215	2		RESISTOR 133 +-1% .05W TF TC=0+-100	12498	CT4-1/8-TO-133R-F
A10R68	0698-7215	2		RESISTOR 133 +-1% .05W TF TC=0+-100	12498	CT4-1/8-TO-133R-F
A10R69	0698-7204	9		RESISTOR 46.4 +-1% .05W TF TC=0+-100	12498	CT4-1/8-TO-46R4-F
A10TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A10TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A10TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A10TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A10TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A10TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A10TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A10TP8△	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A10U1	1826-0161	7	2	IC OP AMP GP QUAD 14-DIP-P PKG	27014	LM324N
A10VR1	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A10VR2	1902-0184	6	2	DIODE-ZNR 16.2V 5% DO-35 PD=.4W	28480	1902-0184
A10VR3	1902-0184	6		DIODE-ZNR 16.2V 5% DO-35 PD=.4W	28480	1902-0184
A10VR4	1902-3182	0	3	DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A10VR5	1902-3182	0		DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A10VR6	1902-3333	3	1	DIODE-ZNR 46.4V 5% DO-35 PD=.4W	28480	1902-3333
A10VR7	1902-3301	5	1	DIODE-ZNR 34.8V 5% DO-35 PD=.4W	28480	1902-3301
A10VR8	1902-3104	6	2	DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A10VR9	1902-3104	6		DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A10VR10△	1902-0943	5	2	DIODE-ZNR 2.37V 5% DO-7 PD=0.4W TC=-.074%	28480	1902-0943
A10VR11△	1902-0943	5	2	DIODE-ZNR 2.37V 5% DO-7 PD=0.4W TC=-.074%	28480	1902-0943

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A11						
1933A to 3618A						
A11	08901-60093	9	1	COUNTER ASSEMBLY (EXCEPT OPTION 002)	28480	08901-60093
A11	08901-60018	8	1	COUNTER ASSEMBLY (OPTION 002 ONLY)	28480	08901-60018
3632A and above						
A11	08901-60292	0	1	COUNTER ASSEMBLY (EXCEPT OPTION 002)	28480	08901-60292
A11	08901-60291	9	1	COUNTER ASSEMBLY (OPTION 002 ONLY)	28480	08901-60291
A11C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C2	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A11C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C7	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A11C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A11C9	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A11C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C14	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A11C15	0160-0161	4	2	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	19701	708D1CC103PK201AX
A11C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C17	0160-0572	1	10	CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
A11C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C20	0160-3874	2	1	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	09969	RPE121-105C0G100D200V
A11C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C22	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A11C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11C24	0160-0570	9	3	CAPACITOR-FXD 220PF +-20% 100VDC CER	09969	RPE121-105X7R221M100V
A11C25	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A11C26	0140-0198	5		CAPACITOR-FXD 200PF +-5% 300VDC MICA	28480	0140-0198
A11C27	0160-3875	3	4	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	09969	RPE121-105C0G220J200V
A11C28	0140-0198	5		CAPACITOR-FXD 200PF +-5% 300VDC MICA	28480	0140-0198
A11C29	0160-0939	4		CAPACITOR-FXD 430PF +-5% 300VDC MICA	28480	0160-0939
A11C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A11CR1	1901-0179	7	10	DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A11CR2	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A11CR3	1901-0535	9	8	DIODE-SCHOTTKY SM SIG	28480	1901-0535
A11CR4	1901-0535	9		DIODE-SCHOTTKY SM SIG	28480	1901-0535
A11CR5	1901-0535	9		DIODE-SCHOTTKY SM SIG	28480	1901-0535
A11CR6	1901-0535	9		DIODE-SCHOTTKY SM SIG	28480	1901-0535

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A11DS1	1990-0647	1	1	LED-LAMP LUM-INT=12MCD IF=20MA-MAX	28480	5082-4558
A11J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A11J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A11J3	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A11J4	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A11J5	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A11J6	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A11L1				NOT ASSIGNED		
A11L2	9100-2248	5	1	INDUCTOR RF-CH-MLD 120NH +-10%	91637	IM-2 .12UH 10%
1933A to 2618A						
A11MP1	08901-00033	1	1	COVER, COUNTER ASSEMBLY	28480	08901-00033
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
2623A and above						
A11MP1	08901-00180	9	1	COVER, COUNTER ASSEMBLY	28480	08901-00180
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A11MP2	5021-0817	8		P.C. BOARD EXTRACTOR	28480	5021-0817
A11MP3	08901-00063	7	1	LABEL (EXCEPT OPTION 002)	28480	08901-00063
A11Q1	1853-0540	3	2	TRANSISTOR PNP SI TO-92 PD=625MW	04713	1853-0540
A11Q2	1853-0540	3		TRANSISTOR PNP SI TO-92 PD=625MW	04713	1853-0540
A11Q3	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A11Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A11Q5	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A11R1	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A11R2	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A11R3	0698-8812	7	1	RESISTOR 1 +-1% .125W TF TC=0+-100	12498	L04D
A11R4	0698-8816	1	1	RESISTOR 2.15 +-1% .125W TF TC=0+-100	12498	L04D
A11R5	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A11R6	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A11R7	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A11R8	0757-0463	4		RESISTOR 82.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8252-F
A11R9	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A11R10	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A11R11	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A11R12	1810-0204	6	1	NETWORK-RES 8-SIP 1.0K OHM X 7	C1433	750-81
A11R13	0757-0397	3	14	RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A11R14	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A11R15	0698-3445	2	5	RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
A11R16△	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A11R17	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A11R18	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A11R19	0698-3153	9		RESISTOR 3.83K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3831-F
A11R20	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A11R21	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A11R22	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A11R23	0757-0398	4	2	RESISTOR 75 +-1% .125W TF TC=0+-100	D8439	MK2
A11R24	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A11R25	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A11R26	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A11R27	0698-3429	2	4	RESISTOR 19.6 +-1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A11R28	0698-3445	2		RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
A11R29	0698-3445	2		RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
A11R30	0757-0424	7	1	RESISTOR 1.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1101-F
A11R31	0757-1000	7	1	RESISTOR 51.1 +-1% .5W TF TC=0+-100	K8479	H2
A11R32	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A11R33	0698-3432	7		RESISTOR 26.1 +-1% .125W TF TC=0+-100	D8439	MK2
A11R34	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A11R35	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A11R36	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A11R37	1810-0206	8	3	NETWORK-RES 8-SIP 10.0K OHM X 7	C1433	750-81
A11R38	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A11R39	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A11TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A11TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A11TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A11TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A11TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A11TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A11TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A11U1	1820-0817	8	4	IC FF ECL D-M/S DUAL	04713	MC10131P
A11U2	1820-0803	2	1	IC GATE ECL OR-NOR TPL	04713	MC10105P
A11U3	1820-1425	6	2	IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74LS132N
A11U4	1820-1416	5	2	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A11U5	1820-1193	5	4	IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS197N

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A11U6	1820-0693	8	2	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A11U7	1820-1217	4	1	IC MUXR/DATA-SEL TTL LS 8-TO-1-LINE	01295	SN74LS151N
A11U8	1820-1251	6	2	IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A11U9	1820-1193	5		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS197N
A11U10	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A11U11	1820-1193	5		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS197N
A11U12	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A11U13	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A11U14	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
	1200-0638	7	2	SOCKET-IC 14-CONT DIP DIP-SLDR	01295	C8714-01
A11U15	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	01295	C8714-01
A11U16	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A11U17	1820-1240	3	1	IC DCDR TTL S 3-TO-8-LINE 3-INP	01295	SN74S138N
A11U18	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A11U19	1820-1193	5		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS197N
A11U20	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A11U21	1820-0723	5	1	IC-INTERFACE RCVR LINE RCVR DUAL	01295	SN75107AN
A11Y1	0410-0423	2	1	CRYSTAL-QUARTZ 10.000 MHZ HC-35/U-HLDR	28480	0410-0423

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A12				NOT ASSIGNED		
A13						
A13	08901-60031	5	1	CONTROLLER ASSEMBLY	28480	08901-60031
A13C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A13C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A13C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C5				NOT ASSIGNED		
A13C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A13C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A13C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A13C9	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
1933A to 2618A						
A13C10	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	28480	0140-0196
A13C11	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	28480	0140-0196
2623A and above						
A13C10				NOT ASSIGNED		
A13C11				NOT ASSIGNED		
A13C12	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A13C13	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A13C14	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C16	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C17	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C18	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C19	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13CR1	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A13CR2Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	28480	1901-1098
A13CR3Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	28480	1901-1098
A13CR4	1901-0159	3		DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A13DS1	1990-0524	3	5	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4550
A13DS2	1990-0524	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4550
A13DS3	1990-0524	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4550
A13DS4	1990-0524	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4550
A13JP1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4
1933A to 2618A						
A13L1	9140-0238	3	1	INDUCTOR RF-CH-MLD 82UH +-5%	91637	IM-4 82UH 5%
2623A and above						
A13L1				NOT ASSIGNED		
A13MP1	4040-0749	4	2	EXTR-PC BD BRN POLYC .062-IN-BD-THKNS	28480	4040-0749
	1480-0073	6	4	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	72962	99-012-062-0250
A13MP2	4040-0751	8	1	EXTR-PC BD ORN POLYC .062-IN-BD-THKNS	28480	4040-0751
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	72962	99-012-062-0250

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A13Q1	1853-0451	5	1	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	28480	1853-0451
A13R1	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A13R2	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A13R3	1810-0126	1		NETWORK-RES 14-DIP 10.0K OHM X 13	11236	760-1-R10K
A13R4	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A13R5	0698-7264	1		RESISTOR 14.7K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1472-F
A13R6	0698-7227	6	5	RESISTOR 422 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-422R-F
A13R7	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A13R8	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A13R9	1810-0229	5	1	NETWORK-RES 8-SIP 330.0 OHM X 7	C1433	750-81
A13R10				NOT ASSIGNED		
A13R11	1810-0126	1		NETWORK-RES 14-DIP 10.0K OHM X 13	11236	760-1-R10K
A13TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13TP11	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A13U1	1820-1425	6		IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74LS132N
A13U2	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
1933A to 2201A						
A13U3				If A13U3, fails, order part listed for serial prefixes 2212A and above. You must also order A13U4, A13U9, and A14U14.		
A13U4				If A13U4, fails, order part listed for serial prefixes 2212A and above. You must also order A13U3, A13U9, and A14U14.		
2212A and above						
A13U3	08901-80040	8	1	ROM #1	28480	08901-80040
A13U4	08901-80041	9	1	ROM #2	28480	08901-80041
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	01295	C8724-01
A13U5	08901-80011	3	1	ROM #3	28480	08901-80011
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	01295	C8724-01
A13U6	08901-80012	4	1	ROM #4	28480	08901-80012
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	01295	C8724-01
A13U7	08901-80013	5	1	ROM #5	28480	08901-80013
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	01295	C8724-01
A13U8	1818-0926	5	1	ROM #6	28480	1818-0926
	08901-80014	6	1	ROM #6 (ALTERNATE)	28480	08901-80014
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	01295	C8724-01

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2201A						
A13U9				If A13U9, fails, order part listed for serial prefixes 2212A and above. You must also order A13U3, A13U4, and A14U14.		
2212A and above						
A13U9	08901-80039	5	1	ROM #7	28480	08901-80039
	08901-80015	7	1	ROM #7 (ALTERNATE)	28480	08901-80015
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	01295	C8724-01
A13U10	08901-80025	9	1	ROM #8	28480	08901-80025
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	01295	C8724-01
A13U11	1820-2027	6	1	IC, MICROPROCESSOR,STATIC MEM. INTERFACE	50088	MK3853N
	1200-0654	7	3	SOCKET-IC 40-CONT DIP DIP-SLDR	01295	C8740-01
A13U12	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A13U13	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A13U14	1820-1928	4	1	IC, MICROPROCESSOR,CENTRAL PROC. UNIT	50088	MK3850N-3
	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	01295	C8740-01
A13U15	1818-0197	2	1	IC NMOS 1024 (1K) STAT RAM 400-NS 3-S	34335	AM91L11BDC
	1200-0539	7	1	SOCKET-IC 18-CONT DIP DIP-SLDR	01295	C8718-01
A13U16	1820-0174	0	1	IC INV TTL HEX	01295	SN7404N
A13U17	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A13U18	1820-1287	8		IC BFR TTL LS NAND QUAD 2-INP	01295	SN74LS37N
A13U19	1826-0275	4	1	IC V RGLTR-FXD-POS 11.5/12.5V TO-92 PKG	04713	MC78L12ACP
	8159-0005	0	8	RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A14						
1933A to 2421A						
A14	08901-60015	5	1	REMOTE INTERFACE ASSEMBLY	28480	08901-60015
2424A and above						
A14	08901-60257	7	1	REMOTE INTERFACE ASSEMBLY	28480	08901-60257
A14C1	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A14C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A14C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C12	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	06383	FD12X7R2A223M
A14C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A14C17	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	28480	0140-0196
A14C18	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	06383	FD12X7R2A223M
A14CR1	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A14J1	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
	1251-4460	8		CLIP-CABLE PLUG RTNG-DUAL INLINE 16 CONT	06776	RC-74
A14MP1	4040-0749	4		EXTR-PC BD BRN POLYC .062-IN-BD-THKNS	28480	4040-0749
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	72962	99-012-062-0250
A14MP2	4040-0752	9	1	EXTR-PC BD YEL POLYC .062-IN-BD-THKNS	28480	4040-0752
	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	72962	99-012-062-0250
1933A to 2421A						
MP6				NOT ASSIGNED		
MP7				NOT ASSIGNED		
2424A and above						
MP6	0363-0205	7		CONNECTOR FINGER	28480	0353-0205
MP7	0363-0205	7		CONNECTOR FINGER	28480	0353-0205
A14R1	0698-3438	3		RESISTOR 147 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-147R-F
A14R2	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A14R3	1810-0206	8		NETWORK-RES 8-SIP 10.0K OHM X 7	C1433	750-81
A14R4	1810-0206	8		NETWORK-RES 8-SIP 10.0K OHM X 7	C1433	750-81
2424A to 2950A						
A14R5	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
3022A and above						
A14R5	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	28480	0698-0084

†Refer to Section 7 for update information *Factory Selected Component (Refer to Section 5) Δ Errata part change

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A14R6	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A14R7	1810-0136	3	1	NETWORK-RES 10-SIP MULTI-VALUE	01121	410S003
A14R8	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A14R9	0698-7224	3		RESISTOR 316 +-1% .05W TF TC=0+-100	12498	CT3-1/8-TO-316R-F
1933A to 2421A						
A14R10				NOT ASSIGNED		
2424A and above						
*A14R10*Δ	0698-7260	7		RESISTOR 10K +-1% .05W F TC=0+-100	12498	CT3-1/8-TO-1002-F
A14S1	3101-1973	7	1	SWITCH-DIP SL 7-1A 0.1A 50VDC	11236	11P-1028
	1200-0485	2	1	SOCKET-IC 14-CONT DIP DIP-SLDR	51167	14-820-90
A14TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A14U1	1820-1689	4	2	IC-INTERFACE XCVR INSTRUMENT BUS IEEE	01295	MC3446N
A14U2	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A14U3	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A14U4	1820-1416	5		IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A14U5	1820-1689	4		IC-INTERFACE XCVR INSTRUMENT BUS IEEE	01295	MC3446N
A14U6	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A14U7	1820-1905	7	1	IC GATE TTL LS NOR DUAL 5-INP	18324	74LS260N
1933A to 2421A						
A14U8	1820-0706	4	1	IC COMPTR TTL MAGTD 5-BIT	07263	9324PC
2424A and above						
A14U8	1820-2740	0	1	IC COMPTR TTL MAGTD 2-INP 8-BIT	28480	1820-2740
A14U9	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A14U10	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A14U11	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A14U12	1820-0621	2	1	IC BFR TTL NAND QUAD 2-INP	01295	SN7438N
	1200-0552	4	1	SOCKET-IC 40-CONT DIP-SLDR	06776	ICN-406-B-S4-G30
A14U13	1820-2100	6	1	IC-PERIPHERAL INPUT/OUTPUT (PIO)	50088	3881/MK90005N
	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	01295	C8740-01

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1836A TO 2201A						
A14U14				If A14U14 fails, order part listed for serial prefixes 2212A and above. You must also order A13U3, A13U4, and A13U9.		
2212A and above						
A14U14	1818-1364	7	1	ROM #11	28480	1818-1364
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	01295	C8724-01
A14U15	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A14U16	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A14U17	08901-80004	4	1	PROM, PROGRAMMED	28480	08901-80004
A14U18	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A14U19	1820-0054	5	1	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A14U20	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A14U21	1820-1200	5	3	IC INV TTL LS HEX	01295	SN74LS05N
A14U22	1820-1200	5		IC INV TTL LS HEX	01295	SN74LS05N
A14VR1	1902-3182	0		DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A15						
1933A to 2201A						
A15	08901-60116	7	1	RF INPUT ASSEMBLY	28480	08901-60116
2212A to 2412A						
A15	08901-60183	8	1	RF INPUT ASSEMBLY	28480	08901-60183
2421A and above						
A15	08901-60256	6	1	RF INPUT ASSEMBLY	28480	08901-60256
1933A to 2412A						
A15AT1-AT3				NOT ASSIGNED		
2421A and above						
A15AT1	0699-1289	0		20 DB ATTENUATOR	28480	0699-1289
A15AT2	0699-1288	9		10 DB ATTENUATOR	28480	0699-1288
A15AT3	0699-1289	0		20 DB ATTENUATOR	28480	0699-1289
1933A to 2542A						
A15C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
2543A and above						
A15C1	0160-4832	4	6	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
1933A to 2201A						
A15C2	0160-4741	4	2	CAPACITOR-FXD .22UF +-10% 50VDC CER	06383	FK22X7R1H224K-T
2212A and above						
A15C2△	0160-6222	0	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6222
1933A to 2542A						
A15C3	0160-0576	5	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
2543A and above						
A15C3	0160-4835	7	2	CAPACITOR-FXD .1UF +-10% 100VDC CER	28480	0160-4835
1933A to 2251A						
A15C4	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
2302A and above						
A15C4	0180-2929	8	6	CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
1933A to 2542A						
A15C5	0160-0576	5	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A15C6	0160-3878	6	47	CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
2543A and above						
A15C5	0160-4835	7	2	CAPACITOR-FXD .1UF +-10% 100VDC CER	28480	0160-4835
A15C6	0160-4822	7	6	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A15C7	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A15C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
1933A to 2542A						
A15C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
2543A and above						
A15C9	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832

†Refer to Section 7 for update information　　*Factory Selected Component (Refer to Section 5)　　△ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2201A						
A15C10	0160-4741	4		CAPACITOR-FXD .22UF +-10% 50VDC CER	06383	FK22X7R1H224K-T
2212A to 2542A						
A15C10	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
2543A and above						
A15C10	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
1933A to 2542A						
A15C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
2543A and above						
A15C11	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
1933A to 2201A						
A15C12	0160-4654	8	1	CAPACITOR-FXD 530PF +-5% 50VDC CER 0+-30	06383	FD12C0G1H531J
2212A and above						
A15C12	0160-4502	2	1	CAPACITOR-FXD 390PF +-5% 100VDC CER 0+-30	28480	0160-4502
1933A to 2251A						
A15C13	0160-0571	0	8	CAPACITOR-FXD 470PF +-20% 100VDC CER	06383	FD11X7R2A471M
2302A to 2412A						
A15C13	0160-4678	5	1	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4678
2421A and above						
A15C13	0160-4062	2	1	CAPACITOR-FXD 470PF +-10% 50VDC CER	28480	0160-4062
1933A to 2201A						
A15C14	0160-4031	5	1	CAPACITOR-FXD 330PF +-5% 100VDC CER	09969	RPE121-105C0G331J100V
2212A and above						
A15C14	0160-4678	5	1	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4678
1933A to 2542A						
A15C15	*0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
2543A and above						
A15C15	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
1933A to 2201A						
A15C16	0160-4889	1	1	CAPACITOR-FXD CER 1800PF	28480	0160-4889
2212A to 2542A						
A15C16	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
2543A and above						
A15C16	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
1933A to 2542A						
A15C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A15C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A15C19	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A15C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
2543A and above						
A15C17	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A15C18	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A15C19	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A15C20	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A15C21	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A15C22	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
1933A to 2542A						
A15C23	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A15C24	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
2543A and above						
A15C23	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A15C24	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A15C25	0160-4492	2	1	CAPACITOR-FXD 18PF +-5% 200VDC CER 0+-30	09969	RPE121-105C0G180J200V
1933A to 2542A						
A15C26	0160-3877	5	9	CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V
2543A and above						
A15C26	0160-4801	7	1	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A15C27	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
1933A to 2201A						
A15C28				NOT ASSIGNED		
2212A and above						
A15C28△	0160-6222	0	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6222
1933A to 2412A						
A15C29				NOT ASSIGNED		
2421A and above						
A15C29	0160-4616	2	2	CAPACITOR-FXD 560PF +-5% 200VDC CER	28480	0160-4616
A15CR1	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
	4330-0145	8		INSULATOR-BEAD GLASS	28480	4330-0145
				SEE R10* FACTORY SELECTION PROCEDURE IN SECTION 5		
A15CR2				NOT ASSIGNED		
A15CR3	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A15CR4	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A15CR5				NOT ASSIGNED		
A15CR6				NOT ASSIGNED		
A15CR7	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A15CR8	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A15J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
A15J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222

†Refer to Section 7 for update information *Factory Selected Component (Refer to Section 5) △ Errata part change

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2201A						
A15K1	0490-1073	8	1	RELAY-REED 1A 250MA 120VAC 4.5VDC-COIL	15636	R2974-1
2212A to 2542A						
A15K1	0490-1185	3	1	RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1185
2543A and above						
A15K1	0490-1452	7	1	RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1452
A15K2	0490-1158	0	4	RELAY 2C 5VDC-COIL 1A 28VDC	11532	712Y-1A22
	3050-0737	0		WASHER-FL NM 1/4 .254-IN-ID .4-IN-OD	00000	ORDER BY DESCRIPTION
A15K3	0490-1158	0		RELAY 2C 5VDC-COIL 1A 28VDC	11532	712Y-1A22
	3050-0737	0		WASHER-FL NM 1/4 .254-IN-ID .4-IN-OD	00000	ORDER BY DESCRIPTION
A15K4	0490-1158	0		RELAY 2C 5VDC-COIL 1A 28VDC	11532	712Y-1A22
	3050-0737	0		WASHER-FL NM 1/4 .254-IN-ID .4-IN-OD	00000	ORDER BY DESCRIPTION
A15K5	0490-1158	0		RELAY 2C 5VDC-COIL 1A 28VDC	11532	712Y-1A22
	3050-0737	0		WASHER-FL NM 1/4 .254-IN-ID .4-IN-OD	00000	ORDER BY DESCRIPTION
1933A to 2201A						
A15L1	9140-0333	9	1	INDUCTOR RF-CH-MLD 910NH +-5%	91637	IM-2 .91UH 5%
A15L2	9140-0143	9	1	INDUCTOR RF-CH-MLD 3.3UH +-10%	91637	IM-2 3.3UH 10%
A15L3	9100-2260	1	1	INDUCTOR RF-CH-MLD 1.8UH +-10%	91637	IM-2 1.8UH 10%
A15L4				NOT ASSIGNED		
2212A and above						
A15L1	9100-2257	6	1	INDUCTOR RF-CH-MLD 820NH +-10% .105D X .26LG	28480	9100-2257
A15L2	9100-2261	2	1	INDUCTOR RF-CH-MLD 2.7UH +-10% .105D X .26LG	28480	9100-2261
A15L3	9140-0142	8	1	INDUCTOR RF-CH-MLD 2.2UH +-10% .105D X .26LG	28480	9140-0142
A15L4	9100-2258	7	1	INDUCTOR RF-CH-MLD 1.2UH +-10% .105D X .26LG	28480	9100-2258
A15MP1	08901-00032	0	1	COVER, RF INPUT (INCLUDES P.C. EXTRACTOR)	28480	08901-00032
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
Δ	3050-0018	8		WASHER-FL MTLC NO.6 .147-IN-ID	00000	ORDER BY DESCRIPTION
A15MP2	8160-0280	6		RFI STRIP-FINGERS BE-CU ZINC PLATED	30817	97-500-ZC
A15MP3	08901-00054	6	1	SUPPORT, SHIELD	28480	08901-00054
A15MP4Δ	5001-5539	9	13	STRAP, GROUND	28480	5001-5539
A15MP5	08901-20082	2	8	P.C. BOARD EXTRACTOR	28480	08901-20082
A15MP6	3050-0023	7		WASHER-FL NM NO.6 .144-IN-9D .25-IN-OD	00000	ORDER BY DESCRIPTION
A15Q1	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A15Q2	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A15Q3				NOT ASSIGNED		
A15Q4				NOT ASSIGNED		
A15Q5				NOT ASSIGNED		
A15Q6	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A15Q7	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A15Q8	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A15Q9	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A15Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A15Q11	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A15R1	0698-7209	4	14	RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A15R2	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A15R3	0698-7195	7	4	RESISTOR 19.6 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-19R6-F
A15R4	0698-7195	7		RESISTOR 19.6 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-19R6-F
A15R5	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A15R6	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A15R7	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A15R8	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A15R9	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
1933A to 2201A						
A15R10	0698-7207	2		RESISTOR 61.9 1% .05W F TC=0+-100	24546	C3-1/8-TO-61R9-F
2212A to 2412A						
A15R10	0698-7205	9		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
2421A and above						
*A15R10*Δ*	0699-0252	5	1	RESISTOR 52.8 +-5% .2W TF TC=0+-100	12498	C3-1/8-TO-52R8-F
	1600-0265	4	1	NICKEL-DISK .15IN .01IN ASTM F-15	28480	1600-0265
A15R11	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A15R12	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A15R13	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A15R14	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
1933A to 2412A						
A15R15	0699-0136	4	2		28480	0699-0136
2421A and above						
A15R15				NOT ASSIGNED		
1933A to 2201A						
A15R16				NOT ASSIGNED		
2212A and above						
A15R16	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A15R17	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A15R18				NOT ASSIGNED		
1933A to 2412A						
A15R19	0699-0136	4			28480	0699-0136
A15R20	0699-0132	0	2	RESISTOR 248 +-1% .25W F TC=0+-100	28480	0699-0132
A15R21	0699-0133	1	3	RESISTOR 61.1 +-1% .25W F TC=0+-100	28480	0699-0133
2421A and above						
A15R19				NOT ASSIGNED		
A15R20				NOT ASSIGNED		
A15R21				NOT ASSIGNED		
A15R22	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A15R23	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A15R24	0699-0071	6	3	RESISTOR 4.64M +-1% .125W TF TC=0+-100	19701	5033R
A15R25	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A15R26	0699-0071	6		RESISTOR 4.64M +-1% .125W TF TC=0+-100	19701	5033R
1933A to 2412A						
A15R27	0699-0137	5	1		28480	0699-0137
2421A and above						
A15R27				NOT ASSIGNED		
A15R28	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
1933A to 2412A						
A15R29	0699-0135	3	3	RESISTOR 71.2 +-1% .25W TF TC=0+-100	11502	HFC65
A15R30	0699-0134	2	1	RESISTOR 96.3 +-1% .25W F TC=0+-100	28480	0699-0134
2421A and above						
A15R29				NOT ASSIGNED		
A15R30				NOT ASSIGNED		
A15R31	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A15R32	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A15R33	0698-3443	0		RESISTOR 287 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-287R-F
A15R34	0698-7212	9	3	RESISTOR 100 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-100R-F
A15R35	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A15R36	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A15R37	0698-3452	1	1	RESISTOR 147K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1473-F
1933A to 2412A						
A15R38	0699-0133	1		RESISTOR 61.1 +-1% .25W F TC=0+-100	28480	0699-0133
2421A and above						
A15R38				NOT ASSIGNED		
A15R39	0698-3266	5	1	RESISTOR 237K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2373-F
1933A to 2412A						
A15R40	0699-0132	0		RESISTOR 248 +-1% .25W F TC=0+-100	28480	0699-0132
2421A and above						
A15R40				NOT ASSIGNED		
A15R41	0699-0071	6		RESISTOR 4.64M +-1% .125W TF TC=0+-100	19701	5033R
A15R42	2100-3054	6	1	RESISTOR-TRMR 50K 10% TKF SIDE-ADJ	73138	89PR50K
A15R43	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A15R44	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
1933A to 2412A						
A15R45	0699-0133	1		RESISTOR 61.1 +-1% .25W F TC=0+-100	28480	0699-0133
2421A and above						
A15R45				NOT ASSIGNED		
1933A to 2201A						
A15R46				NOT ASSIGNED		
A15R47	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
2212A and above						
A15R46	0698-7242	5		RESISTOR 1.78K 1% .05W F TC=0+-100	28480	0698-7242
*A15R47**	0698-3442	9		RESISTOR 237 +-1% .125W F TC=0+-100	24546	CT3-1/8-TO-237R-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A15R48	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A15R49	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A15R50	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A15R51	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A15R52	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A15R53	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A15R54	0698-3454	3		RESISTOR 215K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2153-F
A15R55	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A15R56	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A15R57	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A15R58	0757-0428	1		RESISTOR 1.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1621-F
A15R59	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A15R60	0698-3460	1	1	RESISTOR 422K +-1% .125W TF TC=0+-100	12498	CT4
A15R61	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
1933A to 2201A						
A15R62				NOT ASSIGNED		
2212A to 2542A						
A15R62	0698-7212	9	3	RESISTOR 100 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-100R-F
2543A and above						
A15R62				NOT ASSIGNED		
A15TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A15U1	1826-0013	8	3	IC OP AMP LOW-NOISE 8-TO-99 PKG	24355	AD741CH
A15U2	1826-0098	9		IC COMPARATOR PRCN 8-TO-99 PKG	27014	LM211H
A15U3Δ	1826-0141	3	1	IC COMPARATOR GP DUAL 14-DIP-C-PKG LM319J	27014	LM319J
1933A to 2542A						
A15W1				NOT ASSIGNED		
2543A and above						
A15W1	8150-4819	4	1	WIRE JUMPER	28480	8150-4819

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A16				NOT ASSIGNED		
A17				**08901-60002 – SERIAL PREFIX 1933A TO 2607A**		
A17	08901-60002	0	1	INPUT MIXER ASSEMBLY	28480	08901-60002
A17C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A17C2	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A17C3	0160-3873	1	5	CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	09969	RPE121-105C0G4R7D200V
A17C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A17C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A17C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A17C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A17C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A17C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A17C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A17C11	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A17C12	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A17C13	0160-4497	7	1	CAPACITOR-FXD 82PF +-5% 200VDC CER 0+-30	09969	RPE121-105C0G820J200V
A17C14	0160-4652	6	1	CAPACITOR-FXD 960PF +-1% 500VDC MICA	00853	RDM19F961F5C
A17C15	0160-4647	9	1	CAPACITOR-FXD 154PF +-1% 500VDC MICA	28480	0160-4647
A17C16	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A17C17	0160-4646	8	1	CAPACITOR-FXD 444PF +-1% 500VDC MICA	28480	0160-4646
A17C18	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A17C19	0160-4387	4	2	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	09969	RPE121-105COG470J200V
A17C20	0160-4641	3	1	CAPACITOR-FXD 3520PF +-1% 50VDC	84411	HEW-745
A17C21	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A17C22	0160-4651	5	1	CAPACITOR-FXD 817PF +-1% 500VDC MICA	00853	RDM19F(817)F5S
A17C23	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A17C24	0180-0376	5		CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
A17C25	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	09969	RPE121-105COG470J200V
A17C26	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A17C27	08901-00064	8	1	CAPACITOR STRAP	28480	08901-00064
A17CR1△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17CR2△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17CR3△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17CR4△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17CR5△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17CR6△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17DS1	1990-0524	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4550

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A17				**08901-60002 - SERIAL PREFIX 1933A TO 2607A**		
A17J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
A17J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
A17J3	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
A17L1	9100-3922	4	21	RF CHOKE	28480	9100-3922
A17L2	9100-3922	4		RF CHOKE	28480	9100-3922
A17L3	9100-3922	4		RF CHOKE	28480	9100-3922
A17L4	9100-3922	4		RF CHOKE	28480	9100-3922
A17L5△	9100-4434	5	1	INDUCTOR 240UH +-2% .165D-IN X .385 LG-IN	28480	9100-4434
A17L6	9140-0302	2	1	INDUCTOR RF-CH-MLD 21.9UH +-2%	32159	6-02741
A17L7	9140-0131	5		INDUCTOR RF-CH-MLD 10MH +-5%	91637	IM-10 10000UH 5%
1933A to 2350A						
A17L8	08901-80002	2	1	INDUCTOR, VARIABLE	28480	08901-80002
2410A to 2607A						
A17L8	9140-0840	3	1	INDUCTOR, VARIABLE	28480	9140-0840
A17L9	9140-0131	5		INDUCTOR RF-CH-MLD 10MH +-5%	91637	IM-10 10000UH 5%
A17L10	9100-1626	1	1	INDUCTOR RF-CH-MLD 36UH +-5%	91637	IM-4 36UH 5%
1933A to 2350A						
A17L11	08901-80001	1	1	INDUCTOR, VARIABLE	28480	08901-80001
2410A to 2607A						
A17L11	9140-0841	4	1	INDUCTOR, VARIABLE	28480	9140-0841
A17L12	9140-0303	3	1	INDUCTOR RF-CH-MLD 89.3UH +-2%	32159	6-02742
A17L13	9140-0131	5		INDUCTOR RF-CH-MLD 10MH +-5%	91637	IM-10 10000UH 5%
A17MP1	08901-00030	8	1	COVER, INPUT MIXER (INCLUDES P.C. EXTRACTOR)	28480	08901-00030
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A17MP2	08901-20082	2		P.C. BOARD EXTRACTOR	28480	08901-20082
A17MP3	8160-0280	6		RFI STRIP-FINGERS BE-CU ZINC PLATED	30817	97-500-ZC
A17MP4	5001-0173	7		STRAP, GROUND	28480	5001-0173
A17Q1	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A17Q2	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A17Q3	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A17Q4	1854-0632	6	1	TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR91
A17Q5	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A17Q6	1854-0720	3	1	TRANSISTOR NPN SI PD=500MW FT=4GHZ	28480	1854-0720
A17Q7	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A17Q8	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A17R1	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A17R2	0757-0200	7		RESISTOR 5.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5621-F
A17R3	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A17R4	0698-8821	8		RESISTOR 5.62 +-1% .125W TF TC=0+-100	12498	L04D
A17R5	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A17				**08901-60002 – SERIAL PREFIX 1933A TO 2607A**		
A17R6	0698-0067	2	1	RESISTOR 316 +-1% .25W TF TC=0+-100	12498	NA5-1/4-TO-3160-F
A17R7	0698-0085	0		RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A17R8	0699-0135	3		RESISTOR 71.2 +-1% .25W TF TC=0+-100	11502	HFC65
A17R9	0699-0135	3		RESISTOR 71.2 +-1% .25W TF TC=0+-100	11502	HFC65
A17R10	0698-7204	9	3	RESISTOR 46.4 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-46R4-F
A17R11	0698-7220	9	2	RESISTOR 215 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-215R-F
A17R12	0698-7204	9		RESISTOR 46.4 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-46R4-F
A17R13	0757-0467	8		RESISTOR 121K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1213-F
A17R14	0698-3157	3		RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
A17R15	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A17R16	0699-0392	4	1	RESISTOR 34.8 +-1% .125W TFN TC=0+-100	11502	HFC-55
A17R17	0757-0439	4		RESISTOR 6.81K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6811-F
A17R18	0757-0441	8		RESISTOR 8.25K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8251-F
A17R19	0698-7204	9		RESISTOR 46.4 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-46R4-F
A17R20	0757-0799	9	1	RESISTOR 121 +-1% .5W TF TC=0+-100	K8479	H2
A17R21	0698-0085	0		RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A17R22	0698-7205	0	6	RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A17R23	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A17R24	0698-7216	3		RESISTOR 147 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-147R-F
A17R25	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A17R26	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A17R27	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A17R28	0757-0278	9	3	RESISTOR 1.78K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1781-F
A17R29	0757-0278	9		RESISTOR 1.78K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1781-F
A17R30	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A17R31	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A17R32	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A17R33	0757-0403	2		RESISTOR 121 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-121R-F
A17R34	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A17R35	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A17R36	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A17R37	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A17R38	0757-0403	2		RESISTOR 121 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-121R-F
A17R39	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A17R40	0757-0403	2		RESISTOR 121 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-121R-F
A17R41	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A17R42	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A17T1Δ	08901-80031	7	1	TRANSFORMER ENCAPSULATED	28480	08901-80031
A17U1	08901-67001	3	1	MIXER CIRCUIT	28480	08901-67001
	0340-0850	0	2	INSULATOR-XSTR TFE	13103	7717-158T
	1251-1556	7	18	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	98291	006-4844-00-0-990
A17U2	1826-0412	1		IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number

A17 08901-60104 – SERIAL PREFIX 2609A AND ABOVE

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A17	08902-60104	4	1	INPUT MIXER ASSEMBLY	28480	08902-60104
A17C1	0160-3879	7	8	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C3	0160-3873	1	1	CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A17C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C8	0180-0197	8	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A17C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C11	0160-5469	5	5	CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-5469
A17C12	0160-4835	7	5	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A17C13	0160-4812	0	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A17C14	0160-4652	6	1	CAPACITOR-FXD 960PF +-1% 500VDC MICA	00853	RDM19F961F5C
A17C15	0160-4647	9	1	CAPACITOR-FXD 154PF +-1% 500VDC MICA	28480	0160-4647
A17C16	0180-2929	8	1	CAPACITOR-FXD 68UF+-10% 10VDC TA	28480	0180-2929
A17C17	0160-4646	8	1	CAPACITOR-FXD 444PF +-1% 500VDC MICA	28480	0160-4646
A17C18	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A17C19	0160-4814	2	1	CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4814
A17C20	0160-4641	3	1	CAPACITOR-FXD 3520PF +-1% 50VDC	28480	0160-4641
A17C21	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A17C22	0160-4651	5	1	CAPACITOR-FXD 817PF +-1% 500VDC MICA	00853	RDM19F(817)F5C
A17C23	0160-0576	5	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A17C24	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A17C25	0160-4801	7	1	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A17C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A17C27	08901-00064	8	1	STRAP/CAPACITOR	28480	08901-00064
A17C28	0160-4512	7	2	CAPACITOR-FXD 120PF +-5% 200VDC CER	28480	0160-4512
A17C29	0160-5469	5		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-5469
A17C30	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A17C31	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A17C32	0160-4822	2	1	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A17C33	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A17C34	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A17C35	0160-4512	7		CAPACITOR-FXD 120PF +-5% 200VDC CER	28480	0160-4512
A17C36	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A17CR1 △	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A17CR2 △	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A17CR3	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17CR4	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17CR5	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A17				**08901-60104 - SERIAL PREFIX 2609A AND ABOVE**		
A17CR6	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A17CR7	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A17CR8	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17CR9	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A17DS1	1990-0524	3	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4550
A17E1	9170-0847	3	1	CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE
A17J1	1250-1425	7	2	CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	28480	1250-1425
A17J2	1250-1220	0	2	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
	2190-0124	4	2	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9	2	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A17J3	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A17J4	1250-1425	7		CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	28480	1250-1425
A17L1	9100-3922	4	4	INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A17L2	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A17L3	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A17L4	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A17L5	9100-4434	5	1	INDUCTOR 240UH 2% .165DX.385LF Q=65	28480	9100-4434
A17L6	9100-3313	7	1	INDUCTOR RF-CH-MLD 22UH 5% .166DX.385LG	28480	9100-3313
A17L7	9100-1625	0	1	INDUCTOR RF-CH-MLD 33UH 5% .166DX.385LG	28480	9100-1625
A17L8	9140-0840	3	1	COIL-VAR 18UH-56.3UH Q=20 PC-MTG	28480	9140-0840
A17L10	9100-1626	1	1	INDUCTOR RF-CH-MLD 36UH 5% .166DX.385LG	28480	9100-1626
A17L11	9140-0841	4	1	COIL-VAR 6.1UH-19.1UH Q=20 PC-MTG	28480	9140-0841
A17L12	9140-0303	3	2	INDUCTOR RF-CH-MLD 89.3UH 2%	28480	9140-0303
A17L14	9140-0454	5	1	INDUCTOR RF-CH-MLD 18UH 5% .166DX.385LG	28480	9140-0454
A17MP1	08902-00026	3	1	COVER-MIXER	28480	08902-00026
	2360-0113	2	1	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A17MP2△	5001-5539	9	13	STRAP, GROUND	28480	5001-5539
A17MP3	0363-0159	0	1	RFI STRIP-FINGERS BE-CU ZINC PLATED	28480	0363-0159
A17Q1	1853-0281	9	4	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A17Q2	1853-0314	9	2	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A17Q3	1854-0404	0	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A17Q4	1854-1032	2	1	TRANSISTOR NPN SI PD=2.5W	04713	MRF581
A17Q5	1853-0020	4	2	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A17Q6	1854-1032	2	1	TRANSISTOR NPN SI PD=2.5W	04713	1854-1032

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A17				**08901-60104 – SERIAL PREFIX 2609A AND ABOVE**		
A17Q7	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A17Q8	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A17Q9	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A17Q10	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A17Q11	1854-0610	0	1	TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A17Q12	1858-0008	8	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	04713	MHQ6001
A17Q13	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A17R1	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A17R2	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A17R3	0698-3154	0	5	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A17R4	0698-8821	8	3	RESISTOR 5.62 1% .125W F TC=0+-100	28480	0698-8821
A17R5	0698-8821	8		RESISTOR 5.62 1% .125W F TC=0+-100	28480	0698-8821
A17R6	0698-0087	2	1	RESISTOR 316 1% .25W F TC=0+-100	24546	C5-1/4-TO-3160-F
A17R7	0698-0085	0	2	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A17R8	0699-0135	3	2	RESISTOR 71.2 1% .25W F TC=0+-100	28480	0699-0135
A17R9	0699-0135	3		RESISTOR 71.2 1% .25W F TC=0+-100	28480	0699-0135
A17R10	0698-7204	9	3	RESISTOR 46.4 1% .05W F TC=0+-100	24546	C3-1/8-TO-46R4-F
A17R11	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-TO-215R-F
A17R12	0698-7204	9		RESISTOR 46.4 1% .05W F TC=0+-100	24546	C3-1/8-TO-46R4-F
A17R13	0757-0421	4	1	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A17R14	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A17R15	0757-0422	5	2	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A17R16	0699-0392	4	1	RESISTOR 34.8 1% .125W F TC=0+-100	28480	0699-0392
A17R17	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A17R18	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A17R19	0698-7204	9		RESISTOR 46.4 1% .05W F TC=0+-100	24546	C3-1/8-TO-46R4-F
A17R20	0757-0799	9	1	RESISTOR 121 1% .5W F TC=0+-100	28480	0757-0799
A17R21	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A17R22	0698-7205	0	3	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A17R23	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A17R24	0698-7223	2	1	RESISTOR 287 1% .05W TF TC=0+-100	24546	C3-1/8-TO-287R-F
A17R25	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A17R26	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1211-F
A17R27	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A17R28	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A17R29	0757-0294	9	2	RESISTOR 17.8 1% .125W F TC=0+-100	19701	MF4C1/8-T0-17R8-F
A17R30	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A17R31	0698-3431	6	1	RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
A17R32	0757-0418	9	3	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A17R33	0698-3443	0	3	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A17R34	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A17R35	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

A17 08901-60104 – SERIAL PREFIX 2609A AND ABOVE

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A17R36	0757-0294	9		RESISTOR 17.8 1% .125W F TC=0+-100	19701	MF4C1/8-T0-17R8-F
A17R37	0757-0394	0	2	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A17R38	0757-0180	2	1	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A17R39	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A17R40	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A17R41	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A17R42	0757-0401	0	2	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A17R43	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A17R44	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A17R45	0698-4037	0	2	RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A17R46	0698-8821	8		RESISTOR 5.62 1% .125W F TC=0+-100	28480	0698-8821
A17R47	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A17R48	0698-3438	3	1	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A17R49	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A17R50	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A17T1	08901-80031	7	1	XFMR TORD14.OTRN	28480	08901-80031
A17U1	08901-67001	3	1	MIXER CIRCUIT	28480	08901-67001
Δ	0340-1098	0	1	INSULATOR-IC B-NITRIDE	28480	0340-1098
	1251-1556	7	12	CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A18						
A18	08901-60004	2	1	IF AMPLIFIER ASSEMBLY	28480	08901-60004
A18C1	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A18C2	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A18C3	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A18C4	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A18C5	0180-2619	3	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	12344	T355F226K016AS
A18C6	0160-0156	7	1	CAPACITOR-FXD 3900PF +-10% 200VDC POLYE	19701	708D1CC392PK201AX
A18C7	0160-2257	3		CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	09535	301-000-C0H-100D
A18C8	0140-0198	5		CAPACITOR-FXD 200PF +-5% 300VDC MICA	28480	0140-0198
A18C9	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A18C10	0160-2242	6	2	CAPACITOR-FXD 2.4PF +-.25PF 500VDC CER	09535	301-000-NP00-249C
A18C11	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A18C12	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A18C13△	0160-6623	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6623
A18C14	0160-2266	4	1	CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	09535	301-000-COG0-240J
A18C15	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A18C16	0160-2205	1	1	CAPACITOR-FXD 120PF +-5% 300VDC MICA	28480	0160-2205
A18C17	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A18C18	0160-2242	6		CAPACITOR-FXD 2.4PF +-.25PF 500VDC CER	09535	301-000-NP00-249C
A18C19	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A18C20	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A18C21	0160-2265	3	1	CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	09535	301-000-COG0-220J
A18CR1△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A18CR2△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A18CR3△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A18CR4△	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A18CR5△	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A18CR6△	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A18CR7△	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
1933A to 2439A *A18E1*				NOT ASSIGNED		
2443A and above *A18E1*	9170-0029	3	1	CORE SHEILDING BEAD (ADDED TO BASE OF Q7)	28480	9170-0029
A18J1	1250-1205	1	6	CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	16179	5064-5008-09
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
A18J2	1250-1205	1		CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	16179	5064-5008-09
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
A18L1	9100-1628	3	1	INDUCTOR RF-CH-MLD 43UH +-5%	91637	IM-4 43UH 5%
A18L2	9140-0237	2	1	INDUCTOR RF-CH-MLD 200UH +-5%	91637	IM-4 200UH 5%

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A18MP1	08901-00029	5	1	COVER, IF AMPLIFIER	28480	08901-00029
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A18MP2	08901-20082	2		P.C. BOARD EXTRACTOR	28480	08901-20082
A18Q1	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A18Q2	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A18Q3	1853-0018	0	1	TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
1933A to 2212A						
A18Q4	1854-0345	8	1	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
2227A and above						
A18Q4	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A18Q5	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A18Q6	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A18Q7	1854-0610	0	5	TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A18R1	0698-3429	2		RESISTOR 19.6 +-1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A18R2	0698-3429	2		RESISTOR 19.6 +-1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A18R3	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A18R4	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A18R5	0757-0278	9		RESISTOR 1.78K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1781-F
A18R6	0698-3153	9		RESISTOR 3.83K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3831-F
A18R7	0698-3434	9		RESISTOR 34.8 +-1% .125W TF TC=0+-100	D8439	MK2
A18R8	0757-0418	9		RESISTOR 619 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-619R-F
A18R9	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A18R10	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A18R11	0698-3438	3		RESISTOR 147 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-147R-F
A18R12	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A18R13	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A18R14	0757-0338	2		RESISTOR 1K +-1% .25W TF TC=0+-100	12498	NA5-1/4-TO-1001-F
A18R15	0698-3429	2		RESISTOR 19.6 +-1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A18R16	0698-3446	3		RESISTOR 383 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-383R-F
A18R17	0698-3446	3		RESISTOR 383 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-383R-F
A18R18	0698-3445	2		RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
A18R19	2100-0552	3		RESISTOR-TRMR 50 10% TKF SIDE-ADJ 1-TRN	28480	2100-0552
A18R20	0698-3150	6		RESISTOR 2.37K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2371-F
A18R21	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A18R22	0698-3440	7		RESISTOR 196 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-196R-F
1933A to 2251A						
A18R23	2100-3350	5	1	RESISTOR-TRMR 200 10% TKF SIDE-ADJ 1-TRN	28480	2100-3350
A18R24	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
2302A and above						
A18R23	2100-3351	6	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A18R24	0698-3446	3		RESISTOR 383 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-383R-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A18R25	0757-0402	1	7	RESISTOR 110 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-111-F
A18R26	0757-0395	1		RESISTOR 56.2 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-56R2-F
A18R27	0757-0402	1		RESISTOR 110 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-111-F
A18R28	0698-3151	7		RESISTOR 2.87K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2871-F
A18R29	0698-3447	4		RESISTOR 422 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-422R-F
A18R30	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A18R31	0757-0422	5	7	RESISTOR 909 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-909R-F
A18R32	0698-3431	6	1	RESISTOR 23.7 +-1% .125W TF TC=0+-100	D8439	MK2
A18R33	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**SERIAL PREFIX 1933A TO 2751A**		
1933A to 2617A						
A19	08901-60024	6	1	LO DIVIDER ASSEMBLY	28480	08901-60024
2618A to 2751A						
A19	08901-60274	8	1	LO DIVIDER ASSEMBLY	28480	08901-60274
A19C1	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	09969	RPE121-105X7R221M100V
A19C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C9	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C10	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A19C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A19C13	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A19C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C16	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
1933A to 2617A						
A19C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
2618A to 2751A						
A19C17	0160-0576	5	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE121-105X7R104M50V
A19C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A19C19	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
A19C20	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
A19C21	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C22	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C23	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C24	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C25	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A19C26	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C27	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A19C28	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
A19C29	0160-0690	4	2	CAPACITOR-FXD 1PF +-.5PF 100VDC CER	06383	FD12COG2A1R0D
A19C30	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A19C31	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
A19C32	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V
A19C33	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V
A19C34	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A19C35	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**SERIAL PREFIX 1933A TO 2751A**		
A19C36	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V
A19C37	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	06383	FD11X7R2A471M
1933A to 2346A						
A19C38	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
2350A to 2751A						
A19C38	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A19C39	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
A19C40	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
A19C41	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
A19C42	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	06383	FD12X7R2A222M
1933A to 2021A						
A19C43	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	09969	RPE121-105C0G4R7D200V
2026A to 2751A						
A19C43	0160-4491	1		CAPACITOR-FXD 8.2PF +-5% 200VDC CER	28480	0160-4491
A19C44	0160-3568	1	2	CAPACITOR-FXD 2.7PF +-.25PF 200VDC CER	06383	FD11C0G2D2R7J
A19C45	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C46	0160-3568	1		CAPACITOR-FXD 2.7PF +-.25PF 200VDC CER	06383	FD11C0G2D2R7J
A19C47	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C48	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C49	0160-0690	4		CAPACITOR-FXD 1PF +-.5PF 100VDC CER	06383	FD12COG2A1R0D
A19C50	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C51	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C52	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C53	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C54	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C55	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C56	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	06383	FD11X7R2A471M
A19C57	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C58	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A19C59	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	06383	FD11X7R2A471M
A19C60	0160-0576	5	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE121-105X7R104M50V
A19C61	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE121-105X7R104M50V
A19C62	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A19C63	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V
1933A to 2617A						
A19C64-C70				NOT ASSIGNED		
2618A to 2751A						
A19C64	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C65	0160-4835	7	2	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A19C66	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C67	0160-4835	7	2	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A19C68	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C69	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A19C70	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A19 SERIAL PREFIX 1933A TO 2751A

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19CR1	1901-0033	2	10	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
1933A to 2410A						
A19CR2	0122-0072	6	4		28480	0122-0072
A19CR3	0122-0072	6			28480	0122-0072
A19CR4	0122-0072	6			28480	0122-0072
A19CR5	0122-0072	6			28480	0122-0072
2412A to 2751A						
A19CR2	0122-0161	4	4	DIODE-VVC 2.2PF 7%	28480	0122-0161
A19CR3	0122-0161	4	4	DIODE-VVC 2.2PF 7%	28480	0122-0161
A19CR4	0122-0161	4	4	DIODE-VVC 2.2PF 7%	28480	0122-0161
A19CR5	0122-0161	4	4	DIODE-VVC 2.2PF 7%	28480	0122-0161
A19CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A19CR7	1901-1097	0	2	DIODE-PIN	28480	1901-1097
A19CR8	1901-1097	0		DIODE-PIN	28480	1901-1097
A19CR9	1901-0639	4	1	DIODE-PIN	28480	5082-3080
A19CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A19E1	9170-0029	3	5	CORE-SHIELDING BEAD	78488	57-3452
A19E2	9170-0029	3		CORE-SHIELDING BEAD	78488	57-3452
A19J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A19J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A19J3	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A19JP1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4
A19JP2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4
A19JP3				NOT ASSIGNED		
A19JP4	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4
A19L1	9100-3922	4		RF CHOKE	28480	9100-3922
A19L2	9100-3922	4		RF CHOKE	28480	9100-3922
A19L3	9100-3922	4		RF CHOKE	28480	9100-3922
A19L4	9100-3922	4		RF CHOKE	28480	9100-3922
A19L5	9135-0068	6	2	INDUCTOR, .033 UH	24226	10M033X-1
A19L6	9135-0073	3	3	INDUCTOR, .051 UH	24226	10M051X-1
A19L7	9135-0068	6		INDUCTOR, .033 UH	24226	10M033X-1
A19L8	9135-0073	3		INDUCTOR, .051UH	24226	10M051X-1
A19L9				PART OF ETCHED CIRCUIT BOARD		
A19L10	9100-3922	4		RF CHOKE	28480	9100-3922

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**SERIAL PREFIX 1933A TO 2751A**		
A19L11	9100-3922	4		RF CHOKE	28480	9100-3922
A19L12	9100-3922	4		RF CHOKE	28480	9100-3922
A19L13	9140-0210	1		INDUCTOR RF-CH-MLD 100UH +-5%	91637	IM-4 100UH 5%
A19L14	9135-0073	3		INDUCTOR, .051 UH	24226	10M051X-1
A19L15				PART OF ETCHED CIRCUIT BOARD		
1933A to 2617A						
A19MP1	08901-00028	4	1	COVER, LO DIVIDER (INCLUDES P.C. EXTRACTOR)	28480	08901-00028
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
2618A to 2751A						
A19MP1	08901-00166	1	1	COVER, LO DIVIDER (INCLUDES P.C. EXTRACTOR)	28480	08901-00166
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A19MP2	08662-00039	7	1	SHIELD, CIRCUIT, LARGE	28480	08662-00039
A19MP3	08662-00041	1	1	SHIELD, COMPONENT, LARGE	28480	08662-00041
A19MP4	5001-0173	7		STRAP, GROUND	28480	5001-0173
A19MP5	08901-20082	2		P.C. BOARD EXTRACTOR	28480	08901-20082
A19Q1	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A19Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A19Q3	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A19Q4	1858-0032	8		TRANSISTOR ARRAY 14-PIN PLSTC DIP	27014	LM3146
A19R1	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A19R2	0698-7227	6		RESISTOR 422 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-422R-F
A19R3	0698-7227	6		RESISTOR 422 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-422R-F
A19R4	0698-7227	6		RESISTOR 422 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-422R-F
A19R5	0698-7227	6		RESISTOR 422 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-422R-F
A19R6	0698-7232	3	4	RESISTOR 681 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-681R-F
A19R7	0698-7232	3		RESISTOR 681 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-681R-F
A19R8	0698-7232	3		RESISTOR 681 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-681R-F
A19R9	0698-7232	3		RESISTOR 681 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-681R-F
A19R10	0698-3437	2	1	RESISTOR 133 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-133R-F
A19R11	0757-0402	1		RESISTOR 110 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-111-F
A19R12	0757-0422	5		RESISTOR 909 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-909R-F
A19R13	0757-0422	5		RESISTOR 909 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-909R-F
A19R14	0757-0422	5		RESISTOR 909 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-909R-F
A19R15	0757-0422	5		RESISTOR 909 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-909R-F
1933A to 2617A						
A19R16	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A19R17	0698-7238	9	1	RESISTOR 1.21K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1211-F
2618A to 2751A						
A19R16	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A19R17	0698-3151	7		RESISTOR 2.87K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2871-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**SERIAL PREFIX 1933A TO 2751A**		
A19R18	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R19	0698-7201	6	1	RESISTOR 34.8 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-34R8-F
A19R20	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
1933A to 2346A						
A19R21	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
2350A to 2617A						
A19R21	0698-7214	1		RESISTOR 121 +-1% .05W F TC=0+-100	12498	C3-1/8-TO-121R-F
2618A to 2751A						
A19R21	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A19R22	0757-0440	7		RESISTOR 7.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7501-F
A19R23	0757-0289	2	4	RESISTOR 13.3K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-1332-F
A19R24	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A19R25	0698-3158	4		RESISTOR 23.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2372-F
	1810-0203	5	2	NETWORK-RES 8-SIP 470.0 OHM X 7	C1433	750-81
1933A to 2346A						
A19R27	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
2350A to 2617A						
A19R27	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
2618A to 2751A						
A19R27	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R28	1810-0203	5		NETWORK-RES 8-SIP 470.0 OHM X 7	C1433	750-81
A19R29	1810-0203	5		NETWORK-RES 8-SIP 470.0 OHM X 7	C1433	750-81
A19R30	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A19R31	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A19R32	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
1933A to 2617A						
A19R33	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A19R34	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
2618A to 2751A						
A19R33△	0757-0420	3		RESISTOR 750 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-751-F
A19R34△	0757-0420	3		RESISTOR 750 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-751-F
A19R35	0698-7195	7		RESISTOR 19.6 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-19R6-F
A19R36	0757-0276	7	2	RESISTOR 61.9 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6192-F
A19R37	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A19R38	0698-3151	7		RESISTOR 2.87K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2871-F
A19R39	0757-0276	7		RESISTOR 61.9 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6192-F
A19R40	0698-7229	8	5	RESISTOR 511 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-511R-F
A19R41	2100-2413	9	1	RESISTOR-TRMR 200 10% TKF SIDE-ADJ 1-TRN	73138	82PAR200
A19R42	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R43	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R44	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**SERIAL PREFIX 1933A TO 2751A**		
A19R45	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R46	0698-7229	8		RESISTOR 511 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-511R-F
A19R47	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R48	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A19R49	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R50	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R51	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R52	0757-0316	6	1	RESISTOR 42.2 +-1% .125W TF TC=0+-100	D8439	MK2
A19R53	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R54	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R55	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R56	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R57	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R58	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R59	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R60	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A19R61	0757-0422	5		RESISTOR 909 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-909R-F
A19R62	0698-3158	4		RESISTOR 23.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2372-F
A19R63Δ	0757-0398	4		RESISTOR 75 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-75R-F
A19R64	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R65				NOT ASSIGNED		
A19R66	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A19R67	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R68	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R69	0698-3447	4		RESISTOR 422 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-422R-F
A19R70	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R71	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A19R72*Δ	0757-0422	5	11	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R73				NOT ASSIGNED		
A19R74*Δ	0757-0422	5	11	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R75Δ	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R76	0698-3438	3		RESISTOR 147 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-147R-F
A19R77	0698-3438	3		RESISTOR 147 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-147R-F
A19R78	0698-3438	3		RESISTOR 147 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-147R-F
A19R79	0757-0726	2	1	RESISTOR 511 +-1% .25W TF TC=0+-100	12498	NA5-1/4-TO-511R-F
A19R80	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A19R81	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A19R82	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A19R83	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R84	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R85	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**SERIAL PREFIX 1933A TO 2751A**		
1933A to 2346A						
A19R86	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
2350A to 2751A						
A19R86	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
1933A to 2617A						
A19R87	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
2618A to 2751A						
A19R21	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A19R88	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A19R89	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A19R90	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A19R91	0698-7247	0	2	RESISTOR 2.87K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-2871-F
A19R92	0698-3151	7		RESISTOR 2.87K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2871-F
A19R93	0698-7247	0		RESISTOR 2.87K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-2871-F
A19R94	0698-7208	3	1	RESISTOR 68.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-68R1-F
A19R95	0698-7229	8		RESISTOR 511 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-511R-F
A19R96	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R97	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A19R98	0698-7229	8		RESISTOR 511 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-511R-F
A19R99	0698-3439	4		RESISTOR 178 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-178R-F
A19R100	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R101	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R102	0698-3439	4		RESISTOR 178 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-178R-F
A19R103	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R104	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A19R105	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A19R106	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A19R107	0757-0397	3		RESISTOR 68.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-68R1-F
A19R108	0698-7209	4		RESISTOR 75 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-75R0-F
A19R109	0698-7229	8		RESISTOR 511 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-511R-F
A19R110	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
1933A to 2617A						
A19R111-R116				NOT ASSIGNED		
2618A to 2751A						
A19R111	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R112	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A19R113	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R114	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R115	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19R116	0698-3132	4		RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A19TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A19TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**SERIAL PREFIX 1933A TO 2751A**		
A19U1	1820-1225	4	1	IC FF ECL D-M/S DUAL	04713	MC10231P
A19U2	1826-0372	2	6	IC, A251 LIMITER	28480	A251-0100
A19U3	1826-0013	8		IC OP AMP LOW-NOISE 8-TO-99 PKG	24355	AD741CH
A19U4	08901-67002	4	1	FREQUENCY DOUBLER	28480	08901-67002
	0340-0850	0		INSULATOR-XSTR TFE	13103	7717-158T
	1251-1556	7		CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	98291	006-4844-00-0-990
A19U5	1826-0372	2		IC, A251 LIMITER	28480	A251-0100
A19U6	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
1933A to 2617A						
A19U7	1820-1940	0	2	IC, B196	28480	B196A-0100
A19U8	1820-1940	0		IC, B196	28480	B196A-0100
2618A to 2751A						
A19U7	1820-3485	2		IC PRESCR ECL MC12090L	28480	1820-3485
A19U8	1820-3485	2		IC PRESCR ECL MC12090L	28480	1820-3485
A19U9	1820-0796	2	1	IC GATE ECL NOR QUAD 2-INP	04713	MC1662L
A19U10	1826-0372	2		IC, A251 LIMITER	28480	A251-0100
A19U11	1826-0372	2		IC, A251 LIMITER	28480	A251-0100
A19U12	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A19U13	1820-1400	7	2	IC GATE ECL AND QUAD 2-INP	04713	MC10104P
A19U14	1820-1400	7		IC GATE ECL AND QUAD 2-INP	04713	MC10104P
A19U15	1820-0828	1	2	IC DCDR ECL BIN 3-TO-8-LINE 3-INP	04713	MC10162P
A19U16	1820-0802	1	2	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A19U17	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A19U18	1820-0828	1		IC DCDR ECL BIN 3-TO-8-LINE 3-INP	04713	MC10162P
A19U19	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A19U20	1820-1052	5	1	IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A19VR1△	1902-0943	5		DIODE-ZNR 2.37V 5% DO-7 PD=0.4W TC=-.074%	28480	1902-0943
A19VR2	1902-0049	2	3	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A19VR3	1902-0049	2		DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A19VR4	1902-0049	2		DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**08902-60126 – SERIAL PREFIX 2911A AND ABOVE**		
A19	08902-60126	0	1	LO DIVIDER ASSEMBLY	28480	08902-60126
A19C1	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A19C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C9	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C10	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A19C11	0160-4822	2		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-4822
A19C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A19C13	0160-4822	2		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-4822
A19C14	0160-4832	4		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-4832
A19C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C16	0160-4830	2		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-4830
A19C17	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A19C18	0160-4832	4		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-4832
A19C19				NOT ASSIGNED		
A19C20				NOT ASSIGNED		
A19C21	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C22	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C23	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C24	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C25	0160-4832	4		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-4832
A19C26	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C27	0160-4832	4		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-4832
A19C28				NOT ASSIGNED		
A19C29	0160-0690	4	2	CAPACITOR-FXD 1PF +-.5PF 100VDC CER	28480	0160-0690
A19C30	0160-4832	4		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-4832
A19C31	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A19C32	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A19C33	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A19C34	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C35	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A19C36	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A19C37	0160-0571	0	7	CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A19C38	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A19C39	0160-4830	2		CAPACITOR-FXD 2200PF +-10% 100VDC CER	28480	0160-4830
A19C40	0160-4830	2		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-4830
A19C41	0160-4830	2		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-4830
A19C42	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A19C43*	0160-4491	1	1	CAPACITOR-FXD 8.2PF +-5% 200VDC CER	28480	0160-4491

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**08902-60126 - SERIAL PREFIX 2911A AND ABOVE**		
A19C44	0160-3568	1	2	CAPACITOR-FXD 2.7PF +-5% 200VDC CER	51642	100-100-NP0-279J
A19C45	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A19C46	0160-3568	1		CAPACITOR-FXD 2.7PF +-5% 200VDC CER	51642	100-100-NP0-279J
A19C47	0160-4822	2		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-4822
A19C48	0160-4822	2		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-4822
A19C49	0160-0690	4		CAPACITOR-FXD 1PF +-.5PF 100VDC CER	28480	0160-0690
A19C50	0160-4822	2		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-4822
A19C51	0160-4822	2		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-4822
A19C52	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C53	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A19C54	0160-4822	2		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-4822
A19C55	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C56	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A19C57	0160-4822	2		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-4822
A19C58	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A19C59	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A19C60	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C61	0160-4835	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4835
A19C62	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A19C63	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A19C64	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A19C65	0160-0576	5		CAPACITOR-FXD .1UF +-10% 100VDC CER	28480	0160-0576
A19C66				NOT ASSIGNED		
A19C67	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A19C68				NOT ASSIGNED		
A19C69				NOT ASSIGNED		
A19C70				NOT ASSIGNED		
A19CR1	1901-0033	2	8	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A19CR2	0122-0161	4		DIODE-VVC 2.2PR 7% BVR=30V	28480	0122-0161
A19CR3	0122-0161	4		DIODE-VVC 2.2PR 7% BVR=30V	28480	0122-0161
A19CR4	0122-0161	4		DIODE-VVC 2.2PR 7% BVR=30V	28480	0122-0161
A19CR5	0122-0161	4		DIODE-VVC 2.2PR 7% BVR=30V	28480	0122-0161
A19CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A19CR7	1901-1097	0	2	DIODE-PIN	28480	1901-1097
A19CR8	1901-1097	0		DIODE-PIN	28480	1901-1097
A19CR9	1901-0639	4	1	DIODE-PIN	28480	5082-3080
A19CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A19E1	9170-0029	3	11	CORE-SHIELDING BEAD	28480	9170-0029
A19E2	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A19J1	1250-1425	7		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1425
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A19J2	1250-1425	7		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1425
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**08902-60126 – SERIAL PREFIX 2911A AND ABOVE**		
A19J3	1250-1425	7		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1425
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A19L1	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A19L2	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A19L3	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A19L4	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A19L5	9135-0068	6	2	INDUCTOR RF-CH-MLD 33NH 6% .102DX.26LG	28480	9135-0068
A19L6	9135-0073	3	3	INDUCTOR RF-CH-MLD 51NH 6% .102DX.26LG	28480	9135-0073
A19L7	9135-0068	6		INDUCTOR RF-CH-MLD 33NH 6% .102DX.26LG	28480	9135-0068
A19L8	9135-0073	3		INDUCTOR RF-CH-MLD 51NH 6% .102DX.26LG	28480	9135-0073
A19L9				PART OF ETCHED CIRCUIT BOARD		
A19L10	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A19L11	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A19L12	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A19L13	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A19L14	9135-0073	3		INDUCTOR RF-CH-MLD 51NH 6% .102DX.26LG	28480	9135-0073
A19L15				PART OF ETCHED CIRCUIT BOARD		
A19MP1	08901-00166	1	1	COVER LO DIVIDER	28480	08901-00166
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A19MP2Δ	5001-5539	9		GROUND STRAP	28480	5001-5539
A19MP3Δ	5001-5539	9		GROUND STRAP	28480	5001-5539
A19MP4	08662-00041	1	1	SHIELD COMPONENT	28480	08662-00041
A19MP5	08662-00039	7	1	SHIELD COMPONENT	28480	08662-00039
A19Q1	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A19Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A19Q3	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A19Q4	1858-0032	8		TRANSISTOR ARRAY 14-PIN PLSTC DIP	3L585	CA3146E
A19R1	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A19R2	0698-7227	6	9	RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-TO-422R-F
A19R3	0698-7227	6		RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-TO-422R-F
A19R4	0698-7227	6		RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-TO-422R-F
A19R5	0698-7227	6		RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-TO-422R-F
A19R6	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A19R7	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A19R8	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A19R9	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A19R10	0698-3437	2	1	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A19R12	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R13	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R14	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R15	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R16	0757-0280	3		RESISTOR 1K 1% .5W .125W F TC=0+-100	28480	0757-0280

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**08902-60126 – SERIAL PREFIX 2911A AND ABOVE**		
A19R17	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	0698-3151
A19R18	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R19	0698-7201	6	1	RESISTOR 34.8 1% .05W F TC=0+-100	24546	C3-1/8-TO-34R8-F
A19R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R21	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-51.1R-F
A19R22	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A19R23	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A19R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A19R25	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A19R26	1810-0203	5	3	NETWORK-RES 8-SIP470.0 OHM X 7	01121	208A471
A19R27	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-TO-2610-F
A19R28	1810-0203	5		NETWORK-RES 8-SIP470.0 OHM X 7	01121	208A471
A19R29	1810-0203	5		NETWORK-RES 8-SIP470.0 OHM X 7	01121	208A471
A19R30	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-TO-51R1-F
A19R31	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A19R32	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A19R33	0757-0420△	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-TO-751-F
A19R34△	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C3-1/8-TO-751-F
A19R35	0698-7195	7	2	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-TO-19R6-F
A19R36	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A19R37	0757-0394	0		RESISTOR 51.1 1% .125W F TC+0+-100	24546	C4-1/8-TO-51R1-F
A19R38	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	0757-0394
A19R39	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A19R40	0757-0416	7		RESISTOR 511 1%.125W F TC=0+-100	24546	0757-0416
A19R41	2100-2413	9	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	30983	ET50X201
A19R42	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R43	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R44	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R45	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R46	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A19R47	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R48	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	0757-0346
A19R49	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R50	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R51	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R52	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R53	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R54	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R55	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R56	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R57	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R58	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R59	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R60	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A19R61	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R62	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A19R63*	0757-0398	4	3	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

A19 08902-60126 – SERIAL PREFIX 2911A AND ABOVE

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19R64	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R65				NOT ASSIGNED		
A19R66	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A19R67	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R68	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R69	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A19R70	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R71	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A19R72*	0757-0422	5	11	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R73				NOT ASSIGNED		
A19R74*	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A19R75	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R76	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A19R77	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A19R78	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A19R79	0757-0726	2	1	RESISTOR 511 1% .25W F TC=0+-100	24546	C5-1/4-TO-511R-F
A19R80	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A19R81	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A19R82	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A19R83	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R84	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R85	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R86	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-TO-51R1-F
A19R87	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-TO-51R1-F
A19R88	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A19R89	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R90	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A19R91	0698-7247	0	5	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-F
A19R92	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A19R93	0698-7247	0		RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-F
A19R94	0698-7208	3	1	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-68R1-F
A19R95	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A19R96	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R97	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R98	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A19R99	0698-3439	4	4	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A19R100	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R101	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R102	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A19R103	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R104	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A19				**08902-60126 – SERIAL PREFIX 2911A AND ABOVE**		
A19R105	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A19R106	0698-7209	4		RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-TO-75R0-F
A19R107	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A19R108	0698-7209	4		RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-TO-75R0-F
A19R109	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A19R110	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A10R111	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	28480	0698-3132
A19R112	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A19R113	0698-3132	4		RESISTOR 261 1% .126W F TC=0+-100	24546	C4-1/8-TO-2610-F
A19R114	0698-3132	4		RESISTOR 261 1% .126W F TC=0+-100	24546	C4-1/8-TO-2610-F
A19R115	0698-3132	4		RESISTOR 261 1% .126W F TC=0+-100	24546	C4-1/8-TO-2610-F
A19R116	0698-3132	4		RESISTOR 261 1% .126W F TC=0+-100	24546	C4-1/8-TO-2610-F
A19TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A19TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A19U1	1820-1225	4	1	IC FF ECL D-M/S DUAL	04713	MC10231P
A19U2	1826-0372	2	6	IC MISC 8-DIP-P PKG	28480	1826-0372
A19U3	1826-0013	8	2	IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A19U4	08901-67002	4	1	FREQUENCY DUBLER	28480	08901-67002
	0340-1098	0		INSULATOR-IC B-NITRIDE	28480	0340-1098
	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A19U5	1826-0372	2		IC MISC 8-DIP-P PKG	28480	1826-0372
A19U6	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A19U7	1820-1940	0	2	IC CNTR ECL BIN SYNCHRO POS-EDGE-TRIG	28480	1820-1940
A19U8	1820-1940	0		IC CNTR ECL BIN SYNCHRO POS-EDGE-TRIG	28480	1820-1940
A19U9	1820-0796	2	1	IC GATE ECL NOR QUAD 2-INP	04713	MC1662L
A19U10	1826-0372	2		IC MISC 8-DIP-P PKG	28480	1826-0372
A19U11	1826-0372	2		IC MISC 8-DIP-P PKG	28480	1826-0372
A19U12	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A19U13	1820-1400	7	2	IC GATE ECL AND QUAD 2-INP	04713	MC10104P
A19U14	1820-1400	7		IC GATE ECL AND QUAD 2-INP	04713	MC10104P
A19U15	1820-0828	1	2	IC DCDR ECL BIN 3-TO-8-LINE 3-INP	04713	MC10162P
A19U16	1820-0802	1	2	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A19U17	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A19U18	1820-0828	1		IC DCDR ECL BIN 3-TO-8-LINE 3-INP	04713	MC10162P
A19U19	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A19U20	1820-1052	5	1	IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A20U21	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10216P
A19VR1	1902-0943	5		DIODE-ZNR 2.4V 5% DO-35 PD=.4W TC=-.037%	28480	1902-0943
A19VR2	1902-0049	2	3	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A19VR3	1902-0049	2		DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A19VR4	1902-0049	2		DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A19W1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A19W2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A19W3				NOT ASSIGNED		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A20 08901-60023 – SERIAL PREFIX 1933A TO 2616A

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20	08901-60023	5	1	LO CONTROL ASSEMBLY	28480	08901-60023
A20C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A20C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A20C3	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A20C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A20C5	0180-2853	7	2	CAPACITOR-FXD 10UF+-20% 100VDC TA	56289	109D106X0100C2
A20C6	0180-0490	4	1	CAPACITOR-FXD 68UF+-10% 6VDC TA	12344	T355G686K006AS
A20C7	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A20C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A20C9	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A20C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A20C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A20C12	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A20C13	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A20C14	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	19701	708D1AA102PK201AX
A20C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A20C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A20C17	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	19701	708D1CC103PK201AX
A20C18	0180-2853	7		CAPACITOR-FXD 10UF+-20% 100VDC TA	56289	109D106X0100C2
A20C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A20C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A20C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A20C22	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A20C23	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A20CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A20CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A20CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR17	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A20CR18	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A20CR19	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A20CR20	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20				**08901-60023 – SERIAL PREFIX 1933A TO 2616A**		
A20CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR22	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR23	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR24	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A20CR25	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	9N171	1N4148
A20CR26	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
1933A to 2312A						
A20E1				NOT ASSIGNED		
2324A to 2616A						
A20E1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4
A20JP1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4
A20JP2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4
A20MP1	08901-00027	3	2	COVER, LO CONTROL (INCLUDES P.C. EXTRACTOR)	28480	08901-00027
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A20MP2	08901-20082	2		P.C. BOARD EXTRACTOR	28480	08901-20082
A20Q1	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A20Q2	1853-0034	0	3	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A20Q3	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A20Q4	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A20Q5	1854-0247	9	6	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
	1200-0173	5	13	INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A20Q6	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A20Q7	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A20Q8	1854-0023	9	4	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A20Q9	1854-0023	9		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A20Q10	1855-0273	3	2	TRANSISTOR J-FET P-CHAN D-MODE TO-92 SI	28480	1855-0273
A20Q11	1855-0273	3		TRANSISTOR J-FET P-CHAN D-MODE TO-92 SI	28480	1855-0273
A20Q12	1854-0023	9		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A20Q13	1855-0091	3	4	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0091
A20Q14	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A20Q15	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A20Q16	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A20Q17				NOT ASSIGNED		
A20Q18	1855-0091	3		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0091
A20Q19	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A20Q20	1854-0022	8	4	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A20Q21	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A20Q22	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A20Q23	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	04713	2N2904A
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20				**08901-60023 – SERIAL PREFIX 1933A TO 2616A**		
1933A to 2521A						
A20Q24	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	04713	2N2904A
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A20Q25	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	04713	2N2904A
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
2542A to 2616A						
A20Q24	1853-0594	7		TRANSISTOR DUAL PNP 2N3808 TO-78	28480	1853-0594
A20Q25				NOT ASSIGNED		
A20Q26	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A20Q27	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A20R1*	0698-7276	5	2	RESISTOR 46.4K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-4642-F
A20R2*	0698-7276	5		RESISTOR 46.4K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-4642-F
A20R3	0698-7248	1	1	RESISTOR 3.16K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-3161-F
A20R4	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A20R5	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R6	0698-7258	3	2	RESISTOR 8.25K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-8251-F
A20R7	0698-7270	9	1	RESISTOR 26.1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-2612-F
A20R8	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R9	0698-7212	9		RESISTOR 100 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-100R-F
A20R10	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A20R11	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R12	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R13	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R14	0698-7279	8	1	RESISTOR 61.9K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-6192-F
A20R15	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R16				NOT ASSIGNED		
A20R17	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R18	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R19	0698-7267	4	1	RESISTOR 19.6K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1962-F
A20R20	0698-7259	4	3	RESISTOR 9.09K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-9091-F
A20R21	0698-7251	6		RESISTOR 4.22K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-4221-F
A20R22	0698-7240	3		RESISTOR 1.47K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1471-F
A20R23	0698-7220	9		RESISTOR 215 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-215R-F
A20R24	0757-0470	3	1	RESISTOR 162K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1623-F
A20R25	0698-7282	3	1	RESISTOR 82.5K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-8252-F
A20R26	0698-7274	3	1	RESISTOR 38.3K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-3832-F
A20R27	0698-7261	8	1	RESISTOR 11K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1102-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A20 08901-60023 – SERIAL PREFIX 1933A TO 2616A

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20R28	0698-7253	8		RESISTOR 5.11K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-5111-F
A20R29	0698-7216	3		RESISTOR 147 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-147R-F
A20R30	0698-7251	6		RESISTOR 4.22K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-4221-F
A20R31	0698-7259	4		RESISTOR 9.09K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-9091-F
A20R32	0698-7284	5		RESISTOR 100K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1003-F
A20R33	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R34	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R35	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R36	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R37	0698-7288	9	3	RESISTOR 147K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1473-F
A20R38	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R39	0698-7284	5		RESISTOR 100K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1003-F
A20R40	0698-7243	6	1	RESISTOR 1.96K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1961-F
A20R41	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R42	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R43	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A20R44	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R45	0698-7288	9		RESISTOR 147K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1473-F
A20R46	0698-7275	4	1	RESISTOR 42.2K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-4222-F
A20R47	0757-0460	1	1	RESISTOR 61.9K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6192-F
A20R48	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R49	0698-7253	8		RESISTOR 5.11K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-5111-F
A20R50	0757-0290	5		RESISTOR 6.19K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-6191-F
A20R51	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R52	0698-7258	3		RESISTOR 8.25K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-8251-F
A20R53	0698-7253	8		RESISTOR 5.11K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-5111-F
A20R54				NOT ASSIGNED		
A20R55				NOT ASSIGNED		
A20R56	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R57	0757-0462	3		RESISTOR 75K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7502-F
A20R58	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A20R59	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R60	0698-7259	4		RESISTOR 9.09K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-9091-F
A20R61	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R62	0698-8744	4	1	RESISTOR 2K +-0.05% .1W TF TC=0+-15	09464	PR1/10
A20R63	0698-7284	5		RESISTOR 100K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1003-F
A20R64	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A20R65	0699-0381	1	2	RESISTOR 40K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A20R66	0699-0381	1		RESISTOR 40K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A20R67	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A20R68	0699-0118	2	1	RESISTOR 20K +-0.1% .1W TF TC=0+-5	09464	PR1/10
A20R69	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A20R70	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R71	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R72	0698-7257	2	1	RESISTOR 7.5K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-7501-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20				**08901-60023 – SERIAL PREFIX 1933A TO 2616A**		
A20R73	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R74	0757-0158	4	1	RESISTOR 619 +-1% .5W TF TC=0+-100	K8479	H2
A20R75	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R76	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R77	0698-7218	5	1	RESISTOR 178 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-178R-F
A20R78	0698-7260	7		RESISTOR 10K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1002-F
A20R79	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A20R80	0698-7286	7	1	RESISTOR 121K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1213-F
A20R81	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A20R82	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A20R83	0698-7288	9		RESISTOR 147K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1473-F
A20R84	0698-7262	9	1	RESISTOR 12.1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1212-F
A20TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A20TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A20TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A20TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A20U1	1826-0013	8		IC OP AMP LOW-NOISE 8-TO-99 PKG	24355	AD741CH
A20U2Δ	1820-1547	3		IC MULTIPLEXER 8-CHNL-ANL 16-DIP-C PKG	04713	MC14051
A20U3	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A20U4	1826-0217	4	1	IC OP AMP GP DUAL 8-TO-99 PKG	07933	RC4558H
A20U5	1826-0161	7		IC OP AMP GP QUAD 14-DIP-P PKG	27014	LM324N
A20U6	1820-1200	5		IC INV TTL LS HEX	01295	SN74LS05N
A20U7	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U8	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A20U9	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A20U10	1826-0188	8	2	D/A 8-BIT 16-CERDIP BPLR	04713	MC1408L-8
A20U11	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A20U12	1826-0188	8		D/A 8-BIT 16-CERDIP BPLR	04713	MC1408L-8
A20U13	1990-0643	7		OPTO-ISOLATOR LED-PCNDCT IF=40MA-MAX	03911	CLM6500
A20U14	1990-0643	7		OPTO-ISOLATOR LED-PCNDCT IF=40MA-MAX	03911	CLM6500
A20U15	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A20U16	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U17	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U18	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U19	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U20	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U21	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U22	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U23	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A20VR1	1902-0041	4		DIODE-ZNR 5.11V 5% .4W	07263	1N751A
A20VR2	1902-0041	4		DIODE-ZNR 5.11V 5% .4W	07263	1N751A
A20VR3	1902-0064	1	3	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
A20VR4	1902-0064	1		DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
A20VR5	1902-0064	1		DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

A20 08901-60285 SERIAL PREFIX 2617A AND ABOVE

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20	08901-60285	1	1	LO CONTROL ASSEMBLY	28480	08901-60285
A20C1	0160-4835	7	3	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A20C2	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A20C3	0180-1746	5	2	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A20C4	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A20C5	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A20C6	0180-0269	5	1	CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
A20C7	0160-4801	7	2	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A20C8	0160-4832	4	8	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A20C9	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A20C10	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A20C11	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A20C12	0160-4807	3	1	CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A20C13	0180-0197	8	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A20C14	0160-4814	2	1	CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4814
A20C15	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A20C16	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A20C17	0160-0161	4	1	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A20C18	0160-3324	7	1	CAPACITOR-FXD 1UF +-5% 100VDC MET-POLYC	28480	0160-3324
A20C19	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A20C20	0180-1997	8	1	CAPACITOR-FXD 20UF+50-10% 150VDC AL	28480	0180-1997
A20C21	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A20C22	0160-4822	2	2	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A20C23	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A20C24	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A20CR1	1901-1085	6	2	DIODE-SM SIG SCHOTTKY	28480	1901-1085
A20CR2	1901-1085	6		DIODE-SM SIG SCHOTTKY	28480	1901-1085
A20CR3				NOT ASSIGNED		
A20CR4				NOT ASSIGNED		
A20CR5	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR6	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR7	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR8	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR9	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR10	1901-0518	8	6	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A20CR11	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A20CR12	1901-1098	1	D	IODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR13	1901-1098	1	D	IODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR14	1901-1098	1	D	IODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR15	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR16	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR17	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A20CR18	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A20CR19	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A20CR20	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20				**08901-60285 SERIAL PREFIX 2617A AND ABOVE**		
A20CR21	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A20CR22	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20CR23				NOT ASSIGNED		
A20CR24	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A20CR25	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A20DS1				NOT ASSIGNED		
A20DS2				NOT ASSIGNED		
A20DS3	1990-0717	6	2	LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	HLMP-1501
A20DS4	1990-0717	6		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	HLMP-1501
A20L1	9100-3922	4	3	INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A20L2	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A20L3	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A20MP1	08901-00104	7	1	CVR LO CONT BD	28480	08901-00104
	2360-0113	2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A20Q1	1854-0477	7	5	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A20Q2	1853-0034	0	3	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A20Q3	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A20Q4	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A20Q5	1854-0378	7	1	TRANSISTOR NPN 2N5109 SI TO-39 PD=800MW	3L585	2N5109
A20Q6	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A20Q7	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A20Q8-Q11				NOT ASSIGNED		
A20Q12	1854-0813	5	3	TRANSISTOR NPN 2N3501S SI TO-39 PD=1W	28480	1854-0813
A20Q13	1853-0462	8	2	TRANSISTOR PNP 2N3635 SI TO-39 PD=1W	28480	1853-0462
A20Q14				NOT ASSIGNED		
A20Q15				NOT ASSIGNED		
A20Q16	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A20Q17				NOT ASSIGNED		
A20Q18				NOT ASSIGNED		
A20Q19	1853-0594	7		TRANSISTOR-DUAL PNP 2N3808 TO-78	28480	1853-0594
A20Q20	1854-0474	4	3	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A20Q21	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A20Q22	1854-0813	5	3	TRANSISTOR NPN 2N3501S SI TO-39 PD=1W	28480	1854-0813
A20Q23	1853-0462	8	2	TRANSISTOR PNP 2N3635 SI TO-39 PD=1W	28480	1853-0462
A20Q24	1853-0594	7		TRANSISTOR-DUAL PNP 2N3808 TO-78	28480	1853-0594
A20Q25				NOT ASSIGNED		
A20Q26	1854-0813	5	3	TRANSISTOR NPN 2N3501S SI TO-39 PD=1W	28480	1854-0813
A20Q27	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A20Q28	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A20R1	2100-3161	6	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	02111	43P203
A20R2	0757-0463	4	1	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A20R3	0698-7284	5	2	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A20R4	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A20R5	0698-7260	7	4	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20				**08901-60285 SERIAL PREFIX 2617A AND ABOVE**		
A20R6	0699-0381	1	1	RESISTOR 40K .1% .1W F TC=0+-15	28480	0699-0381
A20R7	0699-0122	8	2	RESISTOR 4.8K .1% .125W F TC=0+-25	28480	0699-0122
A20R8	0699-0122	8		RESISTOR 4.8K .1% .125W F TC=0+-25	28480	0699-0122
A20R9	0698-6360	6	1	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A20R10	0698-8049	2	1	RESISTOR 64K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-6402-B
A20R11	0757-0289	2	3	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A20R12	0698-3152	8	2	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A20R13	0698-3154	0	4	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A20R14	0698-8212	1	1	RESISTOR 6K .25% .125W F TC=0+-25	19701	MF4C1/4-T9-6001-C
A20R15	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A20R16	1810-0204	6	1	NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A20R17	0698-7244	7	4	RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A20R18	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A20R19	0698-7279	8	1	RESISTOR 61.9K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6192-F
A20R20	0698-3449	6	1	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A20R21	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A20R22	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A20R23	0698-0085	0	2	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A20R23	0698-0085	0	2	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A20R24	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A20R25	0698-3266	5	1	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A20R26	0698-7286	7	2	RESISTOR 121K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1213-F
A20R27				NOT ASSIGNED		
A20R28				NOT ASSIGNED		
A20R29	0698-3438	3	1	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A20R30	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A20R31	0698-7259	4	2	RESISTOR 9.09K 1% .05W F TC=0+-100	24546	C3-1/8-T0-9091-F
A20R32	0698-7260	7		RESISTOR 10K K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A20R33	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A20R34	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A20R35	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A20R35	0698-3152	8		RESISTOR 3.48K 1 % .125W F TC+0+-100	24546	C4-1/8-TO-3481-F
A20R36	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A20R37	1810-0206	8	1	NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
A20R38				NOT ASSIGNED		
A20R39				NOT ASSIGNED		
A20R40	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A20R41				NOT ASSIGNED		
A20R42	0757-0123	3	4	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A20R43	0698-7248	1	2	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A20R44	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A20R45	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A20R46	0698-7276	5	1	RESISTOR 46.4K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4642-F
A20R47∆	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	28480	0689-3159
A20R48	0757-0123	3		RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A20R49				NOT ASSIGNED		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). ∆ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20				**08901-60285 SERIAL PREFIX 2617A AND ABOVE**		
A20R50				NOT ASSIGNED		
A20R51	0698-7261	8	1	RESISTOR 11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1102-F
A20R52	0698-7258	3	1	RESISTOR 8.25K 1% .05W F TC=0+-100	24546	C3-1/8-T0-8251-F
A20R53				NOT ASSIGNED		
A20R54				NOT ASSIGNED		
A20R55				NOT ASSIGNED		
A20R56	0698-7236	7	7	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
2617A only						
A20R57	0757-0123	3		RESISTOR 34.8K 1% .125W F TC=-+-100	28480	0757-0123
2618A and above						
A20R57	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=-+-100	24546	C4-1/8-TO-4642-F
A20R58	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A20R59	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A20R60	0698-7259	4		RESISTOR 9.09K 1% .05W F TC=0+-100	24546	C3-1/8-T0-9091-F
A20R61	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A20R60-R69				NOT ASSIGNED		
A20R70	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A20R71	0698-3439	4	1	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A20R72	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A20R73	0698-0082	7	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A20R74	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A20R75	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A20R76	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A20R77	0698-7286	7		RESISTOR 121K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1213-F
A20R78	0699-0069	2	1	RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A20R79				NOT ASSIGNED		
A20R80				NOT ASSIGNED		
A20R81				NOT ASSIGNED		
A20R82	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A20TP1	1251-0600	0	4	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A20TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A20TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A20TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A20U1	1826-0989Δ	7	4	IC OP AMP GP 8-DIP-C PKG	27014	LM307J
A20U2	1826-0605	4	1	IC MULTIPLXR 8-CHAN-ANLG 16-DIP-C PKG	17856	DG508BK
A20U3	1820-1198	0	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A20U4	1826-0328Δ	8	1	IC OP AMP GP DUAL 8-DIP PKG RV4558DE	28480	1826-0328
A20U5	1826-0716	8	1	IC OP AMP LOW-NOISE DUAL 8-DIP-C PKG	18324	NE5532AFE

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A20				**08901-60285 SERIAL PREFIX 2617A AND ABOVE**		
A20U6	1820-1199	1	2	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A20U7	1820-1195	7	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A20U8	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A20U9	1820-1216	3	2	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A20U10	1826-0188	8	2	IC CONV 8-B-D/A 16-DIP-C PKG	04713	MC1408L-8
A20U11	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A20U12	1826-0188	8		IC CONV 8-B-D/A 16-DIP-C PKG	04713	MC1408L-8
A20U13				NOT ASSIGNED		
A20U14	1826-0606	5	2	IC SWITCH ANLG QUAD 16-DIP-C PKG	17856	DG201BK
A20U15	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A20U16	1820-1411	0	7	IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U17	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U18	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U19	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U20	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U21	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U22	1820-1411	0		IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A20U23	1826-0606	5		IC SWITCH ANLG QUAD 16-DIP-C PKG	17856	DG201BK
A20VR1	1902-0955	9	1	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.062%	28480	1902-0955
A20W1	8159-0005	0	1	RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A21						
A21	08901-60025	7	1	LOW FREQUENCY VCXO FILTER ASSEMBLY	28480	08901-60025
A21C1	0160-2028	6	3	CAPACITOR-FXD 2700PF +-5% 500VDC MICA	28480	0160-2028
A21C2	0160-2534	9	2	CAPACITOR-FXD 300PF +-1% 300VDC MICA	28480	0160-2534
A21C3	0160-2028	6		CAPACITOR-FXD 2700PF +-5% 500VDC MICA	28480	0160-2028
A21C4	0160-2028	6		CAPACITOR-FXD 2700PF +-5% 500VDC MICA	28480	0160-2028
A21C5	0160-2534	9		CAPACITOR-FXD 300PF +-1% 300VDC MICA	28480	0160-2534
A21J1Δ	1250-1425	7		CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	28480	1250-1425
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A21J2Δ	1250-1425	7		CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	28480	1250-1425
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A21MP1	08901-00025	1	1	COVER, LF VCXO FILTER (INCLUDES P.C. BOARD EXTRACTOR)	28480	08901-00025
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A21MP2	08901-00044	4	1	GASKET, VCXO FILTER ASSEMBLY	28480	08901-00044
A21MP3Δ	5001-5539	9		STRAP, GROUND	28480	5001-5539
A21MP4	08901-20082	2		P.C. BOARD EXTRACTOR	28480	08901-20082

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A22						
A22	08901-60007	5	1	LOW FREQUENCY VCXO ASSEMBLY	28480	08901-60007
A22C1	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A22C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A22C3	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A22C5	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C6	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C7	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A22C9	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A22C10	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C11	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C12	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	06383	CK45XE3A102K-H
A22C13	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	06383	CK45XE3A102K-H
A22C14	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C15	0160-4678	6	1	CAPACITOR-FXD 560PF +-1% 100VDC MICA	28480	0160-4678
A22C16	0160-4679	7	1	CAPACITOR-FXD 270PF +-1% 300VDC MICA	28480	0160-4679
A22C17	0160-4456	8	1	CAPACITOR-FXD 750PF +-1% 300VDC MICA	28480	0160-4456
A22C18	0160-2328	9	1	CAPACITOR-FXD 200PF +-1% 300VDC MICA	28480	0160-2328
A22C19	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C20	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A22C21	0160-2032	2	1	CAPACITOR-FXD 510PF +-5% 500VDC MICA	28480	0160-2032
A22C22	0160-2030	0	1	CAPACITOR-FXD 1200PF +-5% 500VDC MICA	28480	0160-2030
A22C23	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C24	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A22C25	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A22C26	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A22C27	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A22C28	0160-4680	0	1	CAPACITOR-FXD 4000PF +-5% 100VDC MICA	28480	0160-4680
A22CR1	1901-0535	9		DIODE-SCHOTTKY SM SIG	28480	1901-0535
A22CR2	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A22CR3	1901-0535	9		DIODE-SCHOTTKY SM SIG	28480	1901-0535
A22CR4	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A22CR5	1901-0535	9		DIODE-SCHOTTKY SM SIG	28480	1901-0535
A22CR6	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A22CR7	1901-0535	9		DIODE-SCHOTTKY SM SIG	28480	1901-0535
A22CR8	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A22CR9Δ	0122-0167	0	4	DIODE-VVC 5.05PF 10% C3/C25-MIN=5	28480	0122-0167
A22CR10Δ	0122-0167	0	4	DIODE-VVC 5.05PF 10% C3/C25-MIN=5	28480	0122-0167
A22CR11Δ	0122-0167	0	4	DIODE-VVC 5.05PF 10% C3/C25-MIN=5	28480	0122-0167
A22CR12Δ	0122-0167	0	4	DIODE-VVC 5.05PF 10% C3/C25-MIN=5	28480	0122-0167
A22CR13	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A22CR14	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A22CR15	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A22CR16	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A22E1	9170-0029	3		CORE-SHIELDING BEAD	78488	57-3452
A22E2	9170-0029	3		CORE-SHIELDING BEAD	78488	57-3452
A22J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A22L1	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH +-10%	91637	IM-4 4.7UH 10%
A22L2	9100-1616	9	3	INDUCTOR RF-CH-MLD 1.5UH +-10%	91637	IM-4 1.5UH 10%
A22L3	9140-0325	9	1	INDUCTOR RF-CH-MLD 10UH +-2%	06560	004414-012G
A22L4	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH +-10%	91637	IM-4 4.7UH 10%
A22L5	9100-1615	8	1	INDUCTOR RF-CH-MLD 1.2UH +-10%	91637	IM-4 1.2UH 10%
A22L6	9140-0324	8	1	COIL,FXD,MLD 6.8 UH 2%	06560	004414-010G
A22L7	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH +-10%	91637	IM-4 1.5UH 10%
A22L8	9140-0180	4	1	INDUCTOR RF-CH-MLD 2.7UH +-10%	91637	IM-4 2.7UH 10%
A22L9	9100-1616	9		INDUCTOR RF-CH-MLD 1.5UH +-10%	91637	IM-4 1.5UH 10%
A22L10	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH +-10%	91637	IM-4 4.7UH 10%
A22MP1	08901-00026	2	1	COVER, LF VCXO	28480	08901-00026
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A22MP2	08901-20082	2		P.C. BOARD EXTRACTOR	28480	08901-20082
A22MP3Δ	5001-5539	9		STRAP, GROUND	28480	5001-5539
A22Q1	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A22Q2	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	04713	2N2904A
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A22Q3	1854-0610	0		TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A22Q4	1854-0610	0		TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A22Q5	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A22Q6	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A22Q7	1854-0610	0		TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A22Q8	1854-0610	0		TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A22Q9	1853-0001	1	1	TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A22R1	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A22R2	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A22R3	0757-0422	5		RESISTOR 909 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-909R-F
A22R4	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A22R5	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A22R6	0757-0439	4		RESISTOR 6.81K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6811-F
A22R7	0698-3430	5		RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A22R8	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A22R9	0757-0439	4		RESISTOR 6.81K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6811-F
A22R10	0698-3430	5		RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A22R11	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A22R12	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A22R13	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A22R14	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A22R15	0698-8004	9	4	RESISTOR 200K +-0.1% .1W TF TC=0+-15	09464	PR1/10

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A22R16	0698-8004	9		RESISTOR 200K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A22R17	0698-3445	2		RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
A22R18	0757-0398	4		RESISTOR 75 +-1% .125W TF TC=0+-100	D8439	MK2
A22R19	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A22R20	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A22R21	0698-8004	9		RESISTOR 200K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A22R22	0698-8004	9		RESISTOR 200K +-0.1% .1W TF TC=0+-15	09464	PR1/10
A22R23	0757-0400	9		RESISTOR 90.9 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-90R9-F
A22R24	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A22R25	0698-3430	5		RESISTOR 21.5 +-1% .125W TF TC=0+-100	D8439	MK2
A22R26	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A22R27	0698-3435	0	1	RESISTOR 38.3 +-1% .125W TF TC=0+-100	D8439	MK2
A22R28	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A22R29	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A22R30	0698-3156	2		RESISTOR 14.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1472-F
A22R31	0698-3446	3		RESISTOR 383 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-383R-F
A22R32	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A22R33	0757-0403	2		RESISTOR 121 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-121R-F
A22R34	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A22R35	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A22R36	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A22R37	0757-0399	5		RESISTOR 82.5 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-82R5-F
A22R38	0757-0289	2		RESISTOR 13.3K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-1332-F
A22R39	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A22T1	08660-60369	0	2	TRANSFORMER, RF 5-PIN	28480	08660-60369
A22T2	08660-60369	0		TRANSFORMER, RF 5-PIN	28480	08660-60369
A22TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A22TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
1933A to 2606A						
A22Y1	0410-1181	1	1	CRYSTAL, 9.26 MHZ	28480	0410-1181
	1200-0758	2	2	SOCKET-XTAL 2-CONT HC-25/U DIP-SLDR	91506	8004-1G17
	0361-0026	6	2	RIVET	28480	0361-0026
A22Y2	0410-1182	2	1	CRYSTAL 11.26 MHZ	28480	0410-1182
	1200-0758	2		SOCKET-XTAL 2-CONT HC-25/U DIP-SLDR	91506	8004-1G17
	0361-0026	6		RIVET	28480	0361-0026
2607A and above						
A22Y1	0410-1615	6	1	CRYSTAL, 9.26 MHZ	28480	0410-1615
	1400-0973	7	2	CLIP CMPNT .139D .154 DIA STL	28480	1400-0973
A22Y2	0410-1616	7	1	CRYSTAL, 11.26 MHZ	28480	0410-1616
	1400-0973	7	2	CLIP CMPNT .139D .154 DIA STL	28480	1400-0973

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A23						
1933A to 2543A						
A23	08901-60022	4	1	SAMPLER ASSEMBLY	28480	08901-60022
2545A and above						
A23	08901-60144	1	1	SAMPLER ASSEMBLY	28480	08901-60144
A23C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A23C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A23C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A23C4	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	06383	FD11X7R2A471M
A23C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A23C6	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A23C7	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A23C8	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A23C9	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A23C10	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A23C11	0180-2618	2		CAPACITOR-FXD 33UF+-10% 10VDC TA	12344	T355F336K010AS
A23C12	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A23C13	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A23C14	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A23C15	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A23C16	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	09969	RPE121-105X7R221M100V
A23C17	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V
A23C18	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	09969	RPE121-105X7R470M200V
A23C19	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	09969	RPE121-105X7R470M200V
A23C20	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	09969	RPE121-105C0G4R7D200V
A23C21	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	09969	RPE121-105X7R470M200V
A23C22	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	09969	RPE121-105X7R470M200V
A23C23	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	09969	RPE121-105C0G4R7D200V
A23C24	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V
A23C25	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	09969	RPE121-105C0G4R7D200V
A23C26	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	09969	RPE121-105C0G220J200V
A23C27	0180-1745	4	1	CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
A23C28	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	09969	RPE121-105C0G220J200V
A23C29	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
1933A to 2543A						
A23C30	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	09535	301-000-COG0-200J
2545A						
A23C30	0160-5699	3		CAPACITOR-FXD 20PF +-5% 100VDC CER 0+-30	28480	0160-5699
A23C31	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A23C32	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A23C33	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A23C34	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A23C35	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A23C36	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A23C37	0160-4653	7	1	CAPACITOR-FXD .1UF +-5% 100VDC MET-POLYP	84411	HEW-505
A23C38	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A23C39	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A23C40	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A23C41	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A23C42	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V
A23C43	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	06383	FD11X7R2A471M
A23C44	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	06383	FD11X7R2A471M
1933A to 2026A						
A23C45				NOT ASSIGNED		
2031A and above						
A23C45∆	0160-4490	0		CAPACITOR-FXD 1.8PF +-.25PF 200VDC CER	28480	0160-4490
A23CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A23CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A23CR3	1901-0189	9	1	DIODE-STEP RECOVERY	28480	QSRD-4653
A23CR4	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A23CR5	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A23CR6	1906-0098	9	1	DIODE, MATCHED	28480	1906-0098
A23CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A23CR11	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A23CR12	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A23CR13	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A23CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
A23CR15	1901-0518	8		DIODE-SCHOTTKY SM SIG	12403	5082-2800
A23DS1	1990-0326	3	2	LED-LAMP LUM-INT=300UCD IF=50MA-MAX	28480	5082-4444
A23DS2	1990-0326	3		LED-LAMP LUM-INT=300UCD IF=50MA-MAX	28480	5082-4444
A23E1	9170-0029	3		CORE-SHIELDING BEAD	78488	57-3452
A23J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A23J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A23JP1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	11502	YZO 1/4
A23L1	9100-3922	4		RF CHOKE	28480	9100-3922
A23L2	9100-3922	4		RF CHOKE	28480	9100-3922
A23L3	9100-3922	4		RF CHOKE	28480	9100-3922
A23L4	9100-3922	4		RF CHOKE	28480	9100-3922
A23L5	9140-0210	1		INDUCTOR RF-CH-MLD 100UH +-5%	91637	IM-4 100UH 5%
A23L6	9140-0210	1		INDUCTOR RF-CH-MLD 100UH +-5%	91637	IM-4 100UH 5%
A23L7				PART OF ETCHED CIRCUIT BOARD		
A23L8				PART OF ETCHED CIRCUIT BOARD		
A23L9				PART OF ETCHED CIRCUIT BOARD		
A23L10	9100-2250	9	2	INDUCTOR RF-CH-MLD 180NH +-10%	91637	IM-2 .18UH 10%

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). ∆ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A23L11	9100-2250	9		INDUCTOR RF-CH-MLD 180NH +-10%	91637	IM-2 .18UH 10%
A23L12				PART OF ETCHED CIRCUIT BOARD		
A23L13				PART OF ETCHED CIRCUIT BOARD		
A23L14	9140-0144	0	2	INDUCTOR RF-CH-MLD 4.7UH +-10%	91637	IM-2 4.7UH 10%
A23L15	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH +-10%	91637	IM-2 4.7UH 10%
A23L16	9100-3922	4		RF CHOKE	28480	9100-3922
A23MP1	08901-00024	0	1	COVER, SAMPLER (INCLUDES P.C. EXTRACTOR)	28480	08901-00024
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A23MP2	08901-20082	2		P.C. BOARD EXTRACTOR	28480	08901-20082
A23MP3△	5001-5539	9		STRAP, GROUND	28480	5001-5539
A23Q1	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A23Q2	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A23Q3	1854-0023	9		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A23Q4	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A23Q5	1854-0210	6		TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
1933A to 2026A						
A23Q6	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
2031A and above						
A23Q6	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2097A
	1205-0037	0	1	HEAT SINK TO-18-CS	98978	TXBF-019-025B
A23Q7	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
	1200-0173	5		INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A23Q8	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A23Q9	1855-0049	1		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A23Q10	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
1933A to 2543A						
A23Q11	1855-0091	3		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0091
A23Q12	1855-0091	3		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0091
2545A and above						
A23Q11	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE SI	28480	1855-0420
A23Q12	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE SI	28480	1855-0420
A23R1	0757-0288	1		RESISTOR 9.09K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-9091-F
A23R2	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A23R3	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A23R4	0757-1094	9		RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1471-F
A23R5	0757-0405	4	3	RESISTOR 162 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-162R-F
A23R6	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A23R7	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A23R8	0698-3440	7		RESISTOR 196 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-196R-F
A23R9	0757-0346	2		RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A23R10	0757-0405	4		RESISTOR 162 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-162R-F
A23R11	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A23R12	0757-1094	9		RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1471-F
A23R13	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A23R14	0698-3136	8		RESISTOR 17.8K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1782-F
A23R15	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A23R16	0698-3631	8	1	RESISTOR 330 +-5% 2W MO TC=0+-200	12498	FP-69
A23R17	0698-3399	5	1	RESISTOR 133 +-1% .5W TF TC=0+-100	K8479	H2
A23R18	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A23R19	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A23R20	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A23R21	0757-0441	8		RESISTOR 8.25K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8251-F
A23R22	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A23R23	0698-7205	0		RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A23R24	0757-0441	8		RESISTOR 8.25K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8251-F
A23R25	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A23R26	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A23R27	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A23R28	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A23R29	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A23R30	0698-3151	7		RESISTOR 2.87K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2871-F
A23R31	0698-3151	7		RESISTOR 2.87K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2871-F
A23R32	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A23R33	2100-2633	5	1	RESISTOR-TRMR 1K 10% TKF SIDE-ADJ 1-TRN	73138	82PAR1K
A23R34	0757-0289	2		RESISTOR 13.3K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-1332-F
A23R35	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A23R36	0698-7212	9		RESISTOR 100 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-100R-F
A23R37	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A23R38	0757-0289	2		RESISTOR 13.3K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-1332-F
A23R39	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A23R40	0698-3162	0	1	RESISTOR 46.4K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4642-F
A23R41	0757-1094	9		RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1471-F
A23R42	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A23R43	0757-0420	3	1	RESISTOR 750 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-751-F
A23R44	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A23R45	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A23R46	0698-3260	9	3	RESISTOR 464K +-1% .125W TF TC=0+-100	12498	CT4
A23R47	0698-3260	9		RESISTOR 464K +-1% .125W TF TC=0+-100	12498	CT4
A23R48	0757-0274	5		RESISTOR 1.21K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1211-F
A23R49	0698-3260	9		RESISTOR 464K +-1% .125W TF TC=0+-100	12498	CT4
A23R50	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A23R51	0757-0274	5		RESISTOR 1.21K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1211-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A23R52	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-825R-F
A23R53	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A23R54	2100-2521	0	1	RESISTOR-TRMR 2K 10% TKF SIDE-ADJ 1-TRN	73138	82PAR2K
A23R55*	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A23R56	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A23R57	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A23R58	0698-0082	7		RESISTOR 464 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4640-F
A23R59	0757-0379	1	1	RESISTOR 12.1 +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-12R1-F
A23R60	0698-3441	8		RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A23R61	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A23R62	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A23R63	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A23T1Δ	08901-80042	0	1	SAMPLER TRANSFORMER	28480	08901-80042
A23TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A23U1	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	27014	LM339N
A23U2	1826-0413	2		IC OP AMP LOW-BIAS-H-IMPD 8-TO-99 PKG	34371	HA2-2605-5
A23VR1	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A23VR2	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A23VR3	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	07263	1N751A
A23VR4	1902-0554	4	2	DIODE-ZNR 10V 5% PD=1W IR=10UA	28480	1902-0554
A23VR5	1902-0554	4		DIODE-ZNR 10V 5% PD=1W IR=10UA	28480	1902-0554

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A24						
A24	08901-60021	3	1	HIGH FREQUENCY VCO ASSEMBLY	28480	08901-60021
A24C1	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	06383	FD11X7R2A471M
A24C2	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	09969	RPE121-105X7R101M200V
A24C3				NOT ASSIGNED		
A24C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C6	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	12474	SR205C473MAA
A24C7	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A24C8	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A24C9	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	06383	FD12X7R2A472M
A24C10 △	0160-3531	8	1	CAPACITOR-FXD 330PF +-5% 300VDC	28480	0160-3531
A24C11	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A24C12 △	0160-5951	0	1	CAPACITOR-FXD 390PF +-5% 50VDC CER 0+-30	28480	0160-5951
A24C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A24C14	0160-5034	0	1	CAPACITOR-FXD 120PF +-2% 50VDC CER 0+-30	95275	VJ0805A121GH
A24C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C16				NOT ASSIGNED		
1933A to 2309A						
A24C17	0160-4519	4	1	CAPACITOR-FXD 9.1PF +-.5PF 200VDC CER	09969	RPE121-105C0G9R1D200V
2312A and above						
A24C17	0160-4304	5	1	CAPACITOR-FXD 10PF +-10% 100VDC CER	28480	0160-4304
A24C18	0160-4103	2	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	06383	FD12COG2A221J
A24C19	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C20	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C22	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C23	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C24	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C25	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C26	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C27	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C28	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C29	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	09969	RPE121-105X7R102M100V
A24C30				NOT ASSIGNED		
A24C31	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	09969	RPE121-105X7R470M200V
A24C32	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	09969	RPE121-105C0G220J200V
A24C33	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	09969	RPE121-105X7R470M200V
A24C34	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A24C35	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A24C36	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	09969	RPE121-105X7R103M100V
A24CR1 △	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A24CR2 △	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2410A						
A24CR3△	0122-0326	3		DIODE-VVC 43PF 5%	28480	0122-0326
A24CR4△	0122-0326	3		DIODE-VVC 43PF 5%	28480	0122-0326
2412A and above						
A24CR3△	0122-0173	8		DIODE-VVC 13.5PF 7% C3/C25-MIN-5	28480	0122-0173
A24CR4△	0122-0173	8		DIODE-VVC 13.5PF 7% C3/C25-MIN-5	28480	0122-0173
A24CR5△	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A24CR6△	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A24J1△	1250-1425	7		CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	28480	1250-1425
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A24J2△	1250-1425	7		CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	28480	1250-1425
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A24L1	9100-3922	4		RF CHOKE	28480	9100-3922
A24L2	9100-3922	4		RF CHOKE	28480	9100-3922
A24L3	9100-3922	4		RF CHOKE	28480	9100-3922
A24L4	9100-3922	4		RF CHOKE	28480	9100-3922
A24L5	9100-3922	4		RF CHOKE	28480	9100-3922
A24L6	9100-2251	0	2	INDUCTOR RF-CH-MLD 220NH +-10%	91637	IM-2 .22UH 10%
A24L7	08901-00068	2	1	INDUCTOR	28480	08901-00068
A24L8	9100-2251	0		INDUCTOR RF-CH-MLD 220NH +-10%	91637	IM-2 .22UH 10%
A24L9				PART OF ETCHED CIRCUIT BOARD		
A24L10				PART OF ETCHED CIRCUIT BOARD		
A24MP1	08901-00023	9	1	COVER, HF VCO	28480	08901-00023
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A24MP2	08901-00043	3	1	GASKET, LO OSC. BOARD(USED WITH MP1)	28480	08901-00043
A24MP3				NOT ASSIGNED		
A24MP4	08662-00038	6	1	SHIELD, CIRCUIT, SMALL	28480	08662-00038
A24MP5	08662-00040	0	1	SHIELD, COMPONENT, SMALL	28480	08662-00040
A24MP6△	5001-5539	9		STRAP, GROUND	28480	5001-5539
A24Q1	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
	0340-0834	0	1	INSULATOR-XSTR POLYI	13103	43-05-1
A24Q2	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A24Q3	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	04713	SFE793
A24Q4	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A24Q5	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A24Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A24Q7	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A24Q8	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A24R1	0698-7236	7		RESISTOR 1K +-1% .05W TF TC=0+-100	12498	C3-1/8-T0-1001-F
A24R2	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A24R3	0698-3449	6	1	RESISTOR 28.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2872-F
A24R4	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A24R5	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A24R6	0757-0274	5		RESISTOR 1.21K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1211-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A24R7	0698-3157	3		RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
A24R8	0757-0402	1		RESISTOR 110 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-111-F
A24R9	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A24R10	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A24R11	0698-3151	7		RESISTOR 2.87K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2871-F
A24R12	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A24R13	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A24R14	0757-0405	4		RESISTOR 162 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-162R-F
A24R15	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A24R16				NOT ASSIGNED		
A24R17	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A24R18	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A24R19	0698-3405	4	1	RESISTOR 422 +-1% .5W TF TC=0+-100	K8479	H2
A24R20	0698-7195	7		RESISTOR 19.6 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-19R6-F
A24R21	0757-0402	1		RESISTOR 110 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-111-F
A24R22	0757-0402	1		RESISTOR 110 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-111-F
A24R23	0698-7219	6		RESISTOR 196 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-196R-F
A24R24	0698-7206	1		RESISTOR 56.2 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-56R2-F
A24R25	0698-7222	1	1	RESISTOR 261 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-261R-F
A24R26	0698-8827	4		RESISTOR 1M +-1% .125W TF TC=0+-100	12498	CT4
A24R27	0698-7199	1	1	RESISTOR 28.7 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-28R7-F
A24TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A24TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A24TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A24U1	1826-0372	2		IC, A251 LIMITER	28480	A251-0100
A24U2	1826-0372	2		IC, A251 LIMITER	28480	A251-0100
A24U3Δ	1826-1796	6	1	IC OP AMP H-SLEW-RATE DUAL 8-DIP-P PKG	04713	MC34082P

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A25						
1933A to 2012A						
A25	08901-60026	8	1	AUDIO MOTHER BOARD ASSEMBLY	28480	08901-60026
2021A to 2609A						
A25	08901-60120	3	1	AUDIO MOTHER BOARD ASSEMBLY	28480	08901-60120
2616A and above						
A25	08901-60286	2	1	AUDIO MOTHER BOARD ASSEMBLY	28480	08901-60286
1836A to 2609A						
A25C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	09969	DD106NWB302Y5V103Z100V
A25C2	0160-3466	8	1	CAPACITOR-FXD 100PF +-10% 1KVDC CER	06383	CK45XE3A101K-H
2616A and above						
*A25C1*Δ	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
*A25C2*Δ	0160-4801	7	1	CAPACITOR-FXD 100PF +-5% 1KVDC CER	28480	0160-4801
A25J1	1250-0836	2	1	CONNECTOR-RF SMC M PC 50-OHM	16179	5064-5006-09
A25J2	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
A25J3	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
A25J4	1251-5169	6		CONN-POST TYPE .156-PIN-SPCG 6-CONT	28480	1251-5169
A25J5	1251-5643	1	1	CONN-POST TYPE .156-PIN-SPCG 4-CONT	28480	1251-5643
A25R1	0698-3443	0		RESISTOR 287 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-287R-F
A25R2	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A25X7Δ	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A25X8Δ	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A25X9Δ	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A25XA1				NOT ASSIGNED		
A25XA2Δ	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A25XA3Δ	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A25XA4Δ	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A25XA5Δ	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A25XA6Δ	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A26						
1933A to 2705A						
A26	08901-60020	2	1	POWER SUPPLY MOTHER BOARD ASSEMBLY	28480	08901-60020
2751A and above						
A26	08901-60294	2	1	POWER SUPPLY MOTHER BOARD ASSEMBLY	28480	08901-60294
A26C1	0180-2851	5	1	CAPACITOR-FXD .03F+75-10% 25VDC AL	19701	3186EE303U025BHA2
	2190-0034	5	8	WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
	2680-0099	1	8	SCREW-MACH 10-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A26C2Δ	0180-2990	3	1	CAPACITOR-FXD 7500UF +75-10% 20VDC AL	28480	0180-2990
	2190-0034	5		WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
	2680-0099	1		SCREW-MACH 10-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A26C3	0180-2858	2	1	CAPACITOR-FXD .01F+75-10% 40VDC AL	19701	3186BF103U040BHA3
	2190-0034	5		WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
	2680-0099	1		SCREW-MACH 10-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A26C4	0180-0677	9	1	CAPACITOR-FXD 5800UF+75-10% 40VDC AL	19701	3186BC582U040BHA2
	2190-0034	5		WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
	2680-0099	1		SCREW-MACH 10-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A26C5	0160-3968	5	1	CAPACITOR-FXD .47UF +-10% 250VAC (RMS) (OPTION 004 ONLY)	C0633	PME 271 M 647
A26CR1	1901-0200	5	8	DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A26CR2	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
	1205-0213	4	2	HEAT SINK SGL TO-5/TO-39-CS	13103	2228B
A26CR3	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
	1205-0213	4		HEAT SINK SGL TO-5/TO-39-CS	13103	2228B
A26CR4	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A26CR5Δ	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A26CR6	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A26CR7	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A26CR8	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A26CR9	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A26J1	1251-3412	8	1	CONN-POST TYPE .156-PIN-SPCG 6-CONT	28480	1251-3412
A26J2	1251-5169	6		CONN-POST TYPE .156-PIN-SPCG 6-CONT	28480	1251-5169
A26J3	1251-5169	6		CONN-POST TYPE .156-PIN-SPCG 6-CONT	28480	1251-5169
A26J4	1251-5635	1	1	CONN-POST TYPE .156-PIN-SPCG 12-CONT	28480	1251-5635
A26J5A	1251-5636	2	2	CONNECTOR, 11-PIN, MALE	28480	1251-5636
A26J5B	1251-5636	2		CONNECTOR, 11-PIN, MALE	28480	1251-5636
A26J6	1251-4966	9	2	CONN-POST TYPE .156-PIN-SPCG 8-CONT	28480	1251-4966
1933A to 2705A						
A26K1	0490-0618	5	1	RELAY 2C 24VDC-COIL 5A 115VAC	77342	R40-E0161-1
2751A and above						
A26K1	0490-1647	2	1	RELAY	28480	0490-1647

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A26MP1				NOT ASSIGNED		
A26MP2				NOT ASSIGNED		
A26MP3	08901-20049	1	1	SHIELD, HIGH VOLTAGE	28480	08901-20049
Δ	0361-0207	5	1	RIVET-BLIND DR-PIN RNDH .125DIA	02768	201-080551-00-0108
Δ	2360-0199	4	1	SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
Δ	3050-0003	3	1	WASHER-FL NM NO. 6 .141-IN-ID .375-IN-OD	73734	1471
Δ	3050-0227	3	1	WASHER-FL MTLC NO.6 .149-IN-ID	00000	ORDER BY DESCRIPTION
A26MP4	7120-4163	7	1	LABEL, WARNING-HAZARDOUS VOLTAGE	28480	7120-4163
A26Q1	1884-0250	7	1	THYRISTOR-TRIAC TO-220AB	04713	T2500B
Δ	2200-0141	9	1	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
Δ	2190-0004	9	1	WASHER-LK INTL T NO. 4 .115-IN-ID	00000	ORDER BY DESCRIPTION
A26R1	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A26R2	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A26R3	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A26R4	0698-0085	0		RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A26R5	0698-0085	0		RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A26VR1	1902-3381	1	2	DIODE-ZNR 68.1V 5% DO-7 PD=.4W TC=+.079%	28480	1902-3381
A26VR2	1902-3381	1		DIODE-ZNR 68.1V 5% DO-7 PD=.4W TC=+.079%	28480	1902-3381
A26XA10Δ	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A27						
A27	08901-60030	4	1	DIGITAL MOTHER BOARD ASSEMBLY	28480	08901-60030
A27J1	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
A27J1	1251-4460	8		CLIP-CABLE PLUG RTNG-DUAL INLINE 16 CONT	06776	RC-74
A27J2	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
A27J2	1251-4460	8		CLIP-CABLE PLUG RTNG-DUAL INLINE 16 CONT	06776	RC-74
A27J3	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
A27J3	1251-4460	8		CLIP-CABLE PLUG RTNG-DUAL INLINE 16 CONT	06776	RC-74
A27MP1	0590-0970	4	4	THREADED INSERT-NUT 6-32 .062-IN-LG STL	46384	KF2-632-Z
A27X12A△	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A27X12B△	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A27XA1-A27XA10				NOT ASSIGNED		
A27XA11△	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A27XA13A△	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A27XA13B△	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A27XA14A△	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A27XA14B△	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A28						
1933A to 2126A						
A28	08901-60027	9	1	RF MOTHER BOARD ASSEMBLY	28480	08901-60027
2128A and above						
A28	08901-60139	4	1	RF MOTHER BOARD ASSEMBLY	28480	08901-60139
A28J1	1251-4966	9		CONN-POST TYPE .156-PIN-SPCG 8-CONT	28480	1251-4966
A28J2	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
A28J3	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
A28X16△	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A28XA1-A28XA14				NOT ASSIGNED		
A28XA15△	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A28XA17△	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A28XA18△	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A28XA19△	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A28XA20△	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A28XA21△	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A28XA22△	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A28XA23△	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A28XA24△	1251-0472	4		CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A29						
A29	08901-60068	8	1	SERIES REGULATOR HEAT SINK ASSEMBLY	28480	08901-60068
A29MP1	1400-0017	0	1	CLMP-CA .312-DIA .375-WD NYL	28520	3310 RED
A29MP2	08901-20033	3	1	HEAT SINK (INCLUDES SOCKETS FOR Q1-Q4)	28480	08901-20033
	0400-0227	3	4	GROMMET-RND .375-IN-ID .5-IN-GRV-OD	01538	522
	2360-0203	1	14	SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
A29Q1	1854-0669	9	1	TRANSISTOR NPN 2N6057 SI TO-3 PD=150W	04713	2N6057
Δ	0340-0833	9	4	INSULATOR-XSTR POLYE	28480	0340-0833
Δ	0340-1119	6	4	INSULATOR-XSTR ORG POLYM (COVER)	28480	0340-1119
Δ	5001-5501	5		TRANS SPACER (TO-3)	28480	5001-5501
	2360-0203	1		SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
A29Q2	1853-0351	4	2	TRANSISTOR PNP 2N6053 SI DARL TO-3	04713	2N6053
Δ	0340-0833	9	4	INSULATOR-XSTR POLYE	28480	0340-0833
Δ	0340-1119	6	4	INSULATOR-XSTR ORG POLYM (COVER)	28480	0340-1119
	0340-0875	9		INSULATOR-XSTR THRM-CNDCT	55285	7403-09FR-05
	2360-0203	1		SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
A29Q3	1854-0611	1	1	TRANSISTOR NPN 2N6055 SI DARL TO-3	04713	2N6055
Δ	0340-0833	9	4	INSULATOR-XSTR POLYE	28480	0340-0833
Δ	0340-1119	6	4	INSULATOR-XSTR ORG POLYM (COVER)	28480	0340-1119
	0340-0875	9		INSULATOR-XSTR THRM-CNDCT	55285	7403-09FR-05
	2360-0203	1		SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0207	5	1	SCREW-MACH 6-32 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
	3050-0227	3	1	WASHER-FL MTLC NO. 6 .149-IN-ID	80120	AN960C-6
	2420-0002	6		NUT-HEX-DBL-CHAM 6-32-THD .109-IN-THK	28480	2420-0002
A29Q4	1853-0351	4		TRANSISTOR PNP 2N6053 SI DARL TO-3	04713	2N6053
Δ	0340-0833	9	4	INSULATOR-XSTR POLYE	28480	0340-0833
Δ	0340-1119	6	4	INSULATOR-XSTR ORG POLYM (COVER)	28480	0340-1119
	0340-0875	9		INSULATOR-XSTR THRM-CNDCT	55285	7403-09FR-05
	2360-0203	1		SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
A29W1				NOT SEPARATELY REPLACEABLE		
	1251-3279	5	1	CONN-POST TYPE .156-PIN-SPCG 12-CONT	28480	1251-3279
	1251-4283	3	8	CONTACT-CONN U/W-POST-TYPE FEM CRP	27264	08-56-0106
	1400-0249	0	2	CABLE TIE .062-.625-DIA .091-WD NYL	16956	08-465/GRAY
	0400-0011	3	1	GROMMET-RND .375-IN-ID .5-IN-GRV-OD	83330	2175

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A30						
A30	0960-0443	1	1	LINE POWER MODULE	05245	F2058D
1933A to 2128A						
A30C1				NOT ASSIGNED		
2133A and above						
A30C1	0160-4065	5		CAPACITOR-FXD .1UF +-20% 250 VAC (RMS)	28480	0160-4065
A30TB1△				NOT SEPARATELY REPLACEABLE		
A31						
A31	08901-60012	2	1	REMOTE INTERFACE CONNECTOR BOARD ASSY	28480	08901-60012
A31J1	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	06776	ICN-163B-S3-G30
	1251-4460	8		CLIP-CABLE PLUG RTNG-DUAL INLINE 16 CONT	06776	RC-74
A31J2	1251-3283	1	1	CONN-RECT MICRORBN 24-CKT 24-CONT	28480	1251-3283
1933A to 2244A						
A31MP1	0380-0643	3	2	STANDOFF-HEX .255-IN-LG 6-32-THD	28480	0380-0643
	2190-0017	4	2	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
A31MP1	0380-0644	4	2	STANDOFF-HEX .327-IN-LG 6-32-THD	28480	0380-0644
	2190-0034	5	2	WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
A31MP2	1530-1098	4	2	MACHINED PART-BRS CLEVIS	28480	1530-1098
	2190-0019	6	2	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
	2200-0109	8	2	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2260-0002	6	2	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
A32-A49				NOT ASSIGNED		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A50						
1933A to 2227A						
A50	08901-60014	4	1	AM CALIBRATOR ASSEMBLY (OPTION 010 ONLY)	28480	08901-60014
2229A and above						
A50	08901-60209	9	1	AM CALIBRATOR ASSEMBLY (OPTION 010 ONLY)	28480	08901-60209
A50C1	0160-3459	9	24	CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C2	0180-0058	0	2	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A50C3	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A50C4	0180-2617	1	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	12344	T355F685K035AS
A50C5	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C6	0180-2619	3	6	CAPACITOR-FXD 22UF+-10% 15VDC TA	12344	T355F226K016AS
A50C7	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C8	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C9	0160-0207	9	1	CAPACITOR-FXD .01UF +-5% 200VDC POLYE	19701	708D1CC103PJ201AX
A50C10	0180-2619	3		CAPACITOR-FXD 22UF+-10% 15VDC TA	12344	T355F226K016AS
A50C11	0180-2620	6	8	CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A50C12	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C13	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C14	0180-2619	3		CAPACITOR-FXD 22UF+-10% 15VDC TA	12344	T355F226K016AS
A50C15	0180-2619	3		CAPACITOR-FXD 22UF+-10% 15VDC TA	12344	T355F226K016AS
A50C16	0160-2199	2	5	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A50C17	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C18	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C19	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C20	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C21				NOT ASSIGNED		
A50C22	0160-3454	4	1	CAPACITOR-FXD 220PF +-10% 1KVDC CER	06383	CK45XE3A221K-H
A50C23	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C24	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C25	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C26	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C27	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A50C28	0160-3691	1	1	CAPACITOR-FXD 75PF +-1% 100VDC MICA	28480	0160-3691
A50C29	0180-2619	3		CAPACITOR-FXD 22UF+-10% 15VDC TA	12344	T355F226K016AS
A50C30	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A50C31	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C32	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C33	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C34	0160-2414	4	1	CAPACITOR-FXD .022UF +-5% 200VDC POLYE	19701	708D1HH223PJ201AX
A50C35	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A50C36	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C37	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A50C38	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C39	0180-2619	3		CAPACITOR-FXD 22UF+-10% 15VDC TA	12344	T355F226K016AS
A50C40	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C41	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A50C42	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A50C43	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A50C44	0160-0127	2	1	CAPACITOR-FXD 1UF +-20% 50VDC CER	09969	RPE113-149Z5U105M50V
A50C45	0160-4084	8	1	CAPACITOR-FXD .1UF +-20% 50VDC CER	09969	RPE122-139X7R104M50V

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A50C46	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C47	0160-0153	4	1	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	19701	708D1AA102PK201AX
A50C48	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C49	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A50C50	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A50C51	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A50C52	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50C53	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	12344	T355E225K050AS
A50C54	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A50CR1	1901-0179	7	8	DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A50CR2	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A50CR3	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A50CR4	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A50CR5	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A50CR6	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A50CR7	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A50CR8	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	07263	FD777
A50CR9△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A50CR10△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A50CR11	1901-0535	9	1	DIODE-SCHOTTKY SM SIG	28480	1901-0535
A50CR12△	1901-1098	1		DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A50E1	9170-0847	3	2	CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE C
A50E2	9170-0847	3		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE C
A50J1	1250-1220	0	2	CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4	2	WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9	2	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A50J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A50L1	9100-1635	2	4	INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A50L2	9100-1635	2		INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A50L3	9100-1635	2		INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A50L4	9100-1635	2		INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A50L5	9100-1637	4	2	INDUCTOR RF-CH-MLD 120UH +-5%	91637	IM-4 120UH 5%
A50L6	9100-1637	4		INDUCTOR RF-CH-MLD 120UH +-5%	91637	IM-4 120UH 5%
A50L7	9100-3913	3	1	INDUCTOR RF-CH-MLD 3.3UH +-5%	91637	IM-4 3.3UH 5%
A50L8	9140-0179	1	1	INDUCTOR RF-CH-MLD 22UH +-10%	91637	IM-4 22UH 5%
A50MP1	08901-00017	1	1	COVER, AM CALIBRATOR (INCLUDES P.C. EXTRACTOR)	28480	08901-00017
	2360-0113	2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A50MP2	5021-0817	8	1	P.C. BOARD EXTRACTOR	28480	5021-0817
A50Q1	1858-0032	8	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	27014	LM3146
A50Q2	1854-0345	8	4	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A50Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A50Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2227A						
A50Q5	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
2229A and above						
A50Q5	1854-0475	5		TRANSISTOR DUAL NPN PD=750MW	28480	1854-0475
A50Q6	1854-0019	3	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A50Q7	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A50Q8	1854-0071	7	10	TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
1933A to 2133A						
A50Q9	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
2134A to 2227A						
A50Q9	1854-0811	3		TRANSISTOR NPN SI PD=625MW FT=100 MHZ	28480	1854-0811
2229A and above						
A50Q9	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50Q10	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50Q11	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50Q12	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50Q13	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50Q14	1853-0020	4	2	TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A50Q15	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50Q16	1853-0034	0	2	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A50Q17	1854-0477	7	2	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A50Q18	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50Q19	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A50Q20	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A50Q21	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50Q22	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	2M627	XA22BCP20-1
A50Q23	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A50R1	0757-0346	2	1	RESISTOR 10 +-1% .125W TF TC=0+-100	D8439	MK2
A50R2	0757-0416	7	4	RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A50R3	0757-0401	0	7	RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A50R4	0698-3444	1	5	RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A50R5	0757-0438	3	11	RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R6	0698-0083	8	5	RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A50R7	0698-3152	8	1	RESISTOR 3.48K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3481-F
A50R8	0698-5466	1	1	RESISTOR 5.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5701-F
A50R9	0698-3153	9	2	RESISTOR 3.83K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3831-F
A50R10	0698-3150	6	1	RESISTOR 2.37K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2371-F
A50R11	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R12	0698-3132	4	1	RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A50R13	0698-0084	9	4	RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A50R14	0757-0280	3	9	RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A50R15	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A50R16	0698-3441	8	1	RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A50R17	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A50R18	0698-3158	4	2	RESISTOR 23.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2372-F
A50R19	0698-3158	4		RESISTOR 23.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2372-F
A50R20	0698-4439	6	2	RESISTOR 3.24K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3241-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A50R21	0698-4439	6		RESISTOR 3.24K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3241-F
A50R22	0757-0442	9	5	RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A50R23	0757-0447	4	1	RESISTOR 16.2K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1622-F
A50R24	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A50R25	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A50R26	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A50R27	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A50R28	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A50R29	0757-0465	6	3	RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A50R30	0698-3431	6	2	RESISTOR 23.7 +-1% .125W TF TC=0+-100	D8439	MK2
A50R31	0698-3438	3	2	RESISTOR 147 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-147R-F
A50R32	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A50R33	0698-3431	6		RESISTOR 23.7 +-1% .125W TF TC=0+-100	D8439	MK2
A50R34	0698-3438	3		RESISTOR 147 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-147R-F
A50R35	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A50R36	0698-0085	0	3	RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A50R37	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A50R38	0698-0084	9		RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2151-F
A50R39	2100-3207	1	1	RESISTOR-TRMR 5K 10% TKF SIDE-ADJ 1-TRN	28480	2100-3207
A50R40	0757-0279	0	2	RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A50R41	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A50R42	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A50R43	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A50R44	0757-0421	4	2	RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A50R45	2100-3349	2	1	RESISTOR-TRMR 100 10% TKF SIDE-ADJ 1-TRN	28480	2100-3349
A50R46	0698-3442	9	3	RESISTOR 237 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-237R-F
A50R47	0698-3447	4	1	RESISTOR 422 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-422R-F
A50R48	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A50R49	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A50R50	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R51	0757-0394	0	4	RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A50R52	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A50R53	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R54	0757-0419	0	3	RESISTOR 681 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-681R-F
A50R55	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R56	0698-0085	0		RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A50R57	0757-0419	0		RESISTOR 681 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-681R-F
A50R58	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R59	0698-0085	0		RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A50R60	0698-3153	9		RESISTOR 3.83K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3831-F
A50R61	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A50R62	0757-0394	0		RESISTOR 51.1 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-51R1-F
A50R63	0757-0440	7	3	RESISTOR 7.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7501-F
A50R64	0757-0440	7		RESISTOR 7.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7501-F
A50R65	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A50R66	0698-4190	6	1	RESISTOR 50 +-0.25% .125W TF TC=0+-100	12498	NA4
A50R67	0698-3488	3	1	RESISTOR 442 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-422R-F
A50R68	0757-0428	1	1	RESISTOR 1.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1621-F
A50R69	0698-6235	4	1	RESISTOR 96.25 +-0.5% .125W TF TC=0+-100	12498	NA4
A50R70	0757-0439	4	1	RESISTOR 6.81K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-6811-F
A50R71	0698-7982	0	1	RESISTOR 71.16 +-0.1% .25W TF TC=0+-50	19701	5043R-1/4-T2-71R16-B
A50R72	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A50R73	0757-0419	0		RESISTOR 681 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-681R-F
A50R74	0698-3445	2	1	RESISTOR 348 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-348R-F
A50R75	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A50R76	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A50R77	0698-7981	9	1	RESISTOR 96.25 +-0.1% .25W TF TC=0+-50	19701	5043R-1/4-T2-96R25-B
A50R78	0757-0424	7	1	RESISTOR 1.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1101-F
A50R79	0698-3442	9		RESISTOR 237 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-237R-F
A50R80	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A50R81	0698-3442	9		RESISTOR 237 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-237R-F
A50R82	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A50R83	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R84	0757-0440	7		RESISTOR 7.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-7501-F
A50R85	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R86	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R87	0757-0200	7	1	RESISTOR 5.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5621-F
A50R88	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
A50R89	0698-3444	1		RESISTOR 316 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-316R-F
1933A to 2227A						
A50R90	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
2229A and above						
A50R90	0698-3441	8	1	RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F
A50R91	0757-0402	1	1	RESISTOR 110 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-111-F
A50R92	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A50R93	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A50R94	0757-0279	0		RESISTOR 3.16K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3161-F
A50R95	0757-0421	4		RESISTOR 825 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-825R-F
A50R96	0698-6343	5	1	RESISTOR 9K +-0.1% .125W FF TC=0+-25	12498	NE55
A50R97	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A50R98	0698-3491	8	1	RESISTOR 1K +-0.1% .125W TF TC=0+-50	12498	NC55
A50R99	0698-3449	6	1	RESISTOR 28.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2872-F
A50R100	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A50R101	0698-4158	6	1	RESISTOR 100K +-0.1% .125W TF TC=0+-50	12498	NC55
A50R102	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R103	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A50R104	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A50R105	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A50R106	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A50R107	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A50R108	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
1933A to 2227A						
A50R109				NOT ASSIGNED		
2229A and above						
A50R109	0698-3441	8	1	RESISTOR 215 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-215R-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A50TP1	1251-0600	0	3	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A50TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A50TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A50U1	1826-0059	2	5	IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
A50U2	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
A50U3	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
A50U4	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
A50U5	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
A50U6	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	18324	NE555N
A50U7	1820-1963	7	1	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A50U8	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	27014	LM339N
A50U9	1820-1411	0	1	IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A50U10	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A50VR1	1902-0680	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A50VR2	1902-3059	0	1	DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059
A50VR3	1902-3104	6	1	DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). ∆ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A51						
A51	08901-60013	3	1	FM CALIBRATOR ASSEMBLY (OPTION 010 ONLY)	28480	08901-60013
A51C1	0160-3459	9	10	CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C2	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C3	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C4	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C5	0180-2206	4	2	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A51C6	0160-2199	2	3	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A51C7	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C8	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C9	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
1933A to 2201A						
A51C10	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	28480	0140-0196
2212A and above						
A51C10				NOT ASSIGNED		
A51C11	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A51C12	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A51C13	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A51C14	0160-4040	6	1	CAPACITOR-FXD 1000PF +-5% 100VDC CER	09969	RPE121-105C0G102J100V
A51C15	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A51C16	0140-0205	5	1	CAPACITOR-FXD 62PF +-5% 300VDC MICA	28480	0140-0205
A51C17	0160-3535	2	1	CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A51C18	0160-0574	3	2	CAPACITOR-FXD .022UF +-20% 100VDC CER	06383	FD12X7R2A223M
A51C19	0180-0197	8	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A51C20	0121-0436	4	1	CAPACITOR-V TRMR-AIR 2.6-23.5PF 350V	74970	189-0509-125
A51C21	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	06383	FD12X7R2A223M
A51C22	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C23	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C24	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51C25	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	09969	DD111NWB302Z5V203M100V
A51CR1△	1901-1098	1	5	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A51CR2△	1901-1098	1	5	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
1933A to 2410A						
A51CR3△	0122-0173	8	3	DIODE-VVC 29PF 10% C3/C25-MIN=5 30V	28480	0122-0173
2412A and above						
A51CR3△	0122-0162	5		DIODE-VVC 29PF 10%	28480	0122-0162
A51CR4△	1901-1098	1	5	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
1933A to 2410A						
A51CR5△	0122-0173	8	3	DIODE-VVC 29PF 10% C3/C25-MIN=5 30V	28480	0122-0173
A51CR6△	0122-0173	8	3	DIODE-VVC 29PF 10% C3/C25-MIN=5 30V	28480	0122-0173
2412A and above						
A51CR5△	0122-0162	5		DIODE-VVC 29PF 10%	28480	0122-0162
A51CR6△	0122-0162	5		DIODE-VVC 29PF 10%	28480	0122-0162

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A51CR7Δ	1901-1098	1	5	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A51CR8Δ	1901-1098	1	5	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
A51E1	9170-0847	3	2	CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE C
A51E2	9170-0847	3		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE C
A51J1	1250-1220	0	2	CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4	2	WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9	2	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A51J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	06877	82SMC-50-0-3/111
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	16179	500222
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A51L1	9100-1635	2	5	INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A51L2	9100-1635	2		INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A51L3	9100-1635	2		INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A51L4	9100-1635	2		INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A51L5	9100-1635	2		INDUCTOR RF-CH-MLD 91UH +-5%	91637	IM-4 91UH 5%
A51L6	9140-0310	2	1	INDUCTOR RF-CH-MLD 390NH +-5%	91637	IM-2 .39UH 5%
A51L7	9140-0309	9	1	INDUCTOR RF-CH-MLD 1.8UH +-5%	91637	IM-2 1.8UH 5%
A51MP1	08901-00040	0	1	COVER-FM CALIBRATOR(INCL PC EXTRACTOR)	28480	08901-00040
	2360-0113	2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A51MP2	5021-0817	8	1	P.C. BOARD EXTRACTOR	28480	5021-0817
A51Q1	1853-0034	0	3	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A51Q2	1854-0071	7	4	TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A51Q3	1853-0007	7	4	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A51Q4	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A51Q5	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A51Q6	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A51Q7	1854-0247	9	1	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
	1200-0173	5	1	INSULATOR-XSTR DAP-GL	13103	7717-86 DAP
A51Q8	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
1933A to 2542A						
A51Q9	1854-0475	5	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
2543A and above						
A51Q9	1854-0295	7	1	TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0295
A51Q10	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A51Q11	1854-0071	7		TRANSISTOR NPN SI TO-92 PD=300MW	2M627	CP4071
A51Q12	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A51Q13	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A51R1	0757-0401	0	2	RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A51R2	0757-0443	0	1	RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1102-F
A51R3	0698-3154	0	3	RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A51R4	0698-3153	9	2	RESISTOR 3.83K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-3831-F
A51R5	0757-0442	9	4	RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A51R6	0698-3447	4	1	RESISTOR 422 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-422R-F

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A51R7	0698-6502	8	3	RESISTOR 3.32K +-0.25% .125W TF TC=0+-50	12498	NC55
A51R8	0698-6502	8		RESISTOR 3.32K +-0.25% .125W TF TC=0+-50	12498	NC55
A51R9	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A51R10	0698-3153	9		RESISTOR 3.83K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3831-F
A51R11	0698-8068	5	2	RESISTOR 4.99K +-0.25% .125W TF TC=0+-25	19701	5033R-1/8-T9-4991-C
A51R12	2100-3349	2	1	RESISTOR-TRMR 100 10% TKF SIDE-ADJ 1-TRN	28480	2100-3349
A51R13	0698-8068	5		RESISTOR 4.99K +-0.25% .125W TF TC=0+-25	19701	5033R-1/8-T9-4991-C
A51R14	0698-8024	3	1	RESISTOR 3.09K +-0.25% .125W TF TC=0+-50	19701	5033R-1/8-T2-3091-C
A51R15	0698-3155	1	2	RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A51R16	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A51R17	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-4641-F
A51R18	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A51R19	0757-0464	5	1	RESISTOR 90.9K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-9092-F
A51R20	0757-0416	7	2	RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A51R21	0698-7815	8	1	RESISTOR 2.87K +-0.5% .125W TF TC=0+-50	19701	5033R-1/8-T2-2871-D
A51R22	0698-7839	6	1	RESISTOR 222 +-0.5% .125W TF TC=0+-50	19701	5033R-1/8-T2-222R-D
A51R23	0698-5439	8	2	RESISTOR 1K +-0.25% .125W TF TC=0+-50	12498	NC55
A51R24*Δ	0698-3159	5	1	RESISTOR 26.1K +-1% .125W TF TC=0+-100	24546	CT4-1/8-TO-2612-F
A51R25				NOT ASSIGNED		
A51R26	0698-5439	8		RESISTOR 1K +-0.25% .125W TF TC=0+-50	12498	NC55
A51R27	0698-6502	8		RESISTOR 3.32K +-0.25% .125W TF TC=0+-50	12498	NC55
A51R28	0698-3440	7	1	RESISTOR 196 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-196R-F
A51R29	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A51R30	0698-3157	3	1	RESISTOR 19.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1962-F
A51R31	0698-0085	0	1	RESISTOR 2.61K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2611-F
A51R32*Δ	0757-0443	0	1	RESISTOR 9.09K +-1% .05W TF TC=0+-100	24546	CT3-1/8-TO-9091-F
A51R33	0757-0447	4	1	RESISTOR 16.2K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1622-F
A51R34	0698-3154	0		RESISTOR 4.22K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4221-F
A51R35	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A51R36	0757-0441	8	1	RESISTOR 8.25K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-8251-F
A51R37	0698-7205	0	1	RESISTOR 51.1 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-51R1-F
A51R38	0698-7212	9	3	RESISTOR 100 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-100R-F
A51R39	0757-0420	3	2	RESISTOR 750 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-751-F
A51R40	0698-7212	9		RESISTOR 100 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-100R-F
A51R41	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A51R42	0757-0420	3		RESISTOR 750 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-751-F
A51R43	0698-3132	4	1	RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2610-F
A51R44	0698-7212	9		RESISTOR 100 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-100R-F
A51R45	0757-0438	3	2	RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A51R46	0757-0438	3		RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A51TP1	1251-0600	0	3	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A51TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A51TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	12360	94-155-1010-01-03-00
A51U1	1826-0059	2	4	IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
A51U2	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
A51U3	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2201A						
A51U4	1826-0059	2		IC OP AMP GP 8-TO-99 PKG	27014	LM201AH
2212A and above						
A51U4	1826-0371	1		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF256H
A51U5	1820-1963	7	1	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	04713	MC14013BCP
A51U6	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	27014	LM339N
A51U7	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A51U8	1820-1411	0	1	IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A51U9	1820-0723	5	1	IC-INTERFACE RCVR LINE RCVR DUAL	01295	SN75107AN
A51VR1	1902-3059	0	3	DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059
A51VR2	1902-0680	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	04713	1N827
A51VR3	1902-3104	6	2	DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A51VR4	1902-3104	6		DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A51VR5	1902-3059	0		DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059
A51VR6	1902-3059	0		DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
				MISCELLANEOUS ELECTRICAL PARTS		
B1△	08901-60306	7	1	FAN ASSEMBLY, 115V-50/60 HZ	28480	08901-60306
				(EXCEPT OPTION 004, INCLUDES PARTS LISTED BELOW)		
	08901-80065	7	1	FAN ONLY (NO HARDWARE)	28480	08901-80065
	3160-0300	6		FINGERGUARD	28480	3160-0300
	08901-00046	?	1	FAN COVER	28480	08901-00046
	86701-00017	3		SHIELDING DISK	28480	86701-00017
	1520-0067	4	2	SHOCK MOUNT	61957	WELL-NUT E-632
	2360-0220	2	4	SCREW-MACH 6-32 2.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
				(B1 TO MP16)		
	0360-1089	2		TERMINAL SOLDER LUG	28480	0360-1089
	2510-0099	2		SCREW-MACH 8-32 .25-IN-LG PAN-HD-POZI	28480	2510-0099
				(FOR SOLDER LUG)		
	3050-0227	3	4	WASHER-FL MTLC NO. 6 .149-IN-ID	80120	AN960C-6
B1△	08901-60307	0	1	FAN ASSEMBLY, 115V-48/480 HZ	28480	08901-60307
				(OPTION 004 ONLY, INCLUDES PARTS LISTED BELOW)		
	08901-80060	2	1	FAN ONLY (NO HARDWARE)	28480	08901-80060
	3160-0300	6		FINGERGUARD	28480	3160-0300
	86701-00017	3		SHIELDING DISK	28480	86701-00017
	08901-00046	?	1	FAN COVER	28480	08901-00046
	86701-00017	3		SHIELDING DISK	28480	86701-00017
	1520-0067	4	2	SHOCK MOUNT	61957	WELL-NUT E-632
	2360-0221	3	1	SCREW-MACH 6-32 2.5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
				(B1 TO MP16)		
	2360-0220	2	3	SCREW-MACH 6-32 2.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
				(B1 TO MP16)		
	3050-0227	3	4	WASHER-FL MTLC NO. 6 .149-IN-ID	80120	AN960C-6
F1	2110-0002	9	1	FUSE (INCH) 2A 250V NTD FE UL	75915	312 002
F1	2110-0001	8	1	FUSE (INCH) 1A 250V NTD FE UL	75915	312 001
1933A to 2119A						
J1				(INPUT) NSR, P/O W1		
2126A and above						
J1	1250-1772	7		ADAPTER-COAX STR F-N F-SMA (INPUT)	28480	1250-1772
	0590-0505	1		NUT-KNRLD-R 5/8-24-THD .125-IN-THK	28480	0590-0505
J2				(MODULATION OUTPUT) NSR, P/O W19		
J3				(CALIBRATION OUTPUT) NSR, P/O W32, OPTION 010 ONLY		
J4				(MODULATION OUTPUT) NSR, P/O W38, OPTION 001 ONLY		
J5				(IF OUTPUT) NSR, P/O W9		
1933A to 2119A						
J6				(LO OUTPUT) NSR, P/O W8, OPTION 003 ONLY		
J7				(LO INPUT) NSR, P/O W4, OPTION 003 ONLY		
2126A and above						
J6	1250-1772	7		ADAPTER-COAX STR F-N F-SMA (INPUT)	28480	1250-1772
J7	1250-1772	7		ADAPTER-COAX STR F-N F-SMA (INPUT)	28480	1250-1772
J8				(TIME BASE OUTPUT) NSR, P/O W15, OPTION 002 ONLY		
J9				(TIME BASE INPUT) NSR, P/O W18		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2119A						
J10				(INPUT) NSR, P/O W36, OPTION 001 ONLY		
2126A and above						
J10	1250-1772	7		ADAPTER-COAX STR F-N F-SMA (INPUT)	28480	1250-1772
J11				(CALIBRATION OUTPUT) NSR, P/O W37 OPTION 010+001 ONLY (OPTIONS 001/010 ONLY)		
J12	1250-0083	1	3	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (AM OUTPUT)	24931	28JR130-1
J13	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	24931	28JR130-1
J14	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	24931	28JR130-1
S1	3101-1655	2	1	SWITCH, TOGGLE, SPDT (ON/STBY)	09353	7101-J1CQ/7602-12 JADE
	0520-0129	8	2	SCREW-MACH 2-56 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
T1Δ	9100-4052	3	1	TRANSFORMER ASSEMBLY PARTS & COVER LISTED BELOW)	28480	9100-4052
Δ	08901-00214	0	1	SPACER	28480	08901-00140
	7100-1283	4	1	TRANSFORMER COVER	28480	7100-1283
	2680-0131	2	4	SCREW-MACH 10-32 2.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0034	5	6	WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
	3050-0226	2	2	WASHER-FL MTLC NO. 10 .203-IN-ID	80120	AN960C10L
	2190-0034	5		WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
	2740-0002	4	2	NUT-HEX-DBL-CHAM 10-32 2A-THD	00000	ORDER BY DESCRIPTION
	1400-0249	0	6	CABLE TIE .062-.625-DIA .091-WD NYL	16956	08-465/GRAY
	0890-0007	4	2	TUBING-FLEX .162-ID PVC .02-WALL	28480	0890-0007
	1520-0067	4	2	SHOCK MOUNT (FOR FAN IN REAR PANEL)	61957	WELL-NUT E-632
	0890-0007	4		TUBING-FLEX .162-ID PVC .02-WALL	28480	0890-0007
	1520-0067	4		SHOCK MOUNT (FOR FAN IN REAR PANEL)	61957	WELL-NUT E-632
	2190-0016	3	3	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	3	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	2190-0045	8	8	WASHER-LK HLCL NO. 2 .088-IN-ID	76854	1501-009
1933A to 2119A						
W1	08901-60041	7	1	CABLE ASSEMBLY J1 TO A15J1	28480	08901-60041
2126A and above						
W1	08901-60118	9	1	CABLE ASSEMBLY J1 TO A15J1, EXCEPT OPTION 001	28480	08901-60118
W2	08901-60061	1	1	CABLE ASSEMBLY A15J2 TO A17J2	28480	08901-60061
W3	08901-60060	0	1	CABLE ASSEMBLY A17J1 TO A18J2	28480	08901-60060
1933A to 2119A						
W4	08901-60062	2	1	CABLE ASSEMBLY J7 TO A17J3	28480	08901-60062
2126A and above						
W4	08901-60168	9	1	CABLE ASSEMBLY J7 TO A17J3, OPTION 003 ONLY	28480	08901-60168
W5	08901-60043	9	1	CABLE ASSEMBLY A18J1 TO A6J2	28480	08901-60043
W6	08901-60053	1	1	CABLE ASSEMBLY A6J1 TO A2J1	28480	08901-60053
W7	08901-60054	2	1	CABLE ASSEMBLY A6J3 TO A4J1	28480	08901-60054

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2119A						
W8	08901-60048	4	1	CABLE ASSEMBLY A19J3 TO J6	28480	08901-60048
2126A and above						
W8	08901-60167	8	1	CABLE ASSEMBLY J6 TO A19J3, OPTION 003 ONLY	28480	08901-60167
W9	08901-60044	0	1	CABLE ASSEMBLY A6J4 TO J5	28480	08901-60044
W10	08901-60056	4	1	CABLE ASSEMBLY A4J3 TO A2J2	28480	08901-60056
W11	08901-60059	7	1	CABLE ASSEMBLY A24J1 TO A19J2	28480	08901-60059
W12	08901-60063	3	1	CABLE ASSEMBLY A22J1 TO A21J1	28480	08901-60063
W13	08901-60057	5	1	CABLE ASSEMBLY A21J2 TO A23J1	28480	08901-60057
W14	08901-60055	3	1	CABLE ASSEMBLY A4J2 TO A11J3	28480	08901-60055
W15△	08901-60163	4	1	CABLE ASSEMBLY A11J5 TO J10 (OPTION 002)	28480	08901-60163
W16	08901-60051	9	1	CABLE ASSEMBLY A19J1 TO A11J1	28480	08901-60051
W17	08901-60058	6	1	CABLE ASSEMBLY A24J2 TO A23J2	28480	08901-60058
W18	08901-60042	8	1	CABLE ASSEMBLY J9 TO A11J6	28480	08901-60042
W19	08901-60049	5	1	CABLE ASSEMBLY A25J1 TO J2	28480	08901-60049
W20	08901-60065	5	1	CABLE ASSEMBLY A1J2 TO A27J3	28480	08901-60065
W21	08901-60066	6	2	CABLE ASSEMBLY A28J3 TO A27J1	28480	08901-60066
W22	08901-60066	6		CABLE ASSEMBLY A25J3 TO A28J2	28480	08901-60066
W23	08901-60067	7	1	CABLE ASSEMBLY A25J2 TO A27J2	28480	08901-60067
W24	08901-60073	5	1	WIRING HARNESS A26J1 TO A1J1	28480	08901-60073
W25	08901-60070	2	1	WIRING HARNESS A26J7 TO A28J1	28480	08901-60070
W26				NOT ASSIGNED		
W27△	08901-60296	4	1	CABLE ASSEMBLY A26J3 TO A27J4 MOLEX	28480	08901-60296
W28	08901-60071	3	1	CABLE ASSEMBLY A26J2 TO A25J4 MOLEX	28480	08901-60071
W29	08901-60075	7	1	CABLE ASSEMBLY A25J5 TO J12,13,14	28480	08901-60075
W30	08901-60077	9	1	CABLE ASSEMBLY A14J1 TO A31J1	28480	08901-60077
W31△	08901-60169	0	1	CABLE ASSEMBLY Y1 TO A11J4 (OPTION 002)	28480	08901-60169
W32	08901-60050	8	1	CABLE ASSEMBLY A50J2 TO J3 (OPTION 010 ONLY; EXCEPT OPTION 001)	28480	08901-60050
W33	08901-20083	3	1	CABLE, SEMI-RIGID J6 TO J7	28480	08901-20083
W34	08901-60064	4	1	CABLE ASSEMBLY,A51J2 TO A11J2	28480	08901-60064
W35	08901-60076	8	1	CABLE ASSEMBLY A51J1 TO A50J1	28480	08901-60076
1933A to 2119A						
W36	08901-60045	1	1	CABLE ASSEMBLY J10 TO A15J1	28480	08901-60045
2126A and above						
W36	08901-60118	9	1	CABLE ASSEMBLY J1 TO A15J1, OPTION 001 ONLY	28480	08901-60118
W37	08901-60046	2	1	CABLE ASSEMBLY A50J2 TO J11 (OPTION 001/010 ONLY)	28480	08901-60046
W38	08901-60047	3	1	CABLE ASSEMBLY A25J1 TO J4	28480	08901-60047
W39	08901-60078	0	1	CABLE ASSEMBLY A19J3 TO A17J3	28480	08901-60078
W40	8120-1378	1	1	CABLE ASSEMBLY MAINS POWER	11383	PS-204-625
Y1	0960-0529	4	1	CRYSTAL OSCILLATOR, HI-STABILIZER	28480	0960-0529
△	2360-0205	3	2	SCREW-MACH 6-32 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0205	3	2	SCREW-MACH 6-32 .750-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1	4	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
	3050-0227	3	4	WASHER-FL MTLC NO. 6 .149-IN-ID	80120	AN960C-6

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
				MISCELLANEOUS MECHANICAL PARTS		
1933A to 2518A						
MP1	5020-8805	8	1	FRAME, FRONT	28480	5020-8805
	2360-0114	3	8	SCREW-MACH 6-32 .25-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP2	5020-8836	5	4	CORNER STRUTS 15"	28480	5020-8836
	2510-0192	6	16	SCREW-MACH 8-32 .25-IN-LG 100 DEG	28480	2510-0192
2521A and above						
MP1	5021-5805	4	1	FRAME, FRONT	28480	5021-5805
	2360-0114	3	8	SCREW-MACH 6-32 .25-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP2	5021-5836	1	4	CORNER STRUTS 15"	28480	5021-5836
	0515-1331	5	16	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 7MM	28480	0515-1331
1933A to 2911A						
MP3 †				SEE SECTION 7		
MP4 †				SEE SECTION 7		
2916A and above						
MP3	5041-8802	9	1	TOP TRIM, FRONT FRAME	28480	5041-8802
MP4	5062-3703	3	2	STRAP HANDLE	28480	5062-3703
1933A to 2911A						
MP5-MP8†				SEE SECTION 7		
MP5	5062-3734	0	1	COVER, TOP	28480	5062-3734
MP6	5062-3746	4	1	COVER, BOTTOM	28480	5062-3746
MP7	08901-00204	2	1	COVER, LEFT SIDE	28480	08901-00204
MP8	08901-00203	7	1	COVER, RIGHT SIDE	28480	08901-00203
1933A to 2911A						
MP9-MP12†				SEE SECTION 7		
2916A and above						
MP9	5041-8819	8	2	STRAP, HANDLE, CAP-FRONT	28480	5041-8819
	2680-0118	5	3	SCREW-MACH 10-32 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP10	5041-8820	1	2	STRAP,HANDLE,CAP-REAR	28480	5041-8820
	0515-1239	2		SCREW-MACH M 5 X 0.8 12MM-LG	28480	0515-1239
MP11	5041-8801	8	4	FOOT	28480	5041-8801
MP12	5001-0540	2	2	TRIM, SIDE	28480	5001-0540
MP13	1460-1345	5	2	TILT STAND SST	28480	1460-1345
1933A to 2911A						
MP14†				SEE SECTION 7		
2916A and above						
MP14	08901-00197	8	1	FRONT PANEL (EXCEPT OPTION 001 AND/OR 010)	28480	08901-00197
MP14	08901-00198	9	1	FRONT PANEL (OPTION 001 ONLY)	28480	08901-00198
MP14	08901-00196	7	1	FRONT PANEL (OPTION 010 ONLY)	28480	08901-00196
MP14	08901-00199	0	1	FRONT PANEL (OPTION 001 WITH 010 ONLY)	28480	08901-00199
MP15	08901-00002	4	1	SUB-PANEL, FRONT	28480	08901-00002
	5040-6928	4	3	STRIP DIVIDER	28480	5040-6928
	2200-0145	2	3	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0003	8	10	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0003
	3050-0105	6	10	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2342A						
MP16	08901-00001	3	1	PANEL, REAR	28480	08901-00001
2346A to 2518A						
MP16	08901-20233	5	1	PANEL, REAR	28480	08901-20233
2521A and above						
MP16	08901-20273	3	1	PANEL, REAR	28480	08901-20273
1933A to 2609A						
MP17	08901-00005	7	1	STRUT, CENTER	28480	08901-00005
	2360-0114	3		SCREW-MACH 6-32 .25-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
	2360-0195	0	33	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI (MP17 TO MP16, A26, A27)	00000	ORDER BY DESCRIPTION
	2190-0006	1	39	WASHER-LK HLCL NO. 6 .141-IN-ID (MP17 TO MP16, A26, A27)	28480	2190-0006
2616A and above						
MP17	08901-00167	2	1	STRUT, CENTER	28480	08901-00167
	2360-0114	3		SCREW-MACH 6-32 .25-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
	2360-0195	0	33	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI (MP17 TO MP16, A26, A27)	00000	ORDER BY DESCRIPTION
	2190-0006	1	39	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
Screws for MP17 Center Strut						
1933A to 2229A	0624-0281	3	237	SCREW-TPG 4-20 .5-IN-LG PAN-HD-POZI STL	28480	0624-0281
2238A to 2450A	0624-0100	5	237	SCREW-TPG 4-40 .5-IN-LG PAN-HD-POZI STL	28480	0624-0100
2505A and above	0624-0653	3	237	SCREW 440X1/2 TAPTITE T-10 PNTX	28480	0624-0653
1933A to 2911A						
MP18†				SEE SECTION 7		
2916A and above						
MP18	5041-8821	2	4	STANDOFF, REAR PANEL	28480	5041-8821
Screws for MP18 Rear Panel Standoffs						
1933A to 2518A	2360-0197	2	4	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
2521A and above	0515-1232	5		SCREW-MACH M 3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
1933A to 2609A						
MP19	08901-00008	0	1	BRACKET SUPPORT, AUDIO SECTION	28480	08901-00008
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
2616A and above						
MP19	08901-00168	0	1	BRACKET SUPPORT, AUDIO SECTION	28480	08901-00168
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
Screws for MP19 Audio Section Bracket						
1933A to 2229A	0624-0281	3		SCREW-TPG 4-20 .5-IN-LG PAN-HD-POZI STL	28480	0624-0281
2238A and above	0624-0100	5		SCREW-TPG 4-40 .5-IN-LG PAN-HD-POZI STL	28480	0624-0100
MP20	08901-00009	1	1	BRACKET SUPPORT, POWER SUPPLY	28480	08901-00009
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP21	08901-00047	7	1	BRACKET SUPPORT, DIGITAL	28480	08901-00047
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP22	1400-0510	8	2	CLAMP-CABLE .15-DIA .62-WD NYL	02768	8511-28-00-9909

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). Δ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2618A						
MP23	08901-00035	3	1	GASKET,RFI (BETWEEN MP50, 51 AND A27)	28480	08901-00035
MP24	08901-00011	5	1	GUIDE, PC, DIGITAL	28480	08901-00011
	2360-0193	8	4	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
2623A and above						
MP23				NOT ASSIGNED		
MP24	08901-00174	1	1	GUIDE, PC, DIGITAL	28480	08901-00174
	2360-0193	8	4	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP25	08901-80007	7	4	SHOCK MOUNT (RF SECTION)	28480	08901-80007
MP26	7120-7204	3	1	OPERATING INFORMATION PULL-OUT CARD	28480	7120-7204
1933A to 2911A						
MP27†				SEE SECTION 7		
2916A and above						
MP27	5062-4032	3	1	INFORMATION TRAY	28480	5062-4032
MP28	08901-00046	6	1	COVER, FAN	28480	08901-00046
	0400-0011	3	4	GROMMET-RND .375-IN-ID .5-IN-GRV-OD	83330	2175
	1520-0067	4	4	SHOCK MOUNT .44-EFF-HGT .31-OD (MP28, 33, B1 TO MP16)	61957	WELL-NUT E-632
	2360-0220	2	3	SCREW-MACH 6-32 2.25-IN-LG PAN-HD-POZI (MP28, 33, B1 TO MP16)	00000	ORDER BY DESCRIPTION
	2360-0221	3	1	SCREW-MACH 6-32 2.5-IN-LG PAN-HD-POZI (MP28, 33, B1 TO MP16)	00000	ORDER BY DESCRIPTION
	3050-0227	3	7	WASHER-FL MTLC NO. 6 .149-IN-ID (MP28, 33, B1 TO MP16)	80120	AN960C-6
	0360-0001	5	1	TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	79963	523.144
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
	2420-0002	6	1	NUT-HEX-DBL-CHAM 6-32-THD .109-IN-THK	28480	2420-0002
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP29	08901-20028	6	1	WIRE DUCT	28480	08901-20028
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	3050-0227	3		WASHER-FL MTLC NO. 6 .149-IN-ID	80120	AN960C-6
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP30	08901-20029	7	1	WIRE DUCT COVER	28480	08901-20029
MP31△	08901-00140	1	1	WIRE DUCT SUPPORT,(REAR)	28480	08901-00140
△	08901-00214	0	1	SPACER	28480	08901-00140
MP32△	8160-0072	4		RFI ROUND STRIP MNL-MSH .062-IN-OD RFI SEALING (FOR MP1)	18565	10-04-1687-1215
MP33	3160-0249	2	1	WIRE FINGER GUARD (FOR B1)	12330	055013
MP34	1600-0692	1	3	RETAINING CLIP (HOLD FRONT WINDOW)	28480	1600-0692
MP35	2360-0203	1	4	SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
1933A to 2126A						
MP36	08901-00007	9	1	SUPPORT BRACKET,SHOCK MOUNT, FRONT	28480	08901-00007
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP37	08901-00010	4	1	SUPPORT BRACKET,SHOCK MOUNT, REAR	28480	08901-00010
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP38	08901-00048	8	1	GASKET, EXTRUSION,RF SECTION	28480	08901-00048
2128A and above						
MP36	08901-00086	4	1	SUPPORT BRACKET, SHOCK MOUNT, FRONT	28480	08901-00086
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP37	08901-00087	5	1	SUPPORT BRACKET, SHOCK MOUNT, REAR	28480	08901-00087
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0006	1		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP38	08901-00095	5	1	GASKET, EXTRUSION, RF SECTION	28480	08901-00095

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
MP39	08901-00006	8	1	SCREEN, RFI (FOR MP15)	28480	08901-00006
MP40△	08901-20182	3	1	FRONT WINDOW PANEL	28480	08901-20182
	08901-20181	2	1	WINDOW FOR FRONT PANEL	28480	08901-20181
MP41△				PART NO LONGER SEPARATELY REPLACEABLE		
MP42△				PART NO LONGER SEPARATELY REPLACEABLE		
MP43△				PART NO LONGER SEPARATELY REPLACEABLE		
MP44△				NOT ASSIGNED		
MP45△				PART NO LONGER SEPARATELY REPLACEABLE		
MP46△				PART NO LONGER SEPARATELY REPLACEABLE		
MP47	08901-20050	4	1	SHIELD (SUPPORTS A1)	28480	08901-20050
	2190-0003	8		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0003
	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
1933A to 2126A						
MP48	08901-20041	3	1	EXTRUSION ASSEMBLY, RF SECTION	28480	08901-20041
2128A to 2609A						
MP48	08901-20158	3	1	EXTRUSION ASSEMBLY, RF SECTION	28480	08901-20158
2616A and above						
MP48	08901-20276	6	1	EXTRUSION ASSEMBLY, RF SECTION	28480	08901-20276
	0403-0005	1	3	SHOCK MOUNT (ON BACK OF A28 BOARD)	70485	1059-26012
	0460-1027	9		TAPE-VINYL (ON MP2 NEAR RF SECTION)	76381	4508
Screws for MP48 RF Section Extrusion						
1933A to 2229A	0624-0281	3		SCREW-TPG 4-20 .5-IN-LG PAN-HD-POZI STL	28480	0624-0281
2238A to 2450A	0624-0100	5		SCREW-TPG 4-40 .5-IN-LG PAN-HD-POZI STL	28480	0624-0100
2505A and above	0624-0653	3	237	SCREW 440X1/2 TAPTITE T-10 PNTX	28480	0624-0653
MP49				NOT ASSIGNED		
1933A to 2618A						
MP50△	08901-20043	5	1	EXTRUSION (FOR COUNTER ASSEMBLY)	28480	08901-20043
2623A and above						
MP50	08901-20275	5	1	EXTRUSION (FOR COUNTER ASSEMBLY)	28480	08901-20275
	08901-20028	6	1	HOLE PLUG .500 DIA. (FOR MOUNTING SCREW)	28480	08901-20028
Screws for MP50 Counter Section Extrusion						
1933A to 2229A	0624-0281	3		SCREW-TPG 4-20 .5-IN-LG PAN-HD-POZI STL	28480	0624-0281
2238A to 2450A	0624-0100	5		SCREW-TPG 4-40 .5-IN-LG PAN-HD-POZI STL	28480	0624-0100
2505A and above	0624-0653	3	237	SCREW 440X1/2 TAPTITE T-10 PNTX	28480	0624-0653
MP51	08901-20093	5	1	EXTRUSION ENDPLATE (FOR COUNTER ASSY)	28480	08901-20093
MP52	6960-0002	4	3	PLUG-HOLE TR-HD FOR .5-D-HOLE STL (J4 EXCEPT OPT. 001;J8 EXCEPT OPT. 002 J11 EXCEPT OPT. 001/010)	71785	SS-48152-K1110
MP53	6960-0010	4	1	PLUG-HOLE TR-HD FOR .625-D-HOLE STL (J6,7 EXCEPT OPT. 003; J10 EXCEPT	71785	SS-48172-K1110
1933A to 2609A						
MP54	08901-20039	9	7	EXTRUSION, PUNCHED (FOR AUDIO SECTION)	28480	08901-20039
2616A and above						
MP54	08901-20277	7	7	EXTRUSION, PUNCHED (FOR AUDIO SECTION)	28480	08901-20277
Screws for MP54 Audio Section Extrusion						
1933A to 2229A	0624-0281	3		SCREW-TPG 4-20 .5-IN-LG PAN-HD-POZI STL	28480	0624-0281
2238A to 2450A	0624-0100	5		SCREW-TPG 4-40 .5-IN-LG PAN-HD-POZI STL	28480	0624-0100
2505A and above	0624-0653	3	237	SCREW 440X1/2 TAPTITE T-10 PNTX	28480	0624-0653

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2609A						
MP55	08901-20048	0	1	EXTRUSION-UNPUNCHED (FOR AUDIO SECTION)	28480	08901-20048
MP56	08901-20038	8	1	EXTRUSION ENDPLATE(FOR AUDIO SECTION)	28480	08901-20038
2616A and above						
MP55				NOT ASSIGNED		
MP56				NOT ASSIGNED		
1933A to 2229A						
MP57	0624-0281	3		SCREW-TPG 4-20 .5-IN-LG PAN-HD-POZI STL	28480	0624-0281
2238A to 2450A						
MP57	0624-0100	5		SCREW-TPG 4-40 .5-IN-LG PAN-HD-POZI STL	28480	0624-0100
2505A and above						
MP57	0624-0653	3	237	SCREW 440X1/2 TAPTITE T-10 PNTX	28480	0624-0653
2616A and above						
MP57				NOT ASSIGNED		
MP58	7120-1254	1	1	NAMEPLATE .312-IN-WD .54-IN-LG ABS	28480	7120-1254
	0510-0043	4	2	RETAINER-RING E-R EXT .141-IN-DIA STL	54963	1500-14-ZD
	0570-1171	7	2	SCREW-SPCL 6-32 .468-IN-LG UNCT 100	00000	ORDER BY DESCRIPTION
	0510-0043	4		RETAINER-RING E-R EXT .141-IN-DIA STL	54963	1500-14-ZD
	0570-1171	7		SCREW-SPCL 6-32 .468-IN-LG UNCT 100	00000	ORDER BY DESCRIPTION
	0380-0003	9	1	SPACER-RND .125-IN-LG .18-IN-ID	28480	0380-0003
	2200-0091	7	7	SCREW-MACH 4-40 .562-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	08901-00067	1	1	INSULATOR	28480	08901-00067
	0400-0227	3	2	GROMMET-RND .375-IN-ID .5-IN-GRV-OD	01538	522
	0400-0227	3		GROMMET-RND .375-IN-ID .5-IN-GRV-OD	01538	522
MP59	0590-0505	1	1	NUT-KNRLD-R 5/8-24-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
MP60△	0590-1251	6	1	NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD	28480	0590-1251
	2190-0068	5	1	WASHER-LK INTL T 1/2 IN .505-IN-ID	78189	1924-02
MP61	2950-0035	8	1	NUT-HEX-DBL-CHAM 15/32-32-THD	00000	ORDER BY DESCRIPTION
	2190-0102	8	1	WASHER-LK INTL T 15/32 IN .472-IN-ID	78189	1922-01
MP62	08901-00065	9	2	BRACKET, RETAINING (A13,A14)	28480	08901-00065
	2190-0006 5	2	3		28480	2190-0006 5
	2360-0195	0		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP63	0460-1025	7	1	STICKY TAPE	28480	0460-1025
MP64	08901-00069	4	1	INSULATOR-BOTTOM COVER, LOCATED UNDER RF SECTION	28480	08901-00069
MP65△	08901-00148	9	2	RF SECTION BLANK COVER	28480	08901-00148
1933A to 2423A						
MP66				NOT ASSIGNED		
2439A and above						
MP66	08901-00157	0	1	AUDIO SECTION BLANK COVER	28480	08901-00157
1933A to 2450A						
MP67				NOT ASSIGNED		
2505A and above						
MP67	8710-1637	6	1	TORX BIT, T-10	28480	8710-1637
	1400-0510	8	2	CLAMP-CABLE .15-DIA .62-WD NYL	02768	8511-28-00-9909

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1933A to 2542A						
MP68				NOT ASSIGNED		
2543A and above						
MP68	08901-00108	1	1	POWER ASSEMBLY SUPPORT BRACKET	28480	08901-00108
MP69△	0403-0188	1	2	BUMPER FOOT-SCR .5-IN-OD .188-IN-HGT BLK.	28480	0403-0188
1933A to 2518A						
MP70	7120-8607	2	1	LABEL "THIS INSTRUMENT USES METERIC AND ENGLISH HARDWARE	28480	7120-8607
2521A and above						
MP70				PART NO LONGER SEPARATELY REPLACEABLE		

†Refer to Section 7 for update information. *Factory Selected Component (Refer to Section 5). △ Errata part change.

Table 6-4. Code List of Manufacturers (1 of 2)

Mfr. Code	Manufacturer Name	Address	Zip Code
C0633	RIFA AB	STOCKHOLM, SW	S-163
C1433	AB ELEKTRONIKGMBH	SALZBURG, AU	A-501
D8439	ROEDERSTEIN/RESISTA GMBH	LANDSHUT, GM	8300
K1935	JERMYN INDUSTRIES LTD	KENT SEVENOAKS, EG	
K8479	HOLSWORTHY ELECTRONICS LTD	HOLSWORTHY, EG	
00000	ANY SATISFACTORY SUPPLIER		
00853	SANGAMO WESTON INC	NORCROSS, GA US	30071
01121	ALLEN-BRADLEY CO INC	EL PASO, TX US	79935
01295	TEXAS INSTRUMENTS INC	DALLAS, TX US	75265
01538	SMALL PARTS INC	COSTA MESA, CA	92626
02114	FERROXCUBE CORP	SAUGERTIES, NY US	12477
02768	ITW FASTEX	DES PLAINES, IL US	60016
03911	CLAIREX CORP	MT VERNON, NY US	10550
04713	MOTOROLA INC	ROSELLE, IL US	60195
05245	CORCOM INC	LIBERTYVILLE, IL US	60048
06383	PANDUIT CORP	TINLEY PARK, IL US	60477
06560	JEFFERS ELECTRONICS INC	NOGALES, AZ US	85621
06776	ROBINSON NUGENT INC	NEW ALBANY, IN US	47150
06877	UNITRON INSTRUMENTS INC	WOODBURY, NY	11797
07263	FAIRCHILD SEMICONDUCTOR CORP	CUPERTINO, CA US	95014
07933	RAYTHEON CO SEMICONDUCTOR DIV HQ	MOUNTAIN VIEW, CA	94040
09353	C & K COMPONENTS INC	NEWTON, MA US	02158
09464	DRYCO MFG CO INC	CHICAGO, IL	60612
09535	JOHNSON MATTHEY AND MALLORY LTD	TORONTO, CN	
09969	DALE ELECTRONICS INC	YANKTON, SD US	57078
11236	CTS CORP	ELKHART, IN US	46514
11383	AMETEK/ALUMINUM EXTRUSION	LOS ANGELES, CA	90065
11502	IRC INC	BOONE, NC US	28607
11532	TELEDYNE INDUSTRIES INC	LOS ANGELES, CA US	90067
11870	MELABS INC	PALO ALTO, CA	94304
12330	MONTROSE PRODUCTS CO	AUBURN, MA US	01501
12344	TALLY CORP	KENT, WA	98031
12360	ALBANY PROD CO DIV OF PHEUMO DYN	NORWALK, CT	06850
12403	CANFIELD H O CO OF INDIANA INC THE	SEYMOUR, IN	47274
12474	BEL-RAY CO INC	FARMINGDALE, NJ	07727
12498	CRYSTALONICS, DIV TELEDYNE	CAMBRIDGE, MA	02140
13103	THERMALLOY INC	DALLAS, TX US	75234
15636	ELEC-TROL INC	SAUGUS, CA US	91350
16179	M/A-COM INC	BURLINGTON, MA US	01803
16428	COOPER INDUSTRIES INC	HOUSTON, TX US	77210
16956	DENNISON MFG CO	FRAMINGHAM, MA US	01701
17856	SILICONIX INC	SANTA CLARA, CA US	95054
18324	SIGNETICS CORP	SUNNYVALE, CA US	94086
18565	CHOMERICS INC	WOBURN, MA	01801

Table 6-4. Code List of Manufacturers (2 of 2)

Mfr. Code	Manufacturer Name	Address	Zip Code
19701	MEPCO/CENTRALAB INC	RIVIERA, FL US	33404
2M627	ROHM CORP	IRVINE, CA US	92713
24226	GOWANDA ELECTRONICS CORP	GOWANDA, NY US	14070
24355	ANALOG DEVICES INC	NORWOOD, MA US	02062
24931	SPECIALTY CONNECTOR CO	FRANKLIN, IN US	46131
25403	NV PHILIPS ELCOMA	EINDHOVEN, NE	02876
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA, CA US	95052
27264	MOLEX INC	LISLE, IL US	60532
27735	F-DYNE ELECTRONICS CO	BRIDGEPORT, CT	06605
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO, CA	94304
30817	INSTRUMENT SPECIALTIES CO INC	DEL WATER GAP, PA	07424
32159	WEST-CAP ARIZONA	SAN FERNANDO, CA US	91340
34335	ADVANCED MICRO DEVICES INC	SUNNYVALE, CA US	94086
34371	HARRIS CORP	MELBOURNE, FL US	32901
46384	PENN ENGINEERING & MFG CORP	DOYLESTOWN, PA US	18901
50088	MOSTEK CORP	CARROLLTON, TX US	75006
51167	ARIES ELECTRONICS INC	FRENCHTOWN, NJ US	08825
52763	STETTNER & CO	LAUF, GM	D-856
54963	ANDERTON DARBY INC	CLIFTON, NJ	07015
55285	BERGQUIST CO	MINNEAPOLIS, MN	55420
56289	SPRAGUE ELECTRIC CO	LEXINGTON, MA US	02173
61957	USM CORP	BOSTON, MA	02107
70485	ATLANTIC INDIA RUBBER WORKS INC	CHICAGO, IL	60607
71785	TRW INC	CLEVELAND, OH US	44124
72962	ELASTIC STOP NUT DIVOF HARVARD	UNION, NJ US	07083
73138	BECKMAN INDUSTRIAL CORP	FULLERTON, CA US	92635
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO, IL	60618
74970	EF JOHNSON CO	WASECA, MN US	56093
75915	LITTELFUSE INC	DES PLAINES, IL US	60016
76381	3M CO	ST PAUL, MN US	55144
76854	OAK SWITCH SYSTEMS INC	CRYSTAL LAKE, IL US	60014
77342	POTTER & BRUMFIELD INC	PRINCETON, IN US	47671
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN, IL	60126
78488	STACKPOLE CARBON CO	ST MARYS, PA	15857
79963	ZIERICK MFG CO	MT KISCO, NY	10549
80120	SCHNITZER ALLOY PRODUCTS CO	ELIZABETH, NJ	07206
83186	VICTORY ENGINEERING CORP	SPRINGFIELD, NJ US	07081
83330	KULKA-SMITH INC	MANASQUAN, NJ US	08736
84411	AMERICAN SHIZUKI CORP	CANOGA PARK, CA US	91304
9B253	MOLECU WIRE CORP	FARMINGDALE, NJ	07727
9N171	UNITRODE CORP	LEXINGTON, MA US	02173
91506	AUGAT INC	MANSFIELD, MA US	02048
91637	DALE ELECTRONICS INC	COLUMBUS, NE US	68601
95275	VITRAMON INC	MONROE, CT US	06468
98291	SEALECTRO CORP	TRUMBULL, CT US	06611
98978	INTL ELECTRONIC RESEARCH CORP	BURBANK, CA US	91502

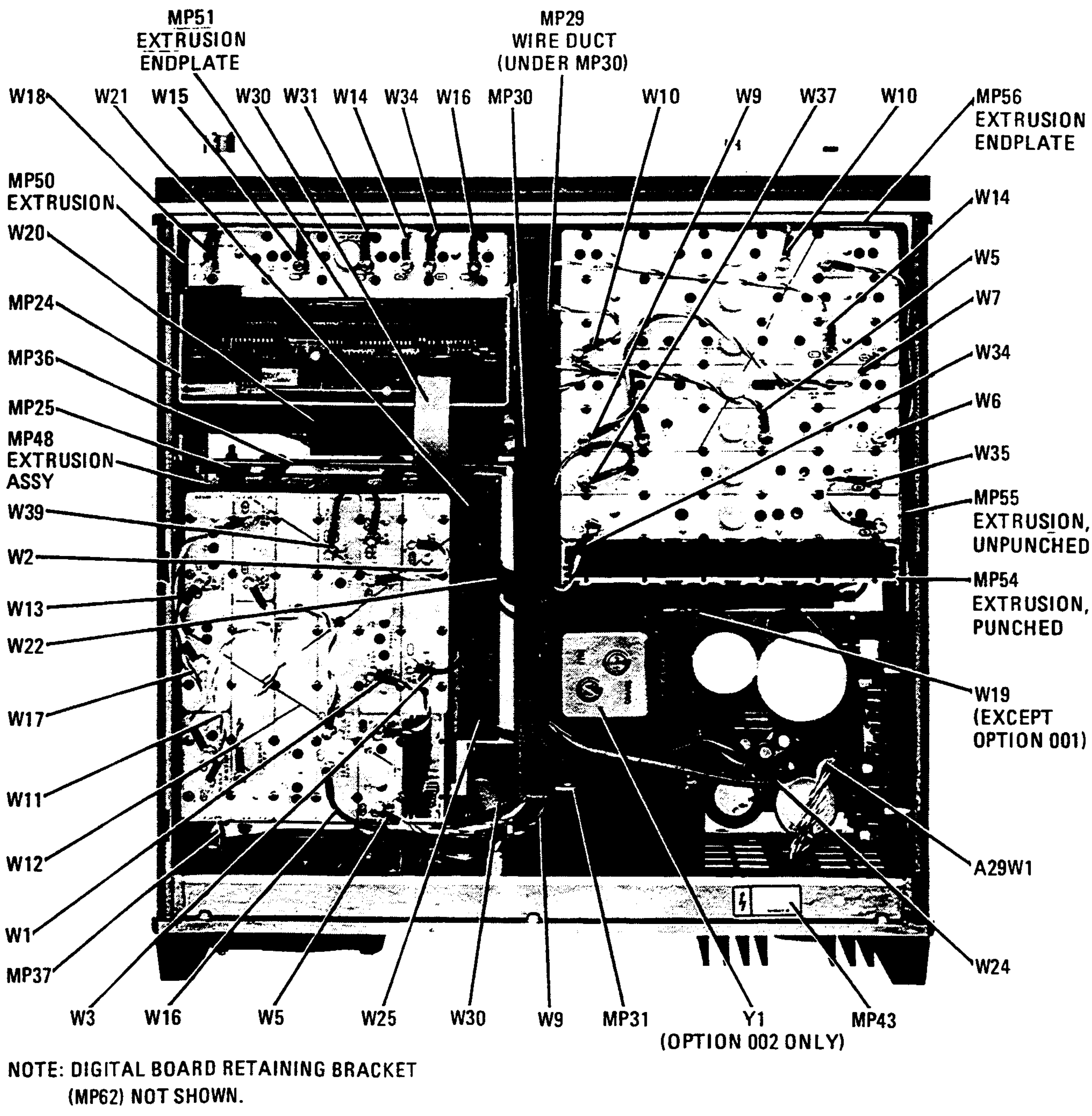


Figure 6–1. Parts and Cable Identification (Top View)

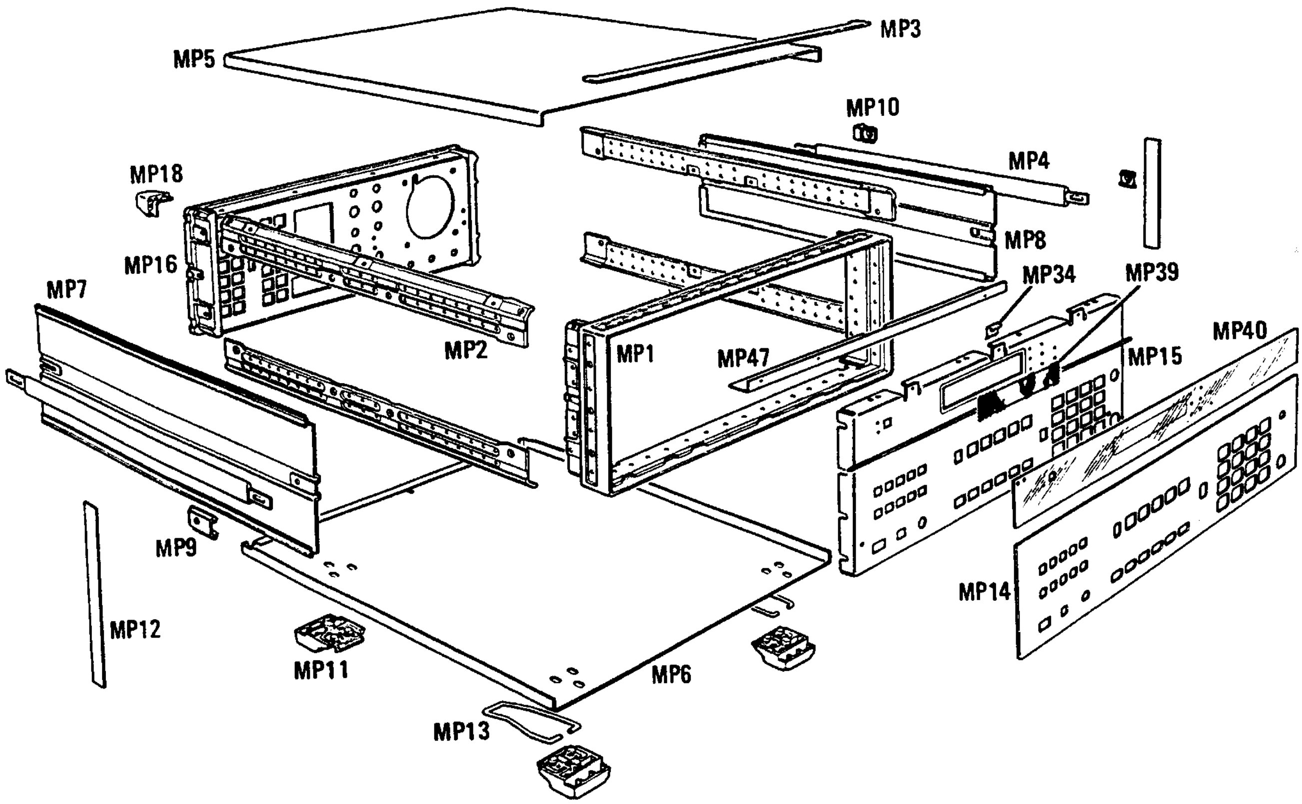


Figure 6–2. *Cabinet Parts*

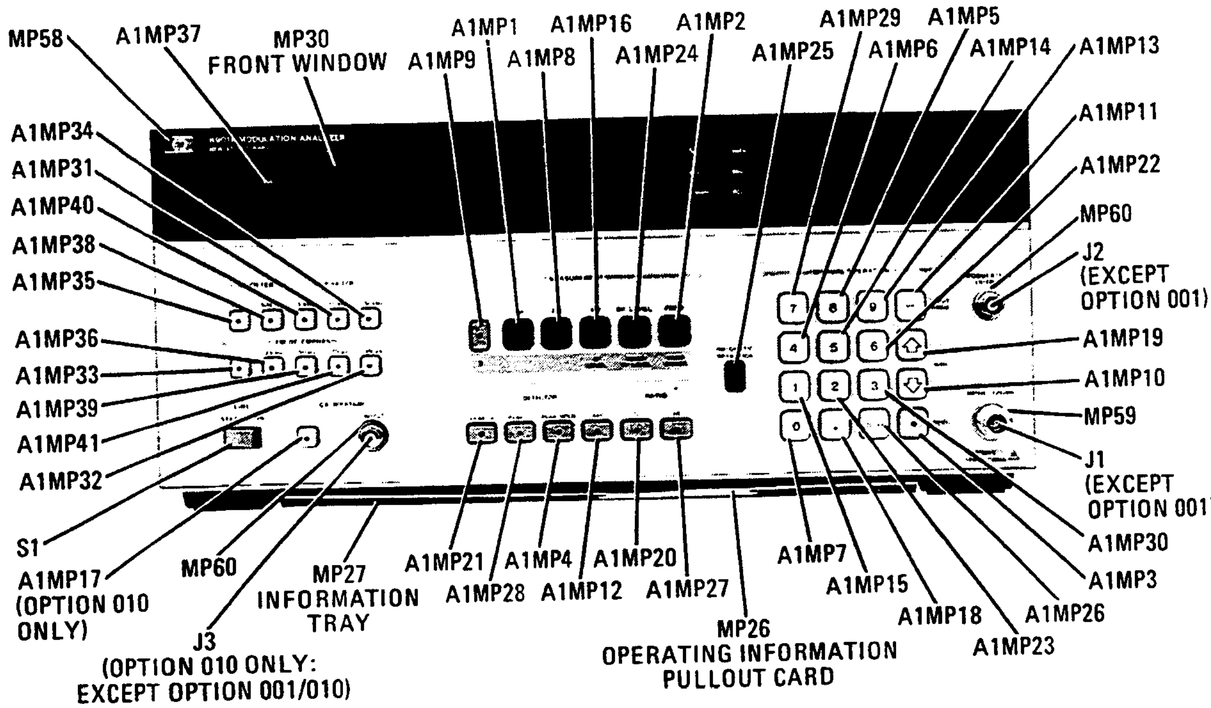


Figure 6–3. Parts Identification (Front View)

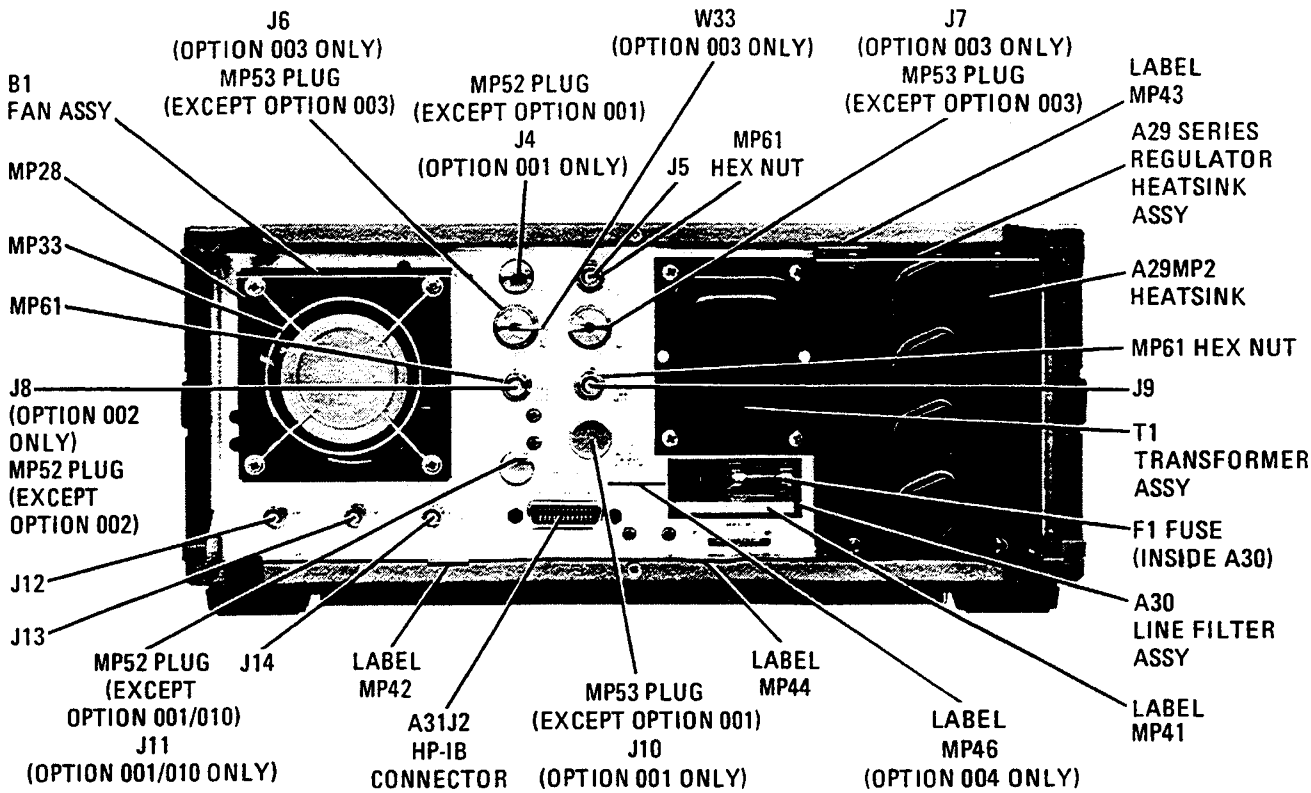


Figure 6–4. Parts Identification (Rear View)

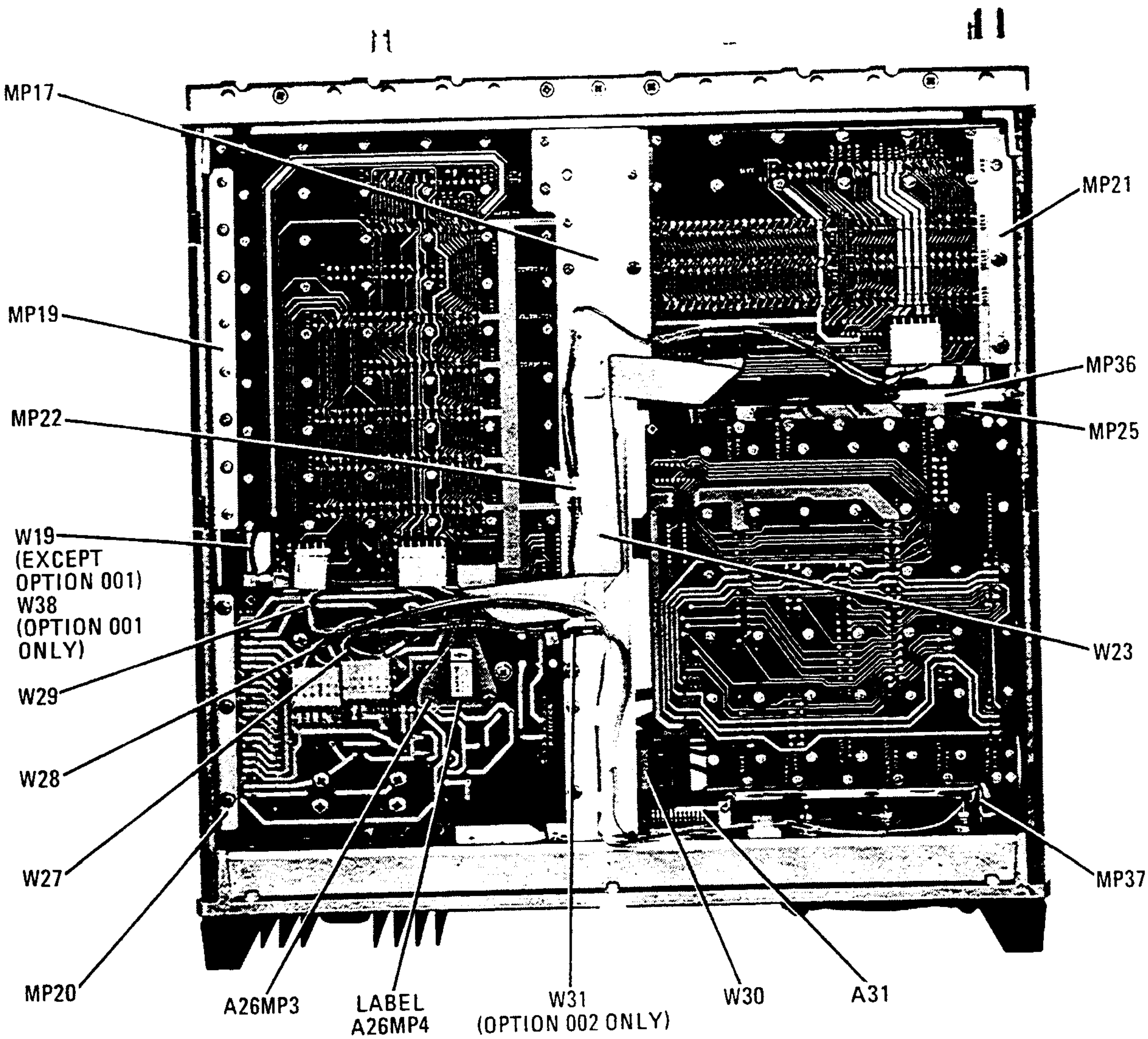


Figure 6–5. *Parts Cable Identication (Bottom View)*

Section 7
MANUAL CHANGES

7-1. INTRODUCTION

This section contains manual change instructions for backdating this manual for HP Model 8901A Modulation Analyzers that have serial number prefixes that are lower than 1933A. This section also contains instrument modification suggestions and procedures that are recommended to improve the performance and reliability of your instrument. At the end of this section you will find instructions for updating pages 8–1 to 8–86 of this manual.

7-2. MANUAL CHANGES

Backdating

To adapt this manual to your instrument, refer to table 7-1 and make all of the manual changes listed opposite your instrument's serial number or prefix. The manual changes are listed in serial number sequence and should be made in the sequence listed. For example, Change A should be made after Change B; Change B should be made after Change C; etc. table 7-2 is a summary of changes by component.

Table 7–1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes
1836A	I, H, G, F, E, D, C, B, A
1901A	I, H, G, F, E, D, C, B
1903A	I, H, G, F, E, D, C
1905A	I, H, G, F, E, D
1911A	I, H, G, F, E
1915A, 1916A	I, H, G, F
1918A, 1921A	I, H, G
1922A	I, H
1925A	I

Updating

If your instrument's serial number or prefix is not listed on the title page of this manual or in table 7-1, it may be documented in a Manual Update Packet.

Table 7-2. Summary of Changes by Component (1 of 3)

Change	A1	A2	A3	A4	A5	A6	A10	A11	A12	A13
A		C12*,U1, U2, U4	R1*, R4*, R7*, R8*, R9*, U12—15		R72					TP10, 11
B		R10*, R20*				R14				
C		C38*, R39*, R51*	U7*, U8*, U10*, U11*			A6 part no.	A10 part no.			
D										
E			C64*, C65*			R31, R32, R39				
F			R32, R34							
G					R49*					
H		C12								
I										U3

* Instrument modification recommended, see paragraph 7-4.

Table 7-2. Summary of Changes by Component (2 of 3)

Change	A14	A15	A17	A18	A19	A20	A21	A22	A23	A24
A					C44*, C46*, C60*, C61*, C63*, E1*, E2*, L8*					
B										C12, C14, C18, R5*, R14*
C										
D										L7, R2, R3, R4, R7
E										
F										
G										
H										
I										

* Instrument modification recommended, see paragraph 7-4.

Table 7-2. Summary of Changes by Component (3 of 3)

Change	A25	A26	A27	A28	A29	A30	A31	A50	A51	No Prefix
A	R2									MP15*
B										
C										
D										
E										
F										
G										
H										
I										

* Instrument modification recommended, see paragraph 7-4.

MANUAL CHANGES

7-3. MANUAL CHANGE INSTRUCTIONS

NOTE

See paragraphs 7-4 through 7-7 for recommended instrument modifications

CHANGE A

Page 6-7, Table 6-2:
Change A2C12 to 0160-2209 CD5 CAPACITOR-FXD 360 PF ±5% 300 VDC MICA.

Pages 6-10 and 6-11, Table 6-2:
Make the following changes to the A3 Assembly listings:
Change R1 to 0698-6883 CD8 RESISTOR 19.3K .5% .125W F TC=0±50.
Change R4 to 0757-0288 CD1 RESISTOR 9.09K 1% .125W F TC=0±100.
Change R7 to 0698-3179 CD9 RESISTOR 2.55K 1% .125W F TC=0±100.
Change R8 to 0757-0123 CD3 RESISTOR 34.8K 1% .125W F TC=0±100.
Change R9 to 0757-0123 CD3 RESISTOR 34.8K 1% .125W F TC=0±100

Page 6-16, Table 6-2:
Change A5R72 to 0698-3446 CD3 RESISTOR 383 1% .125W F TC=0±100.

Page 6-26, Table 6-2:
Delete A13TP10 and A13TP11.

Page 6-33, Table 6-2:
Make the following changes to the A19 Assembly listings:
Change C44 to 0160-3872 CD0 CAPACITOR-FXD 2.2 PF ±.25 PF 200 VDC CER.
Change C46 to 0160-3873 CD1 CAPACITOR-FXD 4.7 PF ± .5 PF 200 VDC CER.
Change C60 and C61 to 0160-4084 CD8 CAPACITOR-FXD .1 UF ±20% 50 VDC CER.
Delete C63.
Delete E1 and E2.
Change L8 to 9100-3922 CD4 RF CHOKE.

Page 6-45, Table 6-2:
Change A25R2 to 0757-0280 CD3 RESISTOR 1K 1% .125W F TC=0±100.

Page 6-58, Table 6-2:
Under MP15, delete the following:
2200-0145 CD2 SCREW-MACH 4-40 .438-IN-LG PAN-HD, POZI
0380-0003 CD9 SCREW-RND .125-IN-LG .18-IN-ID
08901-00067 CD1 KEYBOARD AND DISPLAY BOARD INSULATOR.

Service Sheet 7 (schematic):
Change C12 to 360 pF.

Service Sheet 8 (schematic):
Make the following changes:
Change R1 to 19.3 kΩ.
Change R4 to 9090Ω.
Change R7 to 2.55 kΩ.
Change R8 and R9 to 34.8 kΩ.
Change A25R2 to 1 kΩ.

MANUAL CHANGES

CHANGE A (Cont'd)

Service Sheet 10 (schematic):
Change A5R72 to 383Ω.

Service Sheet 11 (schematic):
Change C44 to 2.2 pF.
Change C46 to 4.7 pF.
Delete C63 (from U3 pin 4 to ground).
Delete inductive beads E1 and E2. Change L8 by deleting the 0.051 μH value callout.

Service Sheet 18 (schematic):
Delete TP10 (labeled "WRT") from the line labeled "WRITE(H) at A13U14, pin 2.
Delete TP11 (labeled "ADR 15") from the line labeled "A15 (H)."

NOTE
See paragraphs 7-8 and 7-9 for recommended instrument modifications.

CHANGE B

Page 6-8, Table 6-2:
Change A2R10 and R20 to 0698-3453 CD2 RESISTOR 196K 1% .125W F TC=0±100.

Page 6-19, Table 6-2:
Change A6R14 to 0757-0439 CD4 RESISTOR 6.81K 1% .125W F TC=0±100.

Page 6-43, Table 6-2:
Make the following changes to the A24 listings:
Change C12 to 0160-3878 CD6 CAPACITOR-FXD 1000 PF ±20% 100 VDC CER.
Change C14 to 0160-4389 CD6 CAPACITOR-FXD 100 PF ±5 PF 200 VDC CER.
Change C18 to 0160-3878 CD6 CAPACITOR-FXD 1000 PF ±20% 100 VDC CER.

Page 6-44, Table 6-2:
Change A24R5 to 0698-0084 CD9 RESISTOR 2.15K 1% .125W F TC=0±100.
Change A24R14 to 0757-0280 CD3 RESISTOR 1K 1% .125W F TC=0±100.

Service Sheet 3 (schematic):
Change A6R14 to 6810Ω.

Service Sheet 7 (schematic):
Change A2R10 and R20 to 196 kΩ.

Service Sheet 12 (schematic):
Make the following changes to the A24 High Frequency VCO Assembly:
Change C12 to 1000 pF.
Change C14 to 100 pF.
Change C18 to 1000 pF.
Change R5 to 2150Ω.
Change R14 to 1000Ω.

CHANGE C

NOTE
See paragraphs 7-10 and 7-11 for recommended instrument modifications.

MANUAL CHANGES

CHANGE C (Cont'd)

Page 6-7, Table 6-2:
Delete A2C38.

Page 6-8, Table 6-2:
Change A2R39 to 0757-0401 CD0 RESISTOR 100 1% .125W F TC=0±100.
Change A2R51 to 0698-3434 CD9 RESISTOR 34.8 1% .125W F TC=0±100.

Page 6-17, Table 6-2:
Change A6 to 08901-60011 CD1 with the same description.

Page 6-21, Table 6-2:
Change A10 to 08901-60019 CD9 with the same description.

Service Sheet 3 (component locations):
Replace Figure 8-72 with Figure 7-1.

Service Sheet 3 (schematic):
Change the A6 assembly part number to 08901-60011.

Service Sheet 4 (component locations):
Replace Figure 8-74 with Figure 7-2.

Service Sheet 4 (schematic):
Change the A6 assembly part number to 08901-60011.

Service Sheet 7 (schematic):
Delete A2C38 1500 pF in parallel with A2C29.
Change A2R39 to 100Ω.
Change A2R51 to 34.8Ω.

Service Sheet 23 (schematic):
Change the A10 assembly part number to 08901-60019.

Service Sheet 24 (schematic):
Change the A10 assembly part number to 08901-60019.

CHANGE D

Page 6-44, Table 6-2:
Make the following changes to the A24 assembly listings:
Change L7 to 08901-00057 CD9 with the same descripton.
Change R2 to 0757-0442 CD9 RESISTOR 10K 1% .125W F TC=0±100.
Change R3 to 0757-0123 CD3 RESISTOR 34.8K 1% .125W F TC=0±100.
Change R4 to 0757-0447 CD4 RESISTOR 16.2K 1% .125W F TC=0±100.
Change R7 to 0698-3158 CD4 RESISTOR 23.7K 1% .125W F TC=0±100.

Service Sheet 12 (Troubleshooting):
Under V3. Tune Voltage Filter and Switch Check Step 7, change voltage limits to 170 and 210 mVrms.

Service Sheet 12 (schematic):
Make the following changes to the A24 assembly listings:
Change R2 to 10 kΩ.
Change R3 to 34.8 kΩ.
Change R4 to 16.2 kΩ.
Change R7 to 23.7 kΩ.
Change the voltage limits at TP2 to −6.4 to −5.5 VDC.

MANUAL CHANGES

CHANGE E

NOTE

See paragraph 7-12 for recommended instrument modification.

Page 6-9, Table 6-2:
Change A3C64 and C65 to 0180-0197 CD8 CAPACITOR-FXD 2.2 UF ±10% 20 VDC TA.

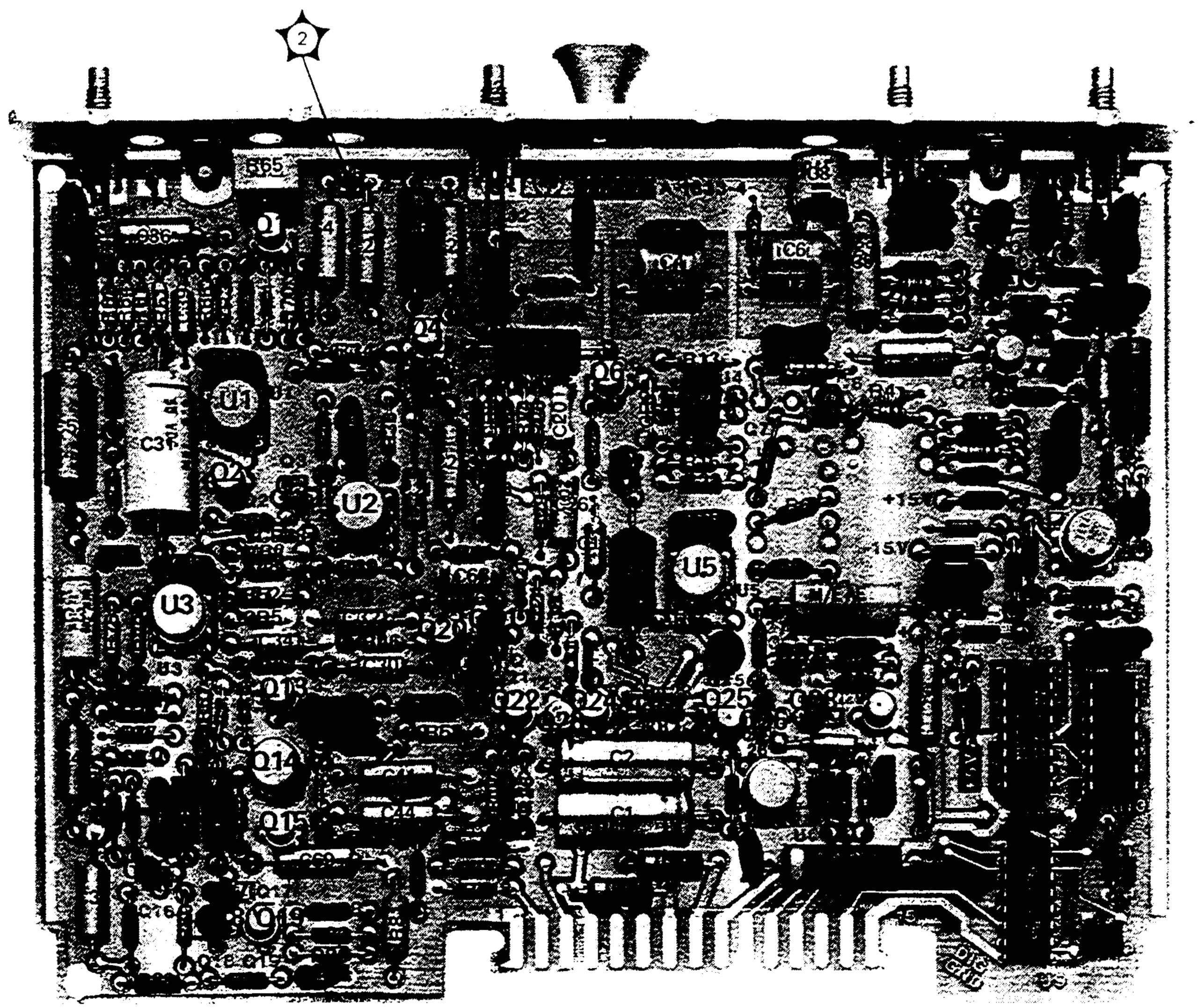


Figure 7-1. P/O A6 AM Demodulator Assembly Component Locations (ALC Loop) (P/O Change C)

MANUAL CHANGES

CHANGE E (Cont'd)

Page 6-19, Table 6-2:

Change A6R31 to 0757-0459 CD8 RESISTOR 56.2K 1% .125W F TC=0±100.
Change A6R32 to 0698-3159 CD5 RESISTOR 26.1K 1% .125W F TC=0±100.
Change A6R39 to 0757-0444 CD1 RESISTOR 12.1K 1% .125W F TC=0±100.

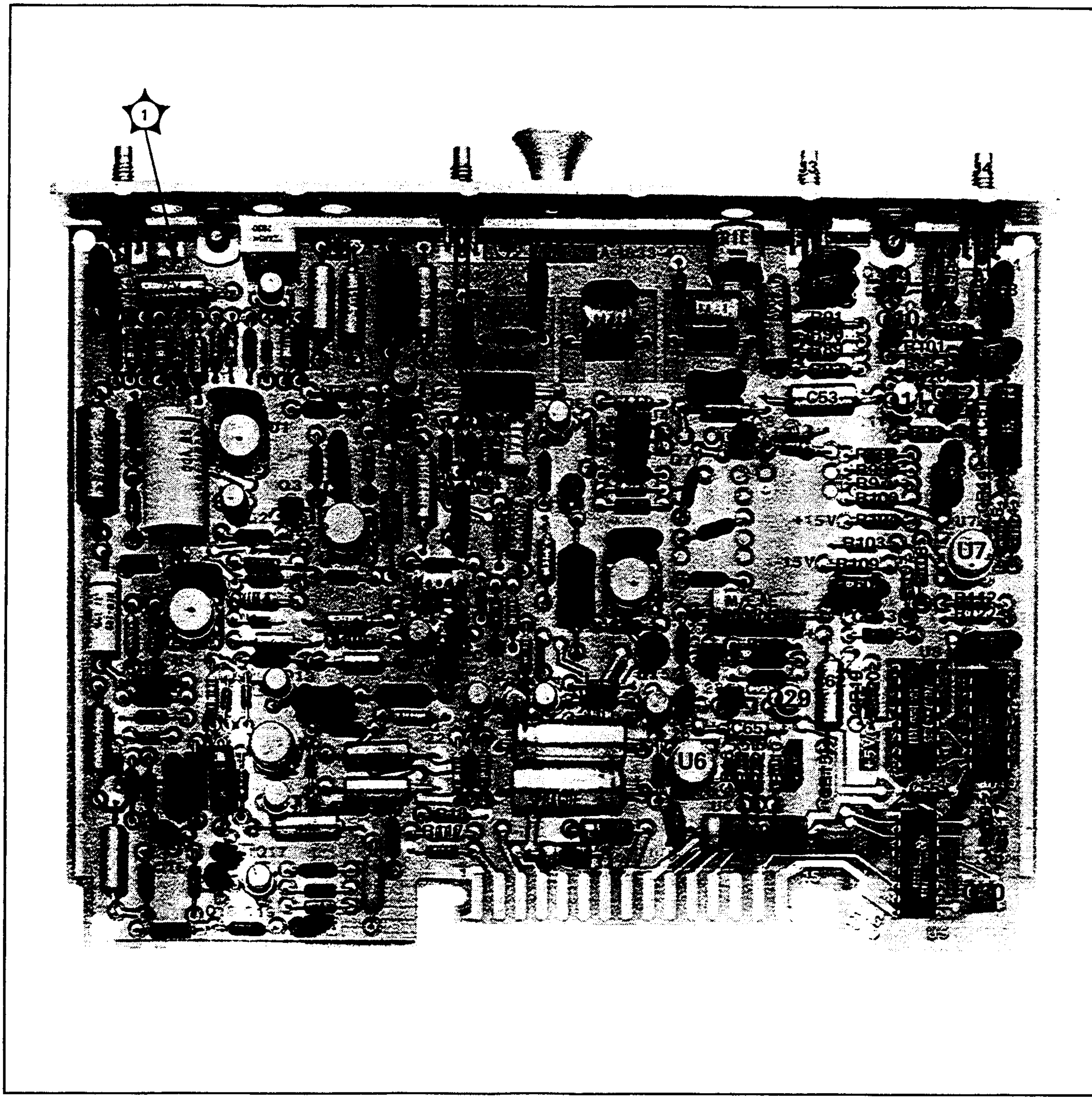


Figure 7-2. P/O A6 AM Demodulator Assembly Component Locations (Control) (P/O Change C)

MANUAL CHANGES

CHANGE E (Cont'd)

Service Sheet 3 (schematic):
Change A6R31 to 56.2 kΩ.
Change A6R32 to 26.1 kΩ.
Change A6R39 to 12.1 kΩ.

Service Sheet 8 (schematic):
Change A3C64 and C65 to 2.2 μF.

CHANGE F

NOTE

See paragraph 7-13 for recommended instrument modification.

Page 6-10, Table 6-2:
Change A3R32 to 0757-0424 CD7 RESISTOR 1.1K 1% .125W F TC=0±100.
Change A3R34 to 0757-0442 CD9 RESISTOR 10K 1% .125W F TC=0±100.

Service Sheet 8 (schematic):
Change A3R32 to 1100Ω.
Change A3R34 to 10 kΩ.

CHANGE G

NOTE

See paragraph 7-14 and 7-15 for recommended instrument modifications.

Page 6-16, Table 6-2:
Change A5R49 to 2100-3353 CD8 RESISTOR-TRMR 20K 10% C SIDE-ADJ-TRM.

Service Sheet 9 (schematic):
Change A5R49 to 20kΩ.

CHANGE H

Page 6-7, Table 6-2:
Change A2C12 to 0140-0200 CD0 CAPACITOR-FXD 390 PF ±5% 300 VDC MICA.

Service Sheet 7 (schematic):
Change A2C12 to 390 pF.

CHANGE I

Page 6-26, Table 6-2:
Change the first part number for A13U3 to 08901-80029 with the same description.

Service Sheet BD4 (Troubleshooting):
Under step 7 of √3 Controller Kernel Check, replace the table with the following:

MANUAL CHANGES

CHANGE I (Cont'd)

With A14 Plugged In		With A14 Not Plugged In	
Test Point	Signature	Test Point	Signature
DATA 0	0C02	DATA 0	A51P
DATA 1	7C7C	DATA 1	9922
DATA 2	807C	DATA 2	2P82
DATA 3	3690	DATA 3	A1PU
DATA 4	1PU9	DATA 4	F10F
DATA 5	A035	DATA 5	2H94
DATA 6	6906	DATA 6	261A
DATA 7	7CUP	DATA 7	60FU

Valid software date 124.1979. Valid ROM part numbers:

ROM	Part No.	ROM	Part No.
1	08901-80029	6	1818-0926 or 08901-80014
2	08901-80030	7	1818-0923 or 08901-80015
3	1818-0920 or 08901-80011	8	1818-0925 or 08901-80025
4	1818-0921 or 08901-80012	11	1818-0924 or 08901-80023
5	1818-0922 or 08901-80013		

Service Sheet 18 (Troubleshooting):

Under step 3 of (√2) Memory Select Decoders and ROM Check, replace the table with the following:

ROM	Start/Stop		Signature on CONTROL BUS DATA Test Point							
	IC	Pin	0	1	2	3	4	5	6	7
1	A13U12	15	F5P8	659H	37FH	9C81	42U8	HU27	P0CC	0440
2	A13U12	14	1CU9	H04A	4FPF	11F5	7127	9436	3198	221C
3	A13U12	13	FUUH	4071	P1U9	86A5	89HC	HC04	UP6U	P675
4	A13U12	12	PF63	CH3C	H738	FFU3	5085	P57A	69FU	HF09
5	A13U12	11	H5C4	U937	86CP	A58F	A136	FC40	9834	A624
6	A13U12	10	0959	U952	FHUF	P0U9	65UU	29UP	CP7H	A0U8
7	A13U12	9	U80C	1A8H	C898	76AA	UC8A	588A	F71A	8627
8	A13U12	7	U451	U20U	P807	HC50	0967	CPU1	84C6	H63A
11	A14U18	9	0147	PFC8	2U9A	4019	9UF0	39H3	F064	6A59

Valid ROM Part Numbers:

ROM	Part Number	ROM	Part Number	ROM	Part Number
1	08901-80029	4	1818-0921 or 08901-80012	7	1818-0923 or 08901-80015
2	08901-80030	5	1818-0922 or 08901-80013	8	1818-0925 or 08901-80025
3	1818-0920 or 08901-80011	6	1818-0926 or 08901-80014	11	1818-0924 or 08901-80023

INSTRUMENT MODIFICATIONS

7-4. Adding an Insulator Behind the Front-Panel Assembly

On instruments with serial prefix 1836A and below, an insulator should be added behind the front-panel assembly to prevent the clipped-off component leads of the Keyboard from puncturing the insulation of the cables that dangle behind it.

Remove the front-panel assembly from the mainframe. Remove the four lower, innermost screws that secure the Keyboard to the front panel. See Service Sheet A. Place the insulator (HP 08901-00067) over the center of the Keyboard and secure it with four longer screws (4-40 x 0.438 inch, HP 2200-0145), the existing washers, and four 0.18 ID x 0.125 inch spacers (HP 0380-0003). The spacers are to hold the insulator away from the Keyboard.

7-5. Improvements to the LO Frequency Doubler

On instruments with serial prefix 1836A and below, if a problem exists on the LO Frequency Doubler with flatness, oscillation, or excessive 1/2 subharmonic level, try the following changes (see Service Sheet 11).

If the Frequency Doubler is not flat enough, change A19C44 and C46 to 2.7 pF (HP 0160-3568). If the doubler oscillates, change A19L8 to HP 9135-0073 and add two ferrite beads (HP 9170-0029) on the lead not soldered to ground. If the level of the 1/2 subharmonic of the doubler is excessive, change A19C60 and C61 to components with narrower lead spacing (HP 0160-0576) and add A19C63 (HP 0160-3877) to decouple the −15V supply.

7-6. Improvement of Flatness of the 3 kHz Low-Pass Filter

On instruments with serial prefix 1836A and below, if flatness of the 3 kHz Low-Pass Filter is out of tolerance, try changing A3R1 to 19.6 kΩ (HP 0698-7062), A3R4 to 9.474 kΩ (HP 0699-0027), A3R7 to 2.61 kΩ (HP 0698-0085), A3R8 to 26.1 kΩ (HP 0698-3159), and A3R9 to 38.3 kΩ (HP 0698-3161). See Service Sheet 8.

7-7. Improvement of AM Flatness at 50 kHz

On instruments with serial prefix 1836A and below, if AM flatness is out of tolerance at 50 kHz, change A2C12 to 390 pF (HP 0140-0200). See Service Sheet 7.

7-8. Improvement in Tuning to a Signal at 1200 MHz

On instruments with serial prefix 1901A and below, if the instrument fails to automatically tune to a signal at 1200 MHz, the problem may be that the Tune Voltage Filter for the HF VCO is not switching off fast enough when tuning is initiated. Change A24R5 to 511Ω (HP 0757-0416) and A24R14 to 162Ω (HP 0757-0405). See Service Sheet 12.

7-9. FM Accuracy Improvement

On instruments with serial prefix 1901A and below, change A2R10 and R20 to 133 kΩ (HP 0698-3451) to improve FM accuracy. See Service Sheet 7.

7-10. Improvement in Flatness of the 15 kHz Low-Pass Filter

On instruments with serial prefix 1903A and below, if the 15 kHz Low-Pass Filter peaks out of tolerance or has a 3 dB cutoff frequency that is out of tolerance, change A2R39 to 90.9 kΩ (HP 0757-0400) and A2R51 to 82.5 kΩ (HP 0757-0399) and add a 1500 pF capacitor A2C38 (HP 0160-2222) in parallel with C29. See Service Sheet 7.

7-11. Recommended Replacement for A3U7, U8, U10, and U11

On instruments with serial prefix 1903A and below, the recommended replacement for A3U7, U8, U10, and U11 is HP 1826-0662. See Service Sheet 8.

7-12. Improvement in Accuracy of Modulation Measurements at 20 Hz Rates

On instruments with serial prefix 1911A and below, if modulation measurements at rates of

INSTRUMENT MODIFICATIONS

20 Hz are inaccurate, change A3C64 and C65 to 22 μF (HP 0180-0228). See Service Sheet 8.

7-13. Adding an Insulator to the Bottom Cover

On instruments with serial prefix 1915A and below, it is highly recommended that an insulator (HP 08901-00069) be added to the inside of the bottom cover directly below the RF Section. The insulator will prevent shorting of the shock-mounted RF Section to the cover when the instrument is given a hard shock or if the RF Section is inadvertently pressed down during servicing. Simply peel the back off the insulator and press the insulator into place.

7-14. Intermittent Connectors

On instruments with serial prefix 1918A and below, a potential intermittency may exist with some of the printed circuit board edge connectors. The problem will be especially apparent in assemblies plugged into housings when the covers are not secured with screws or when the assembly is extended and tilting forward or backward. Contact can sometimes be improved by beveling the edge of the circuit board under the connector fingers with a file. Be careful not to file the fingers that contact the connector. If necessary, replace the connectors with the parts listed in the table below.

7-15. Improving Drift of the Peak Detector in the Voltmeter

On instruments with serial prefix 1921A and below, if the Peak Detector in the Voltmeter drifts or is out of tolerance when serviced, change A5R49 to a 1 MΩ (HP 2100-3358) and perform the Voltmeter Offset and Sensitivity Adjustments. See Service Sheet 9.

Mother Board	Connector Designation	Number of Contacts	Recommended HP Part Number
A25	X7, X8, X9, XA5	2 x 22	1251-6050
A25	XA2, XA3, XA4, XA6	2 x 15	1251-6052
A26	XA10	2 x 22	1251-6050
A27	X12A, XA11, XA13A, XA14A	2 x 22	1251-6050
A27	X12B, XA13B, XA14B	2 x 15	1251-6052
A28	X16, XA18, XA21, XA22, XA23, XA24	2 x 6	1251-6051
A28	XA15, XA19	2 x 15	1251-6052
A28	XA20	2 x 22	1251-6050

7-16. CABINET PARTS COLOR CHANGE

Serial prefix 2912A changes the color of the instrument covers and accessories. The old color cover and accessories are no longer availiable. If your instrument has serial prefixes 2911A and below, and you must replace one of these parts, we recommend that you order the full set of covers and accessories. Affected cabinet parts are MP3-12, MP14, MP18, and MP27, (see Table 6-3).

7-17. CHANGES TO SECTION 8

Page 8-6, Table 8-2.

Replace table 8-2 with the following table.

Table 8-2. Assembly and Service Sheet Cross Reference Index

Assembly	Service Sheet	Block Diagram	Principles of Operation Page Number	Parts List Page Number
A1 Keyboard and Display	20,21	BD4	8-75	6-6
A2 Audio Filters	7	BD3	8-59	6-13
A3 Audio De-emphasis and Output	8	BD3	8-59	6-17
A4 FM Demodulator	5, 6	BD3	8-57	6-23
A5 Voltmeter	9, 10	BD3	8-61	6-31
A6 AM Demodulator	3, 4	BD3	8-53	6-41
A10 Power Supply Regulators	23, 24	BD2	8-81	6-56
A11 Counter	16, 17	BD4	8-72	6-61
A13 Controller	18	BD4	8-74	6-65
A14 Remote Interface	22	BD4	8-76	6-68
A15 RF Input	1	BD2	8-51	6-71
A17 Input Mixer	2	BD2	8-52	6-78
A18 IF Amplifier	2	BD2	8-52	6-85
A19 LO Divider	11	BD2	8-64	6-88
A20 LO Control	14, 15	BD2	8-70	6-102
A21 Low Frequency VCXO Filter	13	BD2	8-70	6-112
A22 Low Frequency VCXO	13	BD2	8-69	6-113
A23 Sampler	12	BD2	8-65	6-116
A24 High Frequency VCO	12	BD2	8-69	6-121
A25 Audio Motherboard	25		N/A	6-124
A26 Power Supply Motherboard	23, 24	BD2	N/A	6-125
A27 Digital Motherboard	26	BD2	N/A	6-127
A28 RF Motherboard	27		N/A	6-128
A29 Series Regulator Heat Sink	23, 24	BD2	N/A	6-129
A30 Line Power Module	23	BD2	N/A	6-130
A31 Remote Interface Connector	22	BD4	8-76	6-130
A50 AM Calibrator	29	BD3	8-83	6-131
A51 FM Calibrator	28	BD3	8-82	6-137

Page 8-9, figure 8-4.

Change U1A, U1B, and U1C to U12A, U12B, and U12C respectively. Change U7A and U7B to U14A and U14B respectively.

Page 8-9, paragraph 8-27.

In example #1, change U1A, U1B, and U1C to U12A, U12B, and U12C respectively. Change U7A and U7B to U14A and U14B respectively.

Page 8-11, paragraph 8-28.

Under 50.N Display Internal Voltages, change "N=4" to "+15 V Supply. The display should read between 2.8500 and 3.1500. See Service Sheet 10."

Page 8-14, table 8-5.

Change HP 9625A program line 3 to red 714, A.

Page 8-16, paragraph 8-31.

In E75, second line, change 3.0 to 30.

Page 8-50.

In the bottom line of the right-hand column, change "input bytes" to "input bits."

Under Remote Interface Assembly (A14), second sentence, change "Handshake Control Logic" to "Interface Control Logic."

Page 8-53, paragraph 8-72.

Replace paragraph 8-72 with the following:

8-72. AM Demodulator (A6) Service Sheet 3

General. AM is demodulated by rectifying the IF signal and by forcing the average of the IF signal to be a constant level by means of an automatic level control (ALC) loop. The rectified IF, after filtering the IF carrier, accurately represents the carrier average plus its AM envelope. In fact, the % AM equals the level of the ac component divided by the level of the dc component times 100%. Since the averge carrier level is forced to be constant, the % AM is proportional to the level of the ac component alone. The demodulation process is illustrated in figure 8-45.

2.5 MHz Low Pass Filter and AM IF Buffer. The 2.5 MHz Low-Pass Filter determines the IF frequency response when using the 1.5 MHz IF or when the input signal is not down-converted. The filter has six poles and is designed for best flatness up to 2.5 MHz. At 2.5 MHz the flatness can be fine adjusted with C8 (IF FLATNESS) for minimum incidental AM. The filtered IF is routed to the AM IF Buffer and an FM IF Buffer (see Service Sheet 4) where it is further routed to the FM Demodulator, IF Level and IF Present Detectors, and the rear-panel IF OUTPUT.

Voltage Variable Amplifier. The Voltage-Variable Amplifier adjusts its gain in response to the dc output from the AM and Level Detector. The amplifier is, then, the "leveler" of the ALC loop and, as shown in figure 8-44, it is an ac-coupled, variable-gain, non-inverting operational amplifier.

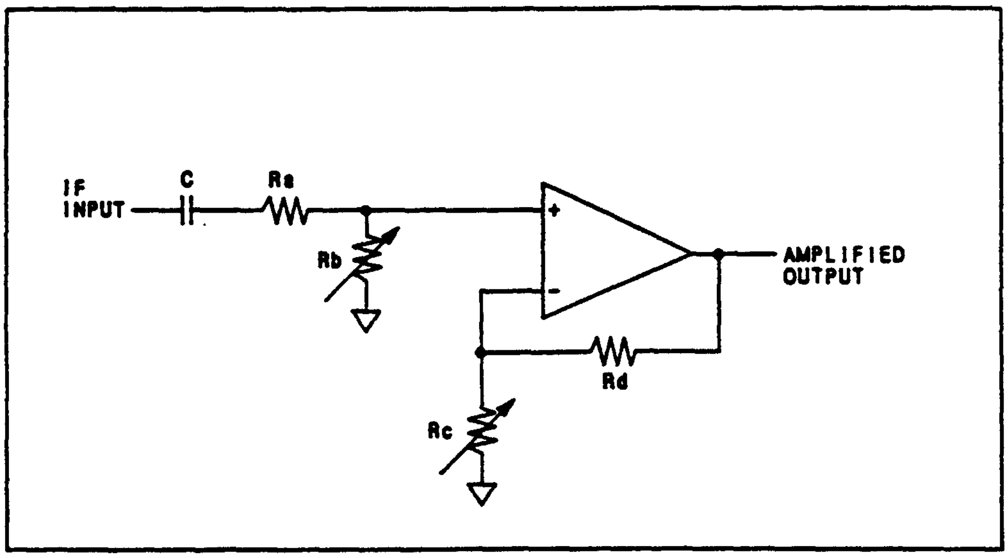


Figure 8-44. Simplified Diagram of the Voltage-Variable Amplifier

The gain of the Voltage-Variable Amplifier is computed with the following equation:

$$\frac{Rb}{Ra + Rb} \times \frac{Rc}{Rc + Rd}$$

Ra is R10. Rb is the parallel combination of R16 and the resistance of the channel of FET Q7, which predominates. Rc is the parallel combination of R37, R22, R21, and the resistance of Q6, which predominates. Rd is R34.

The R-Setting (that is, Resistance-Setting) Circuit adjusts the input attenuation and feedback division ratio of the Voltage-Variable Amplifier in proportion to the output voltage of U2. The output of U2, in turn, is proportional to the amplitude error of the IF signal.

Figure 8–45. *AM Demodulation Process (as shown in old paragraph 8-72)*

The variable resistors (FETs Q6 and Q7), which set the gain of the Voltage-Variable Amplifier, are controlled by two matched current sources Q2C and Q2D, and two local feedback amplifiers U4A and U4B. U4A drives n-channel FET Q6 in such a way as to hold the dc voltage at the drain of Q6 at the same potential as the reference voltage at the inverting input of U4A. The reference voltage, determined by the voltage divider R23 and R25, is approximately +50 mV. If the current from the collector of Q2D changes, the voltage at the drain of Q6 changes proportionally. The change is sensed by U4A. U4A drives Q6 which changes the channel resistance and brings the drain voltage back to +50 mV. The operation of Q2C, Q7, and U4B is similar to Q2D, Q6, and U4A except that Q7 is a p-channel FET and U4A is referenced to −50 mV. Another difference is that Q2C must supply the current to R13 as well as to Q7. Thus the FETs work in opposition–the resistance of Q6 decreases when Q7 increases (resulting in an increase in gain of the Voltage-Variable Amplifier).

To clarify the action of the R-Setting Circuit, suppose that a change in IF level (in this case a decrease) causes the output of U2 to decrease. The reduction in voltage at the bases of transistors Q2C and Q2D causes an increase in their collector currents. As the drain voltage of Q6 rises, U4A responds by increasing the gate voltage of Q6 (that is, making it less negative) which reduces the resistance of the FET's channel and brings the drain voltage back to a nominal +50 mV. At the same time, as the drain voltage of Q7 rises (that is, becomes less negative), U4B responds by increasing the gate voltage of Q7 (making it more positive) which increases the resistance of the FET's channel and brings the drain voltage back to a nominal −50 mV.

The reduction in channel resistance of Q6 reduces the negative feedback around the amplifier formed by Q4 and Q5 and increases its gain. The increase in channel resistance of Q7 decreases the attenuation of the voltage divider between the output of Q8 and the base of Q5. Thus the gain of the overall Voltage-Variable Amplifier is increased which is the desired effect since in this example, the IF level was too low.

The Voltage-Variable Amplifier is designed to operate over a gain ranging from unity (0 dB) to at least 16 (24 dB). Q4 and Q5 provide the forward gain of the amplifier with well-defined performance at 1.5 MHz. Two RC networks, R14 and C16 and R28 and C23, aid in canceling distortion created in the FET channels by the IF frequency. The networks inject a small amount of IF signal into the gates of the FETs. C17 and C21 set the response time of the local feedback amplifiers U4B and U4A.

Q21 and Q20 form a unity-gain, IF buffer amplifier which drives the AM and Level Detector. Q31 improves the symmetry of the overdrive characteristics of the buffer amplifier. This improvement is needed because the ALC loop initially receives signals when its ALC gain is maximum (the no-signal condition).

AM and Level Detector. The AM and Level Detector rectifies the IF carrier. Q13 to Q16, CR9 and CR10, and associated components form a precision, active, half-wave rectifier. A simplified diagram of the rectifier is shown in figure 8–46. The circuit is essentially an inverting operational amplifier with two parallel feedback paths. Each path conducts current in a different direction as determined by CR9 and CR10. The path through CR9 can produce only negative voltages at the output to the Level Amplifier and Carrier Filter. This feedback path contains the network R73, R74, C43, and L8 which acts as a constant resistance (equal to R73) between CR9 and the amplifier's inverting (–) input, but low-pass filters the IF going to the AM Output Buffer.

Figure 8–46. *Simplified Diagram of AM and Level Detector (as shown old paragraph 8-72)*

The emitter of Q13 is the amplifier's common-base inverting input. The base of Q13 is the ac grounded, non-inverting input of the amplifier. Q13 is followed by a cascade stage (a common-emitter transistor driving a common-base transistor) Q15 and Q14. R58 and C40 frequency compensate the amplifier. Q16 is a +13.8 V regulator and RF decoupling circuit. CR6 and CR7 protect the amplifier in the event of unusual conditions at the input.

AM Output Buffer. Q17, Q18, and Q19 form a unity-gain buffer amplifier which interfaces the demodulated AM with the rear-panel AM OUTPUT jack and the audio circuits. R87 and C50 further filter the IF carrier. R88 and C51 form the first two elements of a complex 260 kHz Low-Pass Filter (see Service Sheet 7).

Level Amplifier and Carrier Filter. U3 and associated components form an inverting amplifier and IF carrier and AM ripple filter. Note that the non-inverting (+) input of U3 connects through R75 to the inverting input (namely, the emitter of Q13) of the AM and Level Detector which is its "virtual" ground. Thus the two amplifiers have a common signal-ground reference.

BW Control and Level Comparison Amplifier. The dc output of U3 represents the IF carrier's average level. This output is compared against a stable reference voltage. Differences between the two voltages are amplified by U1 to alter the drive voltage (through U2) to the bases of Q2C and Q2D of the R-Setting Circuit. U1 adds more filtering to the detected IF and determines the response time of the ALC loop to variations in IF level (that is, it determines the ALC bandwidth). U5B permits selection of the 0.1 dB bandwidth of either 20 Hz when open or 200 Hz when closed. When U5B is closed, the time constant of the integrator U1 is the product of R55 and C31. When U5B is open, the time constant is the product of R51+R54+R55 and C31; C36 adds even more filtering.

ALC Reference. The very stable voltage reference for the ALC loop is supplied by the voltage-reference diode VR3. VR3 is biased on by a regulated current source formed by Q1, VR4, and associated components. The reference output is divided by R69, R65, and R66. Fine adjustment of the ALC Reference is via R65 (ALC REF).

Resistor Drive Amplifier. U2 amplifies (with a gain of 1.1) and inverts the output of U1. Switch U5A is normally closed, and U5C is normally open. U2, then normally drives the bases of Q2C and Q2D of the R-Setting Circuit. The output of U2 works against the +15 V supply through R26, R31, R32, and Q2A, which is wired as a diode to temperature compensate the base-emitter voltages of Q2C and Q2D.

Q2B produces a voltage at its collector that is proportional to the control currents of Q2C and Q2D. This voltage is monitored by the Voltmeter to check that the ALC loop is operating within its proper range. The automatic leveling can be defeated, if desired, by opening U5A and closing U5C (user Special Function 6.2). The bases of Q2C and Q2D are then biased by voltage divider R26, Q2A, and R27.

Page 8-71.

Under Power Supply Decoupling, change Q5 to C5.

Page 8-76, paragraph 8-73.

Replace paragraph 8-91 with the following:

The keyboard and Display Assembly contains the front-panel displays, annunciators, key lights, and the decoders and latches that control them. Lighting of a display is accomplished by straight-forward decoding of the Instrument Bus. For example, to display the digit 3 in display U2, the controller issues esd=613 to the Instrument Bus. Output 1G of Select Decoder, U24, goes low (uniquely) and enables latch U42. The data code (d=3) is decoded by ROM, U40, which is programmed to be a seven-segment decoder that is always enabled. In this example, U40 places lows on lines a, b, c, d, g, and highs on lines e and f. U40 drives U42 which lights the appropriate segments of U2. (A “low” lights the corresponding segment.) In this example, a 3 is displayed. The segment information is latched in U42 when a different e, s, or es code is issued to the instrument bus. For a discussion of lthe Instrument Bus, see Instrument Bus, page 8–48.

Page 8-88

In figure 8–59, note that there is now a cover over the empty circuit-board slot in the RF section. The reference designator for this cover is MP65.

SECTION VIII
SERVICE

8-1. INTRODUCTION

This section contains information for troubleshooting and repairing the Modulation Analyzer. Included are troubleshooting tests, schematic and block diagrams, and principles of operation (as outlined below):

8-2. SERVICE SHEETS

The foldout pages in the last part of this section are block diagrams (BD1, 2, 3 and 4) and service sheets (1 to 29 and A to D).

8-3. Block Diagrams

Block Diagram 1 (BD1) is an overall block diagram that breaks the instrument into functional sections. It serves as an index to the other block diagrams and as a starting point for troubleshooting (refer to TROUBLESHOOTING, page 8-7). The other block diagrams (BD2, BD3, and BD4) are, respectively, of the RF, Audio, and Digital Sections of the instrument. The power supply is included with the RF Section on BD2. These block diagrams break the sections into physical assemblies and serve as an index to the schematic Service Sheets. Included with the block diagrams are troubleshooting checks and assembly location photographs.

8-4. Schematics

Service Sheets 1 through 29 consist of assembly schematic diagrams, component locator photographs, troubleshooting checks and hints, and when necessary, mnemonic tables. Symbols used on the schematic diagrams are defined on pages 8-19 through 8-36.

8-5. Additional Service Sheets

Service Sheets A and B contain disassembly procedures and exploded views of the front and rear panel assemblies. Service Sheet C contains a summary of Service Special Functions and Error Messages. Service Sheet D contains a summary of Direct Control Special Functions.

8-6. SAFETY CONSIDERATIONS

8-7. Before Applying Power

Verify that the instrument is set to match the available line voltage and that the correct fuse is installed. An uninterrupted safety earth ground must be provided from the main power source to the instrument input wiring terminals, power cord, or supplied power cord set.

8-8. Safety

Pay attention to WARNINGS and CAUTIONS. They must be followed for your protection and to avoid damage to the equipment.

WARNINGS

Maintenance described herein is performed with power supplied to the instrument and with the protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power supplied, the power should be removed.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnection of the protective earth terminal will create a potential shock hazard that could result in personal injury. Grounding one conductor of a two conductor outlet is not sufficient. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative (i.e., secured against unintended operation).

If this instrument is to be energized via an autotransformer, make sure that the autotransformer's common terminal is connected to the earth terminal of the power source.

Capacitors inside the instrument can still be charged even if the instrument is disconnected from its source of supply.

Make sure that only 250 volt fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. Do not use repaired fuses or short-circuited fuseholders. To do so could create a shock or fire hazard.

CAUTIONS

Do not unplug any boards in the Modulation Analyzer unless the instrument is unplugged or switched to standby. Some boards contain devices which can be damaged if the board is removed when the power is on. Use conductive foam when removing MOS devices from sockets. Use care when unplugging ICs from high-grip sockets.

8-9. RECOMMENDED TEST EQUIPMENT AND ACCESSORIES

Test equipment and test accessories required to maintain the Modulation Analyzer are listed in Tables 1-3 through 1-5. Equipment other than that listed may be used if it meets the listed critical specifications.

8-10. SERVICE TOOLS, AIDS AND INFORMATION

8-11. Service Support Kit

The HP 08901-60089 Service Support Kit contains extender boards, extender cables, and other items needed for servicing the Modulation Analyzer. The extender boards have a height that matches the assembly extrusions and, for 12 pin connectors, improves mechanical stability of the extender assembly. The kit also contains a special Digital Test/Extender Board (HP 08901-60081) which facilitates troubleshooting of the Controller and Remote Interface Assemblies (see Figure 8-1).

8-12. Pozidriv Screwdrivers

Many screws in the Modulation Analyzer appear to be Phillip's types, but are not. To avoid damage to the screw slots, Pozidriv screwdrivers should be used. HP 8710-0899 is the No. 1 Pozidriv. HP 8710-0900 is the No. 2 Pozidriv.

8-13. Tuning Tools

For adjustments requiring non-metallic tuning tools, use the HP 8710-0033 blade tuning tool or the HP 8710-1010 (JFD Model No. 5284) hex tuning tool. For other adjustments an ordinary small screwdriver or suitable tool is sufficient. No matter which tool is used, never force any adjustment control. This is especially critical when adjusting variable inductors or capacitors.

8-14. Heat Staking Tool

The front panel pushbutton switches and the plastic divider on the front sub-panel have small plastic pins protruding from the back. These tabs fit

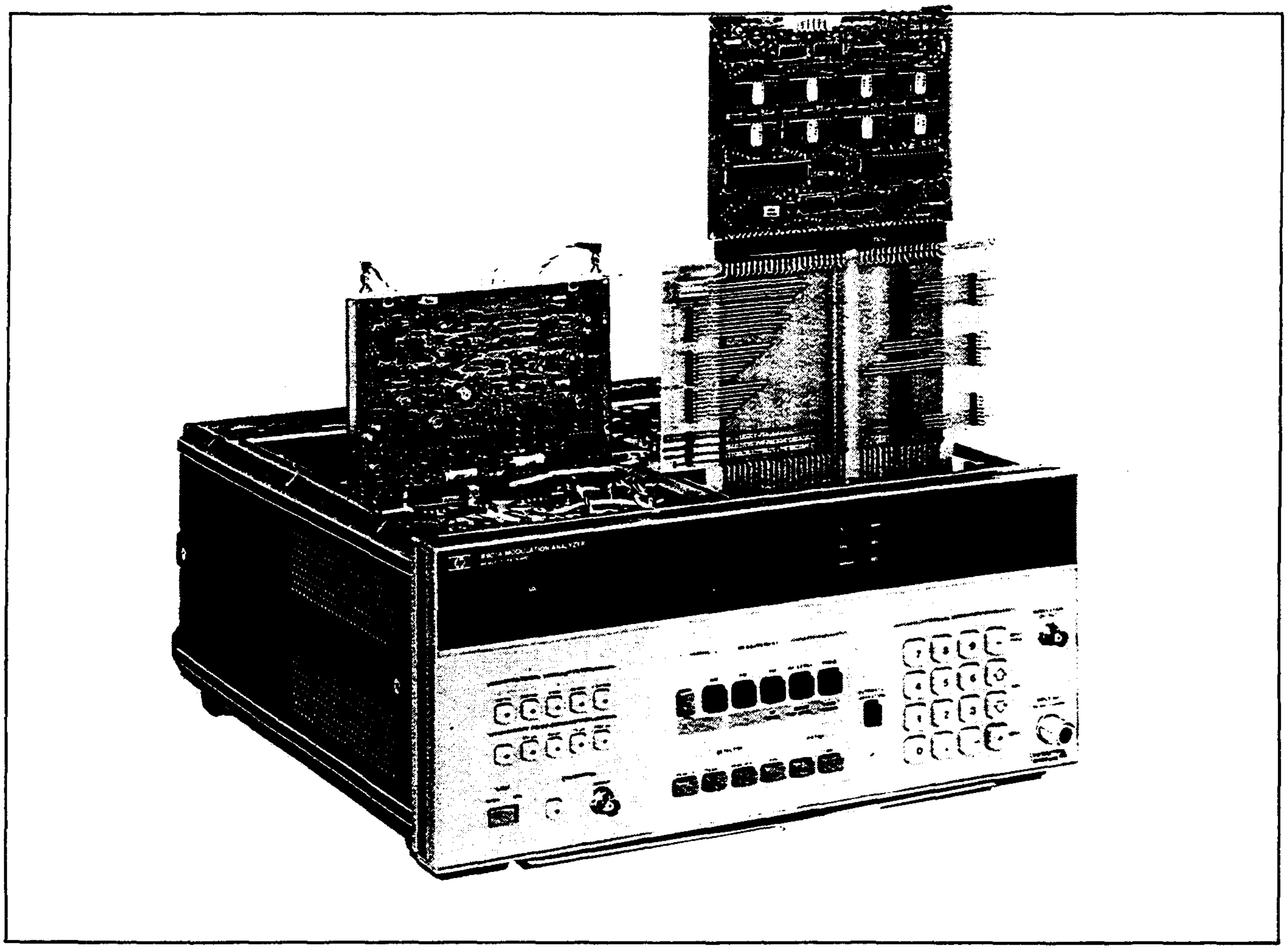


Figure 8-1. Assemblies on Extender Boards

through holes in the front-panel printed circuit board (A1 Assembly) and are melted down to hold the switch in place. This process is known as heat staking. The heat staking tool is a standard soldering iron with a special tip attached (see Figure 8-2).

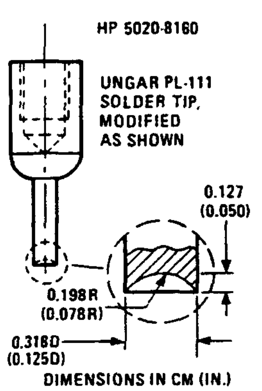


Figure 8-2. Heat Staking Tip

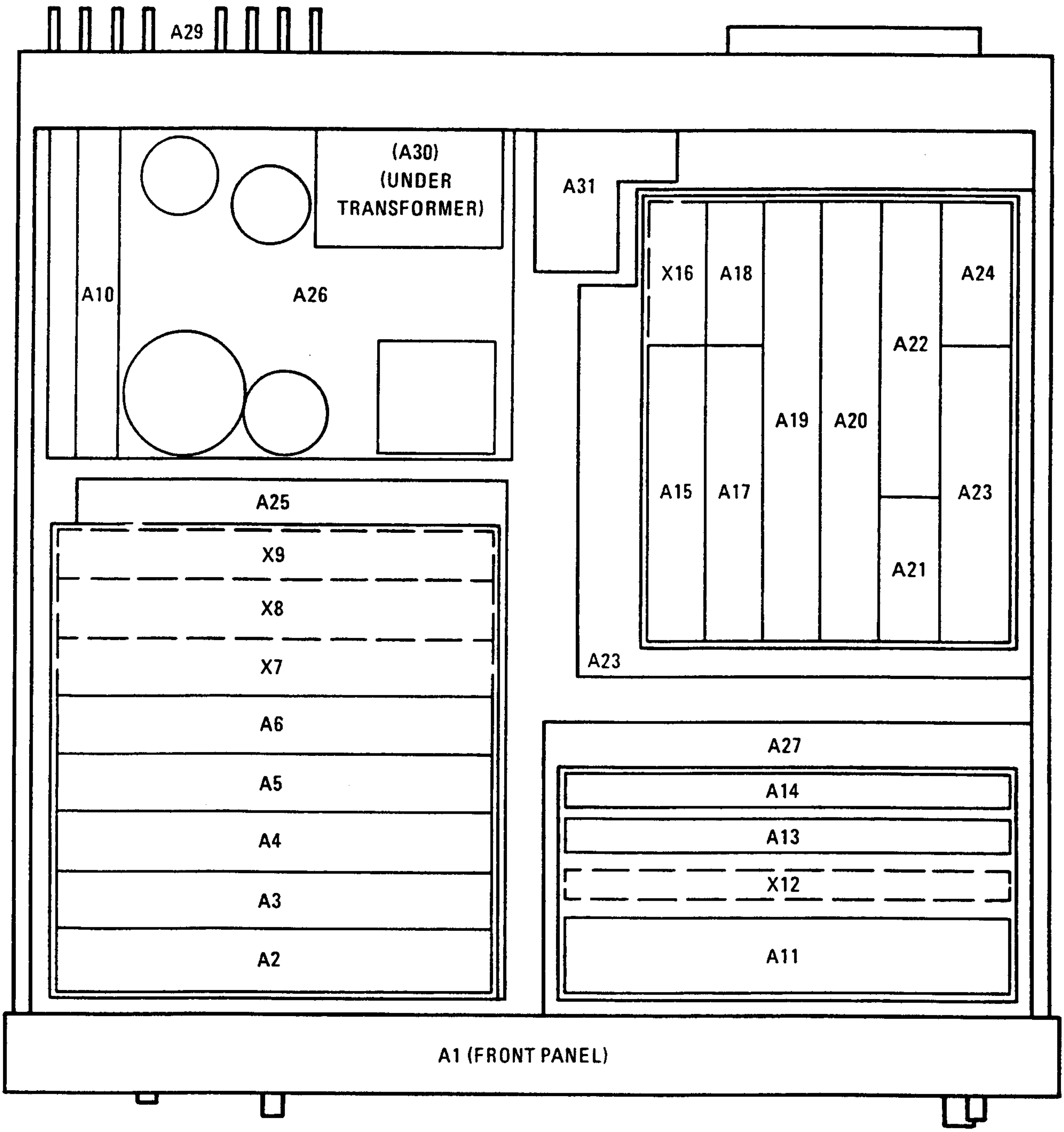
Refer to Table 8-1 for specifications and recommended equipment. See the front panel disassembly procedure at the rear of this manual (page 8-154) for the heat staking procedure.

8-15. Silver Solder

Silver solder must be used whenever soldering mono-block capacitors (small, leadless capacitors) to the A24 High Frequency VCO Assembly printed circuit board. This restriction is due to the lower temperature requirements of the capacitors. A small amount of silver solder is first applied to the printed circuit board at the mono-block connection points. The capacitor is then laid down on the board with its silvered ends touching the pre-soldered printed circuit traces. Just enough heat must then be applied to the solder to make it melt and adhere to the ends of the block.

8-16. Assembly Locations

Assemblies in the Modulation Analyzer are numbered sequentially, front to back, left to right, top to bottom (see Figure 8-3 and Table 8-2). A1 is part of the front panel assembly of the instrument.



X7, X8, AND X9 ARE THE OPTION SLOTS FOR A50–SERIES OPTIONS
X12 IS THE OPTION SLOT FOR A70–SERIES OPTIONS
X16 IS THE OPTION SLOT FOR A80–SERIES OPTIONS

Figure 8-3. Assembly Locations

Table 8-1. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended	HP Part No.
Soldering Tool	Soldering, Heat Staking	Wattage: 35W Tip Temp.: 390°-440°C (735°-825°F)	Ungar No. 135 Ungar Division Eldon Ind. Corp. Compton, CA 90220	8690-0167
Soldering Tip	Soldering, Unsoldering	*Shape: Chisel	*Ungar PL113	8690-0007
Soldering Tip	Heat Staking	Shape: Cupped	HP 5020-8160 or modified Ungar PL111 (See figure 8-2)	5020-8160
De-Soldering Aid	To remove molten solder from connection	Suction Device	Soldapullt by Edsyn Co., Van Nuys, CA 91406	8690-0060
Rosin (flux) Solvent	To remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board	Freon	8500-0232
Solder	Component replacement; Circuit Board repair wiring	Rosin (flux) core, high tin content (63/37 tin/lead), 18 gauge (SWG) 0.048 in. diameter preferred.		8090-0607
Silver Solder	Mono-block replacement	Rosin (flux) core, silver saturated tin/lead alloy 0.031 in. diameter.	X25 Rosin Core DIVCO 233 Division Lead Co. Summit, IL 60501	8090-0022

• For working on circuit boards; for general purpose work, use No. 555 Handle (8690-0261) and No. 4037 Heating Unit 47½ - 56½ W (HP 8690-0006); tip temperature of 850° - 900°F; and Ungar No. PL113 ⅛" chisel tip.

A2 through A6 are the first five assemblies in the Audio Section. X7, X8, and X9, at the rear of the Audio Section, are vacant parallel-wired motherboard edge connectors intended for optional A50-Series assemblies. A51, the FM Calibrator Assembly, should always be placed in X8 for ventilation purposes. The other option assemblies can be plugged into X7 or X9.

A10 is the Power Supply Regulator Assembly. A26 is the Power Supply Mother Board Assembly. A30, below the transformer (T1), is the Line Power Module. A29 is the Heat Sink Assembly. A31 is the Remote Interface Connector Assembly.

The Digital Section is composed of A11, A13, and A14 and contains an extra parallel-wired slot (X12) into which optional A70-Series assemblies can be inserted. A27 is the Digital Mother Board Assembly.

The RF Section is composed of assemblies A15 and A17 through A24. X16 is a vacant slot intended for optional A80-Series assemblies.

8-17. Parts and Cable Locations

The locations of individual components mounted on printed circuit boards or other assemblies are shown adjacent to the schematic diagram on the appropriate Service Sheet. The part reference designator is the assembly designator plus the part designator. For example, A6R9 is R9 on the A6 assembly. For specific component descriptions and ordering information, refer to Table 6-2, Replaceable Parts, in Section VI. Chassis and frame parts, as well as mechanical parts and cables, are identified on Figures 6-1 through 6-5. In addition, several of the alphabetical service sheets in this section contain illustrated parts breakdowns that locate many mechanical parts and cables.

Table 8-2. Assembly and Service Sheet Cross Reference Index

Assembly	Schematic Service Sheet No.	Block Diagram	Principles of Operation Page No.	Parts List Page No.
A1 Keyboard and Display	20, 21	BD 4	8-75	6-4
A2 Audio Filters	7	BD 3	8-59	6-7
A3 Audio De-Emphasis and Output	8	BD 3	8-59	6-9
A4 FM Demodulator	5, 6	BD 3	8-57	6-11
A5 Voltmeter	9, 10	BD 3	8-61	6-15
A6 AM Demodulator	3, 4	BD 3	8-53	6-17
A10 Power Supply Regulators	23, 24	BD 2	8-81	6-21
A11 Counter	16, 17	BD 4	8-72	6-23
A13 Controller	18	BD 4	8-74	6-25
A14 Remote Interface	22	BD 4	8-76	6-27
A15 RF Input	1	BD 2	8-51	6-28
A17 Input Mixer	2	BD 2	8-52	6-30
A18 IF Amplifier	2	BD 2	8-52	6-31
A19 LO Divider	11	BD 2	8-64	6-33
A20 LO Control	14, 15	BD 2	8-70	6-36
A21 Low Frequency VCXO Filter	13	BD 2	8-70	6-39
A22 Low Frequency VCXO	13	BD 2	8-69	6-39
A23 Sampler	12	BD 2	8-65	6-41
A24 High Frequency VCO	12	BD 2	8-69	6-44
A25 Audio Motherboard	25		N/A	6-45
A26 Power Supply Motherboard	23, 24	BD 2	N/A	6-45
A27 Digital Motherboard	26	BD 2	N/A	6-46
A28 RF Motherboard	27		N/A	6-47
A29 Series Regulator Heat Sink	23, 24	BD 2	N/A	6-47
A30 Line Power Module	23	BD 2	N/A	6-47
A31 Remote Interface Connector	22	BD 4	8-76	6-47
A50 AM Calibrator	29	BD 3	8-83	6-49
A51 FM Calibrator	28	BD 3	8-82	6-53

Major mechanical parts have reference designations that begin with the letters MP. Other mechanical parts, such as screws, are listed in the replaceable parts list below the part to which they fasten. To find the part number and description of a mechanical part, find the part in one of the figures in Section VI or Section VIII. The part in the figure will be labelled with its reference designator. Look up that reference designator in the Table of Replaceable Parts. If the part is a fastener, such as a screw, nut, or washer, look to the figure for the part to which it fastens. Then, look up the fastened part in the parts list. Just below it you will see the part numbers and description of the desired hardware.

Illustrated parts breakdowns of chassis and frame parts, as well as mechanical parts and cables, can be identified on Figures 6-1 through 6-5. Parts breakdowns of the front and rear panels are located on service sheets at the rear of this manual (see pages 8-155 and 8-157).

8-18. Test Points and Adjustment Locations

Most test points and adjustments are indicated on the top covers of the individual assemblies. Test points and adjustments can also be found on the component locator photograph adjacent to the particular assembly's schematic.

8-19. Service Aids on Printed Circuit Boards

Service aids on printed circuit boards include test points, indicator lights, transistor and integrated circuit and relay designations, adjustment names, and assembly part numbers. Of particular importance are the four test LEDs and associated test points on the A13 Controller Assembly. These are used with the Modulation Analyzer's power-up test routine to aid in troubleshooting the Controller Assembly.

8-20. Other Service Documents

Service Notes, Manual Change Supplements, and other service literature are available through Hewlett-Packard. For further information, contact your nearest Hewlett-Packard office.

8-21. TROUBLESHOOTING

Instrument problems usually fall into three general categories: operator errors, operation out of specification, and catastrophic failures. The troubleshooting strategy is different for each category.

8-22. Operator Errors

Apparent failures sometimes result from using the instrument outside of its specified range. Usually, the instrument can sense the condition and will display an error message. At other times it cannot, such as when it attempts to tune to a signal with more than 400 kHz FM deviation. Consult the specification table (Table 1-1) and the Detailed Operating Instructions in the Operating Manual for additional information.

8-23. Operation Out of Specification

The specifications are listed in Table 1-1. Performance tests that can be used to verify the specifications are found in Section IV. If instrument performance is only slightly out of limits, it can sometimes be corrected by an adjustment. The procedures for all adjustments are in Section V. References listed for each adjustment indicate which service sheet to consult when the adjustment procedure fails. In general, however, it is good practice to perform the troubleshooting checks for Service Sheet BD1 first since they take only a few minutes and reveal much information.

8-24. Catastrophic Failures

Nearly any catastrophic failure will cause the instrument to appear to fail to tune and lead one to conclude that the LO is defective. This is very often an erroneous conclusion. The tuning routine utilizes nearly every circuit in the instrument, and thus a failure in any one of these circuits results in the instrument appearing to not tune properly. The RF LEVEL measurement is not a tuned measurement and will often work when no other measurement will.

Begin troubleshooting at Service Sheet BD1. The simple procedures there will quickly show if the LO is at fault and will differentiate between a control (digital) problem and a hardware (analog) problem. The checks then give cross-references to the detailed block diagrams (Service Sheets BD2 to BD4) or to a schematic.

The troubleshooting information found on all service sheets consists of a series of performance checks. The purpose of the checks is not to identify which circuit or component has failed but rather to verify whether or not the assembly or circuit is operating correctly. Information on the possible cause of failure is given in the form of hints whenever they can be given reliably. The limits given in the troubleshooting checks are rather loose to facilitate the use of general-purpose equipment (usually an oscilloscope). If a slightly-out-of-tolerance condition is suspected, the test can usually be run more rigorously paying greater attention to measurement accuracy.

Troubleshooting on the block diagram level normally utilizes User and Service Special Functions, that on the schematic level normally utilizes Direct Control Special Functions. Direct Control Special Functions will require some study of their operation before using them for the first time.

8-25. SPECIAL FUNCTIONS

8-26. General

Special Functions extend user control of the instrument beyond that normally available from the front panel. They are intended for the user who has a thorough understanding of the instrument and the service technician who needs arbitrary control of the instrument functions. During normal use, the Modulation Analyzer safeguards itself against invalid measurements. Safeguards come in the form of automatic tuning and ranging, overpower protection, squelch, MODULATION OUTPUT blanking, and error messages. When Special Functions are used, some of these safeguards are removed, depending on the Special Function selected, and thus there is a degree of risk that the measurement may be invalid. However, there is no risk of damage to the instrument.

To enter a Special Function, enter the Special Function code (usually a prefix, decimal, and suffix), then press the SPCL key. The Special Function code will appear on the display as it is being entered. If a mistake is made during entry of the Special Function code, press the CLEAR key and start over. When a Special Function is entered, the light in the SPCL key will usually go on (if it is not already on). The readout on the display will depend on the Special Function entered. The readout may be a measured quantity, an instrument setting, a special code, or, in some cases, the display is unaltered. Special Functions can be entered from the HP-IB by issuing the Special Function code followed by the code SP.

The Special Functions are grouped by prefix range as follows:

0: **Direct Control Special Functions.** These functions are used for service. They halt the functioning of the Controller and configure the instrument hardware as dictated by the suffix. All software safeguards are relinquished.

1-39: **User Special Functions.** These functions are used during normal instrument operation when a special configuration, measurement, or information is required. Many of the instrument safeguards remain implemented. More information on User Special Functions can be found under Special Functions in the Detailed Operating Instructions in the Operating Manual and on the Operator's Information pull-out card.

40-99: **Service Special Functions.** These functions are used to assist in troubleshooting an instrument fault. The functions available are quite diverse and include special internal measurements, software control, and special service tests and configurations. Safeguards are generally relinquished.

8-27. Direct Control Special Functions (Prefix 0)

Communication between the instrument's Controller and its hardware is via the Instrument Bus. During normal instrument operation, the Instrument Bus carries measurement results, status information, and commands (which control hardware). The Direct Control Special Functions halt the bus activity and send out commands as determined by the code suffix. One command is sent for each Special Function entry. A summary of the Direct Control Special Functions and codes is contained in Service Sheet D.

Direct Control Special Function Code Format. The Direct Control Special Function code is in the form 0.esd, where 0 is the prefix (which may be omitted) and esd represents a three-digit hexadecimal number. The significance of esd (which stands for enable, select, and data) is discussed in the Principles of Operation for Service Sheet BD4. Specific Direct Control codes are used in the Troubleshooting section of the individual service sheets.

As the Direct Control code is entered, the code will appear on the display. Pressing the SPCL key initiates the Special Function. The display will then be in the form rrrr.wwww, where each digit represents a binary bit (0 or 1). The rrrr is the d (data) read back from the Instrument Bus. The wwww is the d (data) written to the bus. Thus rrrr and wwww are normally the binary form of the hexadecimal value for d. Exceptions to this are Special Functions 0.5sd and 0.6sd, which control the display itself.

Since the display has a limited set of alphabetic characters, the hexadecimal characters A, B, C, D, E, and F are displayed on entry as —, E, H, L, P, and blank, respectively, and they are entered from the keyboard as Shift 0, Shift 1, Shift 2, etc., or from the HP-IB as X0, X1, X2, etc. Table 8-3 summarizes the hexadecimal entry and readback for Direct Control Special Functions.

Table 8-3. Hexadecimal Information for Direct Control Special Functions

Hexadecimal Character	Decimal Equivalent	Binary Equivalent	Keystroke Entry	HP-IB Code Entry	Display On Entry
0	0	0000	0	0	0
1	1	0001	1	1	1
2	2	0010	2	2	2
3	3	0011	3	3	3
4	4	0100	4	4	4
5	5	0101	5	5	5
6	6	0110	6	6	6
7	7	0111	7	7	7
8	8	1000	8	8	8
9	9	1001	9	9	9
A	10	1010	S(Shift) 0	X0	—
B	11	1011	S(Shift) 1	X1	E
C	12	1100	S(Shift) 2	X2	H
D	13	1101	S(Shift) 3	X3	L
E	14	1110	S(Shift) 4	X4	P
F	15	1111	S(Shift) 5	X5	(blank)

Direct Control Special Function Applications. Direct Control Special Functions are most often used to provide manual control of various switches or digital-to-analog devices in the hardware. The following examples illustrate how to use Direct Control Special Functions:

Example #1

In the path of the demodulated audio signal is a set of selectable, active high-pass filters which are located on the A3 Audio De-emphasis and Output Assembly. A simplified diagram of the filters is shown in Figure 8-4. The filters and through path are selected by analog switches U1A, U1B, and U1C. Table 8-4, which is associated with the troubleshooting of the filters, lists the Direct Control Special Functions normally used to control the switches.

Table 8-4. Audio High-Pass Filter and FM Pre-Display De-Emphasis Direct Control Special Functions

Check	Direct Control Special Function	
	Pre-Display On	Pre-Display Off
Thru Path	0.141	0.149
50 Hz HPF	0.142	0.14A
300 Hz HPF	0.144	0.14C

To insert the 50 Hz High-Pass Filter, key in 0.142 SPCL or .142 SPCL. The display will show 0010.0010, indicating that the Controller received d • 2 from the keyboard (or HP-IB), issued it to the Instrument Bus, and read it back. If circuitry on the assembly is working properly, switch U1A will close and the audio signal will pass through the 50 Hz High-Pass Filter.

Notice that the display no longer shows a measurement result. No annunciators are lighted (except REMOTE and ADDRESSED, if the Special Function is entered via HP-IB) and only the SPCL key is lighted. If any key other than a number key, S (Shift) key, or the LCL key is pressed, the instrument hardware will revert back to the measurement mode it was in before the Direct Control Special Function was entered. Thus, in this example, unless the 50 Hz High-Pass Filter had been previously selected with the front-panel key, it would be removed from the audio path, when any other key is pressed. (However, note that there are some Service Special Functions that will maintain the requested configurations even if another key is pressed.)

Table 8-4 indicates that 0.14A will also select the 50 Hz High-Pass Filter. Any Special Function of the form 0.14d also controls the pre-display filter on/off switches U7A and U7B. For pre-display on (0.142), U7A is closed. For pre-display off (0.14A), U7B is closed. As it turns out, 0.14d codes other than those shown in the table will also affect the high-pass filters. For example, 0.147 will close U1A, U1B, and U1C, simultaneously (with U7A also closed). This fact is ascertained from the service sheet schematic.

Example #2

A second example from the A3 assembly illustrates data readback when using the Direct Control Special Function. One of the means of detecting an overrange of the audio circuits is by the Audio Overvoltage Detector. The detector is on the audio input line before any active (and

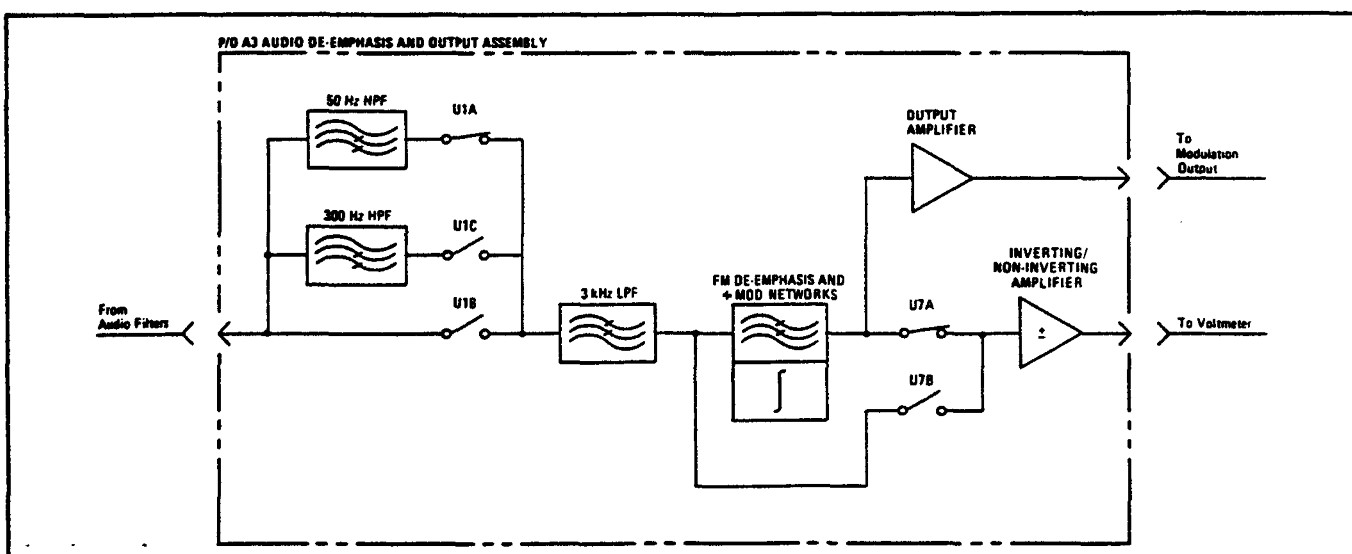


Figure 8-4. Example Showing High-Pass Filter Switching.

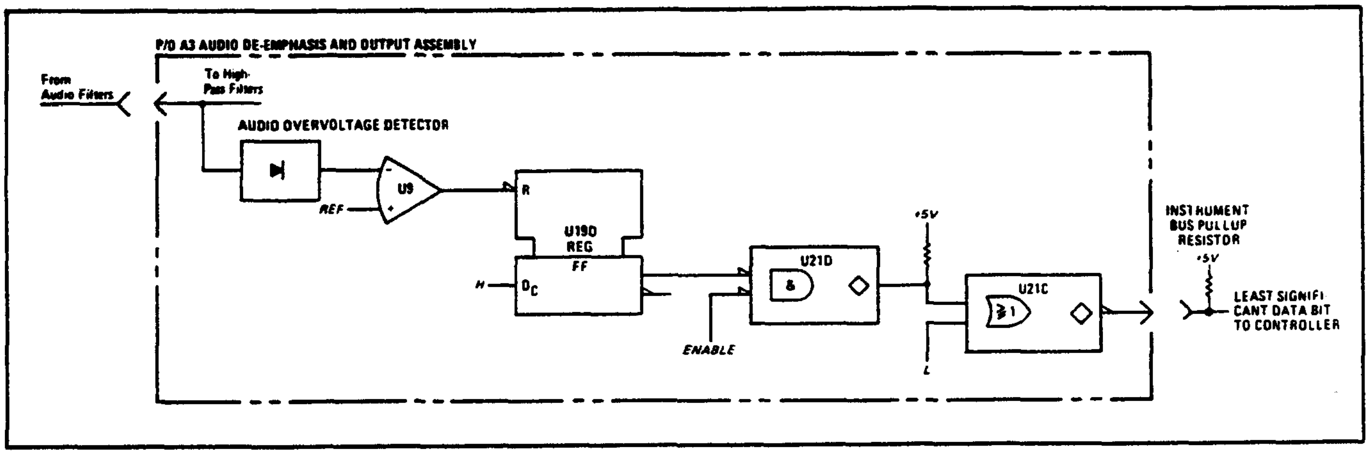


Figure 8-5. Example Showing Audio Overvoltage Detector Readback

hence, distortable) filters (See Figure 8-5). The audio input line is the same as in the previous example. The Audio Overvoltage Detector senses the peak signal level on the line and U9 compares it against a reference. If the detected level rises above the reference, the output of U9 goes low and resets flip-flop U19D. Other flip-flops (not shown) are also reset and open the audio path ahead of the detector (without intervention of the Controller). U21D and U21C, when enabled, invert the output of U19D twice. The output of U21C is across the least-significant bit of the readback data line of the Instrument Bus. In the normal measurement cycle, the Controller reads the status of the Audio Overvoltage Detector (by enabling U21D and reading the output of U21C) and displays an error if U9 has tripped.

At this point in the discussion, a more detailed description of the Instrument Bus data lines is needed. Data (d) is read out from the I/O port of the Controller to the Instrument Bus through buffers (TTL inverters). However, data is read back to the I/O port directly, bypassing the buffers. An I/O port outputs a low by actively pulling the line to ground. It outputs a high by allowing the output to be passively pulled up by an external pull-up resistor. When a Controller I/O port inputs data from other circuits of the Modulation Analyzer, these circuits must operate against the passive pull-up resistor.

Readback devices that are read out to the data lines, such as U21C, are similarly configured. U21C has an open-collector TTL output. When not outputting data, its output device is off, pulling it to a high-impedance (inactive) state. When it outputs data, a low is produced by switching the output device to ground. A high is produced by switching the device off and allowing the output to be passively pulled-up. The readback lines are low true (i.e., r=1 when the line is low).

When U21D is disabled (enable is high), its output is low. Therefore, U21C is high (inactive) and has no effect on the data line. U21D is enabled by Direct Control Special Function 0.15d. The value of d is arbitrary to enable U21D, but the least-significant bit must be 0 (i.e., d must be even) to switch off the output device of the I/O data port.

To clarify this concept, suppose that U19D has not been reset. If Direct Control Special Function 0.152 is entered, the display will show 0010.0010. (0.15d also controls FM squelch. Using 0.152 deactivates squelch.) The second four digits are 0010 because d=2 was received by the Controller from the keyboard and issued to the Instrument Bus. The set flip flop (U19D) puts a high on the input of U21D and an inactive high on the least-significant data line. This is read by the Controller as r=0 and thus is the same as the bit issued. The other three data readback lines are unaffected by the readback command and remain 001. Therefore, the d read back is 0010.

If U19D is reset, U21D puts a low on the least-significant data bit (r=1), and the data read back is 0011. The display is therefore 0011.0010. (Note that rrrr is different from wwww.) If d is keyed in as a hexadecimal F, the display is 1111.1111 regardless of the state of U21D. This is because all output devices on the data I/O port of the Controller are on (logical 1).

One final note, after a Direct Control Special Function is entered, it is periodically issued to the Instrument Bus. If a fault causes rrrr to indicate a malfunction, the display will begin to read correctly as soon as the fault is removed.

8-28. Service Special Functions (Prefix 40-99)

The Service Special Functions are used to perform a variety of tasks related to service. The functions are cataloged below. A suffix N indicates that a parameter other than 0 may be required to complete the Special Function Code. See Table 8-3 for entry of hexadecimal suffixes.

40.0 Controller Reset. Initializes the Controller to its power-up state. Because this function affects the HP-IB hardware, it is unavailable from the interface bus (causes error E24).

41.0 Controller Clear. Initializes the Controller to its power-up state but bypasses the operational checks. Leaves HP-IB hardware unaffected but clears any service request message (SRQ) being issued by the Modulation Analyzer, sets the service request condition to its power-up state, and clears all bits in the status byte.

42.0 Display Software Date. Displays the date of the software in the form
<day of year>.<year>.

43.N Service Error Display Control. Service Errors are errors 70 to 89. Refer to page 8-16.
- N=0 Disables display of Service Errors.
- N=1 Enables display of Service Errors.

46.N Count Internal Signals. The Counter counts the internal signal selected by N for 100 ms and displays the count. This is equivalent to measuring the frequency of the signal with 10 Hz resolution for most signals.
- N=1 Intermediate Frequency. See Service Sheet 5.
- N=2 Voltage-to-Time Converter. 10 000 counts equal one volt, but includes a 0.6V offset. See Service Sheet 10 or Special Function 49.N.
- N=3 FM Calibrator. See Service Sheet 28.
- N=4 High Frequency VCO Divided by 8. This is the 40 to 80 MHz signal which is proportional to the LO frequency. See Service Sheet 11.
- N=8 Selected Time Base Reference. The display should read 1000000 ± 1. See Service Sheet 16.
- N=9 External Time Base Reference. The display should read 1000000 ± 1 when an external reference is connected. See Service Sheet 16.
- N=A Internal Time Base Reference. The display should read 1000000 ± 1 when no external reference is connected. See Service Sheet 16.
- N=B Spare.

49.N Display Internal Voltages. The Voltmeter measures and displays the internal voltage (in volts) selected by N.
- N=0 Ground. See Service Sheet 10.
- N=1 RF Level Ground. See Service Sheet 1.
- N=2 RF Level/2.96. See Service Sheets 1 and 10.
- N=3 RF Level. See Service Sheet 1.
- N=4 X10 AM Calibrator Level. See Service Sheet 29.
- N=5 X1 AM Calibrator Level. See Service Sheet 29.
- N=6 Audio Range Detector. See Service Sheet 8.
- N=8 Ground. See Service Sheet 10.
- N=9 Average Detector. See Service Sheet 9.
- N=A Peak Detector. See Service Sheet 9.
- N=B Average IF Level. See Service Sheet 3.
- N=D IF Level. See Service Sheet 4.
- N=E ALC Current. See Service Sheet 3.

NOTE

The suffix can also be two digits, XY. The difference 49.X SPCL − 49.Y SPCL is then displayed. For example, 49.3 SPCL or 49.30 SPCL gives a display of the RF level with respect to ground. 49.31 SPCL gives a display of the RF level with respect to RF level ground.

50.N Display Internal Voltages. The Voltmeter measures and displays the internal voltage (in volts) selected by N. See also the previous note.
- N=0 Ground. See Service Sheet 10.
- N=1 −15V Supply. The display should read between 2.7200 and 3.0000. See Service Sheet 10.
- N=2 −5V Supply. The display should read between 2.8400 and 3.1400. See Service Sheet 10.
- N=3 +5V Supply. The display should read between 2.8800 and 3.1900. See Service Sheet 10.
- N=4 +15V Supply. The display should read between 3.0400 and 3.1700. See Service Sheet 10.
- N=5 +40V Supply. The display should read between 2.9800 and 3.2900. See Service Sheet 14.

52.N Read Only Memory Verification. The Controller displays the checksum of the read only memory (ROM) specified by N. When specifying a ROM, use N=1 through 8 or 11. The 11 is a two digit entry of 11, not the keystroke entry S(Shift)1 for the hexadecimal value B. The Display is in the form <actual checksum>.<expected checksum>. An initial zero (or zeros) before the decimal will be blanked. Thus, for example, 24.024 would be correct but 24.124 would be incorrect. See Service Sheets 19 and 22.

54.N Local Oscillator Test. The Controller sequences the local oscillator (LO) through a series of test specified by N and returns an error code corresponding to the test that failed. For N=1 to N=5, four tests each are performed. If any tests fail, the test numbers appear on the display in the positions indicated. All leading zeros in the display are blanked. For example, in the sequence defined by N=1, a simultaneous time base (Test 2) and HF VCO or Divider (Test 4) failure will result in the display 20004 (three leading zeros blanked). The tests are continuously sequenced, and the display will change as the fault is corrected. The tests are most easily visualized by referring to Figures 8-38 and 8-39.

N=0 Performs all tests in the sequence listed for N=1 through N=5 (below). Displays the number of the first test that failed. If no test fails, a zero is displayed.

NOTE

If the display is not zero, it is important that all other tests be checked (54.1 through 54.5). Some LO faults cause more than one test to fail. For example, a failure of the HF VCO÷8 output will result in failures of

N=1, Test 4
N=2, Tests 5, 6, and 7
N=3, Tests 9 and 10
N=5, Tests 17 and 18.

This is because a frequency measurement of the LO is made in these particular tests.

N=1 Test 1 Undefined.

N=1 Test 2 Time Base Test (see Service Sheets 16 and 17).

Tests the 6.25 kHz TTL time base signal to determine if it toggles within a reasonable length of time. The Controller looks at U14D's output for 260 μs. At least one transition (high-to-low or low-to-high) of the clock should occur during this time. If no clock transition occurs, 2 will be displayed in digit position 3. However, if a transition is detected, a second (verification) check is made by the Controller.

N=1 Test 3 Counter Test (see Service Sheet 17).

Counts the selected Time Base, which should be exactly 10000000. If the result is not 10000000, 3 will be displayed in digit position 6.

N=1 Test 4 HF VCO and Divider Output (see Service Sheets 11 and 12).

Connects the DAC output to the HF VCO and counts the Local Oscillator frequency to determine if it is within certain limits. The Controller turns off the Sweep-Up and Sweep-Down Current Sources and LF VCXO tune filter, allowing the HF VCO to free run. The Controller then outputs the approximate center frequency code to the tuning DAC and checks if the HF VCO output is between 250 and 800 MHz. If the frequency is not within these limits, 4 will be displayed in digit position 8.

N=2 Test 5 HF VCO Top of Range Test (see Service Sheet 12).

Tests the DAC's ability to drive the HF VCO to the top of its frequency range. The DAC is programmed to output the highest tune voltage. If the HF VCO does not tune to between 655 and 800 MHz, 5 will be displayed in digit position 2.

N=2 Test 6 HF VCO Bottom of Range Test (see Service Sheet 12).

Tests the DAC's ability to drive the HF VCO to the bottom of its frequency range. The DAC is programmed by the Controller to output the lowest tune voltage. If the HF VCO does not tune to between 280 and 310 MHz, 6 will be displayed in digit position 4.

NOTE

Test 6 is not always conclusive. The test may not always detect a failure of the VCO to tune to the bottom of the band. If the VCO does fail to tune to the bottom of its band, the instrument will not tune to certain frequencies in the track mode.

N=2 Test 7 HF VCO Mid-Range Test (see Service Sheet 12).

Tests the DAC's ability to control the HF VCO near the center of its frequency range. The DAC is programmed by the Controller to output a tune voltage near the center of the range. If the HF VCO does not tune to between 454 and 575 MHz, 7 will be displayed in digit position 6.

N=2 Test 8 Undefined.

N=3 Test 9 Gain Test For Most Significant DAC (see Service Sheet 14).

Tests the gain of the most significant DAC. The Controller sends a hexadecimal 55 to the most significant DAC (MSDAC) and a hexadecimal AA to the least significant DAC (LSDAC). The Controller then counts the frequency of the HF VCO. The MSDAC is then changed to AA. The Controller again counts the frequency of the HF VCO and then computes the difference between the first and second frequencies. This difference should fall between 139 and 285 MHz. If it does not, 9 will be displayed in digit position 2.

N=3 Test 10 Gain Test For Least Significant DAC (see Service Sheet 14).

Tests the gain of the least significant DAC. The Controller sends a hexadecimal AA to the most significant DAC (MSDAC) and a hexadecimal 55 to the least significant DAC (LSDAC). The Controller then counts the frequency of the HF VCO. The LSDAC is then changed to AA. The Controller again counts the output of the HF VCO and then computes the difference between the first and second frequencies. This difference should fall between 1.95 and 4.5 MHz. If it does not, 10 will be displayed in digit positions 3 and 4.

N=3 Test 11 Undefined.

N=3 Test 12 Undefined.

N=4 Test 13 Phase Lock Loop Acquisition (see Service Sheets 12 and 14).

Tests the HF VCO's ability to lock to the LF VCXO. The Controller turns off the Sweep Current Sources and the LF VCXO tune filter. It then programs the DAC to output a tune voltage which causes the HF VCO to operate near the center of its frequency range. The Controller rapidly switches the DAC output to the LF VCXO (with the DAC still programmed to midrange). The sampler loop is then closed and the output of the HF VCO is counted. If the HF VCO is operating properly, it will drift until it locks to a harmonic of the LF VCXO (via the sampler). If the HF VCO frequency moves more than 2 MHz, it has failed to lock to a harmonic of the LF VCXO, and 13 will be displayed in digit positions 1 and 2.

N=4 Test 14 Phase Lock Loop Stability (see Service Sheet 14).

Tests the ability of the HF VCO to follow step changes in the LF VCXO. The Controller sends the DAC a code which forces the LF VCXO to the bottom of its frequency range. The frequency of the HF VCO is counted. The DAC is then instructed to quickly slew the LF VCXO to the top of its frequency range and then back down to the bottom again. When the DAC output voltage reaches minimum, the HF VCO is again counted. The frequency change of the HF VCO should be less than 100 kHz. If it is not, 14 will be displayed in digit positions 3 and 4.

N=4 Test 15 Undefined.

N=4 Test 16 Undefined.

N=5 Test 17 LF VCXO Range Test (see Service Sheets 13 and 14).

Tests to see if the DAC moves the LF VCXO within the proper frequency limits. Since the LF VCXO frequency can not be measured directly, an indirect process is used. The Controller sends a hexadecimal 00 to the DAC, which drives the LF VCXO to its minimum frequency. This frequency change causes a proportional change in the HF VCO frequency, which is measured by the Counter. The Controller then sends a hexadecimal FF to the DAC, driving the LF VCXO to its highest frequency. The HF VCO output is again counted. The difference between the highest and lowest frequencies from the HF VCO should be between 2.95 and 5.5 MHz. If the frequency difference does not fall within this range, 17 will be displayed in digit positions 1 and 2.

N=5 Test 18 Gain of LF VCXO Drive (see Service Sheets 13 and 14).

Tests the gain of the LF VCXO. This is the hardest test in this series for the instrument to pass. The Controller sends a hexadecimal 55 to the most significant DAC (MSDAC) and a hexadecimal AA to the least significant DAC (LSDAC) and then counts the frequency of the HF VCO. The Controller then changes the MSDAC to a hexadecimal AA and the LSDAC to a hexadecimal 55, and again counts the frequency of the HF VCO. The difference between the first and second frequencies should be within the range of 1.05 to 2.4 MHz. If it is not, 18 will be displayed in digit positions 3 and 4.

N=5 Test 19 Undefined.

N=5 Test 20 Undefined.

55.0 Sweep Doubler Band. Sweeps the LO slowly back and forth across the doubler band. See Service Sheet 11.

56.0 Sweep Bands 4 through 8. Sweeps the LO slowly and sequentially across bands 4 through 8. See Service Sheet 11.

57.0 Sweep Bands DBLR through 3. Sweeps the LO slowly and sequentially across bands DBLR through 3. See Service Sheet 11.

60.0 Key Scan. The keyboard is scanned and a key code is displayed and output to the HP-IB. The key codes are shown in Figure 8-6.

To use the Key Scan Special Function, remove the instrument top cover. Key in 60.0 SPCL then jumper A13TP3 (INT) to A13TP1 (GND) on the A13 Controller Assembly. Press the front-panel keys and observe the display. If two or more keys are pressed simultaneously, the display shows the code corresponding to the first one found in its normal scan. See Service Sheet 20.

Two simple programs for displaying the key codes on a computing controller are shown in Table 8-5. Removal of the top and bottom covers is unnecessary. The Modulation Analyzer is assumed to have HP-IB address 14.

Table 8-5. Key Scan Programs

HP 9825A	HP 9835A/9845A
`0: fxd 0`	`10 FIXED 0`
`1: rem 714;llo 7`	`20 REMOTE 714`
`2: wrt 714,"60.SP"`	`30 LOCAL LOCKOUT 7`
`3: red 714`	`40 OUTPUT 714;"60.SP"`
`4: dsp A;jmp-1`	`50 ENTER 714;A`
`5: end`	`60 DISP A`
	`70 GOTO 50`
	`80 END`

61.N Display HP-IB Status. Displays the status of the HP-IB lines selected by N. The display is in binary. See Service Sheet 22 for troubleshooting and a complete list of HP-IB mnemonics.

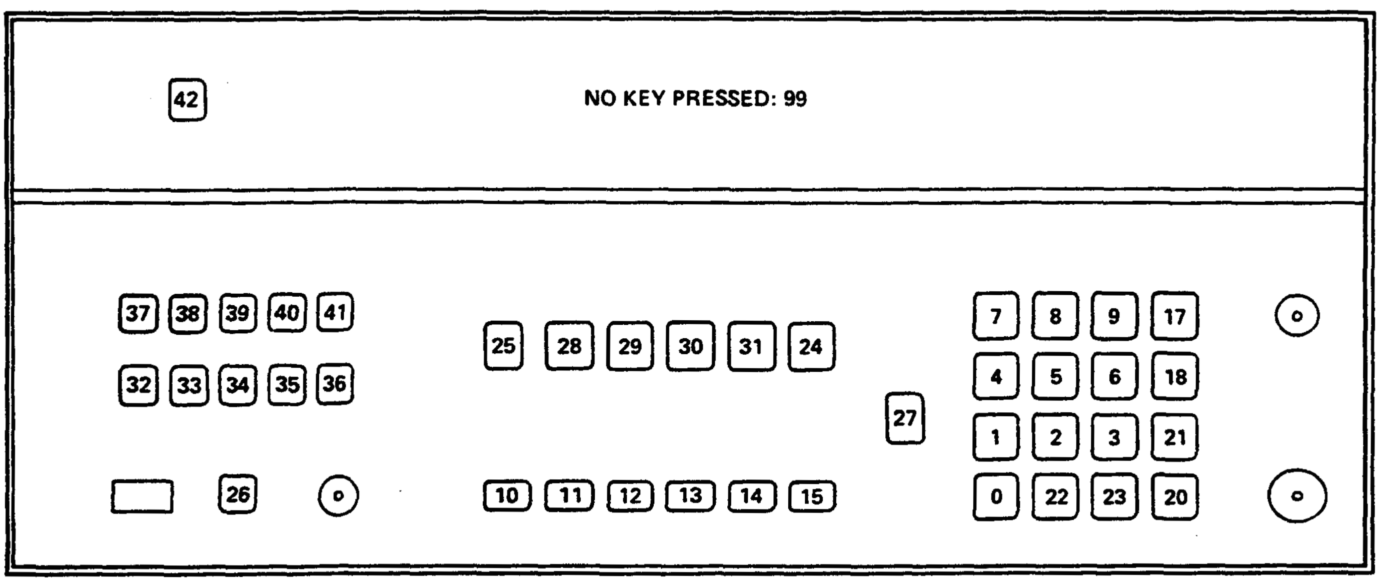


Figure 8-6. Key Codes for Key Scan (Service Special Function 60.0)

NOTE

Information within brackets appears on the Modulation Analyzer's display.

N=0 <Addressed to Talk>.<Addressed to Listen>. This function reads back and displays the present state of the Talk and Listen Address flip-flops (A14U16A and B). For example, if the display shows 1.0, the Modulation Analyzer is addressed to talk (and unaddressed to listen). This means the Talk Address flip-flop is set (and the Listen Address flip-flop is reset).

N=1 <DAV>.<RFD>.<DAC>. This function reads back and displays the present state of the three bus handshake lines. <DAV> reflects the state of the Data Valid bus handshake line as being driven by the Modulation Analyzer (1=being driven; 0=not being driven). Thus, when in Listen Only, this display will always show 0 for <DAV>. The <RFD> and <DAC> always track the bus lines Ready For Data and Data Accepted. For example, 1 for <RFD> means line Ready For Data is true (high).

N=2 <ATN>.<REN>. This function reads back and displays the present state of the ATN (Attention) bus control line and the state of the Remote Enable Flip-Flop. A 1 for either <ATN> or <REN> indicates ATN is true (low at the bus) or that the Remote Enable Flip-Flop is set.

N=3 <SPM>.<SRQ>. This function reads back and displays the state of the Serial-Poll flip-flop and the state of the SRQ bus-control line as being driven by the Modulation Analyzer. A 1 for either <SPM> or <SRQ> indicates the Modulation Analyzer is in serial-poll mode (SPM) or that it is presently driving the SRQ bus control line.

N=4 PIO Port A. This function inputs and displays (without modifying) the data at PIO port A (A14U13). Leading zeros are blanked. The following table interprets the display.

PIO Port A

A14 Pin No.	2	37	36	31	30	25	24	19
Display Digit	1	2	3	4	5	6	7	8
Mnemonic	IO8	IO7	IO6	IO5	IO4	IO3	IO2	IO1
1 = True								

N=5 PIO Port B. This function is similar to the function above except PIO port B is displayed. The display is interpreted as shown in table below.

PIO Port B

A14 Pin No.	1	38	35	32	29	26	23	20
Display Digit	1	2	3	4	5	6	7	8
Mnemonic	ATN	ARD	AAD	SRQ	RNL	ATT	ATL	SDV
1 = True								

8-29. ERROR MESSAGES

8-30. General

The instrument generates error messages to indicate operating problems, incorrect keyboard entries, or service-related problems. The error message is cleared when the error condition is removed.

The Error Messages are grouped by error code as follows:

E01 through E19 and E90 through E99. These are Operating Errors which indicate that not all conditions have been met to assure a calibrated measurement. Operating Errors can usually be cleared by readjustment of the front-panel controls. The Error Disable Special Function (8.N) can be used to selectively disable certain error messages. More information on Operating Errors and error message disabling can be found under Error Message Summary and Error Disable in the Detailed Operating Instructions in the Operating Manual and on the Operating Information pull-out card.

E20 through E29. These are Entry Errors which indicate that an invalid key sequence or keyboard entry has been made. These errors require that a new keyboard entry or function selection be made. More Information on Entry Errors can be found under Error Message Summary in the Detailed Operating Instructions in the Operating Manual and on the Operating Information pull-out card.

E30 through E89. These are Service Errors which provide additional service-related information and are discussed below.

8-31. Service Errors (E30-E89)

Service Errors are not normally displayed. When a service-related problem is suspected, enable the Service Errors by keying in 43.1 SPCL. Service Errors can be disabled by keying in 43.0 SPCL or by pressing AUTOMATIC OPERATION. Not all Service Errors are an indication of a problem but may be a normal occurrence depending upon the circumstances.

E70 **Phase Lock Loop Step-Down.** The LO phase lock loop has stepped to a lower harmonic of the LF VCXO in an attempt to tune the LO to the required frequency. Stepping down once is occasionally necessary during normal tuning. See Service Sheet BD2 and Service Special Function 54.N on page 8-12.

E71 **Phase Lock Loop Step-Up.** This error message is the same as E70 except that the loop has stepped to a higher harmonic.

E72 **Audio Overload.** The Audio Overvoltage Detector has tripped. This may have been due to the nature of the audio signal (e.g., a high-frequency audio signal which overrides the circuits preceeding a low-pass filter) or due to a problem in the audio circuits. See Service Sheet BD3.

E74 **FM Calibrator Overdeviation.** The frequency deviation of the FM Calibrator is greater than 38 kHz. See Service Sheet 28.

E75 **FM Calibrator Underdeviation.** The frequency deviation of the FM Calibrator is less than 3.0 kHz. See Service Sheet 28.

E76 **AM Calibrator Modulators Unequal.** The difference between the x10 AM Cal signal for the two channels is greater than 0.6V. See Service Sheet 29.

E77 **AM Calibrator Channel B Out of Range.** The AM Cal level from Channel B is not within the range of +1.8 to +2.2V. An unterminated CALIBRATION OUTPUT will cause this error. See Service Sheet 29.

E78 **Key Not Found.** A key closure was not found after a keyboard interrupt (except when a keyboard entry is in progress). See Service Sheet 20.

E79 **Audio Autorange Rangeback.** The audio autorange routine has found the audio signal level is too high, has changed to a less sensitive range, and has immediately found the signal is too low. The routine does not then range back, but instead displays error E79 and remains on the low-sensitivity range for the rest of the measurement cycle. The error signifies that the routine would normally have ranged back but did not actually do it. This may have been due to the nature of the audio signal (e.g., the voice signal) or due to a problem in the audio gain stages or detection circuits. See Service Sheet 8.

E80 **Audio Settling Timeout.** First-time measurement results are not output to the display until the measurement result has settled or until one second has elapsed, whichever is first. Settling is determined by comparing successive measurements. This error message indicates that a one-second timeout has occured. This may be due to the nature of the signal or an instability in the audio circuits. See Service Sheet BD3.

E81 **LO Tuning Adjusted to Center Signal in IF Passband.** This error message only occurs in automatic tuning, low-noise lock. If the signal in the IF drifts out of the acceptable IF passband limits (see the Spectrum Diagram in Tuning Figure in the Operating Manual) but is still present in the total IF passband such that the IF level is still acceptable, the LO frequency will be adjusted to center the signal in the IF passband. When this occurs, error 81 will be displayed. In certain situations it is possible to trick the Controller into making this tuning adjustment when the signal is properly tuned; e.g., when the IF signal has an excessively high AM depth (>99% at normal RF signal levels) which cannot be accurately counted during the trough. Also note that if tuning adjustments are necessary three times in a row (without any intervening measurement), then the full auto-tuning sequence will be initiated, searching the entire input spectrum for a signal.

E89 **Software Error.** Perform the Read Only Memory Verification. See Service Special Function 52.N on page 8-11.

8-32. POWER-UP CHECKS

When the Modulation Analyzer is first turned on (or if 40.0 SPCL is entered), the instrument goes through a series of operational checks. If a check fails, an error code is displayed for two seconds on the four internal TEST LEDs on the A13 Controller Assembly. The sequence then continues on to the next check.

Except for the check of the front-panel LED annunciators, no indication of the power-up sequence or its results is given on the front-panel display. The principal advantage to using the Power-Up Checks is that the keyboard and display need not be operational.

To use the Power-Up Checks, remove the top cover (refer to Removal of Top and Bottom Covers, page 8-155), remove any jumpers that may be on the four TEST test points (A, B, C, and D) on the A13 Controller Assembly, remove any signal at the INPUT, and switch the line to STBY for five seconds (to discharge the supplies) and back to ON. Observe the four TEST LEDs on the top of the Controller Assembly as the instrument powers up. The LEDs should light in the following sequence:

	8	4	2	1
1. Indeterminate for about 1/4 second.	-O-	●	●	-O-
2. ( )( )( )(1) for about 1/4 second.	●	●	●	-O-
3. ( )(4)( )( ) for about 1/4 second.	●	-O-	●	●
4. (8)(4)(2)(1) for about 10 seconds.	-O-	-O-	-O-	-O-
5. ( )( )( )(1), with (1) blinking indefinitely until a key is pressed.	●	●	●	-O-

The Power-Up Checks proper begin at step 2 and are carried out in the following order:

1. **Front Panel Annunciator Check.** All front-panel LEDs and display segments and decimal points are lighted and remain so throughout the tests that follow and for a few seconds afterwards. Failure of one or more LEDs or display segments to light indicates that the respective components or drive circuits have failed. See Service Sheet 21.
2. **Read Only Memory Check.** The checksum of each of the read only memories (ROMs) is read and compared against a stored reference (stored in ROM 1). This is similar to issuing a series of 52.N SPCL commands (see Service Special Functions on page 8-11). When a wrong checksum is found, the four TEST LEDs blink for one second with the binary code of the ROM number. For example, if ROM 5 is faulty, the TEST LEDs will blink ( )(4)( )(1) (i.e., 0101, a binary 5). The check then continues on to the next ROM. See Service Sheets BD4, 19, and 22. If no faulty ROM is found, a steady ( )( )( )(1) appears for about 1/4 second.
3. **Random Access Memory Check.** Data is stored into and retrieved from the random access memory (RAM). If the data read back differs from the data entered, error code ( )( )(2)( ) is output to the TEST LEDs for two seconds. See Service Sheet 18.
4. **Instrument Bus Parity Check.** A parity check of the data lines of the Instrument Bus is made. A failure is indicated by ( )( )(2)(1) on the TEST LEDs for two seconds. See Service Sheets BD4, 10, and 18.
5. **Local Oscillator Check.** The Local Oscillator (LO) is given a series of tests similar to issuing the 54.0 SPCL command (see Service Special Functions on page 8-11). During the test, ( )(4)( )( ) is output to the TEST LEDs for about 1/4 second. A failure is indicated by outputting the same code for an additional two seconds. See Service Sheet BD2.
6. **Keyboard Checks.** The keyboard is scanned to see if any keys are down. If a key is down, error code ( )(4)( )(1) is output to the TEST LEDs for two seconds. See Service Sheets BD4 and 20.

8-33. CONTROLLER TEST LEDs AND TEST POINTS

Near the top edge of the A13 Controller Assembly are located four test points and four associated LED annunciators labeled TEST which are used primarily for troubleshooting the instrument. The LED annunciators are labeled (from left to right) 8, 4, 2, and 1 and are associated with test points A, B, C, and D respectively.

The label on the annunciators is sometimes used to represent a binary weighting. They function in the following ways:

1. At instrument power-up the TEST annunciators light in a certain sequence that indicates proper functioning of several vital areas of the instrument. A failure in any of the areas is indicated on the annunciators. For details see Power-Up Checks.

2. After power-up, annunciator 1 toggles once for each measurement cycle.
3. After power-up, annunciator 2 toggles once for each keyboard interrupt (i.e., each time a key is pressed).
4. After power-up, annunciator 4 toggles once for each HP-IB interrupt.

Grounding of certain of the TEST test points alters instrument operation in the following ways.

1. Grounding test point B causes some of the power-up sequence to be bypassed and thus shortens the turn-on time of the instrument. The power-up checks are now invalid.
2. Grounding test point C initiates the Counter signature analysis troubleshooting routine. See Service Sheet 17.
3. Grounding test point D initiates the Keyboard signature analysis troubleshooting routine. The signature analyzer's start and stop leads are then connected to test point A and the probe is connected to test point B. See Service Sheet 20.

Whenever a test point is grounded, the associated annunciator is extinguished.

8-34. SIGNATURE ANALYSIS

Signature analysis is a simple method of verifying the operation of digital circuitry. When properly used, signature analysis can detect extremely subtle hardware faults. Signatures must identically match those given in the signature tables. If everything is working correctly, signatures will all match exactly. If they don't match, by even one digit, something is wrong.

The Counter, Controller, and Keyboard and Display Assemblies are designed for troubleshooting with signature analysis. Signature analysis is a method of digital signal tracing using test routines programmed in the Modulation Analyzer's ROM. With the Modulation Analyzer's Controller executing the signature analysis routine, the signature analyzer's test probe is used to check nodes in the circuit under test. The signature analyzer converts the signals at the node into a four digit "signature", which it displays. This signature is then compared to the signature in the troubleshooting checks adjacent to the appropriate schematic. These two signatures must be identical.

Signature analysis can be speeded up if the following considerations are kept in mind:

1. Make sure that every step is performed as described in the set-up procedure. That is, make sure that the clock, start, and stop connections and triggering are correct.
2. Double-check that the signatures are being taken at the correct node.
3. Make sure that the signature analyzer probe is making good contact with the pin being checked. Oxidation on pins can cause invalid signatures due to poor contacts.
4. When you think that you have found a bad signature, double check to make sure.
5. When checking a node, check that the unstable-signature indicator is not blinking.

8-35. DISASSEMBLY PROCEDURES

Procedures for removal of the top, bottom, and side covers, and the front and rear panels of the instrument and the illustrated parts breakdowns (IPBs) are contained in Service Sheets A and B.

8-36. REPAIR

8-37. Factory-Selected Components (*)

Some component values are selected at the time of final checkout at the factory (See Table 5-1). These values are selected to provide optimum compatability with associated components. These components are identified on individual schematics and the parts list by an asterisk (*).

8-38. Manual Backdating (†)

A dagger (†) by an item of service information means that information is different for Modulation Analyzers with serial number prefixes lower than the one that this manual applies to directly. Table 7-1 lists the backdating changes by serial number prefix. The backdating changes are contained in Section VII. Recommended modifications are also contained in Section VII.

8-39. Manual Updating (Manual Changes Supplement)

Production changes to Modulation Analyzers made after the publication date of this manual are indicated by a change in the serial number prefix. Changes to this manual's information are recorded by a serial number prefix on the Manual Changes supplement. Errors are also noted in the ERRATA portion of the Manual Changes supplement.

Keep this manual up to date by periodically requesting the latest, complimentary supplement from your Hewlett-Packard office.

8-40. Etched Circuits (Printed Circuit Boards)

The etched circuit boards in the Modulation Analyzer have plated-through holes which make a solderable path through to both sides of the insulating material. Soldering can be done from either side of the board with equally good results. When soldering to any circuit board, keep in mind the following recommendations:

1. Avoid unnecessary component substitution. Substitution can result in damage to the circuit board and/or adjacent components.
2. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.
3. Use a suction device or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

8-41. MOS and CMOS Integrated Circuit Replacement

MOS and CMOS integrated circuits are used in this instrument. They are prone to damage from both static and transients and must be handled carefully. When working on the Modulation Analyzer, keep in mind the following recommendations to avoid damaging these sensitive components.

1. Do not remove any board unless the Modulation Analyzer has been turned off or unplugged.
2. When removing a socketed MOS or CMOS device from an assembly, be careful not to damage it. High-grip sockets are used throughout the instrument. Avoid removing devices from these sockets with pullers. Instead, use a small screwdriver to pry the device up from one end, slowly pulling it up one row of pins at a time.
3. Once a MOS or CMOS device has been removed from an assembly, immediately stick it into a pad of conductive foam or other suitable holding medium.
4. When replacing a MOS or CMOS device, ground the foam on which it resides to the instrument before removing it. If a device requires soldering, make sure that the assembly is lying on a sheet of conductive foam, and that the foam and soldering iron tip are grounded to the assembly. Apply as little heat as possible.
5. Before turning the instrument off, remove any large ac sources which may be driving MOS switches.

8-42. Front-Panel Switch Replacement

If it becomes necessary to replace a front panel switch, refer to the switch replacement procedure in Service Sheet A.

8-43. RETROFITTING OPTIONS

The Operating Manual lists the optional equipment available for use with the Modulation Analyzer. Read the descriptions following each listed option before ordering, since some options cannot be used if others are already in place.

8-44. SCHEMATIC SYMBOLOGY

The following pages summarize the symbology used in presenting many of the devices found in the Modulation Analyzer.

8-45. Logic Symbology

The logic symbols used in this manual are based on the American National Standard Institute (ANSI) Y32.14-1973, "Graphic Symbols for Logic Diagrams (Two State Devices)". A summary of this symbology is provided to aid in interpreting these symbols.

Basic Logic Symbols (Gates) and Qualifiers. This section includes a brief description of the basic logic symbols used on the service sheets (see Figure 8-7), a summary of indicator symbols (see Figure 8-8), a discussion of contiguous blocks, control blocks, and dependency notation, and a summary of symbology for some of the more complex devices.

Qualifiers are that portion of a device symbol that denotes the logic function. For example, "&" denotes the AND function. See Figure 8-7 for a summary of the basic logic symbols and their qualifiers.

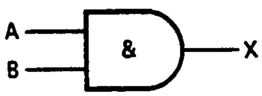
Power supply and ground connections are not shown on the symbols. This information is tabulated on the right margins of the service sheets.

Indicator Symbols. Indicator symbols identify the active state of a device's input or output, as shown in Figure 8-8.

Contiguous Blocks. Two symbols may share a common boundary parallel or perpendicular to the direction of signal flow. Note that in the examples shown in Figure 8-9, there is generally no logic connection across a horizontal line, but there is always an implied logic connection across a vertical line. Notable exceptions to this rule are the horizontal lines beneath control blocks and between sections of shift registers and counters (dividers).

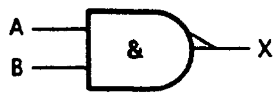
Dependency Notation. Dependency Notation simplifies symbols for complex integrated circuit elements by defining the interdependencies of inputs or outputs without actually showing all the elements and interconnections involved (see Figures 8-10 through 8-12). The following examples use the letter A for address, C for control, G for AND, V for OR, and F for free dependencies. The dependent input or output is labeled with a number that is either prefixed (e.g., 1X) or subscripted (e.g., X_1). They both mean the same thing. Note that many times a controlled line may already be labeled with a number that indicates input or output weighting (for example, in a coder). In this case, the controlling or gating input will be labeled with a letter (see Figure 8-11).

AND GATE

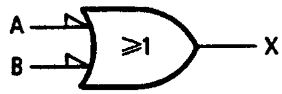


A	B	X
H	H	H
H	L	L
L	H	L
L	L	L

NAND GATE

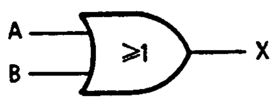


OR GATE WITH INVERTED INPUTS



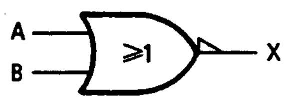
A	B	X
H	H	L
H	L	H
L	H	H
L	L	H

OR GATE

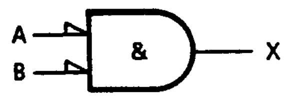


A	B	X
H	H	H
H	L	H
L	H	H
L	L	L

NOR GATE

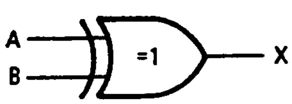


AND GATE WITH INVERTED INPUTS



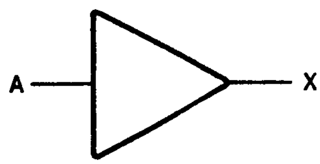
A	B	X
H	H	L
H	L	L
L	H	L
L	L	H

EXCLUSIVE-OR GATE

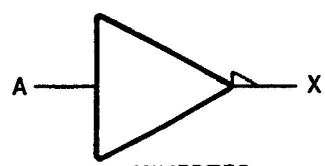


A	B	X
H	H	L
H	L	H
L	H	H
L	L	L

BUFFER



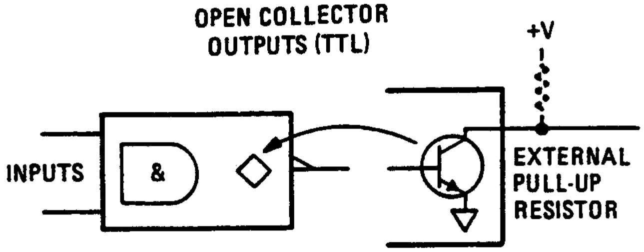
A	X
H	H
L	L



INVERTER

A	X
H	L
L	H

OPEN COLLECTOR OUTPUTS (TTL)



OPEN EMITTER OUTPUTS (ECL)

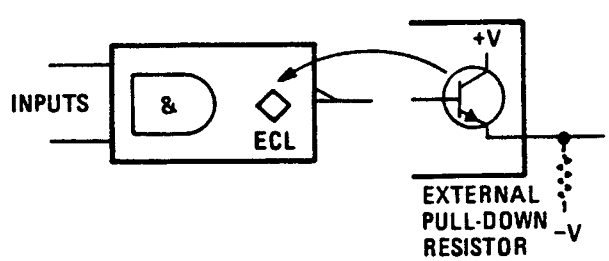
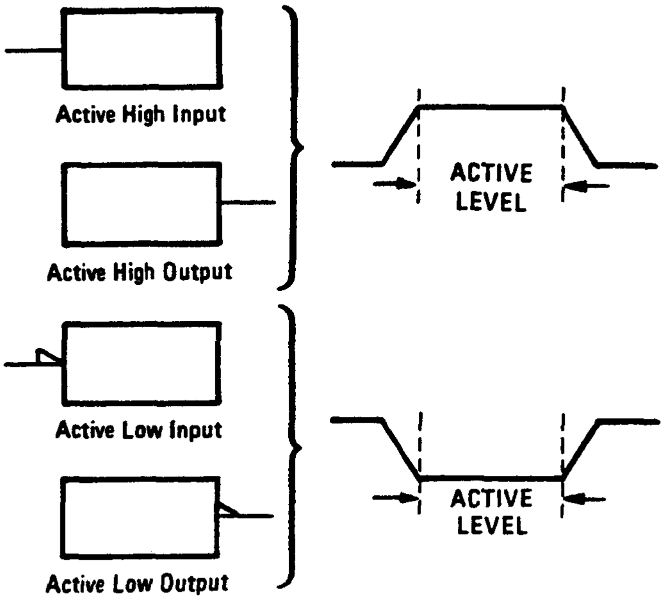


Figure 8-7. Basic Logic Symbols and Qualifiers

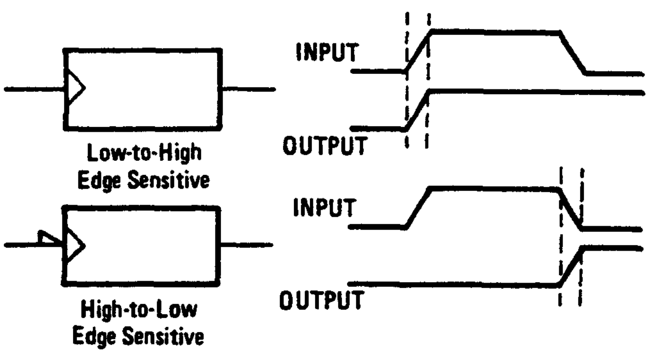
ACTIVE LEVELS



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 (⊵).

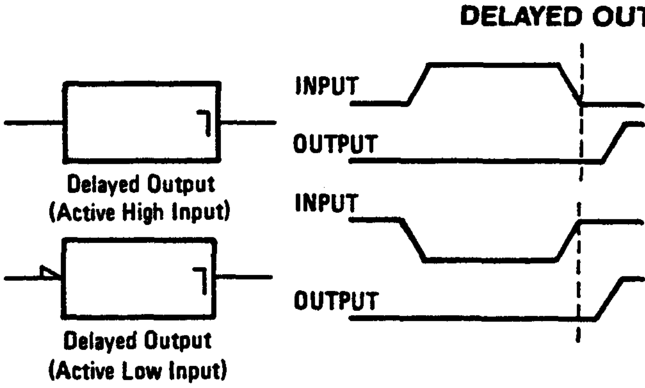
EDGE SENSITIVE INPUTS



EDGE SENSITIVE (low-to-high) inputs are indicated by the presence of the dynamic indicator symbol (—▷).

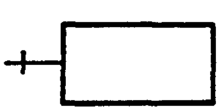
EDGE SENSITIVE (high-to-low) inputs are indicated by the presence of both the dynamic indicator and the polarity indicator symbols (—⊵▷).

DELAYED OUTPUT RESPONSE



OUTPUT DELAY indicator symbol (˥) shows that the output becomes effective *after* the input signal returns to its inactive state.

INHIBIT INPUTS



INHIBIT indicator symbol (+) indicates an input that, when active, inhibits (blocks) the output(s) from achieving their active states (the outputs remain inactive).

ANALOG LINES

ANALOG indicator symbol (X) indicates a line that has an analog input or output.

Figure 8-8. Indicator Symbols

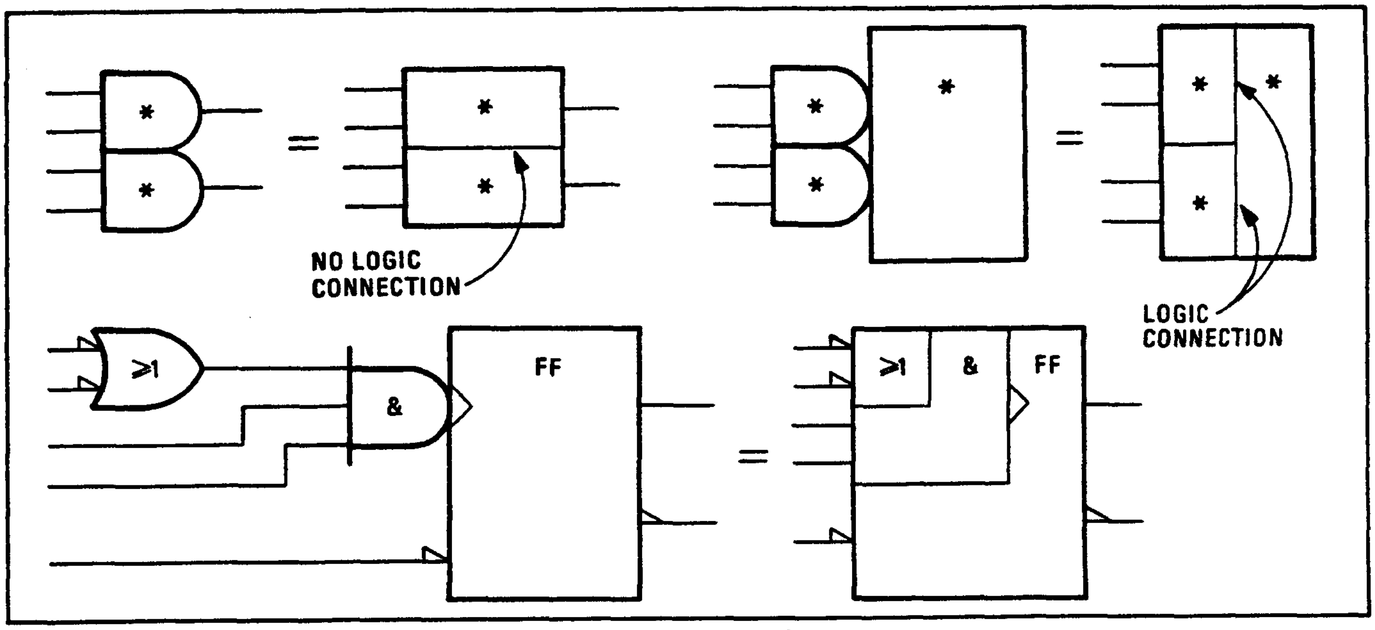
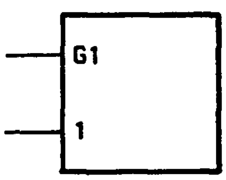
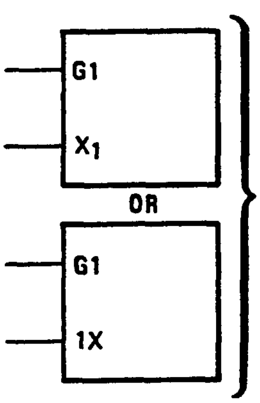


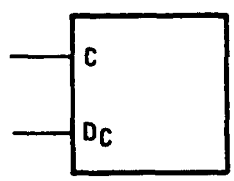
Figure 8-9. Contiguous Blocks



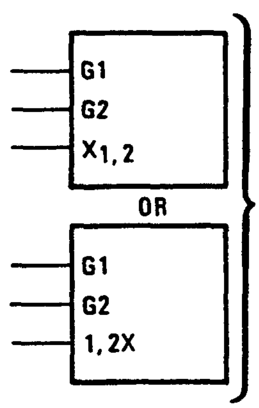
The input that controls or gates other inputs is labeled with a C or a G, followed by an identifying number.
The controlled or gated input or output is labeled with the same number. In this example, 1 is controlled by G1.



When the controlled or gated input or output already has a functional label (X is used here), that label will be prefixed or subscripted by the identifying number.

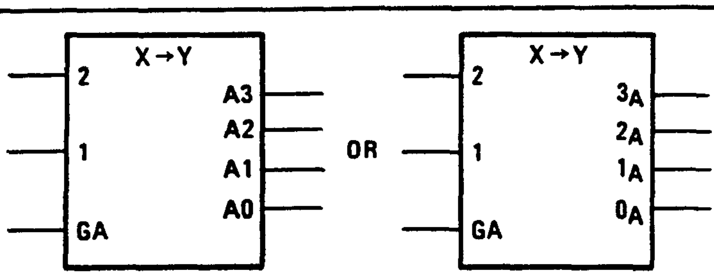


If a particular device has only one gating or control input, then the identifying number may be eliminated and the relationship shown with a subscript.



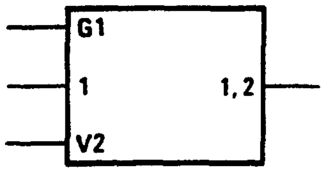
If the input or output is affected by more than one gate or control input, then the identifying numbers of each gate or control input will appear in the prefix or subscript, separated by commas. In this example, X is controlled by G1 and G2.

Figure 8-10. AND Dependency Notation

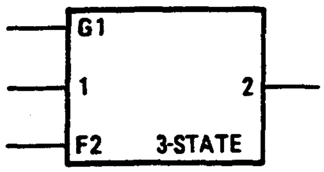


When GA is active, the active address line (0 through 3) is the decoded value of the 1 and 2 binary inputs. When the controlled address lines have a functional value, that value will be prefixed or subscripted by the identifying letter.

Figure 8-11. Address Dependency Notation: Coder Example Using Alpha Characters (Letters)



When a V input is active, the output will be in its active state. With the V input inactive, the device functions as if the V input doesn't exist.



When an F input is active, the output is enabled to function normally. When an F input is inactive, the output becomes a high impedance, effectively removing that device from the circuit.

The 3-STATE label is sometimes used with the free dependency notation.

Figure 8-12. OR and Free Dependency Notation

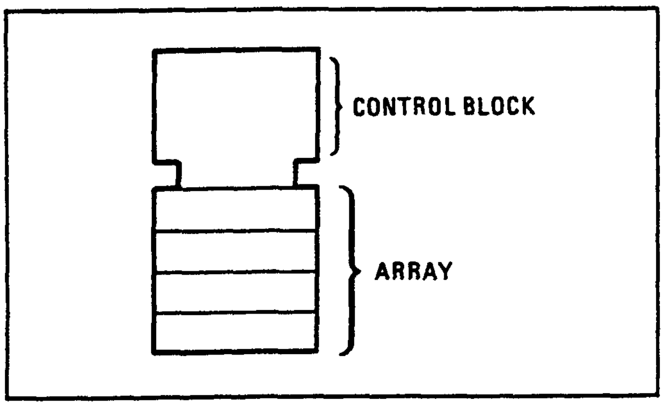


Figure 8-13. Common Control Block

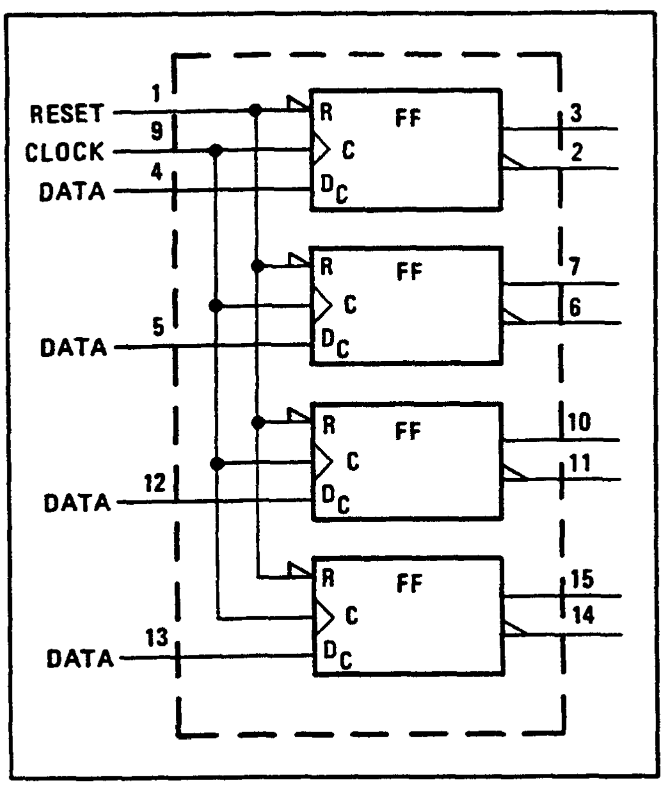


Figure 8-14. Quad D-Type Latch (Individual)

Common Control Block. The Control block is used in conjunction with an array of related symbols in order to group common logic lines. Figure 8-13 shows how the Control block is usually represented. Figure 8-14 shows a quad D-type flip-flop with reset. This can be redrawn as shown in Figure 8-15. Note that the more complex representation shown in Figure 8-14 can be used when the flip-flops are functionally scattered around the schematic (i.e., not used as a quad unit).

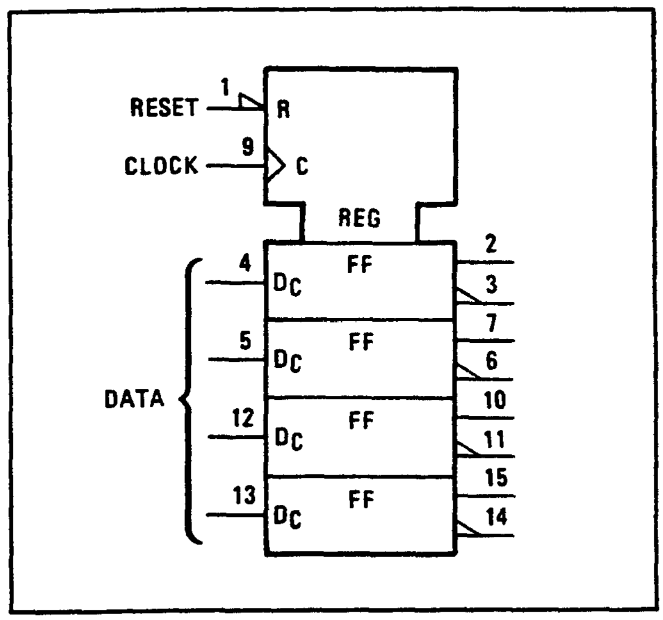


Figure 8-15. Quad D-Type Latch (Combined)

Complex Device Symbology. Figures 8-16 through 8-19 show how the basic symbols can be combined to illustrate behavior of fairly complex devices.

Shift Register. 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, it may be omitted. Inputs "a" and "b" are each single IC pins that have two functions. Input "a" enables one of the inputs to the top D-type flip-flop (1D) and also shifts the register contents down "m" units. Input "b" enables one of the inputs to the bottom flip-flop (2D), and also shifts the register contents up "m" units. Input "c" loads all four flip-flops in parallel (3D). Input "d" is a common reset. The output delay indicator is used because these are master-slave flip-flops.

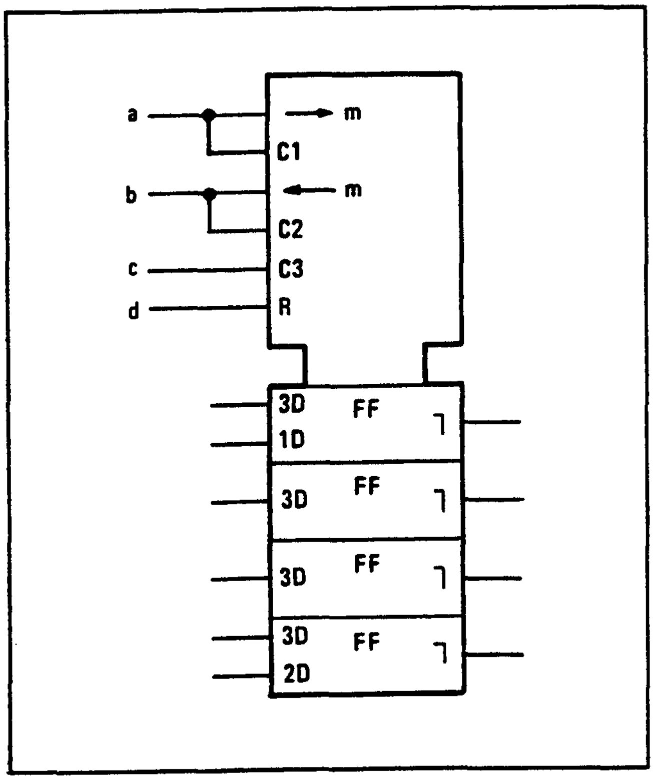


Figure 8-16. Shift Register

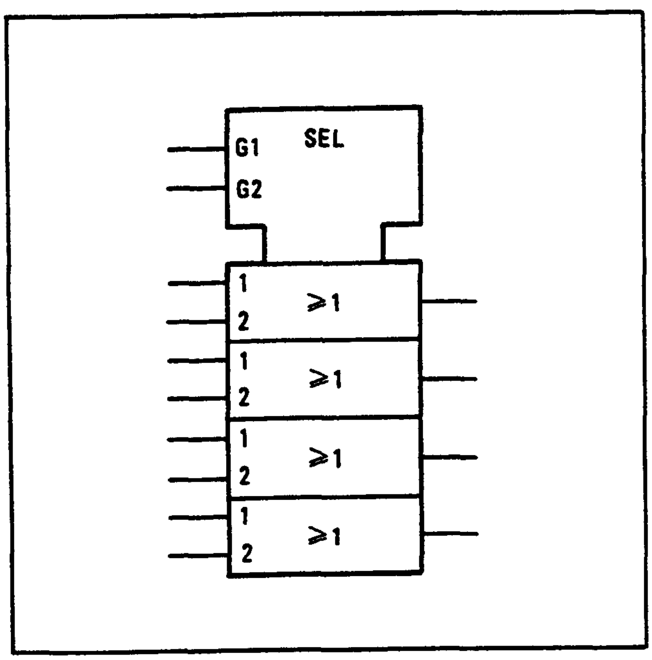


Figure 8-17. AND-OR Selector

AND-OR Selector. The Selector Control 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 will be gated through. When G2 is high, the data presented at the "2" inputs will be gated through.

Up/Down Counter. The Counter Control Block is used to show 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: if m = 1, it may be omitted. Since the D-type flip-flops are master-slave, the output delay indicator is used. The "=9, +1" and "=0, −1" notation defines when the carry and borrow outputs are generated. They also define it as a decade counter; a binary counter would have the carry indicated with "=15, +1". Flip-flop weighting is indicated in parenthesis. Input "C1" allows all four "D1" flip-flops to be preset in parallel.

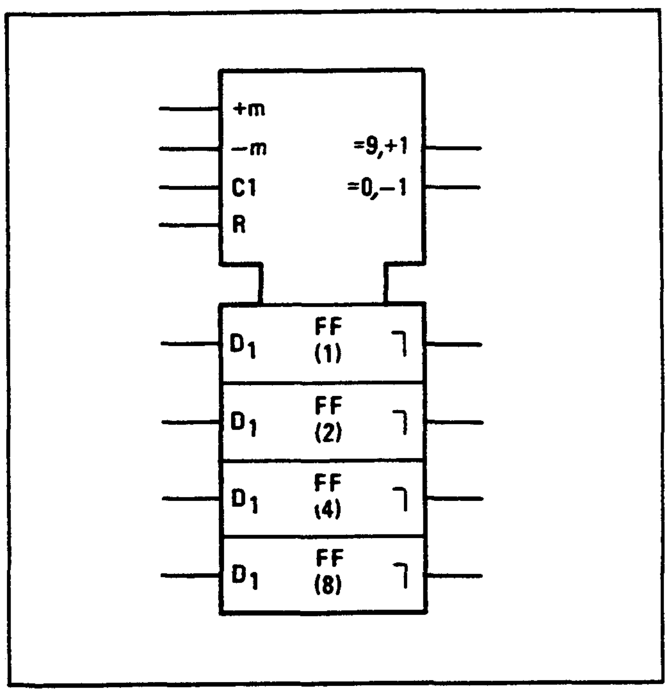


Figure 8-18. Up/Down Counter

Quad D-Type Latch. 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 functions (D) are subscripted with a C.

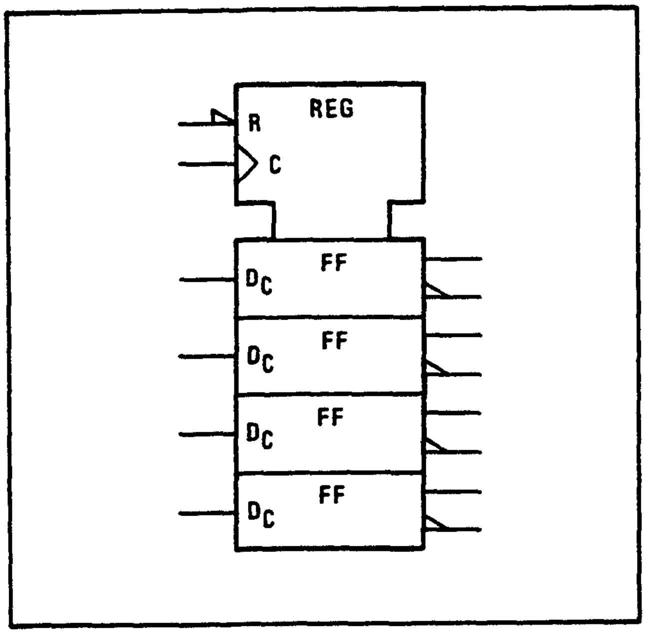


Figure 8-19. Quad D-Type Latch

8-46. LOGIC DEVICE THEORY

8-47. Schmitt Trigger

A typical Schmitt trigger is shown in Figure 8-20. Some Schmitt triggers have complimentary outputs. When the input signal increases in voltage, the device changes state as the input surpasses a voltage reference called the upper trip point. When the input signal is decreasing in voltage, the device changes back to its original state as the input voltage passes a voltage reference called the lower trip point.

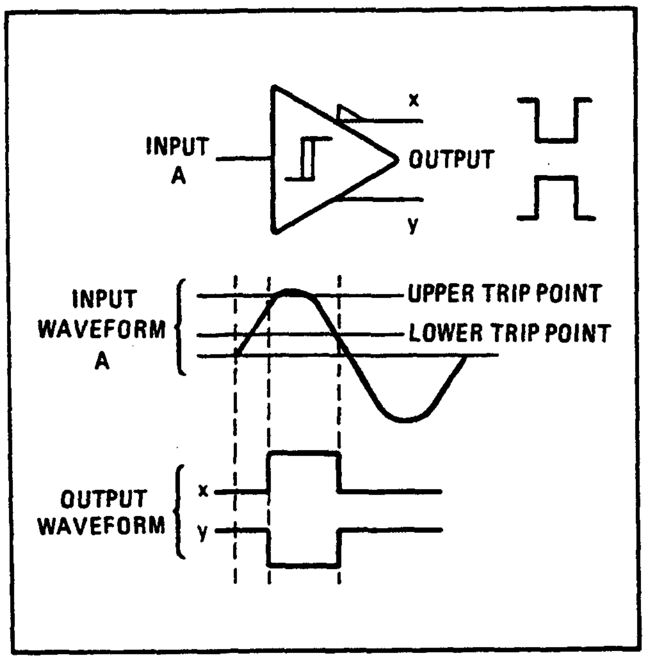


Figure 8-20. Schmitt Trigger

8-48. ECL-to-TTL Translator

This particular level translator is used to interface ECL family logic to TTL family logic. The translator shown in Figure 8-21 is essentially a comparator and a voltage reference. Comparator biasing sets the output level limits, the reference voltage source sets the input point. The Xs on the input and output lines indicate that the signals at those pins are analog in nature.

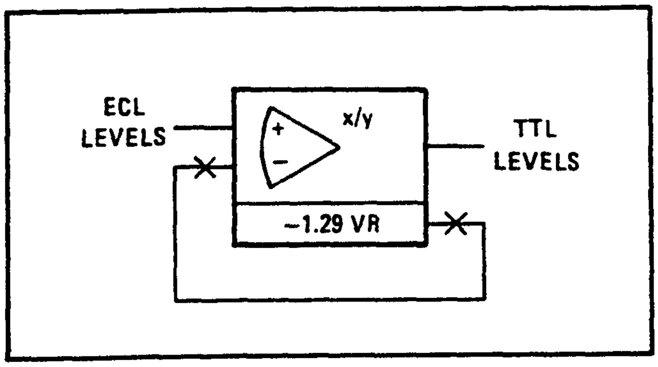


Figure 8-21. ECL-to-TTL Translator

8-49. One-Shot Multivibrator

The one-shot or monostable multivibrator, when triggered, produces a pulse of pre-programmed length. The length of the pulse is determined by the external resistor (R) and capacitor (C). See Figure 8-22.

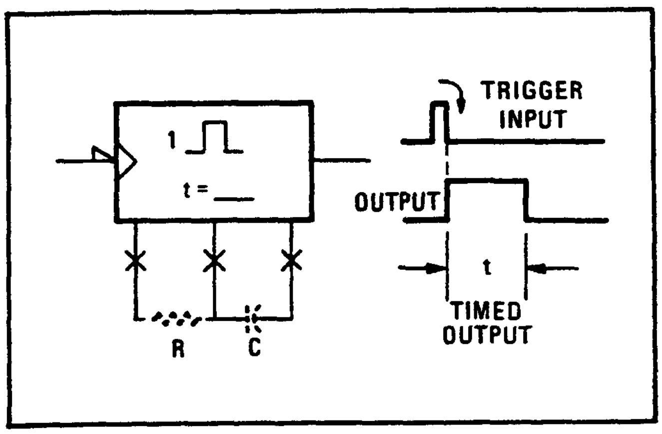


Figure 8-22. One-Shot Multivibrator

8-50. D-Type Flip-Flop (Edge-Triggered)

D-type flip-flops are used for temporary storage of one bit of binary data. the D_C input is stored and transferred to the output at X when the control input (C) gives a low-to-high transition. Y is the complement of X (i.e., $Y=\overline{X}$). The S and R inputs set (S) and reset (R) the outputs independent of the control input status. Only one of these inputs is normally active at a time. If both are active, then X and Y are either both high or both low, depending on the particular device used. See Figure 8-23.

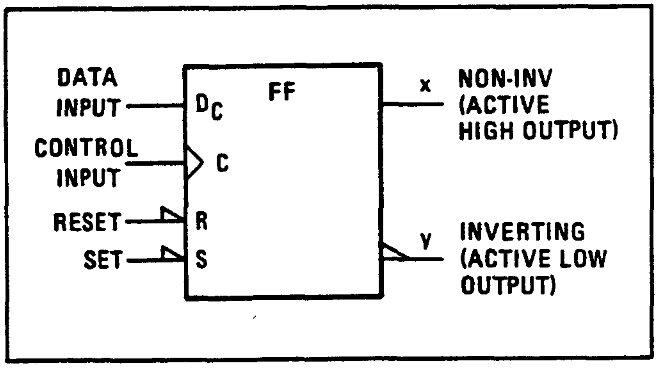


Figure 8-23. D-Type Flip-Flop (Edge-Triggered)

8-51. Four-Bit Register (Level-Triggered)

A four-bit register is used for temporarily storing four bits of binary data. Data at the D_1 inputs are stored when clocked by the C_1 control input. Data at the D_2 inputs are stored when clocked by the C_2 control input. The outputs follow the inputs as long as the control inputs remain high. When the control inputs are low, the data that was present at the D inputs (when the control inputs when low) are retained (latched) at the outputs until the control inputs go high again. See Figure 8-24.

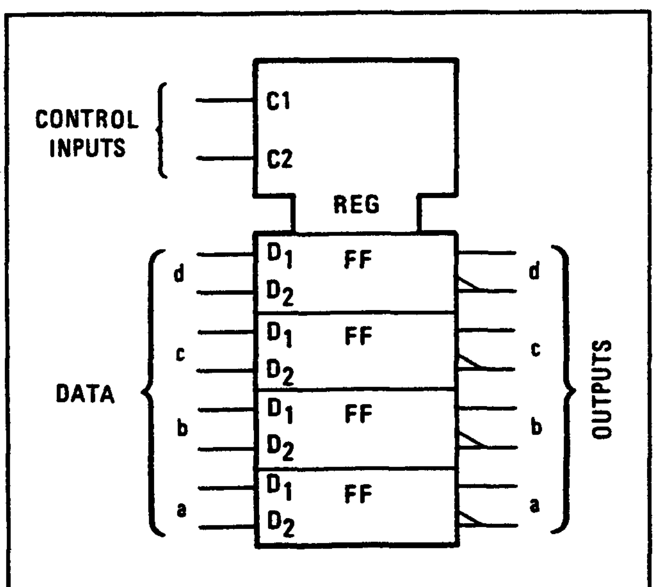


Figure 8-24. Four-Bit Register (Level-Triggered)

8-52. Presettable Counter

Presettable counters consist of four D flip-flops which are internally connected to provide a divide-by-two and a divide-by-five counter for a BCD counter or a divide-by-two and a divide-by-eight for a hexadecimal counter. The outputs of these devices can be preset to any state by placing a low on the load/count (C) input and applying the desired data to the D inputs. As long as the load/count input is low, the outputs will follow the D inputs. When the load/count input is set high the outputs are latched to the preset values, and the output will advance one count with each low-to-high transition of the clock. The reset (R) function is asynchronous. See Figure 8-25.

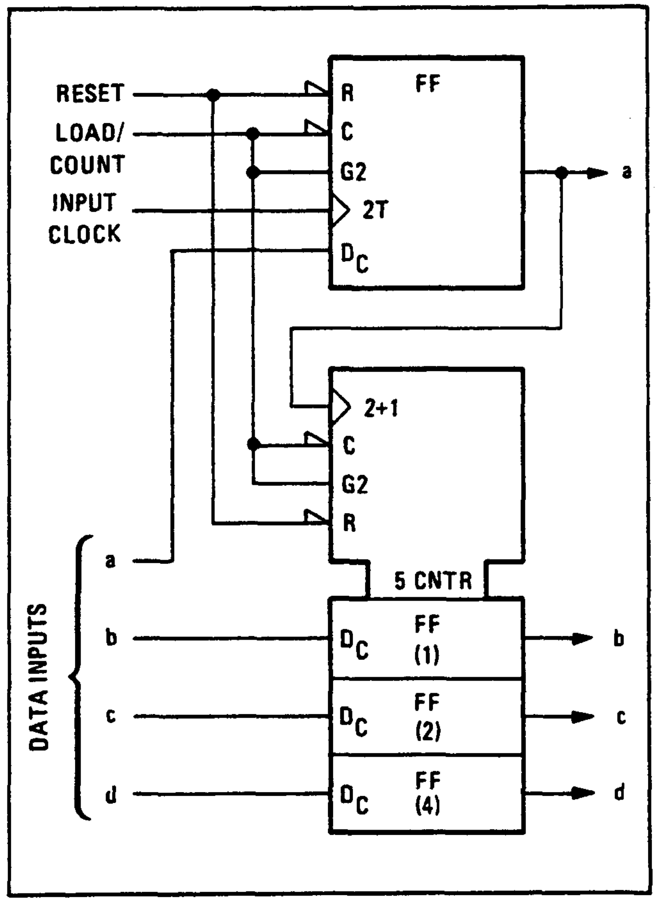


Figure 8-25. Presettable Counter

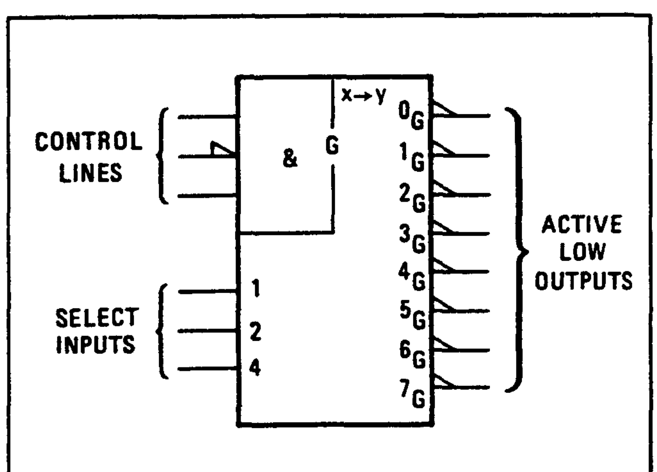


Figure 8-26. Three-Bit Binary One-of-Eight Decoder

8-53. Three-Bit Binary One-of-Eight Decoder

This device selects an output line (1-of-8) corresponding to the value of the binary input. For example, to make the 5G output go low, a binary 101 must be presented to the select inputs. For the output to reflect the weighted binary input, all three lines to the control section must be active. See Figure 8-26.

8-54. Analog Multiplexer

This device is the electronic version of a single-pole-eight-throw (SP8T) switch. The binary code at the select inputs determines which analog input (1-of-8) will be routed to the output. The output is enabled by the F input. See Figure 8-27.

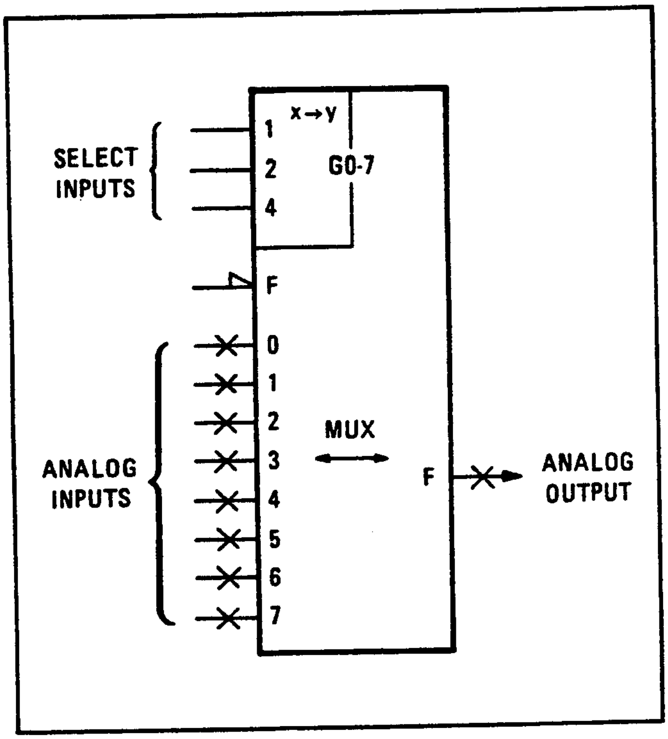


Figure 8-27. Analog Multiplexer

8-55. Digital-to-Analog Converter

The analog output of the digital-to-analog converter is a current which is proportional to the binary-weight of the input multiplied by $[V_{REF(+)} - V_{REF(-)}]/R$. In other words, the output current is proportional to the maximum possible current through R divided by the binary value at the digital input. The analog output is thus attenuated by any value between 0 and 255. See Figure 8-28.

8-56. Seven-Segment Decoder/Driver/Latch (Coder)

The seven-segment decoder converts a four-bit binary code to drive a variable number of the "a" through "g" output lines, which in turn drive the individual segments of a seven-segment common cathode display. Internal circuitry drives the individual LED elements of the display and limits the current flowing through them. This device latches the coded input when C1 is low. The output lines are enabled when V_2 is high or any flip-flop is high. See Figure 8-29.

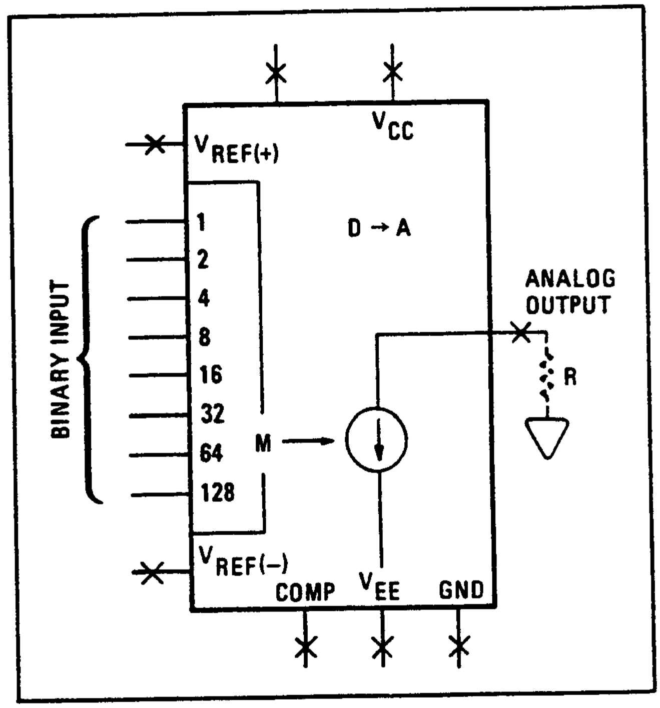


Figure 8-28. Digital-to-Analog Converter

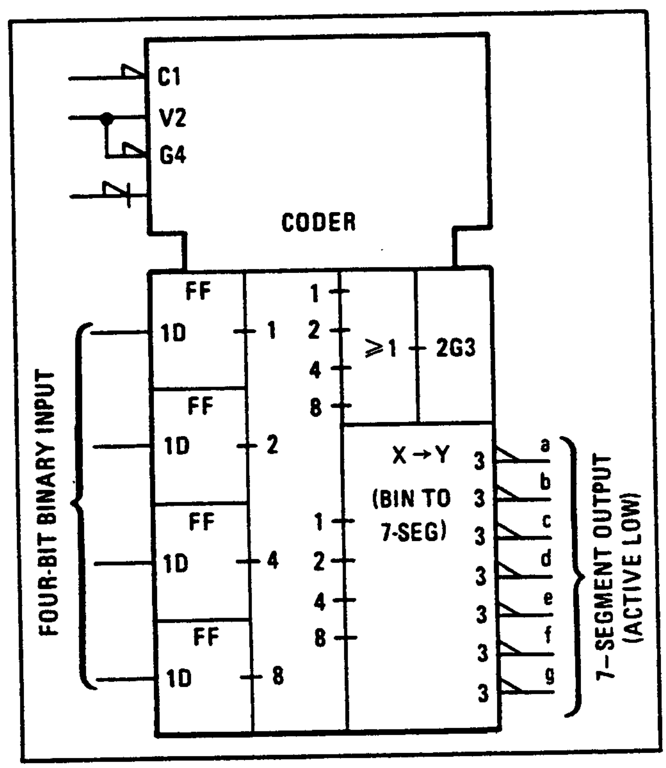


Figure 8-29. Seven Segment Decoder/Driver/Latch (Coder)

8-57. Analog Switch

The analog switch is a bi-directional device, as is indicated by the double-ended arrow. The F1 input is the gate. F1 indicates the input and output (labeled with "1's") are dependent on this input. See Figure 8-30.

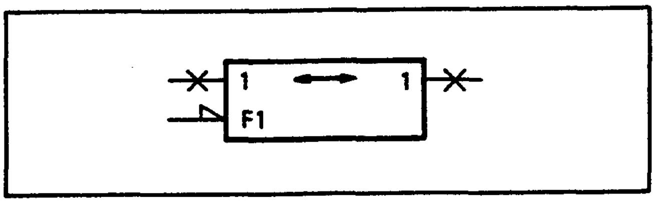


Figure 8-30. Analog Switch

8-58. Read Only Memory (ROM)

This device has an eight-bit word length. Locations in memory (32 total) are addressed by the five-bit binary code at the Address Input. The G input must be low to enable the outputs. The outputs are open-collector. See Figure 8-31.

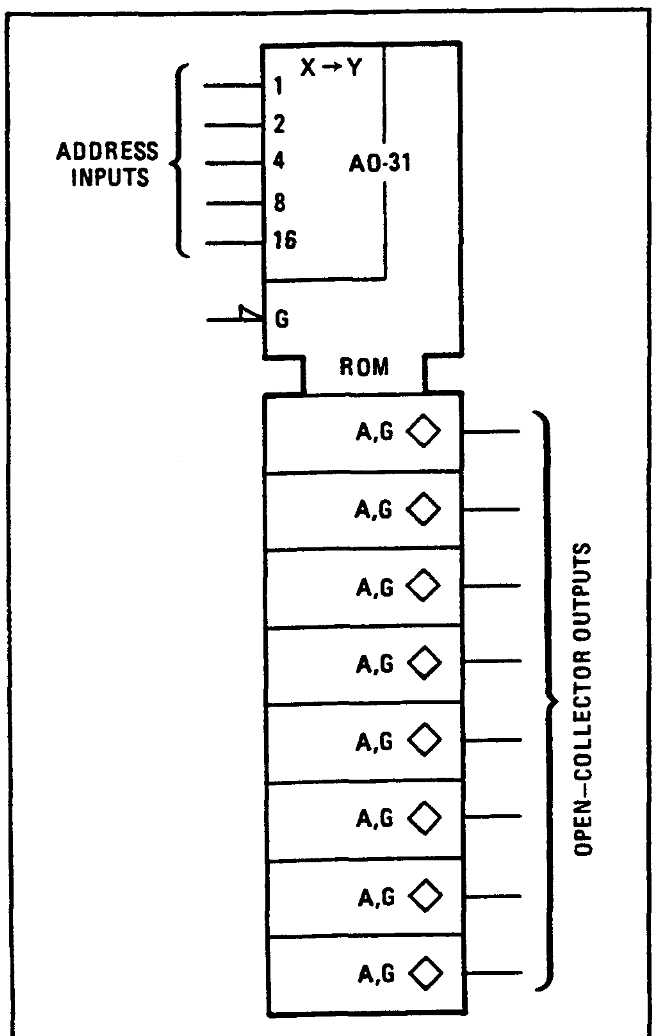


Figure 8-31. Read Only Memory (ROM)

8-59. Static Random Access Memory (RAM)

This device is a 256 word static memory. Each word is four bits in length and is addressed via the address lines. Both of the inputs to G1 must be low to enable the device. The G2 input must be low to write into memory and the G3 input must be high to read from memory. F4, when low, enables the output; F4, when high, disables the output. See Figure 8-32.

8-60. LINEAR DEVICE THEORY

8-61. Operational Amplifiers

The source of gain in an operational amplifier can be characterized as an ideal, differential voltage amplifier having low output impedance, high input impedance, and very high differential gain. The output of an operational amplifier is proportional to the difference in the voltages applied to the two input terminals. In use, the amplifier output drives the input voltage difference close to zero through a feedback path.

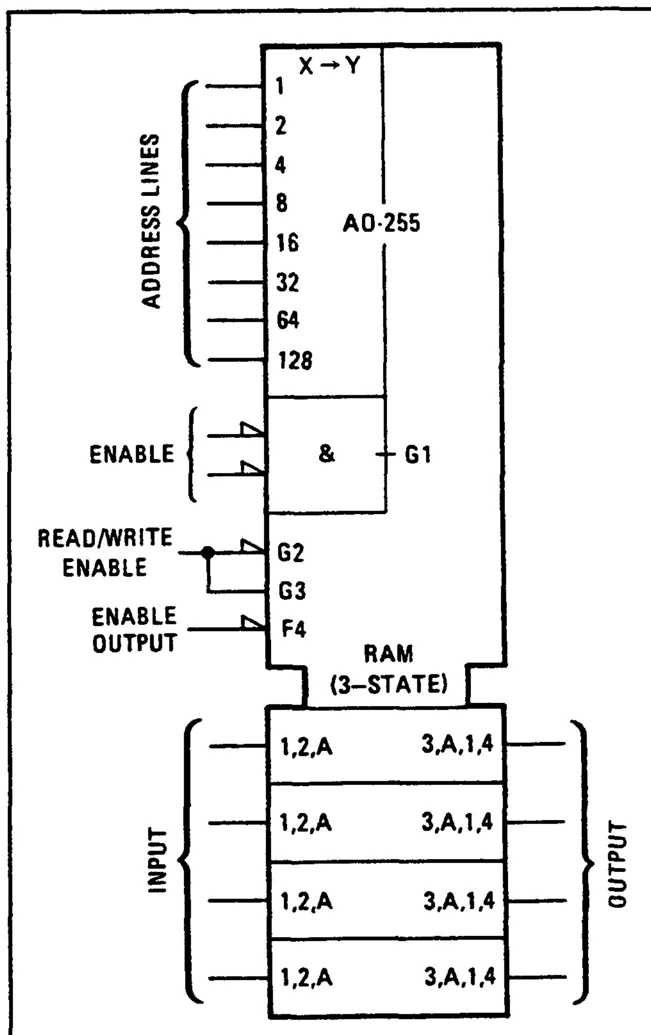


Figure 8-32. Static Random Access Memory (RAM)

When troubleshooting an operational amplifier circuit, measure the voltages at the two inputs; the difference between these voltages should be less than 10 mV. (Note: This troubleshooting procedure will not work for operational amplifiers which are configured as comparators.) A difference voltage much greater than 10 mV indicates trouble in the amplifier or its external circuitry. Usually, this difference will be several volts and one of the inputs will be very close to one of the supply voltages (e.g., +15V or −15V).

Next, check the amplifier's output voltage. It will probably also be close to one of the supply voltages (e.g., ground, +15V, or −15V). Check to see that the output conforms to the inputs. For example, if the inverting input is more positive than the non-inverting input, the output should be negative; if the non-inverting input is more positive than the inverting input, the output should be positive. If the output conforms to the inputs, check the amplifier's external circuitry. If the amplifier's output does not conform to its inputs, it is probably defective.

Figures 8-33, 8-34, and 8-35 show typical operational amplifier configurations. Figure 8-33 shows a non-inverting buffer amplifier with a gain of 1. Figure 8-34 is a non-inverting amplifier with gain determined by R1 and R2. Figure 8-35 is an inverting amplifier with a gain determined by R1 and R2.

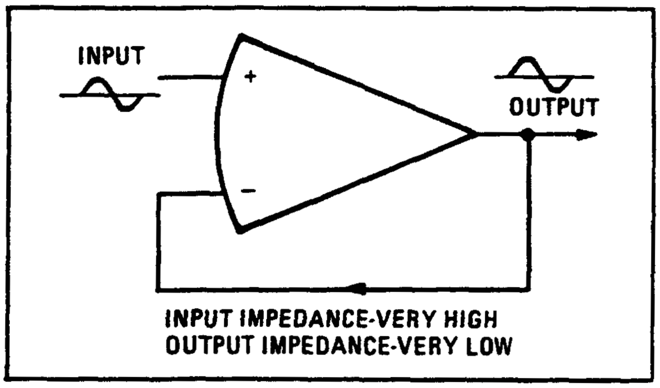


Figure 8-33. Non-Inverting Amplifier (Gain = 1)

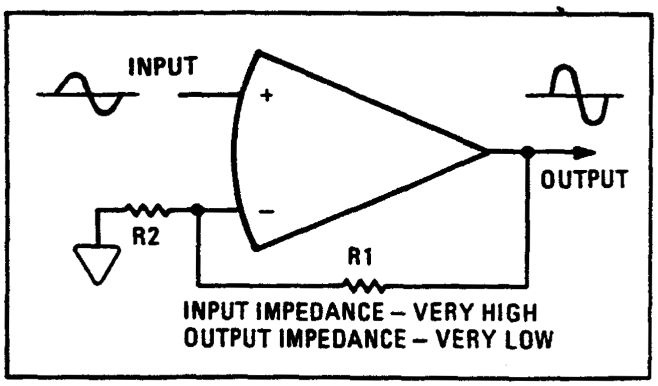


Figure 8-34. Non-Inverting Amplifier (Gain = 1 + R_1/R_2)

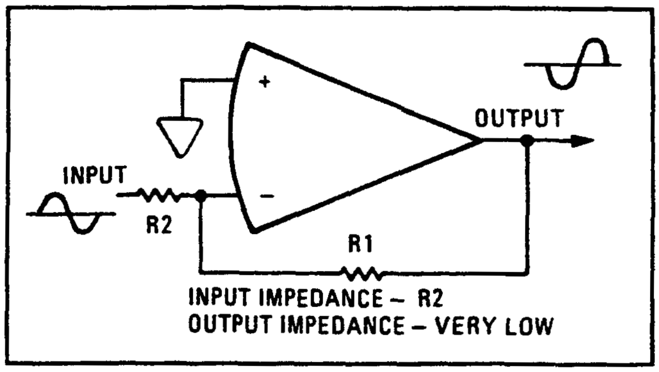


Figure 8-35. Inverting Amplifier (Gain = $-R_1/R_2$)

8-62. Comparators

Comparators are used as level sense amplifiers, switch drivers, pulse height discriminators, and voltage comparators. A voltage reference is connected to one of the amplifier's outputs as shown in Figures 8-36 and 8-37. When the input signal voltage crosses the reference, the output goes positive; the output remains positive until the signal re-crosses the reference.

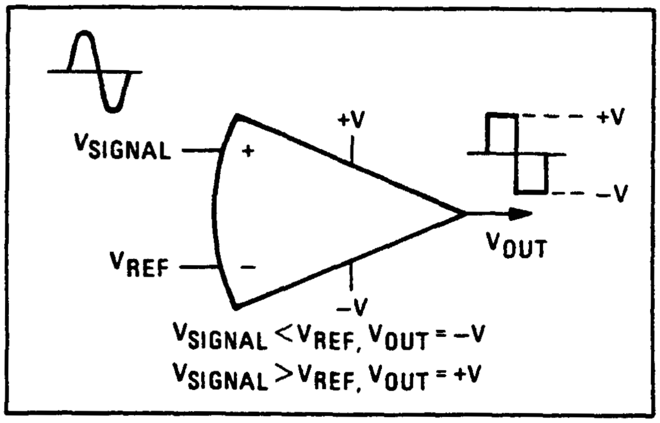


Figure 8-36. Non-Inverting Comparator

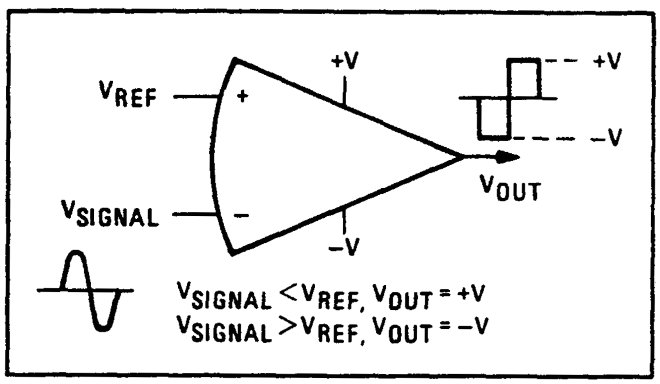


Figure 8-37. Inverting Comparator

8-63. SCHEMATIC DIAGRAM NOTES

Table 8-6 summarizes the symbology used in presenting many of the devices used in the Modulation Analyzer.

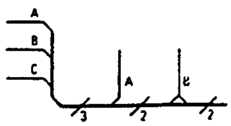
Table 8-6. Schematic Diagram Notes (1 of 7)

SCHEMATIC DIAGRAM NOTES

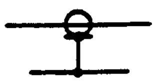
*	Asterisk denotes a factory-selected value. Value shown is typical.
†	Dagger indicates circuit change. See Section VII.
	Tool-aided adjustment.
O	Manual control.
	Encloses front-panel designation.
	Encloses rear-panel designation.
	Circuit assembly borderline.
	Other assembly borderline.
	Heavy line with arrows indicates path and direction of main signal.
	Heavy dashed line with arrows indicates path and direction of main feedback.
	Indicates stripline (i.e., RF transmission line above ground).
CW	Wiper moves toward cw with clockwise rotation of control (as viewed from shaft or knob).
1	Numbered Test Point measurement aid provided.
	Encloses wire or cable color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, and the third number identifies the narrower stripe, e.g., 947 denotes white base, yellow wide stripe, violet narrow stripe.
	A direct conducting connection to earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).
	A conducting connection to a chassis or frame.
	Common connections. All like-designation points are connected.
AK 12	Letters = off-page connection, e.g., AK. Number = Service Sheet number for off-page connection, e.g., **12**.
1 THIS PAGE	Number (only) = on-page connection.

Table 8-6. Schematic Diagram Notes (2 of 7)

SCHEMATIC DIAGRAM NOTES

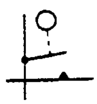


Indicates multiple paths represented by only one line. Letters or names identify individual paths. Numbers indicate number of paths represented by the line.



Coaxial or shielded cable.

Relay. Contact moves in direction of arrow when energized.

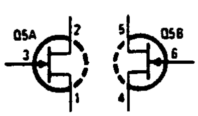


Indicates a pushbutton switch with a momentary (ON) position.

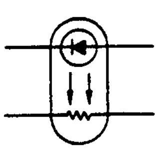
Indicates a PIN diode.

Indicates a step-recovery diode (typically used as comb generator).

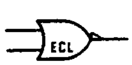
Indicates a Schottky (hot-carrier) diode.



Multiple transistors in a single package—physical location of the pins is shown in package outline on schematic.



Indicates an opto-isolator of a LED and a photoresistor packaged together. The resistance of the photoresistor is a function of the current flowing through the LED.

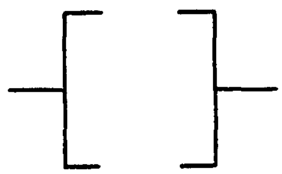


Identification of logic families as shown (in this case, ECL).

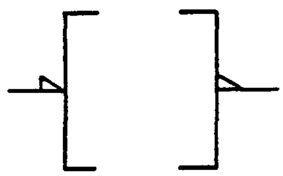
Table 8-6. Schematic Diagram Notes (3 of 7)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

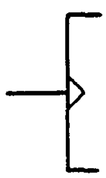
Input and Output Indicators



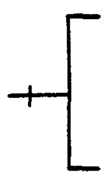
Implied Indicator—Absence of polarity indicator (see below) implies that the active state is a relative high voltage level. Absence of negation indicator (see below) implies that the active state is a relative high voltage level at the input or output.



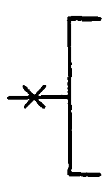
Polarity Indicator—The active state is a relatively low voltage level.



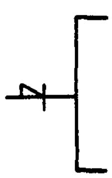
Dynamic Indicator—The active state is a transition from a relative low to a relative high voltage level.



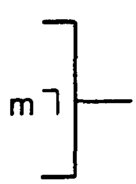
Inhibit Input—Input that, when active, inhibits (blocks) the active state outputs of a digital device.



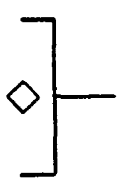
Analog Input—Input that is a continuous signal function (e.g., a sine wave).



Polarity Indicator used with Inhibit Indicator—Indicates that the relatively low level signal inhibits (blocks) the active state outputs of a digital device.



Output Delay—Binary output changes state only after the referenced input (m) returns to its inactive state (m should be replaced by appropriate dependency or function symbols).



Open Collector or Open Emitter Output — Output that must form part of a distributed connection.

Table 8-6. Schematic Diagram Notes (4 of 7)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Input and Output Indicators (Cont'd)

3-STATE	Three-state Output—Indicates outputs that can have a high impedance (disconnect) state in addition to the normal binary logic states.

Combinational Logic Symbols and Functions

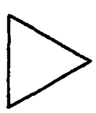
&	AND—All inputs must be active for the output to be active.
≥1	OR—One or more inputs being active will cause the output to be active.
≥m	Logic Threshold—m or more inputs being active will cause the output to be active (replace m with a number).
=1	EXCLUSIVE OR—Output will be active when one (and only one) input is active.
=m	m and only m—Output will be active when m (and only m) inputs are active (replace m with a number).
=	Logic Identity—Output will be active only when all or none of the inputs are active (i.e., when all inputs are identical, output will be active).
	Amplifier—The output will be active only when the input is active (can be used with polarity or logic indicator at input or output to signify inversion).
X/Y	Signal Level Converter—Input level(s) are different than output level(s).
←→	Bilateral Switch—Binary controlled switch which acts as an on/off switch to analog or binary signals flowing in both directions. Dependency notation should be used to indicate affecting/affected inputs and outputs. Note: amplifier symbol (with dependency notation) should be read to indicate unilateral switching.
X→Y	Coder—Input code (X) is converted to output code (Y) per weighted values or a table.
(Functional Labels)	The following labels are to be used as necessary to ensure rapid identification of device function.
MUX	Multiplexer—The output is dependent only on the selected input.
DEMUX	Demultiplexer—Only the selected output is a function of the input.
CPU	Central Processing Unit
PIO	Peripheral Input/Output
SMI	Static Memory Interface

Table 8-6. Schematic Diagram Notes (5 of 7)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions

1	Monostable—Single shot multivibrator. Output becomes active when the input becomes active. Output remains active (even if the input becomes inactive) for a period of time that is characteristic of the device and/or circuit.
G	Oscillator—The output is a uniform repetitive signal which alternates between the high and low state values. If an input is shown, then the output will be active if and only if the input is in the active state.
FF	Flip-Flop—Binary element with two stable states, set and reset. When the flip-flop is set, its outputs will be in their active states. When the flip-flop is reset, its outputs will be in their inactive states.
T	Toggle Input—When active, causes the flip-flop to change states.
S	Set Input—When active, causes the flip-flop to set.
R	Reset Input—When active, causes the flip-flop to reset.
J	J Input—Analogous to set input.
K	K Input—Analogous to reset input.
D	Data Input—Always enabled by another input (generally a C input—see Dependency Notation). When the D input is dependency-enabled, a high level at D will set the flip-flop; a low level will reset the flip-flop. Note: strictly speaking, D inputs have no active or inactive states—they are just enabled or disabled.
+m	Count-Up Input—When active, increments the contents (count) of a counter by "m" counts (m is replaced with a number).
−m	Count-Down Input—When active, decrements the contents (count) of a counter by "m" counts (m is replaced with a number).
→m	Shift Right (Down) Input—When active, causes the contents of a shift register to shift to the right or down "m" places (m is replaced with a number).
←m	Shift Left (Up) Input—When active, causes the contents of a shift register to shift to the left or up "m" places (m is replaced with a number).

NOTE

For the four functions shown above, if m is one, it is omitted.

(Functional Labels)	The following functional labels are to be used as necessary in symbol build-ups to ensure rapid identification of device function.
mCNTR	Counter—Array of flip-flops connected to form a counter with modules m (m is replaced with a number that indicates the number of states: 5 CNTR, 10 CNTR, etc.).

Table 8-6. Schematic Diagram Notes (6 of 7)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions (Cont'd)

REG	Register—Array of unconnected flip-flops that form a simple register or latch.
SREG	Shift Register—Array of flip-flops that form a register with internal connections that permit shifting the contents from flip-flop to flip-flop.
ROM	Read Only Memory—Addressable memory with read-out capability only.
RAM	Random Access Memory—Addressable memory with read-in and read-out capability.

Dependency Notation

mAm	Address Dependency—Binary affecting inputs of affected outputs. The m prefix is replaced with a number that differentiates between several address inputs, indicates dependency, or indicates demultiplexing and multiplexing of address inputs and outputs. The m suffix indicates the number of cells that can be addressed.
Gm	Gate (AND) Dependency—Binary affecting input with an AND relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or letter (the identifier).
Cm	Control Dependency—Binary affecting input used where more than a simple AND relationship exists between the C input and the affected inputs and outputs (used only with D-type flip-flops).
Vm	OR Dependency—Binary affecting input with an OR relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or the letter (the identifier).
Fm	Free Dependency—Binary affecting input acting as a connect switch when active and a disconnect when inactive. Used to control the 3-state behavior of a 3-state device.

NOTE

The identifier (m) is omitted if it is one—that is, when there is only one dependency relationship of that kind in a particular device. When this is done, the dependency indicator itself (G, C, F, or V) is used to prefix or suffix the affected (dependent) input or output.

Miscellaneous

Schmitt Trigger—Input characterized by hysterisis; one threshold for positive going signals and a second threshold for negative going signals.

Table 8-6. Schematic Diagram Notes (7 of 7)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Miscellaneous (Cont'd)

Active	Active State—A binary physical or logical state that corresponds to the true state of an input, an output, or a function. The opposite of the inactive state.
Enable	Enabled Condition—A logical state that occurs when dependency conditions are satisfied. Although not explicitly stated in the definitions listed above, functions are assumed to be enabled when their behavior is described. A convenient way to think of it is as follows: A function becomes active when: • it is enabled (dependency conditions—if any—are satisfied) • and its external stimulus (e.g., voltage level) enters the active state.

8-64. PRINCIPLES OF OPERATION

The discussions that follow cover the principles of operation of the Modulation Analyzer. Each discussion is based on and referenced to a Service Sheet. For an introductory discussion of overall instrument theory of operation, see Principles of Operation for Simplified Block Diagram in the Operating Manual.

8-65. Overall Instrument—Service Sheet BD1

General. The Modulation Analyzer is physically divided into five functional sections. Service Sheets BD2 through BD4 break the operation of the instrument along similar lines as listed in Table 8-7.

Table 8-7. Instrument Block Diagram and Functional Section Breakdown

Service Sheet	Functional Section	Circuits
BD2	RF	RF Input, Input Mixer, IF, Local Oscillator
BD2	Power Supply	Power Supplies, Fan
BD3	Audio	Demodulators, Audio Circuits, Voltmeter, Calibrators
BD4	Digital	Controller, Instrument Bus, Counter, Remote Interface
BD4	Front Panel	Keyboard and Display

RF Input. The Modulation Analyzer measures RF signals in the frequency range from 150 kHz to 1300 MHz and power levels of −25 to +30 dBm into its 50 Ω input. The voltage, sensed at the input by the RF Level Detector, is used to help set the proper input attenuation and, if the input exceeds 1W, to trip the Overpower Protection relay. When MEASUREMENT is set to RF LEVEL, the Voltmeter reads the output from the RF Level Detector. The Controller converts the output from the Voltmeter into power in watts.

The 5.25 MHz High-Pass Filter is manually selectable. Since the IF will generally respond to signals 2.5 MHz and below, the filter eliminates any low frequencies which may be present on the input. For signals in the range of 150 kHz to 10 MHz, the filter should be switched out.

The Input Attenuator is set to provide the Input Mixer with an optimum input level. The attenuator pads are set by the Controller which receives signal level information from the RF and IF level detectors (via the Voltmeter).

Mixer and IF. The Input Mixer down-converts the RF input to the IF. The frequency of the IF is normally the LO frequency minus the signal frequency.

The IF is centered at 1.5 MHz for input signals in the range 10 to 1300 MHz. (However, an IF of 455 kHz can be manually selected.) For signals between 2.5 and 10 MHz, the IF is 455 kHz. Below 2.5 MHz, the signal is passed directly into the IF without being down converted (unless the 455 kHz IF is manually selected).

The IF is amplified by a low-noise, 33 dB IF Amplifier. The 2.5 MHz Low-Pass Filter following the amplifier determines the IF frequency response when the 1.5 MHz IF is selected. The 455 kHz Bandpass filter preceeding the amplifier determines the response of the IF when the 455 kHz IF is selected.

AM Demodulator. The AM Demodulator is an ALC loop with a relatively slow response time. The IF signal is amplified and detected by the AM and Level Detector. The dc component of the detected signal is compared to a stable, dc reference. If the dc voltage is different from the reference, the difference is amplified by the ALC Feedback Amplifier which drives the Voltage-Variable Amplifier to force the detected voltage to equal the reference.

The AM, which is riding on the IF carrier, is too fast for the ALC loop to respond to and produces an ac voltage in the detector which is proportional to the AM. After demodulation and filtering by the 260 kHz Low-Pass Filter, the signal is processed by the Audio Circuits. The unfiltered AM from the detector, along with its dc component, is sent to the rear-panel AM OUTPUT jack.

The filtered IF signal is buffered and sent to the rear-panel IF OUTPUT jack and FM Demodulator. It is also detected by the IF Detectors which sense for the presence of IF during an automatic signal search (the IF Present and Stop Sweep lines) and output the IF level to the Voltmeter (the IF Level line) to help set the input attenuation and to make a TUNED RF LEVEL measurement.

FM Demodulator. The FM Demodulator consists of IF Limiters and an FM Discriminator (frequency-to-voltage converter). The limiters provide 66 dB of gain with limiting to reduce the effects of AM and noise on FM measurements. The signal from the limiters also drives a Counter input when IF frequency is measured. The FM Discriminator produces a voltage linearly proportional to the IF frequency. The FM variations in the IF frequency appear as an ac component on the output. The ac component is amplified then filtered by the 260 kHz Low-Pass Filter and processed by the Audio Circuits. The output from the FM discriminator (with both ac and dc components) is also sent to the rear-panel FM OUTPUT jack, and the filtered dc component is used to tune the LO in the track-tune mode.

Audio Circuits. Before the audio signal is measured or sent to the MODULATION OUTPUT jack it is processed by various filters, amplifiers, and attenuators. For FM, the audio may also be de-emphasized. For ΦM the signal is integrated. Factors which control the audio processing are measurement mode, selected features, audio level, input frequency, and selected special functions. Table 8-8 summarizes the types of signal processing.

Table 8-8. Types of Audio Signal Processing

Type of Processing	Range of Processing
High-Pass Filters	< 20 Hz (through path) 50 Hz 300 Hz
Low-Pass Filters	3 kHz 15 kHz >20 kHz (low ringing) >200 kHz (260 kHz LPF)
FM De-emphasis Networks	25 μs 50 μs 75 μs 750 μs None
FM De-emphasis Selection	Pre-display On Pre-display Off
Signal Polarity	Inverting Non-inverting
Relative Gain Steps	0 dB 20 dB 40 dB

The Audio Range Detectors are used to determine the audio gain (the Audio Range line) and to sense audio overloading (the Audio Overload line).

Voltmeter. The demodulated signal is detected by both the Average Detector and the Peak Detector. The output from the Peak Detector is always present at the rear-panel RECORDER OUTPUT jack. The detector outputs are two of several Voltmeter inputs switched by the Input Selector. The Voltmeter consists of a Voltage-to-Time Converter whose output is applied to the Counter. The Voltage-to-Time Converter produces a Stop-Count Pulse with a duration interval between pulses proportional to the dc input voltage. The pulse gates the Counter which counts the 10 MHz time base reference. The count accumulated during the gate interval is proportional to the input voltage. Other inputs into the Voltmeter include: RF level, IF level, average IF level (normally equal to the ALC reference), audio range level, AM calibrator level, and various service-related voltages not shown.

Local Oscillator. The heart of the LO is a 320 to 650 MHz High-Frequency Voltage-Controlled Oscillator (HF VCO). After passing through the programmable LO Divider, the HF VCO signal becomes the LO drive to the Input Mixer. The LO Divider is programmed to divide the HF VCO by powers of two from 2^{-1} to 2^8, (i.e., from a times 2 to a divide by 256). Thus the LO can tune from 1300 MHz to 1.24 MHz in ten octave ranges. A fixed divide-by-eight output from the LO Dividers is the LO (HF VCO÷8) input to the Counter.

There are three tuning modes:

1. manual tuning—low noise,
2. automatic signal seeking and tuning—low noise, and
3. automatic tracking of a moving signal.

Consider the sequence followed for manual tuning. When a frequency is entered from the Keyboard, the LO is configured as in Figure 8-38. The Digital-To-Analog Converter (DAC) is connected to the HF

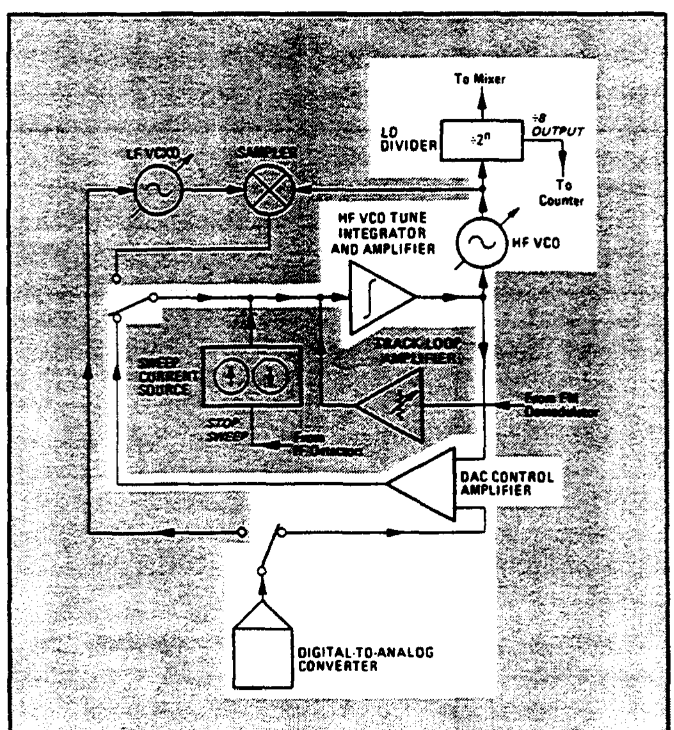


Figure 8-38. LO Configuration: DAC to HF VCO

VCO tune input as shown. Knowing the desired frequency, the Controller computes the octave number (n) for the LO Divider and sets the DAC to its mid-range. Then an iterative sequence of counting the LO and adjusting the DAC is carried out until the LO is near the correct frequency.

Next, the LO is configured as a phase lock loop as shown in Figure 8-39. The DAC is now connected to the tune input of a highly stable, Low-Frequency Voltage-Controlled Crystal Oscillator (LF VCXO). The LF VCXO drives the Sampler at a nominal (but tunable) 2 MHz rate. The other input to the Sampler is the HF VCO. The Sampler drives the HF VCO tune line through the Tune Integrator and Amplifier. The HF VCO is thus phase locked to a harmonic of the LF VCXO which greatly improves its noise and frequency stability.

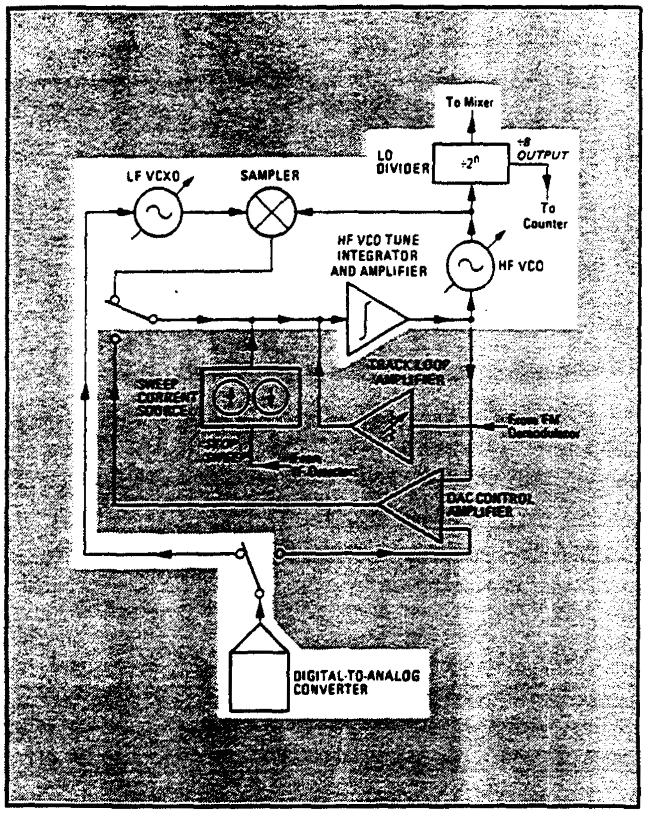


Figure 8-39. LO Configuration: DAC to LF VCXO

Before closing the phase lock loop, the DAC is set near the low end of its range. When the loop is first locked, the LO frequency is slightly low, but after an iterative sequence of counting the HF VCO and tuning the LF VCXO by the DAC, the LO is brought to within 500 Hz of the desired frequency. During the process of fine tuning the LO, the DAC may reach the end of its tuning range. If this happens, the Controller will break the lock loop, set the DAC to the other end of its range, and lock will be reestablished to a different harmonic of the LF VCXO.

The automatic tune mode is similar to the manual tune mode except the LO is first swept from the top to the bottom of each octave range by the Sweep Current Source. See Figure 8-40. If the LO sweeps past a signal at the INPUT, the down-converted signal appears in the IF and is detected by the IF Detectors. The signal on the Stop Sweep line immediately turns off the Sweep Current Source. With no input to the Tune Integrator and Amplifier, the HF VCO will remain approximately tuned to the input signal, and the frequency of the LO (and thus the input) can be determined by the Controller. Once the signal has been found after a sweep of all octaves, it is found four more times by sweeping just the octave where it was first found and two octaves above it. This is necessary in case the signal has AM which was in a deep trough when the fundamental of the LO passed through and was out of the trough when the strong third harmonic of the LO passed through.

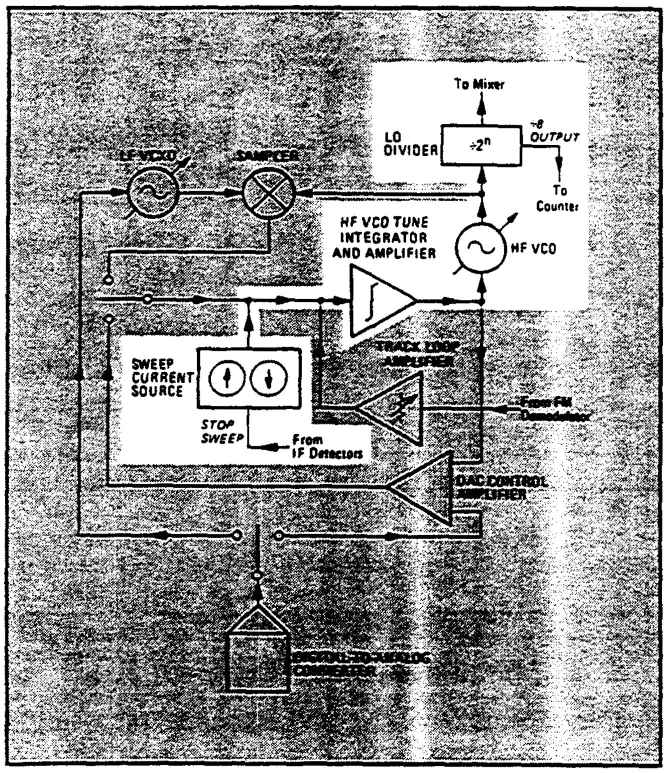


Figure 8-40. LO Configuration: HF VCO Sweep

Having now found an input signal, the Controller manipulates the LO through a series of tuning sequences to search for the fundamental of the input that was found. Once the fundamental of the input signal is identified, the LO is tuned to approximately 1.5 MHz above that signal. The Counter then accurately counts the LO and the IF and thus determines the frequency of the input signal. (Signal frequency = LO frequency − intermediate frequency.)

At this point the LO is configured as in Figure 8-40, and the tuning continues as in the manual tune mode using the computed input frequency in place of a keyboard-entered frequency.

In the track mode the LO is configured as in Figure 8-41. Here a dc voltage from the FM Demodulator is fed back to the HF VCO tune line. This forms a frequency lock loop. If the frequency of the input signal changes, the HF VCO is tuned to follow it. The gain of the loop depends on the octave number of the LO Divider. This gain variation is compensated for by adjusting the gain of the Track Loop Amplifier in the tune line.

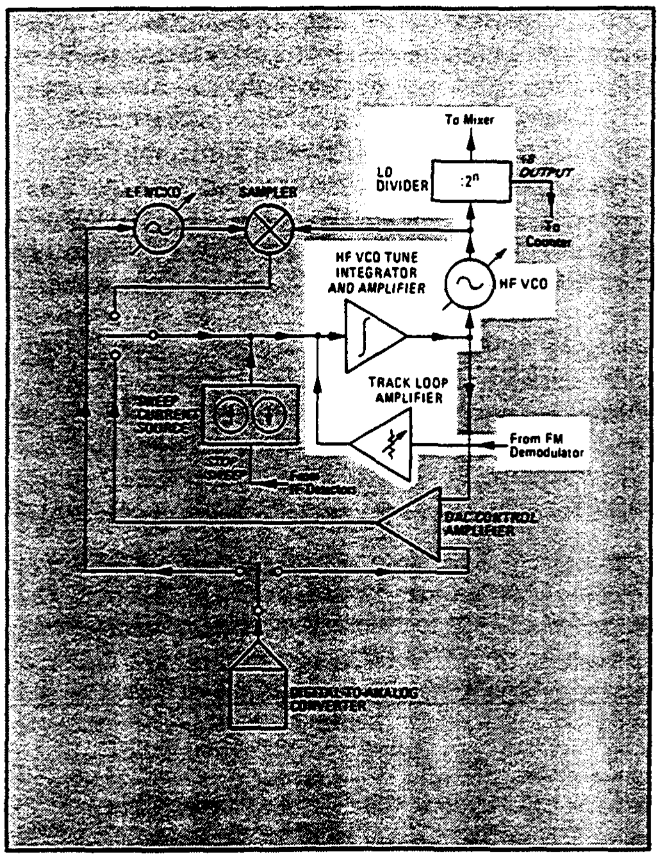


Figure 8-41. LO Configuration: Track

Counter. Operation of the Counter is conventional. The input signal to the Counter is gated by a Time Base pulse which has an accurately known period. While the Counter is gated, the Counter increments one count for each input cycle. When the Time Base disables the Counter, the accumulated count is transferred to storage registers (in this case, the Controller), and the Counter is cleared. When the Time Base again gates the Counter, the count sequence repeats. The stored count is then processed by the Controller (it is multiplied by an appropriate scale factor) and transferred to the display or used internally by the Controller. The Controller itself also forms the final stages of the Counter and keeps track of the number of Time Base pulses that occur while the Counter is gated.

The Time Base is derived from a 10 MHz reference. The reference can be either internal or external. Switching to external is done automatically when an external reference is applied to the rear-panel TIME BASE 10 MHz INPUT jack. The 10 MHz reference is divided by 1600 by the Time Base Divider to become the Counter gate. A 2 MHz output (from a divide-by-five) is used as the Controller clock.

The Input Selector selects one of several possible inputs to the Counter. In the case of the input from the Voltmeter, the output from the Voltage-to-Time Converter gates the 10 MHz reference which is counted by the Counter, while a Ramp Gate pulse from the Counter periodically resets the Voltage-to-Time Converter.

Calibrators (Option 010). The FM Calibrator consists of a 10.1 MHz VCO which toggles between two frequencies at a 10 kHz rate. During each measurement cycle, the VCO switches to the upper frequency and is measured by the Counter. It then switches to the lower frequency and is again counted. The Controller then computes the deviation (one-half the difference of the two frequencies). The FM Source is then allowed to toggle. When the CALIBRATION OUTPUT is connected to the INPUT, the FM calibration factor is displayed.

The AM Calibrator receives its input from the output of the 10.1 MHz VCO of the FM Calibrator which is not toggled during AM calibration. This signal is limited and applied to the Amplitude Modulator. The modulator toggles at a 10 kHz rate between a nominal level and twice that level. This produces 33% AM.

To enhance the accuracy of the calibrator, measurements are made on the output of the modulator with the Amplifier/Detector on a static basis, and the AM depth is computed. As with the FM Calibrator, the AM Calibrator output, when measured by the instrument, displays the AM calibration factor.

Power Supplies. The instrument is run from five regulated supplies: +40V, +15V, −15V, +5V, and −5V. The +15V supply continues to power the high-stability time base reference (Option 002) when the instrument LINE is switched to STBY.

Controller and Remote Interface. The Controller plays a key role in governing the instrument operation. The Microprocessor in the Controller outputs information to configure the instrument, reads back and processes measurement results, reads back vital status information to prevent invalid measurements, and services interrupts from the Keyboard or Remote Interface. Information from the Input/Output (I/O) port of the Microprocessor is carried to the rest of the instrument by the Instrument Bus. Typically, the data on the Instrument Bus are decoded and latched at the various assemblies, then the decoded information is distributed to the appropriate circuit.

Information within the Controller itself is handled by three main buses: the ROM Control Bus (which coordinates the various devices which make up the Controller), the Address Bus (which addresses the ROM and RAM), and the Data Bus (which carries information to or from the ROM and RAM). Since the Remote Interface contains some Controller devices, these buses are also distributed to it.

The Remote Interface receives inputs from the external interface bus (HP-IB), processes the information, and interrupts the Controller in a manner similar to the Keyboard. It also processes the measurement information and outputs it on the HP-IB if requested. The Remote Interface is designed to make operation from an external computing controller as similar as possible to operation from the front panel.

Instrument Software Supervisor Flowchart. The instrument's software is structured in a form called the supervisor. It is a loop that is continuously traversed, with measurements made near the end, after checks for proper frequency tuning, proper RF and IF level, and correct audio range. Arithmetic manipulation (e.g., for the ratio function) follows the measurement, and the program then loops back up to display.

The frequency, level, and audio blocks verify that the instrument is adjusted to make an accurate measurement. A measurement is not made until all of the tests are passed in immediate succession. If a test is not passed, corrective action is taken. The decision after that block then forces the program back to the top of the supervisor, bypassing the measurement for that loop.

The software interface with the hardware makes use of two concepts called software state and hardware state. The software is located in 22 bytes of RAM and totally describes the state of the instrument. On power-up, the initialization procedure loads the software state from ROM. Keyboard and HP-IB entry routines modify only the software state and do not effect the hardware immediately. The setup block in the supervisor is where the hardware state is made to conform with the software state. Setup is not the only place where hardware is affected; the frequency tuning, leveling, audio ranging, and measurement blocks manipulate the hardware as well.

In a normal stable measurement cycle, the program takes the measurement display branch at the top of the supervisor and so avoids the time overhead associated with the setup block. However, if the program loops back before taking a measurement, or if an error condition exists, the nonmeasurement display branch will be traversed, thus lighting an appropriate display and going through the setup block.

The Keyboard and HP-IB interrupt the flow around the loop, forcing the Microprocessor to execute a short program and then return to the loop as shown in the diagram. Since the supervisor can be interrupted at any point but always returns to a single location, Keyboard and HP-IB interrupts must abort the current measurement and start a new measurement cycle.

The Keyboard and HP-IB can be thought of as a medium through which the user requests a certain instrument setup. It is important to note that the actual instrument setup is guaranteed to conform to the Keyboard request only at the moment a measurement is taken. The Controller may change the instrument hardware at other times to optimize its tuning, leveling, and ranging functions. For example, in troubleshooting, 3.1 SPCL may be keyed in to check if the 455 kHz IF filter is being selected properly. If there is no RF input signal and the instrument is trying to auto-tune, it would be discovered that both IF filters are being used. The proper test would have been to use a Direct Control Special Function (0.031 SPCL).

The microprocessor-based Controller interacts closely with the hardware of the instrument. Many circuits are used by the Controller for different functions at different times. Thus, a specific failure in one circuit can show up as a collection of symptoms that superficially seem unrelated. For example, a failure of the squelch detector in the FM Demodulator can result in frequency errors when tuning to an RF signal with large amounts of AM. The appearance of several symptoms can often be used to advantage as they provide many avenues to pursue when tracking down a problem.

A clear line is drawn between special functions used for service (i.e., Direct Control Special Functions and Service Special Functions) and normal instrument operation. When these special functions are used, normal instrument functions are suspended. When the special function mode is left to resume normal measurements, all effects of these special functions on hardware are lost. As an example, a Direct Control Special Function can be used to activate a particular Input Attenuator to check its operation. But once normal measurements are resumed, the attenuator setting will revert back to what it was before the Direct Control Special Function was invoked.

8-66. RF and Power Supply Sections— Service Sheet BD2

General. The RF Section contains the RF Input, IF Amplifier, and Local Oscillator (LO). The entire section is shock mounted to minimize microphonics on the LO and well shielded to minimize RF leakage.

RF Input Assembly (A15). The RF Input Assembly is the instrument's front end. It receives the RF input signal and attenuates it to an optimum level for the Input Mixer.

The RF level is sensed by the RF Level Detector. The output of the detector is buffered by the Detector Amplifier and applied to the Voltmeter. The Controller uses the RF Level Detector when automatically setting the RF Attenuator and when making RF LEVEL measurements. The RF Level Detector senses the peak of the RF voltage including AM envelope peaks.

The Overpower Detector compares the detected RF level with a reference. If the RF level (with AM envelope) exceeds 1W, the Overpower Protection relay is de-activated (opened) and latched. Pressing any key will reset the relay.

If the instrument is tuned to a frequency greater than 10 MHz, the 5.25 MHz High-Pass Filter can be switched in to eliminate low-frequency signals on the input which can pass directly into the IF. Special Function 3 controls the selection of the 5.25 MHz High-Pass Filter (as well as the IF filter).

The Input Attenuator consists of one 10 dB pad and two 20 dB pads for a range of 0 to 50 dB. The RF path is switched between the thru-lines and attenuator pads by RF relays as determined by the Controller. Table 8-9 lists the pads which are switched in on the attenuation ranges.

Table 8-9. Attenuator Pad Selection

Attenuation	Pads Selected
0 dB	Thru-Line
10 dB	10 dB
20 dB	20 dB No. 1
30 dB	10 dB & 20 dB No. 1
40 dB	Both 20 dB
50 dB	All

Table 8-10 lists the attenuation selected for various measurement conditions and approximate RF input signal levels.

Table 8-10. Signal Level vs. Attenuation

Input Signal Level (dBm)		Input Attenuation* (dB)	
0.15-650 MHz	650-1300 MHz	FM & ΦM Demodulation	AM Demodulation
−25 to −16	−20 to −13	0	0
−16 to −6	−13 to −3	0	10
−6 to 4	−3 to 7	10	20
4 to 14	7 to 17	20	30
14 to 24	17 to 27	30	40
24 to 30	27 to 30	40	50

*Input Attenuation for RF LEVEL measurement is 50 dB and overrides Special Functions 1.1 to 1.5.

Input Mixer Assembly (A17). The Input Mixer Assembly converts the input RF signal to the IF. Part of the IF filtering is included in this assembly. The LO is tuned so that the LO frequency minus the signal frequency is the IF. The LO can also be manually tuned so the IF responds to the image, i.e., when the signal frequency minus LO frequency equals the IF. In this case the phase of the FM is inverted.

The Input Mixer has two modes of operation: it down converts the input signal to the 1.5 MHz or 455 kHz IF; or, for signals below 2.5 MHz, it passes the signal directly into the IF. The frequency range of the Input Mixer (for down conversion) is 2.5 to 1300 MHz. (Down conversion can be extended below 2.5 MHz with the 455 kHz IF and manual tuning.) The normal operating signal level is less than −16 dBm for AM and −6 dBm for FM and ΦM. The down-converted input signal is not used during RF LEVEL measurements.

The LO signal for the Input Mixer comes from the LO Dividers through the LO Amplifier.

The IF frequency response is determined by the IF Filters and IF Amplifier. The 455 kHz Bandpass Filter determines the response of the 455 kHz IF and is switched in automatically for input signals in the range of 2.5 to 10 MHz. The frequency response of the 1.5 MHz IF is determined by RF input blocking capacitors (not shown), the 4 MHz Low-Pass Filter, and (principally) the 2.5 MHz Low-Pass Filter (in the A6 AM Demodulator Assembly). The 4 MHz Low-Pass Filter is switched in when the 1.5 MHz IF is selected. When the IF filter selection is automatic, the 1.5 MHz IF is selected for signals in the range of

10 to 1300 MHz or 150 kHz to 2.5 MHz. Special Function 3 controls the IF frequency (as well as the 5.25 MHz High-Pass Filter in the RF Input Assembly).

IF Amplifier Assembly (A18). The IF Amplifier increases the signal from the Input Mixer to a level suitable to drive the AM and FM Demodulators. The IF strip is designed for low noise, linear phase shift vs. frequency (i.e., constant group delay) to minimize FM distortion, and flat frequency response to minimize incidental AM (i.e., AM occurring as the result of FM).

Local Oscillator. The Local Oscillator consists of the LO Divider Assembly (A19), LO Control Assembly (A20), Low Frequency VCXO Filter Assembly (A21), Low Frequency VCXO Assembly (A22), Sampler Assembly (A23), and High Frequency VCO Assembly (A24). The overall operation and different tuning modes of the LO are described in Service Sheet BD1. Special Function 4 controls LO tuning.

High Frequency VCO Assembly (A24). The High Frequency VCO has a nominal frequency range of 320 to 650 MHz. The output is buffered by two Output Buffer Amplifiers. One output drives the LO Divider, the other the Sampler. The tune input to the HF VCO has a switchable lead-lag network (Tune Voltage Filter) to reduce phase noise. The network is switched out while seeking a signal and is switched in when tuned.

LO Divider Assembly (A19). The signal from the HF VCO, after passing through the LO Divider Assembly, is the LO drive to the Input Mixer. The LO Divider Assembly has one Doubler stage (640 to 1300 MHz LO range), one thru-path (320 to 640 MHz range), and eight LO Dividers (1.25 to 325 MHz ranges). Each divider is a high-speed divide by two. The Divider Output Gates enable and cascade the appropriate dividers for the range selected. The first three dividers are always enabled. The 40 to 81.25 MHz output of the third divider is the LO (HF VCO÷8) input to the Counter.

To prevent mistuning on the doubler range, which can result from spurious LO signals, the input to the Doubler is filtered by a tunable Doubler Input Filter. The filter primarily suppresses the third harmonic of the HF VCO which becomes the 3/2 harmonic of the doubled signal. The Doubler High-Pass Filter following the Doubler suppresses the fundamental feedthrough (the 1/2 harmonic).

Low Frequency VCXO and Filter Assemblies (A22 and A21). The Low Frequency VCXO is a highly stable, tunable reference oscillator to which the HF VCO is locked in the low-noise tune modes. It consists of two tunable crystal oscillators (nominally 9.26 and 11.26 MHz) mixed together to produce a 2 MHz output. The two oscillators can each be tuned in opposition approximately 6.25 kHz for a total tuning range of 2 MHz ± 6.25 kHz. This tuning scheme allows a broad tuning range while retaining the high stability of the individual oscillators. The 2 MHz Low-Pass Filter and 2 MHz Bandpass Filter (A21) reject unwanted mixing products which appear as spurious AM and FM residual tones. Careful selection of the crystal frequencies minimizes the output of spurious mixing products.

Sampler Assembly (A23). The Sampler is the phase detector of the phase lock loop. The tunable 2 MHz signal from the LF VCXO drives the Sampling Bridge through the 2 MHz Limiter and Impulse Generator. The output of the Impulse Generator is a train of extremely short-duration pulses with the repetition rate of the 2 MHz signal. The pulses momentarily turn on the diodes (i.e., close the switch) of the Sampling Bridge and pass the signal from the HF VCO. The output from the Sampling Bridge is thus the HF VCO sampled at a 2 MHz rate. If the two signals are harmonically coherent, the output will be a dc voltage with a level determined by the phase and amplitude of the HF VCO. The action of the phase lock loop tunes the HF VCO to drive the voltage to zero. If the relationship is not strictly harmonic (i.e., phase lock is broken), the output is a beat note with a frequency equal to the difference between the HF VCO and the nearest harmonic of the LF VCXO. The output of the Sampling Bridge, which is the phase error voltage, is smoothed and buffered by the Sampler Amplifier.

The tune voltage for the HF VCO is supplied by the HF VCO Tune Integrator and Amplifier. The Tune Integrator has several sources of input: the Sampler Amplifier, the Track Loop Amplifier, the Sweep Up Current Source, the Sweep Down Current Source, and the DAC Control Amplifier. Only one input is active at a time. If one of the current sources is active, the Tune Integrator sweeps the HF VCO. If the input is one of the amplifier outputs, the Tune Integrator is configured as part of a feedback loop receiving its input from the FM Demodulator.

The grounding switch at the input of the Tune Integrator is open only when the Sampler Amplifier is connected to its input. When the amplifier is not connected, the switch is closed to keep signals at the Sampler Amplifier output from coupling into the Tune Integrator. The Out-of-Lock Detector at the Sampler Amplifier output senses the presence of ripple and lights the OUT OF LOCK annunciator to indicate lock has broken. A BW Control line also lights the annunciator when the Tune Voltage Filter has not been turned on. This line also controls the bandwidth of the Tune Integrator. The bandwidth is narrowed in the low-noise phase lock and track modes (i.e., always when tuned).

The No-HF-VCO Detector lights the NO HF VCO annunciator if the amplitude of the signal from the HF VCO is too low. The 700 MHz Low-Pass Filter in the Sampling Bridge input line filters out harmonics of the HF VCO to assure proper sampler gain.

LO Control Assembly (A20). The LO Control Assembly contains the digital decoders and latches for the entire RF Section and the low-frequency analog circuits that control and tune the LO.

The Digital-to-Analog Converters (DACs) drive either the LF VCXO (through the LF VCXO Amplifier) or the HF VCO (through the DAC Control and HF VCO Tune Integrator and Amplifier). The DAC outputs a current that is proportional to the weighting of the bits of its digital input. The amplifiers following the DAC convert the current into a tune voltage.

The LF VCXO Tune Voltage Filter filters the tune line to the LF VCXO to reduce phase noise in the low-noise phase lock mode. This is necessary because the tune input is outside of the phase lock loop.

The Sweep Down Current Source sweeps the HF VCO when the LO searches for the input signal. The Sweep Up Current Source is the retrace for the sweep.

The Track Loop Amplifier is used only in the track mode. Its input is the dc output from the FM Demodulator which is proportional to the IF center frequency. If the input signal changes frequency, the HF VCO is tuned via the Track Loop Amplifier and Tune Integrator to keep the IF at a nominal 1.5 MHz. (Track tuning is not permitted with the 455 kHz IF.) Thus the track mode is the only tuning mode where the LO "locks" on to the input signal (i.e., a frequency lock loop is formed).

The Track Loop Amplifier has a different gain for each LO range. This compensates for the change in LO tuning sensitivity caused by the LO Dividers.

Power Supply Assemblies (A10 and A26). The five regulated supplies are: +15V, −15V, +40V, +5V, and −5V. Each supply has its own secondary winding on the Line Transformer and its own full-wave rectifier. The latter four supplies are referenced from the +15V supply. Each supply is a series regulator type. When the instrument is switched to STBY, the +15V supply remains on and supplies current only to the high-stability time base reference oscillator (Option 002). In STBY the other supplies become referenced to 0V and thereby shut themselves off. The supply switching is via the ON/STBY Relay. The fan is also switched by the relay.

8-67. Audio Section—Service Sheet BD3

General. The Audio Section contains the AM and FM Demodulators, Audio Circuits (including amplifiers, filters, attenuators, switches, FM de-emphasis, etc.), Voltmeter, and AM and FM Calibrators (Option 010).

AM Demodulator Assembly (A6). The down-converted signal from the IF Amplifier is filtered by a 2.5 MHz Low-Pass Filter. The FM IF Buffer drives the FM Demodulator and rear-panel IF OUTPUT jack. The AM IF Buffer drives the AM Demodulator.

The AM is demodulated by means of a precision, half-wave rectifier in an automatic leveling control (ALC) circuit. The buffered IF signal is amplified by a Voltage-Variable Amplifier then rectified (detected) by the AM and Level Detector. The detected signal, after carrier filtering, represents the carrier level (dc component) plus AM (ac component). The ac component accurately represents the AM only if the dc component is known or set to a known level. The detected signal is filtered and amplified by the Level Amplifier and Carrier Filter. It is then compared to a constant ALC Reference by the BW Control and Level Comparison Amplifier. The output of this amplifier is the carrier level error. The error voltage is amplified by the Resistor Drive Amplifier which sets the variable-resistor input to the Voltage-Variable Amplifier. The resistor adjusts the IF level to cause the dc component of the carrier to equal the ALC Reference.

The amount of filtering in the comparison amplifier determines the minimum AM rate which can be accurately demodulated. An ALC Bandwidth Control line sets the ALC loop for a fast or slow response. The feedback loop may also be defeated by the ALC Defeat line. Special Function 6 controls the ALC loop.

The second output of the AM and Level Detector is buffered by the AM Output Buffer. One output of the buffer is fed to the rear-panel AM OUTPUT jack. The other output is fed to the audio circuits for filtering and audio processing.

The output of the FM IF Buffer is detected by two detectors. The IF Level Detector output is read by the Voltmeter. It is used by the automatic tuning routine and for making TUNED RF LEVEL measurements. The IF Present Detector is used to stop the LO sweep during a signal search (independent of the Controller).

The Voltmeter also receives IF level information from the output of the Level Amplifier and Carrier Filter which is used for IF LEVEL measurements. The voltage from the Resistor Drive Amplifier is an indication of the ALC current driving the input resistor circuit. It is used for setting the Input Attenuator when the ALC is on. (When the ALC is off, the Input Attenuator is set using the IF Level Detector for FM or the level on the Average IF Level line for AM.)

FM Demodulator (A4). The signal from the FM IF Buffer drives the FM IF Limiters. The limiters strip AM and noise off the IF to minimize demodulation of AM by the FM Demodulator (known as incidental FM). The three stages each have a gain of 22 dB. The output of the limiters is a square wave which drives a Precision Limiter. This limiter clamps the upper and lower levels of the squarewave to highly stable references required by the Charge-Count Discriminator. For each cycle of the IF signal, the discriminator passes a fixed quantity of charge through the feedback resistor of an amplifier. The voltage developed at the amplifier's output is proportional to the amount of charge delivered per unit of time. Fluctuations in IF frequency (FM) produce fluctuations in the output of the discriminator. The demodulated FM passes through the FM Output Amplifier and on to the audio circuits for further filtering and audio processing.

The Squelch Switch grounds the output of the discriminator whenever the IF level detected by the Squelch Detector is insufficient. This attenuates the large noisy output that would then result and speeds up recovery of the audio circuits from tuning induced transients. The Controller also activates squelch during tuning, measurement of RF LEVEL, and during part of the AM and FM Calibrator sequence.

The signal from the FM IF Limiter also drives the Counter via the Counter IF Buffer.

Audio Filter Assembly (A2). The residual IF carrier on the demodulated AM or FM is filtered out by the 260 kHz Low-Pass Filter in each path. These filters determine the audio bandwidth when LP FILTER is set to >200 kHz (except when the 455 kHz IF is selected). 20 dB Attenuator 1 partly sets the audio gain in FM and ΦM.

The demodulated signal then passes through Amplifier 1 which has a gain of 8.9 dB. When selected, the 15 kHz or >20 kHz Low-Pass Filters further filter the signal. The 15 kHz is automatically selected for the 455 kHz IF. (The >20 kHz Low-Pass Filter can also be selected.) The 6 dB Attenuator in the thru path matches the 6 dB loss through the other two filters. Amplifier 2 has 13.7 dB of gain. 20 dB Attenuator 2 gives further audio range control. Amplifier 3 has 20 dB of gain. The three amplifiers distribute the audio gain for optimum noise and distortion. Special Function 2 controls the overall audio gain. Table 8-11 lists the modulation ranges and the associated attenuation.

Table 8-11. Attenuation vs. Modulation Range

Modulation Range			20 dB Attenuator	
AM Depth (%)	FM Deviation (kHz)*	ΦM Deviation (radians)	1	2
40	4	4	out	out
100	40	40	out	in
100	400	400	in	in

*With 750 μs FM DE-EMPHASIS and PRE-DISPLAY selected the FM ranges are 0.4, 4, and 40 kHz.

Audio De-emphasis and Output Assembly (A3). The Audio De-emphasis and Output Assembly contains further audio filtering, FM deemphasis, a ΦM integrator, audio output amplifiers, and two audio level detectors.

The 50 and 300 Hz High-Pass and 3 kHz Low-Pass Filters are active filters selected by the front panel. The four FM de-emphasis networks are single-pole low-pass filters with time constants of 750, 75, 50, and 25 μs. The 750 μs network is an active filter with 20 dB of gain.

The Phase Modulation Integrator converts the FM input into an equivalent ΦM. This is because the instantaneous phase deviation is the integral of the instantaneous frequency deviation.

The front-panel MODULATION OUTPUT is driven by an inverting Output Amplifier. The output is always affected by audio filtering and FM deemphasis when selected. The output to the Voltmeter is through the Inverting/Non-Inverting Amplifier. The amplifier has a gain of −1 when PEAK+ is selected and, for FM and ΦM, the input signal is down converted by the Input Mixer; otherwise, the gain is +1. The input to the amplifier can be selected to include (PRE-DISPLAY) or exclude FM de-emphasis.

The Absolute Peak Detector, Audio Overvoltage Detector, and the Voltmeter together sense the audio signal level for determining the audio range. The Audio Overvoltage Detector compares the audio voltage to a reference. If the audio level is too large, the audio gain is reset to minimum. The detector is quick acting and sets a status flag which can be read by the Controller. The output of the Absolute Peak Detector (which detects the greater of the positive and negative peaks) is read by the Voltmeter. If either peak or the displayed measurement exceeds the limits set by the Controller, and if automatic ranging has been selected, the audio gain is reduced. The display normally predominates unless the signal is filtered out by one of the filters on the assembly. The Absolute Peak Detector thus prevents the active circuits ahead of the filters from being overdriven.

Voltmeter Assembly (A5). The Voltmeter consists of an average detector, a peak detector, and a voltage-to-time converter.

The average detector consists of a precision Half-Wave Rectifier and a Summer and Filter. The summer amplifier adds the input signal, weighted by a factor of one, to the inverted and half-wave rectified input, weighted by a factor of two. The resultant sum is a full-wave rectified output. After filtering, the output dc voltage is equal to the signal's rectified average.

The Peak Detector captures the positive ac peak. A sampling switch at the output of the detector controls the transfer of the output to the Voltage-to-Time Converter and the discharging of the detector. Special Function 5 controls the discharge rate.

The Input Selector selects one of many dc inputs into the Voltage-to-Time Converter. The output of the selector is a reference input into a Comparator. The Comparator's other input is a constant ramp. The ramp is initiated by the Counter. As the ramp rises, the Counter counts its time base reference (10 MHz). When the ramp voltage equals the level of the other input, the Comparator signals the Counter to stop counting. The accumulated count represents the dc voltage. Ground is measured separately and subtracted from the Voltmeter measurement. Special Functions 49 and 50 allow direct access and display of the Voltmeter readings.

FM Calibrator Assembly (Option 010, A51). The heart of the FM Calibrator is a 10.1 MHz VCO. A 10 kHz trapezoidal wave is applied to the tune line of the VCO which generates FM. During the CALIBRATION measurement, the VCO input is switched to the upper frequency, f_U, and the frequency is measured by the Counter. Then the VCO input is switched to the lower frequency, f_L, and the frequency is again measured. The Controller calculates the peak deviation as

$$\mathrm{FM} = \frac{f_U - f_L}{2}$$

A measurement of residual FM is also made on the unmodulated VCO and entered into the calculation of the FM calibration factor. The FM signal is then measured, and the calibration factor is calculated and shown on the display. The sensitivity of the VCO and tune voltage are designed to give approximately 34 kHz peak deviation.

To prevent ringing of the demodulated signal in the audio circuits, the modulation signal is given a slow risetime by the Trapezoid Generator—a soft limiter which receives its input from the Triangle Generator. The Triangle Generator and Mode Control comparator together form a relaxation oscillator. The output from the Mode Control comparator switches between a positive and negative output current.

The integrator generates a negative or positive ramp depending on its input. When the output reaches the Mode Control reference, the comparator output switches sense to initiate a ramp in the opposite direction.

Special Function 12 controls the FM Calibrator and permits its use with another HP 8901A.

AM Calibrator Assembly (Option 010, A50). The input to the AM Calibrator is the unmodulated 10.1 MHz from the FM Calibrator. The signal passes through a Limiter and is applied to two similar Modulators (A and B) through two Amplifiers (A and B). Modulator B is then switched on and off by the 10 kHz Modulation Oscillator through Current Source B. The outputs from the two Modulators are then summed in the Summing Amplifier, and the summed signal appears (after attenuation) at the CALIBRATION OUTPUT jack. If both signal paths are identical, the output from the calibrator is periodically toggling between a specific RF level and twice that level. This produces 33.33% AM.

Because the two paths may differ slightly, accuracy of the AM Calibrator is enhanced by detecting and measuring the levels from the Modulators statically during an initial calibration sequence. First, the voltage from the detector is measured with only Modulator B on via the X1 DC Amplifier (V_B). It is also measured via the X10 DC Amplifier (V_{10B}). Then Modulator B is switched off and Modulator A on. The level is now measured via the X 10 DC Amplifier (V_{10A}). AM is then calculated by the formula

$$\%AM = \frac{100\%}{3 - \left(\frac{2}{10}\right)\left(\frac{V_{10A} - V_{10B}}{V_B}\right)}$$

A measurement of residual AM is also made on the unmodulated RF and entered into the calculation of the AM calibration factor. The AM signal is then measured and the calibration factor is calculated and shown on the display.

To prevent ringing of the demodulated signal in the audio circuits, the modulation squarewave is given a slow risetime by the Current Sources. Special Function 13 controls the AM Calibrator and permits its use with another HP 8901A.

8-68. Digital and Front Panel Sections— Service Sheet BD4

General. The Digital Section contains the Counter, Controller, and Remote Interface. The Front Panel Section contains the Keyboard and Display.

Counter Assembly (A11). The Counter consists of a 10 MHz Reference Oscillator, Time Base Divider, Input Selector, four counter stages, and counter control circuits. The input to Stages 2 through 4 is selected by the Input Selector switch. When the LO frequency is counted, Counter Stage 1 is enabled and fed into Stage 2. The input to Stage 1 is the High Frequency VCO signal divided by eight. When the Voltmeter input is selected, the Selected Time Base Reference (10 MHz), gated by the Voltmeter Gate, is the input to Stage 2. Other inputs which can be selected are IF, FM Calibrator, and Internal and External Time Base (useful as a Counter self-check).

The Counter counts in binary. Stage 1 is a divide-by-eight. Stages 2 through 4 are divide-by-sixteens. More stages of counting are contained in the microprocessor. In addition, the microprocessor also counts the number of Time Base periods.

At the end of a count sequence, the Time Base disables the Counter via the Counter Gate Control. The Counter Transfer Logic then transfers the count of the individual stages in parallel to the Controller via the Counter Output & Time Base Gating. First, the output from Stage 4 is transferred. Then the output from Stage 3 is loaded into Stage 4, and the output from Stage 4 is again transferred. This process is again repeated with Stage 2 loading into Stage 4 via Stage 3 and transferring. Finally, Stage 1 is loaded into Stage 4 via Stages 2 and 3 and transferred. (The output from Stage 1 is used only when counting the LO frequency.)

To make a voltage measurement, the Voltage-to-Time Converter generates a pulse whose time interval is proportional to its dc input voltage. During this time interval, the Counter counts its time base reference. The count thus accumulated is proportional to the input voltage. The count is initiated when the Counter enables its Input Selector and the Voltage-to-Time Converter (via the Ramp Gate). The Voltage-to-Time Converter then closes the Voltmeter Gate (via the Stop Count line) and the Selected Time Base Reference passes into Counter Stage 2. When the time interval ends, the Voltmeter Gate is opened. Some time later, the Controller disables the Counter and transfers the accumulated count to the Controller.

The time base reference is either the standard 10 MHz Reference Oscillator, the Option 002 10 MHz High Stability Crystal Oscillator, or an external input from the rear-panel TIME BASE 10 MHz INPUT jack. For Option 002, the crystal from the 10 MHz Reference Oscillator is removed and the oscillator's circuitry is driven by the High Stability Oscillator. In either case, when an external reference is applied, a detector senses the signal and throws the Time Base Select Switch to the external position. This is done in such a way as to minimize the interruption of the reference since (after dividing by five) it is also the Controller clock.

The Time Base Divider divides the 10 MHz reference by 1600. The 6.25 kHz Time Base signal controls the enable period of the Counter and hence determines the Counter accuracy.

Controller (A13). The Controller consists of a microprocessor, read-only memory (ROM), random-access memory (RAM), a memory select decoder, and input/output interface circuitry. The microprocessor is divided into two devices—the Central Processing Unit (CPU) and a Static Memory Interface (SMI). A third device, a Peripheral Input/Output (PIO), is also included when the microprocessor interfaces with the Remote Interface Assembly.

The Controller's program is stored in ROM. To retrieve information from ROM, the SMI, under control of the CPU, outputs the appropriate address on the Address Bus. Five of the sixteen address bits are decoded by the Memory Select Decoder to enable one of the ROM devices. Eleven other address bits address the individual ROMs. The enabled ROM then outputs eight bits of data onto the Data Bus from the location corresponding to the input address. Information in ROM may be either a program instruction or data. In a similar manner temporary information is written to or read from the RAM. The RAM, however, is addressed by only eight of the eleven address bits, and inputs or outputs only four data bits.

The CPU interprets bytes from the ROM as data or instructions depending on the context of the program. If the byte is an instruction, the outcome depends on the nature of the instruction. A simple instruction (such as add or shift) is executed immediately and the instruction in the next address fetched. More complex instructions fetch additional data or instructions from following addresses and, in the case of jumps and subroutine calls, cause program execution to move to another location in memory.

When a front-panel key is pressed, an interrupt is generated. The interrupt causes program execution to jump to a specified address location where the interrupt service subroutine is located. The subroutine interrogates the Keyboard to determine which key was pressed and then takes the appropriate action. HP-IB codes and commands interrupt the Microprocessor in a similar way.

The CPU communicates with the SMI and PIO through the ROM Control (ROMC) lines and the Data Bus. The CPU does data manipulation (arithmetic and logic computations) and contains the clocking and control circuitry. The clock is normally derived from the Counter's time base reference; however, if the clock fails (to an open circuit) or if the Counter Assembly is unplugged, a clock internal to the CPU will continue to generate clock pulses. The SMI interfaces with the external ROMs and RAM.

The CPU also contains the bidirectional input/output (I/O) ports for communicating with the instrument hardware. This is done via the Instrument Bus discussed in the next paragraph. Four of the I/O bits, however, are reserved for servicing of the Controller. Four LEDs driven from the port indicate errors encountered during power-up verification tests, measurement cycles, and Keyboard and HP-IB interrupts. Four test points on the port can be used to initiate troubleshooting routines which use signature analysis. See TEST LEDs and Test Points, page 8-17.

Instrument Bus. Figure 8-42 shows a typical hookup on the Instrument Bus. The Instrument Bus lines are broken down into three groups: enable (e), select (s), and data (d). The enable code (e0 to e3) comes from I/O lines 10 through 13 of the CPU (A13U14). Three of the lines are decoded by the Enable Code Decoder (A13U17) to activate one of eight unique enable lines (e = 0 to e = 7). The fourth line enables the decoder itself. The enable lines run to various instrument sections. Typically, each line is dedicated to a specific section or operational function; e.g., enable line e = 1 controls audio-related functions in the Audio Section.

The select (s0 to s3) and data codes (d0 to d3) come from I/O lines 00 to 07. The eight lines run in parallel to all sections of the instrument where they are decoded on the assemblies. (In the RF Section one assembly, the A20 LO Control Assembly, decodes the Instrument Bus for the entire section.) Up to 16 data codes for each of the 16 select codes are possible for each active enable line. The select code typically selects a functional category on an assembly and the data code selects the specific function or configuration. On a given assembly the select codes are decoded only while the corresponding enable line is active. The data codes are in turn decoded and latched only when triggered by the decoded select line. The latched data drive the digital-to-analog devices which control the instrument hardware.

On the schematic diagrams the lines leaving the I/O ports of the CPU are labeled with a mnemonic such as s2(L) for I/O line 02. The "s" indicates a select code, "2" indicates that it is the third least-significant bit of the un-decoded select code, and "(L)" indicates that the line is true (1) when the logic level is low. All bit position numbering begins with 0. The select codes go out on the Instrument Bus through Select Buffers which are simple inverters. Thus s2(L) goes out on the bus as s2(H). Decoded codes are labeled as e = 1(L) for example. The "e" indicates an enable code, "=" indicates decoding, "1" indicates a decoded hexadecimal 1 (binary 0001), and "(L)" indicates the logic level corresponding to a true. The mnemonic e = 1 corresponds to e3e2e1e0 = 0001. Data codes are also buffered. However, unbuffered data lines are also connected to the Instrument Bus for reading back data to the I/O ports.

The example of Figure 8-42 will be used to illustrate how the 50 Hz High-Pass Filter is selected. The filter (not shown) is activated when the output line of the High-Pass Filter Control (A3U16) labeled 50 Hz HPF(L) goes low. Register U16 is simply a latch; it does not decode the data. To activate the 50 Hz High-Pass Filter, the CPU sends out the binary enable code 0001 (hexadecimal 1), select code 0100 (hexadecimal 4), and data code 0010 (hexadecimal 2). The Enable Decoder activates the line e = 1(L). The decoder was enabled because e3(H) was low. Since s3(H) is low, and since e = 1(L) is also low, the Select

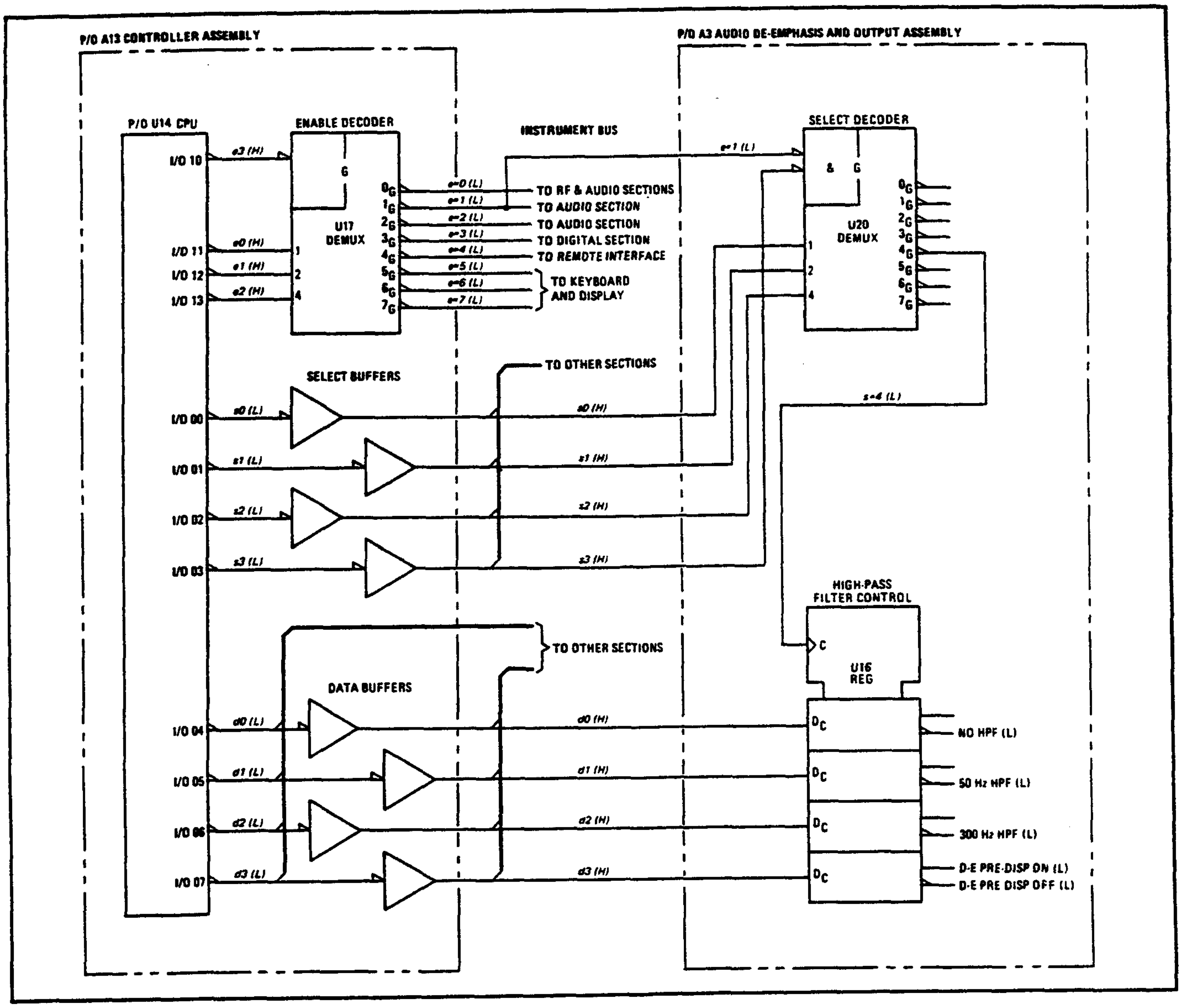


Figure 8-42. Example Showing Instrument Bus Hookup

Decoder (A3U20) is enabled. The three least-significant bits of the select code are decoded and activate the s =4(L) line out of the decoder. This line clocks the data into the High-Pass Filter Control latch. Since the d1(H) line is high, the 50 Hz HPF(L) line goes low. This selects the 50 Hz High-Pass Filter.

There is a direct relationship betwen the codes output on the Instrument Bus and the Direct Control Special Functions discussed on page 8-8. If the enable, select, and data codes are combined into a hexadecimal number "esd", this becomes the Direct Control suffix. In the example here it is 142, corresponding to Direct Control code 0.142 discussed in the example there. Instrument control can be visualized as a series of Direct Control Special Functions issued under program control.

The example above decoded only three of the four select code bits and used the data bits directly (or inverted them). Notice that if the code esd = 147 were issued, the thru path (No HPF), 50 Hz High-Pass Filter, 300 Hz High-Pass Filter, and De-emphasis Pre-Display switches would all be activated. On some assemblies the data codes may be decoded and select codes above 7 may be used. On other assemblies certain select codes are used to enable readback devices which read back status or measurement data onto the unbuffered data lines. This is discussed in more detail in connection with Special Functions, page 8-8.

Keyboard and Display Assembly (A1). The Keyboard and Display Assembly is both an input peripheral and an output peripheral to the Controller. The pressing of a key is sensed by the

Keystroke Detector. The detector interrupts the Microprocessor which then enters an interrupt service routine. The routine causes the key rows and columns to be scanned sequentially via the Key Row and Column Scanner to ascertain which key is down. This is accomplished by driving the rows in sequence with the select decoder and reading the state of the columns with the data readback lines. If no key closure is found (due, perhaps, to key bounce), the scan repeats. If no key closure is found after 50 ms, the Microprocessor leaves this routine and begins making a new measurement.

Lighting of the key and annunciator lights and display digits and decimal points is by a straightforward decoding of the Instrument Bus. Note that the lights in the keys do not light as a direct result of a key closure, but rather the Microprocessor, having recognized a key closure, sends the command out on the Instrument Bus to light the key light.

Remote Interface Assembly (A14). The Remote Interface Assembly interfaces the Controller with the Hewlett-Packard Interface Bus (HP-IB). It performs necessary handshake operations, interprets the HP-IB control lines, and is both an input and output peripheral to the Controller.

As an input peripheral, it accepts a byte from the HP-IB data lines under control of the bus handshake lines. It then interprets the data byte and the bus control lines to see if the byte is an address (talk or listen), a command, or a data byte. When a byte is processed, one of three things happens: (1) the byte is ignored, (2) the byte is processed in hardware (e.g., some bus commands), or (3) the byte causes a Microprocessor interrupt (e.g., codes received while addressed to listen). The Microprocessor treats an HP-IB interrupt as it would an interrupt from the Keyboard. However, the HP-IB interrupt service routine first checks whether or not the byte is a command (e.g., Device Clear), address, or data (e.g., "M1"). If it is an address or command, the byte is processed. If it is data, the routine first checks whether or not the instrument is in remote. If it is, the incoming byte is processed as program code. If not, the byte is ignored. After processing a byte, the Microprocessor tells the Remote Interface what to do next (e.g., input another byte, set a status latch, or prepare to output a byte).

As an output peripheral, the Remote Interface takes a byte of status or measurement data from the Microprocessor and processes it over the HP-IB. It does this only after determining that the Modulation Analyzer has been addressed to talk. The require service message (SRQ) is also output via the Remote Interface.

The Remote Interface Assembly consists of Handshake Logic, HP-IB Input/Output Transceivers, Interface Control Logic, Address Decoder, part of the Microprocessor, and Instrument Bus interface circuits.

The Handshake Logic controls the asynchronous transfer of bytes over the HP-IB. It does this without interruption of the Microprocessor whenever the byte is data but the Modulation Analyzer is not addressed to listen or whenever the byte is not an interrupting bus command. It also provides the means for the Microprocessor to complete the handshake if the byte is an interrupting type.

When the Modulation Analyzer is accepting bytes, the Handshake Logic monitors the Microprocessor and HP-IB and signals the HP-IB talker or bus controller when the Modulation Analyzer is ready to receive, tells the Microprocessor when valid data is on the HP-IB, and tells the HP-IB talker when the Microprocessor has accepted the data. When the Modulation Analyzer is outputting data or status bytes, the Handshake Logic tells the Microprocessor when the HP-IB listener is ready to receive, provides the Microprocessor with logic to tell the listener when data is valid, and tells the Microprocessor when the listener has accepted data.

The HP-IB Input/Output Transceivers act as HP-IB buffers and send/receive switches. They are controlled by the Interface Control Logic.

The Interface Control Logic together with the Address Decoder determines the talk or listen status of the interface and whether or not the Microprocessor should be interrupted. The ROM in the Handshake Control Logic is addressed by two of the HP-IB data lines, the Address Decoder, and one of the HP-IB control lines (Attention, ATN). The ROM contains the control information for the Interface Control Logic and the Microprocessor.

If the Modulation Analyzer's listen address is recognized by the Address Decoder, the Microprocessor attempts to set the Remote Enable Flip-Flop. If the HP-IB Remote Enable (REN) control line is true, the flip-flop is set (if not already set), and the Microprocessor sets a status bit in memory. Each time the Microprocessor performs any remote-dependent operation, it checks both the status bit and the flip-flop output (Remote Enable Latch, RNL). Both must be set for the instrument to remain in remote. If REN goes false at any time, the Remote Enable Flip-Flop is cleared, and the instrument is no longer in remote.

The Address Decoder compares the address set by the Address Switches with the five least significant input bytes to determine if the instrument is being addressed. The Interface Control Logic looks at the output of the Address Decoder and the next two input bits to determine if it is a talk or listen address and if the instrument should respond to it. The result of this determination modifies the address to the ROM in the Interface Control Logic.

The Address Readback Gates output the address from the Address Switches onto the Instrument Bus data lines when Special Function 21 (HP-IB Address) is selected. This is how the Controller reads the HP-IB address. (See HP-IB Address in the Detailed Operating Instructions in the Operating Manual.)

The portion of the Microprocessor that directly handles the HP-IB input/output resides on the Remote Interface Assembly. This includes the ROM (not to be confused with the ROM in the Interface Control Logic) that contains the HP-IB routines of the instrument software, a Memory Select Decoder (to enable the ROM when needed), and a Peripheral Input/Output (PIO). The PIO is a device that routes the HP-IB data to and from the CPU and the HP-IB, provides a communication link between the CPU and the Remote Interface hardware, and provides the means for interrupting the CPU. One of the two, eight-bit PIO output ports connects to the HP-IB data lines and the other to the handshake and control logic.

NOTE

For purposes of troubleshooting the Controller, the Remote Interface Assembly may be unplugged. Provision has been made to allow the instrument to work with only the loss of the HP-IB and LIMIT functions.

Although the Remote Interface Assembly receives data and operating information from the PIO, it is primarily through the Instrument Bus that it is controlled. (Commands such as SRQ that need rapid processing come from the PIO). A Select Decoder decodes the select lines when enabled by code e = 4. The decoded select lines enable or disable parts of the Remote Interface Assembly.

8-69. RF Input (A15)—Service Sheet 1

General. The RF Input Assembly contains the Input Attenuator, Overpower Protection, RF Level and Overpower Detector, and 5.25 MHz High-Pass Filter. Together, these circuits provide a suitable input signal for the Input Mixer (see Service Sheet 2).

5.25 MHz High-Pass Filter. The 5.25 MHz High-Pass Filter must be switched in by entering user Special Function 3.3 or 3.4 SPCL. Its function is to prevent the IF from responding to low-frequency, spurious signals which may be present along with a higher frequency input signal. The filter is a diplexer type which presents a 50Ω termination to all frequencies present at its output (whether above or below the cutoff frequency). An example of such a signal is the IF itself. The 50Ω termination improves the RF flatness of the Input Mixer over the wide range of input frequencies. The filter is switched in by relay K2 via driver transistor Q2.

Input Attenuator. The Input Attenuator is composed of two 20 dB pads and one 10 dB pad for a range of 0 to 50 dB in 10 dB steps. Each pad is a resistive pi network. The first shunt arm of 20 dB No. 1 has two resistors (R15 and R19) in parallel to handle the brunt of high-level RF power. The pads are switched in by relays K3, K4, and K5 driven by transistors Q6, Q7, and Q8 respectively.

RF Level Detector. The RF Level Detector (CR1 and CR2) senses the positive peak of the input signal. The detected dc voltage is used to initially set the Input Attenuator, to give an indication of RF level when the RF LEVEL measurement mode is selected, and to de-activate the Overpower Protection relay. Because the detector can introduce a slight amount of clipping on the input signal, it is switched slightly off after the instrument is tuned to the input signal except when measuring RF level. The detector is shut off when Q10 is on.

Detector Amplifier. U1 and U2 form a unity-gain amplifier and peak detector with offset. U2 detects the peaks of the signal from the RF Level Detector when AM is present on the signal. Whenever the voltage at the non-inverting (+) input of U2 exceeds that of the inverting input (−), the output transistor of U2 (see Note 2 on the schematic) turns on and charges C22 from its emitter until the voltage across C22 equals the input voltage at the inverting input plus the constant drop across CR7, R34, CR8, and R42. U1 is simply a unity-gain buffer amplifier. When the input voltage drops, the output of U2 shuts off, and C22 remains charged to its previous level. R39 and R41 slowly discharge C22 when the input signal level is lowered or removed. CR7 and CR8 are biased on by R26 which acts as a current source. CR7 and CR8 are hot carrier diodes whose offset voltage tracks that of CR1 and CR3 with temperature. Fine adjustment of the offset is made with R42 which is set for zero output from U1 when no input signal is present.

Overpower Detector. The Overpower Detector amplifier U3 senses when the output from the RF Level Detector and voltage divider R36, R54, and R37 exceeds +2.7V (set by R43, R44, and hysteresis resistor R56) which corresponds to 1W of input power. The output of U3A then goes low and deactivates the Overpower Protection relay K1 via the LO Control circuits (see Service Sheet 15). K1 remains de-activated until reset by the operator pressing any front-panel key.

The OVERPOWER(L) output line from U3A is also an input line from the LO Control circuit which performs two other functions. First, the line is used to discharge the storage capacitor C22 of the Detector Amplifier between RF LEVEL measurements. Second, the line is used to turn off the RF Level Detector when RF LEVEL is not being measured after the instrument is tuned. To accomplish these two tasks, a quasi-low is put on the line by the LO Control circuits. The low does not trip the overpower circuit but is low enough to set the Detector Amplifier Discharge comparator U3B low which discharges C22. It also turns off the RF Level Detector by turning on Q11, Q9, and Q10. In this state the RF Level Detector can still sense an overpower condition and trip the Overpower Protection.

Relay Drivers. The drivers for the five relays are similar. A TTL low at the base of a driver transistor (Q1, Q2, Q6, Q7, or Q8) turns the transistor on and energizes the relay. The relay contacts move in the direction of the arrow. The capacitors across the relay coils suppress the flyback voltage when the coil is de-energized and improve switching speed. Control of the relays is via the LO Control circuits (see Service Sheet 15).

8-70. Input Mixer (A17)—Service Sheet 2

General. The Input Mixer Assembly down-converts the input signal to an intermediate frequency (IF). For input signals above 2.5 MHz, the IF is equal to the LO frequency minus the signal frequency. The IF is normally 1.5 MHz for frequencies above 10 MHz and 455 kHz for frequencies between 2.5 and 10 MHz. Below 2.5 MHz the input signal passes directly through the Mixer into the IF Amplifier without down-conversion. The Input Mixer Assembly contains the Mixer, LO Amplifier, and two IF filters (a 455 kHz Bandpass Filter and a 4 MHz Low-Pass Filter). The 4 MHz Low-Pass Filter is followed by a 2.5 MHz Low-Pass Filter in the AM Demodulator Assembly which determines the frequency response of the 1.5 MHz IF (see Service Sheet 3). For principles of operation of the IF Amplifier (A18), see Paragraph 8-71, this page.

LO Amplifier. The input to the LO Amplifier is a 1.25 to 1301.5 MHz signal which comes from the LO Divider Assembly (see Service Sheet 11). The amplifier has a gain of approximately 10 dB and drives the L port of the Mixer (U1) at about +10 dBm. The amplifier has two stages, Q4 and Q6, which are actively biased by Q5 and Q7 respectively. Using Q4 and Q5 to illustrate the biasing, notice that for dc levels the emitter of Q5 is connected directly to the collector of Q4—L3 is an RF choke. The base of Q5 is fixed at the voltage determined by voltage divider R1 and R2. The emitter of Q5 is normally a junction drop above this. The collector of Q5 is the source of dc base current for Q4. Changes in the collector voltage of Q4 alter the collector current of Q5 which regulates the collector voltage of Q4.

The gain of each stage is inversely proportional to the total emitter resistance and directly proportional to the collector load. C3 increases the gain slightly at high frequencies.

Mixer. Mixer U1 is a single-balanced type (i.e., signals at the L port are balanced out at the R and I ports but signals at the R port are not balanced at the I port). This permits low-frequency input signals to pass into the IF without down-conversion. The LO signal is coupled into the Mixer by U1T2. IF is coupled out from the center tap of the same transformer. U1C1 is the first element of the IF filters that follow. U1T1 optimizes the impedance seen by the IF Amplifier. The Input Pad before the Mixer's R port improves the flatness over the wide range of input frequencies by presenting a constant impedance to the IF at the R port. The Limiter adds protection to the Mixer.

IF Filters. The 455 kHz Bandpass Filter has seven poles and a 3 dB bandwidth of 200 kHz. L8 is adjusted for best passband flatness to minimize incidental AM (AM generated in the IF as the result of FM). L11 is adjusted primarily for best phase linearity vs. frequency in order to minimize FM distortion generated in the IF. The filter is switched in by Q3 and Q1 which forward-bias CR3 and CR6 when the output of U2B goes low. This also turns on DS1.

The 4 MHz Low-Pass Filter has three poles. It is switched in by Q2 which forward-biases CR4 and CR5 when U2A goes low. Control of the filters is via the LO Control Assembly (see Service Sheet 15).

8-71. IF Amplifier (A18)—Service Sheet 2

General. The signal from the Input Mixer, whether down-converted or not, is amplified by the IF Amplifier. The amplifier is a low-noise type with 33 dB of gain and a phase compensation network to reduce FM distortion. The IF Amplifier has three stages. For principles of operation of the Input Mixer (A17), see page 8-52.

IF Input Amplifier. The first stage, Q7 and Q5, is low noise and has 20 dB of gain. An active input impedance, the result of feeding signal back to the input through R6, generates a lower source noise than would be generated by a strictly passive resistance. The input impedance is essentially equal to R6 divided by the amplifier gain. The gain is approximately R9 divided by R7.

Inverting Amplifier. The second stage is a unity-gain amplifier with a phase-shift characteristic that can be adjusted to compensate for phase shifts generated in the 1.5 MHz IF system. This compensation improves FM distortion. The IF shape can also be adjusted to minimize incidental AM.

A simplified diagram of this stage is shown in Figure 8-43. Q1 is shown as an amplifier with a gain of −1, Q2 with a gain of +1. The voltage gain for the circuit is

$$\frac{V2}{V1} = \frac{(R-jX)}{(R+jX)}$$

which has a constant magnitude (+1) and a variable phase shift. The impedance jX is formed by L1, L2, C15, and C16. R is formed by the combination of R17, R23, and R24. R is fine adjusted by R23 for optimum phase shift (minimum FM distortion) at 1.5 MHz. R19 fine adjusts the gain of Q1 for best flatness (minimum incidental AM) at 1.5 MHz.

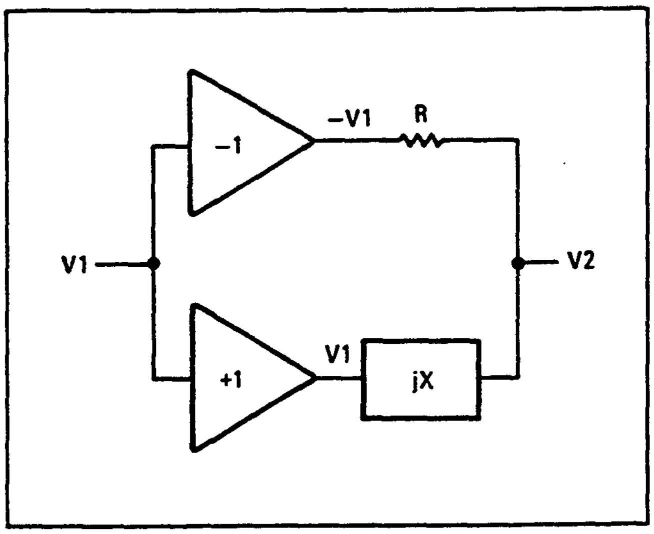


Figure 8-43. Simplified Diagram of Phase Compensation Amplifier

IF Output Amplifier. The third stage is a 13 dB amplifier which drives the AM Demodulator. Its gain is approximately one plus R29 divided by R27.

8-72. AM Demodulator (A6)— Service Sheet 3

General. AM is demodulated by rectifying the IF signal and by forcing the average of the IF signal to be a constant level by means of an automatic level control (ALC) loop. The rectified IF, after filtering the IF carrier, accurately represents the carrier average plus its AM envelope. In fact, the % AM equals the level of the ac component divided by the level of the dc component times 100%. Since the average carrier level is forced to be constant, the % AM is proportional to the level of the ac component alone. The demodulation process is illustrated in Figure 8-45.

2.5 MHz Low-Pass Filter and AM IF Buffer. The 2.5 MHz Low-Pass Filter determines the IF frequency response when using the 1.5 MHz IF or when the input signal is not down-converted. The filter has six poles and is designed for best flatness up to 2.5 MHz. At 2.5 MHz the flatness can be fine adjusted with C8 for minimum incidental AM. The filtered IF is routed to the AM IF Buffer and an FM IF Buffer (see Service Sheet 4) where it is further routed to the FM Demodulator, IF Level and IF Present Detectors, and the rear-panel IF OUTPUT.

Voltage-Variable Amplifier. The Voltage-Variable Amplifier adjusts its gain in response to the dc output from the AM and Level Detector. Thus it is the "leveler" of the ALC loop. In its most basic form it is a variable-gain, inverting operational amplifier as shown in Figure 8-44.

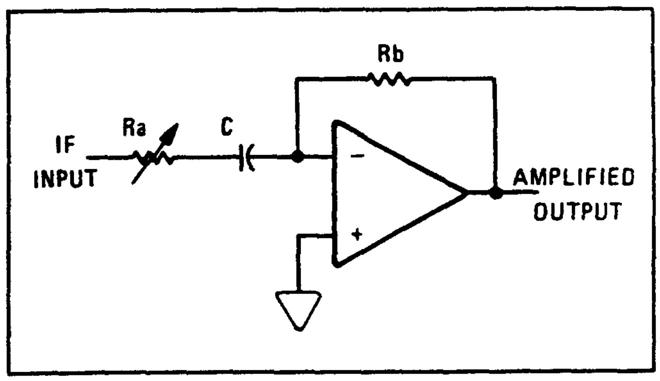


Figure 8-44. Simplified Diagram of the Voltage-Variable Amplifier

The gain of the Voltage-Variable Amplifier is −Rb/Ra and it is ac coupled. Ra is the photoresistor of the opto-isolator U4. Rb is R24.

The R-Setting (that is, Resistance-Setting) Loop is a feedback circuit which adjusts the input resistance of the Voltage-Variable Amplifier in proportion to the collector current of Q23 (the Control Current Source). This current, in turn, is proportional to the amplitude error of the IF signal.

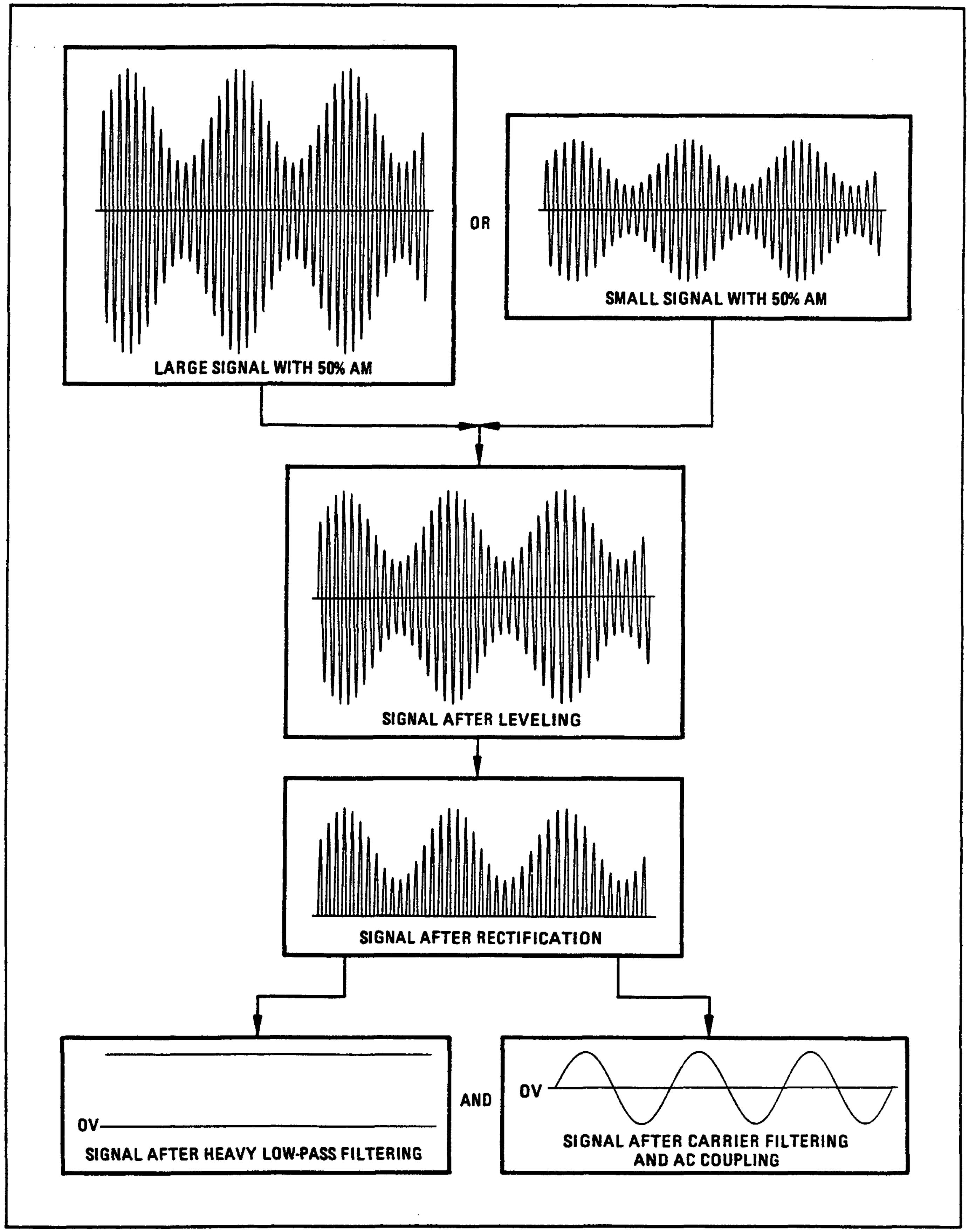


Figure 8-45. AM Demodulation Process

Comparison Amplifier U5 senses the difference in the voltage drop between R14 and the photoresistor of U4 in series with R22. The voltage drop across R14 is fixed. The voltage across the photoresistor and R22 depends on the collector current of Q23 and the resistance of the photoresistor. The difference in the two voltage drops is amplified by U5 which drives the LED of U4 via current source Q6. This varies the resistance of the photoresistor in such a manner as to reduce the voltage drop difference to zero. (The higher the current through the LED, the lower the resistance of the photoresistor.)

To clarify the action of the R-Setting Loop, suppose that a condition of too high an IF level causes the collector current of Q23 to decrease. The voltage at the inverting (−) input of U5 drops and lowers the collector current of Q6. The LED of U4 glows less brightly and the resistance of the photoresistor increases. This results in two effects: the voltage at the inverting input of U5 rises to the level present at the non-inverting (+) input, and the gain of the Voltage-Variable Amplifier decreases. Thus the IF level is reduced.

The Voltage-Variable Amplifier is designed to operate over a gain range of at least 16:1 (24 dB) with a maximum gain of 4 (12 dB). Q4 and Q5 provide the forward gain of the amplifier. The transistors are in cascode (a common-emitter transistor driving a common-base transistor) for well-defined performance at 1.5 MHz. C23 and R29 frequency compensate the amplifier. C20 prevents high-frequency peaking of the amplifier.

Q21 and Q20 form a unity-gain, buffer amplifier which drives the AM and Level Detector. Q31 improves the symmetry of the overdrive characteristics of the buffer amplifier. This is needed because the ALC loop initially receives signals when its ALC gain is maximum (the no-signal condition).

AM and Level Detector. The AM and Level Detector rectifies the IF carrier. Q13 to Q16, CR9 and CR10, and associated components form a precision, active, half-wave rectifier. A simplified diagram of the rectifier is shown in Figure 8-46. The circuit is essentially an inverting operational amplifier with two parallel feedback paths which each conduct current in a different direction as determined by CR9 and CR10. The path through CR9 can produce only negative voltages at the output to the Level Amplifier and Carrier Filter. This feedback path contains the network R73, R74, C43, and L8 which acts as a constant resistance (equal to R73) between CR9 and the amplifier's inverting (−) input, but low-pass filters the IF going to the AM Output Buffer.

The emitter of Q13 is the amplifier's common-base inverting input. The base of Q13 is the ac grounded, non-inverting input of the amplifier. Q13 is followed by a cascode stage Q15 and Q14. R58 and C40 frequency compensate the amplifier. Q16 is a +13.8V regulator and RF decoupling circuit. CR6 and CR7 protect the amplifier in the event of unusual conditions at the input.

AM Output Buffer. Q17, Q18, and Q19 form a unity-gain buffer amplifier which interfaces the demodulated AM with the rear-panel AM OUTPUT and the audio circuits. R87 and C50 further filter the IF carrier. R88 and C51 form the first two elements of a complex 260 kHz Low-Pass Filter (see Service Sheet 7).

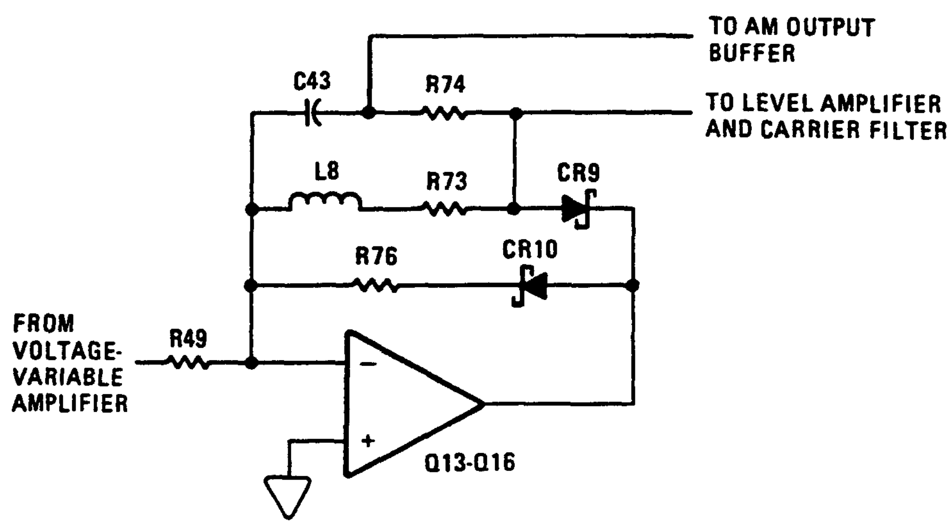


Figure 8-46. Simplified Diagram of AM and Level Detector

Level Amplifier and Carrier Filter. U3 and associated components form an inverting amplifier and IF carrier and AM ripple filter. Note that the non-inverting (+) input of U3 connects through R75 to the inverting input (namely, the emitter of Q13) of the AM and Level Detector which is its "virtual" ground. Thus the two amplifiers have a common signal-ground reference.

BW Control and Level Comparison Amplifier and Inverting Amplifier. The dc output of U3 represents the IF carrier level. This output is compared against a stable reference voltage. Any difference between the voltages is amplified by U1 and U2 and alters the current from the Control Current Source. U1 adds additional filtering to the detected IF and determines the response time of the ALC loop to variations in IF level (i.e., it determines the ALC bandwidth). Q2 permits selection of the 0.1 dB bandwidth of either 20 Hz when off or 200 Hz when on. When Q2 is on, the time constant of the integrator U1 is the product of R55 and C31. When Q2 is off, the time constant is the product of R51 + R54 + R55 and C31; C36 adds additional filtering. Q2 is switched by Q27 and Q3.

ALC Reference. The very stable voltage reference for the ALC loop is supplied by the voltage-reference diode VR3. VR3 is biased on by a regulated current source formed by Q1, VR4, and associated components. The reference output is divided by R69, R65, and R66. Fine adjustment of the ALC Reference is via R65.

Control Current Source. Q23 generates a current which adjusts the input resistance and, hence the gain, of the Voltage-Variable Amplifier. This is done via the R-Setting Loop.

Switches Q26 and Q28 are normally off and Q25 is normally on. Thus the output of U2 establishes the base voltage of Q23 and its emitter current. The collector of Q23 is a constant (load-invariant) current source. The output of U2 works against the +15V supply through R26, R31, R32, and Q24 which is wired as a diode to temperature compensate the base voltage of Q23.

Q22 produces a voltage at its collector that is proportional to the control current of Q23. This voltage can be monitored by the Voltmeter. The automatic leveling can be defeated, if desired, by switching off Q25 (user Special Function 6.2). The base of Q23 is then biased by R26, Q24, and R27. The combination of R123 and C17 forms a noise filter.

8-73. AM Demodulator (A6)— Service Sheet 4

General. The filtered IF signal is buffered and detected by two peak detectors. The output of the IF Level Detector is measured by the Voltmeter for use in determining the setting of the Input Attenuator and for the TUNED RF LEVEL measurement. The output of the IF Present Detector is used in the automatic tuning mode to sense the presence of an IF signal as the LO is swept through its ranges. Its output stops the LO sweep, bypassing the Controller, but can also be read by the Controller as needed.

FM IF Buffer. Q9 is an emitter-follower amplifier which drives the input to the FM Demodulator and the IF Detector Amplifier. Q10 is an emitter-follower amplifier which drives the rear-panel IF OUTPUT jack. Q10 receives its input from the output of Q9 which is divided down by R92 and R93.

IF Detector Buffer. Q11 and Q12 and associated components form an active 50 kHz high-pass filter with approximately 16 dB of passband gain. It suppresses a phantom signal that can appear in the IF as the result of the LO sweep even when no input signal is present.

IF Level Detector. CR15 detects the positive peaks of the IF signal. The detected peak is stored on C65. Q29 is a momentary switch to quickly discharge C65 upon request from the Controller. C70 charges C65 to a slightly negative value after being discharged by Q29. U6 and associated components form a unity-gain amplifier. A dc offset is generated by CR16 that thermally compensates CR15. The output is attenuated by R117 and R118 to make it compatible with the Voltmeter.

IF Present Detector. CR14 detects the negative peaks of the IF signal. The detected peak is stored on C63. The value of C63 is small enough to allow rapid charging. U7 compares the output of the detector with a reference at its inverting (−) input. The reference is established by the +15V and −15V supplies, R104, R105, R109, and CR13 which thermally compensates CR14. When an IF signal is sensed, the output of U7 goes to a TTL low. R112 provides hysteresis.

IF Present Latch. U10C and U10D form a set-reset flip-flop. When the IF Present Detector senses an IF signal, the flip-flop is set; that is, the output of U10C goes low and U10D goes high. This condition remains until the Controller resets the flip-flop by momentarily causing a low on pin 9 of U8. Readback of the IF Present Latch is via Q30. Q30 is enabled when the Controller, via U9, places a low on the emitter. CR17 prevents Q30 from becoming an active transistor in the inverted mode (i.e., the roles of collector and emitter are reversed) when the emitter is high and the collector is low. (For a discussion of the readback operation, see Direct Control Special Functions, page 8-8).

Select Decoder and Data Latch. See the general discussion under Instrument Bus, page 8-48.

8-74. FM Demodulator (A4) — Service Sheet 5

General. The IF signal to be FM demodulated is first passed through three amplifier/limiter stages to remove amplitude fluctuations. A buffer amplifier is also provided to drive the Counter and to isolate the demodulator from the digital noise on the line to the Counter.

IF Limiters. The three limiter stages are nearly identical, non-saturating differential amplifiers. Stage 2 is discussed here in detail. The low-level differential gain is about 22 dB and is stabilized by the negative-feedback resistors R14 and R22. The feedback resistors also extend the small-signal bandwidth so that the small-signal delay is equal to the large-signal delay. C10 compensates for phase changes with level. The high-signal, output level is determined by the current from current source Q19E being switched back and forth between differential transistors Q19A and Q19B. This switching develops an output voltage across load resistors R19 and R21. Emitter-followers Q19D and Q19C drive the next stage. Stage 3 drives the FM discriminator with its differential outputs and the Counter IF Buffer with one of its emitters.

Counter IF Buffer. Transistors Q2 and Q1 amplify and limit the IF signal to TTL levels. DC feedback through R40 and R39 sets the operating point. This amplifier also performs an isolating function.

8-75. FM Demodulator (A4) — Service Sheet 6

General. The IF signal is FM demodulated by a "charge-count" discriminator. Operation is similar to a "pulse-count" discriminator except that it is pulses of constant charge that are formed directly and averaged instead of voltage or current pulses of constant amplitude and width (that is, duration). For each cycle of IF signal, a large, amplitude-stable square wave charges and discharges a small capacitor. Steering diodes on the other side of the capacitor direct the negative discharge pulses to the inverting input of an operational amplifier which also partially smooths the charge pulses. In actual operation, two capacitors are charged and discharged on opposite phases of the IF signal. This doubles the sensitivity of the discriminator and doubles the frequency of the charge pulses.

The discriminator output is lightly filtered and is utilized in three places. A dc coupled signal goes to the rear-panel FM OUTPUT jack. Another dc coupled signal is fed back to the LO tune input to form an automatic frequency control loop when in the track-tune mode. The main, ac coupled signal goes to the FM Output Amplifier and is then processed by the audio circuits. A Squelch Switch at the input to the FM Output Amplifier cuts off the FM output when the IF signal level is too low for good noise performance.

FM Discriminator (Simplified). Figure 8-47 shows a simplified schematic of the FM discriminator. The differential IF inputs from the IF Limiters alternately cause the collectors of Q12 and Q13 to clamp to one diode drop above a +6V reference and one diode drop below a −10V reference. The two collectors move out of phase with each other. Thus the left end of C27 swings 16 V_{pp} plus two diode drops. Diodes CR10 and CR12 clamp the right end of C27 to within one diode drop of −10V. Thus C27 is alternately charged to 16V and discharged to 0V. A fixed amount of charge flows through CR12 from the inverting (−) input of the operational amplifier each time the collector of Q12 drops from +6V to −10V, namely, once per cycle of the IF signal. The value of the charge is CV, where C is the value of C27 and V = 16V. The average current flowing through CR12 is CVf, where f is the IF signal frequency. The operational amplifier forces this current to flow through R69 and R71, thus producing a voltage which is directly proportional to capacitance, voltage, resistance, and frequency. Since the first three quantities are held constant, the discriminator output is a linear function of frequency.

Exactly the same behavior happens in connection with C28, but 180 degrees out of phase, with the result that the discriminator output voltage is doubled and the ripple frequency is doubled (twice the IF). C31 and C33 smooth the ripple as do R85, R87, and C42. The high-frequency response of the entire FM system is adjusted with R85.

Upper Clamp, Lower Clamp Regulator, and Upper Clamp Buffer. Refer now to the schematic diagram of Service Sheet 6. The Upper and Lower Clamp

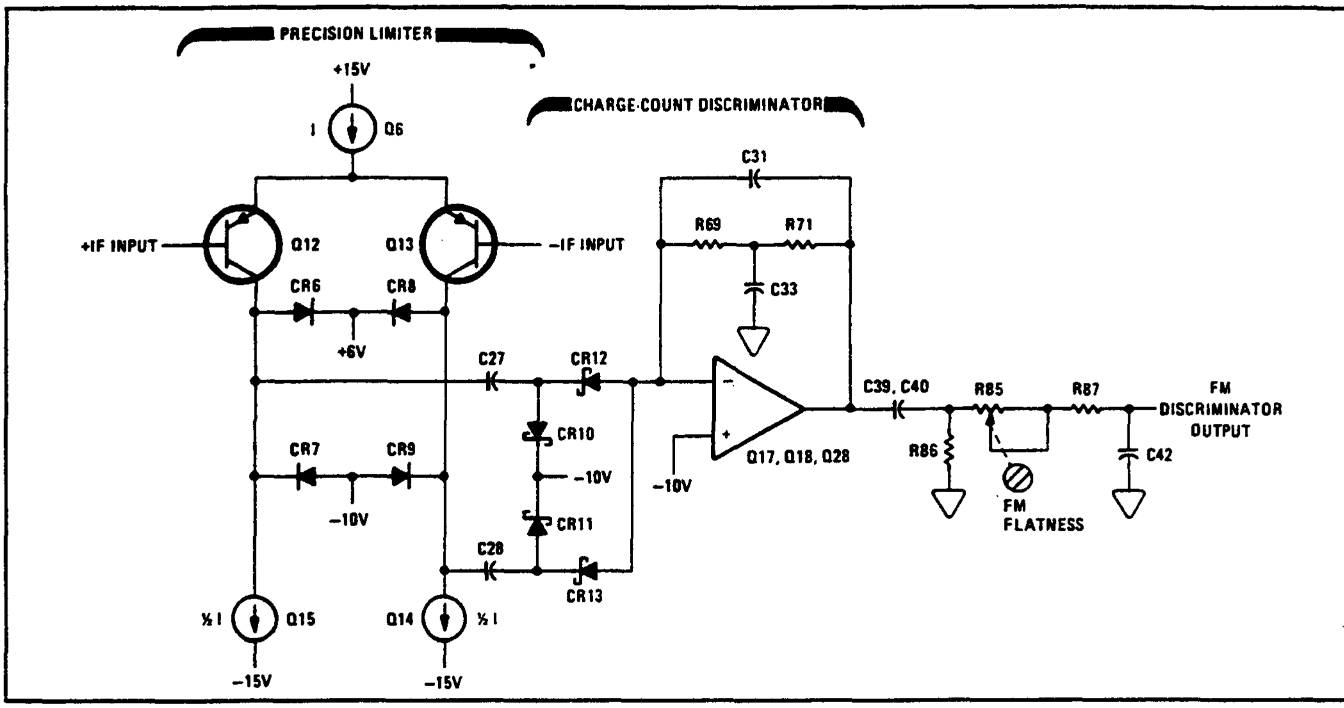


Figure 8-47. Simplified Schematic Diagram of FM Discriminator

voltages (nominally +6V and −10V) must be very stable and quiet since they directly affect FM demodulator sensitivity and noise. The basic reference is a temperature-stable reference diode VR1. The reference is fed from current source Q8, which itself is temperature stable because its base-emitter junction and its reference (LED DS1) have similar thermal behavior. The Upper Clamp voltage is taken directly from VR1 through emitter-followers Q9 and Q10 whose thermal variations cancel. The Lower Clamp voltage is referenced to VR1 with the Lower Clamp Regulator composed of comparison transistors Q4 and Q3 and pass transistor Q5, and is adjustable with R50. This adjustment changes the sensitivity of the demodulator and is used to calibrate the FM system. C24 and C25 reduce noise.

Precision Limiter and Charge-Count Discriminator. The three current sources (shown in Figure 8-47) are temperature-compensated and consist of transistors Q6, Q14, and Q15, and voltage references (LEDs) DS1 and DS2. Q7 and C26 filter the −15V supply. RL networks R64 and L1 and R65 and L2 speed up shut-off of charge steering diodes CR10 and CR11 by means of a controlled amount of overshoot, which improves linearity. R66 and C29 improve linearity by introducing a small frequency-dependent voltage in series with charge steering diodes CR10 and CR11.

The discriminator amplifier, a discrete operational amplifier, consists of amplifier transistors Q18, Q17, and Q28 and current-source transistors Q29, Q34, and Q33. Q34 and Q33 comprise a conventional two-transistor current source in which negative feedback causes the voltage drop across the emitter resistor (R81) of Q33 to equal the base-emitter voltage of Q34. The voltage that is thus established at the base of Q33 (two junction drops above the −15V supply) is also used as the reference for three other current source transistors (Q29, Q27, and Q26). R75 is added to reduce the sensitivity of the latter three current sources to power supply ripple.

R69 and R71 are the feedback resistors mentioned above and, in combination with C31 and C33, form a bridged-T network in the feedback path of the discriminator operational amplifier, producing the complex pole pair of a three-pole, low-pass filter. The third pole is produced later in the signal chain (see Service Sheet 8). The bridged-T network also produces a real-axis zero which is cancelled by the pole introduced by R85, R87, and C42. C35 and RC network R68 and C32, frequency-compensate the amplifier.

FM Output Amplifier. The FM Output Amplifier is an FET input, non-inverting amplifier with a voltage gain of 3.3 that is determined by feedback resistors R95 and R93. C43 and C44 are compensation elements. R97 and R99 establish the output impedance of the amplifier in order to properly drive the 260 kHz Low-Pass Filter which is at the amplifier's output (see Service Sheet 7). C45 is the first element of that filter.

Squelch Circuits. The squelch circuits short the signal path to ground by means of FET switch Q21 when the IF signal is too weak for proper operation of the instrument. Q21 is controlled by the Squelch Detector at the output of the IF Limiters and by the Controller through Squelch Switch Drive transistors Q32 and Q31. Q21 is a low-impedance short when its gate-to-source voltage is zero (Q32 and Q31 off).

8-76. Audio Filters (A2)—Service Sheet 7

General. The Audio Filter Assembly contains some of the circuits that process the audio signal: low-pass filters, attenuators, and amplifiers. The inductors of all filters are carefully oriented and shielded to minimize mutual coupling and pickup of stray power line fields.

260 kHz Low-Pass Filters and 20 dB Attenuator 1. The two 260 kHz Low-Pass Filters remove any IF carrier remaining on the demodulated AM or FM. Both are seven-pole, Butterworth filters with a nominal 3 dB cutoff frequency of 260 kHz. The filters determine the high-frequency response of the audio system when LP FILTER is set to ALL OFF. For each filter the first shunt capacitor is on the previous assembly (see Service Sheets 3 and 6). Filter switching is via U1. An additional range of FM is provided by 20 dB Attenuator 1 (R8 and R9) at the output of its 260 kHz Low-Pass Filter. R5 and C12 form a real-axis zero to equalize for a real-axis pole found later in the audio chain (see Service Sheet 8) when in AM only. In FM the pole is utilized in determining the overall frequency response. C11 is a dc blocking capacitor. R6 permits adjustment of the AM sensitivity.

Amplifier 1. Amplifier 1 is a low-noise, high slew-rate, non-inverting amplifier with a gain of 2.8. It must pass 200 kHz signals with minimum loss of fidelity. Amplifier transistors Q1, Q3, Q6, and Q7 and current source transistors Q2, Q5, and Q4 form a discrete operational amplifier. The overall amplifier gain is determined by feedback resistors and is equal to 1 + (R27/R22). The bases of differential pair Q1A and Q1B are respectively the non-inverting and inverting inputs of the amplifier. Q4 and Q5 comprise a conventional two-transistor current source in which negative feedback causes the voltage drop across the emitter resistor (R24) of Q4 to equal the base-emitter voltage of Q5. The voltage that is thus established at the base of Q4 (two junction drops above the −15V supply) is also used as a reference for current source transistor Q2. Complementary transistors Q6 and Q7 provide the current necessary to drive the output load at high modulation rates or levels. R11 and C14 frequency compensate the amplifier.

15 kHz and >20 kHz Low-Pass Filters. The 15 kHz Low-Pass Filter is selected when LP FILTER is set to 15 kHz or when the 455 kHz IF is being used (unless overridden). It is also switched in whenever the 3 kHz Low-Pass Filter (see Service Sheet 8) is selected to improve stopband rejection. The filter is a five-pole, Butterworth filter with a 3 dB frequency of 15 kHz.

The >20 kHz Low-Pass Filter has nine-poles and approximates a Bessel response to minimize overshoot. The 3 dB frequency is approximately 110 kHz.

The filters are switched by U2 and U4D. Since each filter has a 6 dB loss in the passband, the 6 dB Attenuator is inserted into the through path. Thermistors RT2 and RT3 compensate for thermal changes in the resistance of the filter inductors (and hence the insertion loss). The passband gain of the filters is adjusted by means of R40 and R44. When the 15 kHz Low-Pass Filter is selected, the outputs of the 6 dB Attenuator and >20 kHz Low-Pass Filter are grounded to minimize leakage through the output switches.

Amplifiers 2 and 3 and 20 dB Attenuator 2. Amplifier 2 is non-inverting and has a gain of 4.84. Thermistor RT1 compensates for thermal changes in the resistance of the filter inductors of the 260 kHz Low-Pass Filters.

Two of the audio gain ranges are determined by 20 dB Attenuator 2 and the through path as set by the Audio Gain Selectors U4C and U4B.

Amplifier 3 is non-inverting and has a gain of 10 overall (including the attenuation due to R46 and R47). R47, R48, and the amplifier load (on Service Sheet 8) are grounded in such a way as to minimize the effect of ground loops.

8-77. Audio De-emphasis and Output (A3) — Service Sheet 8

General. The Audio De-emphasis and Output Assembly contains some of the circuits that process the audio signal—high- and low-pass filters, amplifiers, and an integrator for phase de-modulation. It also contains the Instrument Bus decoding logic for it and the Audio Filter Assembly and the FM Demodulator Assembly.

300 Hz and 50 Hz High-Pass Filters and High-Pass Filter Switching. The 300 Hz and 50 Hz High-Pass Filters are active, two-pole, Butterworth filters with unity passband gain. Selection of the filter outputs or the through line is via U12A, U12B, and U12C. The 50 Hz High-Pass Filter is automatically selected when measuring ΦM.

3 kHz Low-Pass Filter, Low-Pass Filter Switching, and 300 kHz Pole. The 3 kHz Low-Pass Filter is an active, five-pole, Butterworth filter with unity passband gain. U4A is a unity-gain input buffer to the filter; R7 and C24 at its output form a real-axis pole. The R8, R9, C25, C26 and U4D form a pair of complex poles, and R11, R12, C33, C34, and U4C form another pair. Selection of the filter output or the through line is via U13A and U12D. R18 and C42 form a real-axis pole at 300 kHz that completes the filter for the Charge-Count Discriminator in the FM Demodulator (see Service Sheet 6). U3 is a unity-gain buffer amplifier.

De-emphasis Networks and Phase Modulation Integrator. The de-emphasis networks can be selected only in FM. They are simple single-pole low-pass filters with 3 dB frequencies as follows:

Time Constant (μs)	3 dB Frequency (Hz)
25	6366
50	3183
75	2122
750	212.2

The 750 μs de-emphasis network is followed by an amplifier (U9A, R32, and R34) with a gain of 10. The gain is needed because 750 μs FM de-emphasis is normally used in situations where more resolution is desired because of low levels of deviation and noise.

The Phase Modulation Integrator, U9B, converts the voltage from the FM Demodulator, which is proportional to frequency deviation, into a voltage proportional to phase deviation. Mathematically, the instantaneous phase deviation is equal to the time integral of the instantaneous frequency deviation (see Modulation Basics in the Operating Manual). VR2 and VR3 limit the integrator output for large inputs and low frequencies. The integrator sensitivity is adjusted using R27.

Switching of the de-emphasis networks and Phase Modulation Integrator is via the switches at their outputs. U14A and U14B select the input to the amplifiers that drive the Voltmeter, whether the input is before or after the de-emphasis. When de-emphasis is used, the de-emphasized signal is always present at the MODULATION OUTPUT jack.

Output Amplifiers. U10, U8, and associated resistors form two, closely matched amplifiers with a gain of two. U11 inverts the output of U10 and drives the MODULATION OUTPUT jack through 600Ω impedance (R54 and A25R1). U7 either inverts or does not invert the output of U8 depending on its configuration determined by the states of U14C and U14D. When U14C is active, the amplifier is non-inverting. When U14D is active, the amplifier is inverting.

Absolute Peak Detector. The input level to the assembly is sensed by the Absolute Peak Detector to determine if audio ranging is necessary. Range sensing is normally done by the Peak Detector (see Service Sheet 9). However, large signals of stopband frequency at the input to an active filter may go undetected by the Peak Detector and overdrive the filter. The Absolute Peak Detector and the Peak Detector are both read by the Voltmeter to determine the proper setting of audio gain.

The Absolute Peak Detector consists of an inverting, negative-peak detector (U6) and a non-inverting, positive-peak detector (U5) driving a common hold capacitor C44. The voltage across C44, then, is never negative. When the input voltage is negative, CR4 is off. The action of U5 is to turn on CR2 and reverse bias CR6 because the voltage across C44 is positive and the output of U5 is at least one junction drop more negative than the negative input voltage. Ignoring those components that have no effect, the detector can be simplified as shown in Figure 8-48. The circuit shown is a conventional inverting, negative-peak detector.

When the input voltage is positive, CR2 is off. The action of U6 is to turn on CR4 and reverse bias CR5 because the voltage across C44 is positive and the output of U6 is one junction drop below ground. Ignoring those components that have no effect, the detector can be simplified as shown in Figure 8-49. The circuit shown is a conventional non-inverting, positive-peak detector.

CR1 and CR7 are protection diodes. The hold capacitor can be discharged by switching on Q1 via U15D at the request of the Controller. The detector's output goes to the Voltmeter.

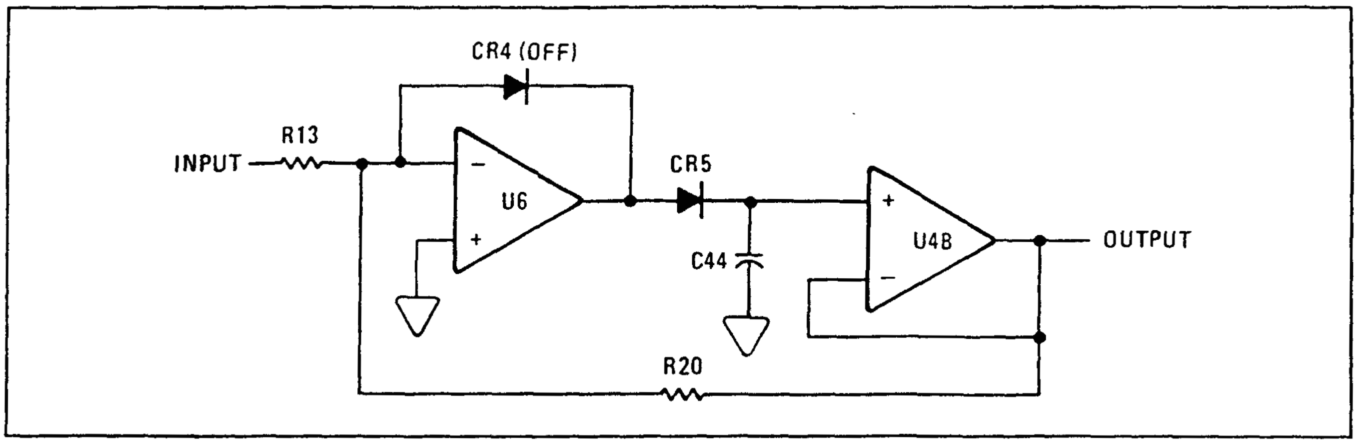


Figure 8-48. The Absolute Peak Detector Shown as an Inverting, Negative-Peak Detector

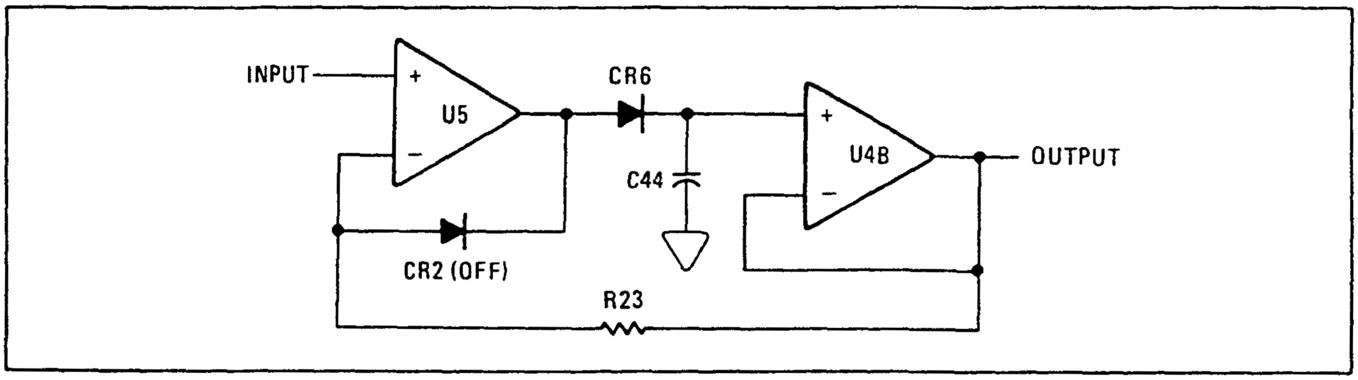


Figure 8-49. The Absolute Peak Detector Shown as a Non-Inverting, Positive-Peak Detector

Audio Overvoltage Detector. The Audio Overvoltage Detector is a positive-peak detector followed by a comparator. If the peak input level should exceed +3.6V, U9D goes low and resets register U19. This opens up the audio path from the 260 kHz Low-Pass Filters via the Modulation Selectors (see Service Sheet 7). The status of the detector is read by the Controller via gates U21D and U21C.

Digital Circuits. Some of the digital circuits on this assembly also control circuits on the FM Demodulator and Audio Filter Assemblies (see Service Sheet 6 and 7). For a general discussion of instrument control, see Instrument Bus, page 8-48.

The FM SQUELCH (L) line going to the FM Demodulator is both an input and an output line. FM is squelched when either the Squelch Detector (see Service Sheet 6) senses a low IF level or when the Controller requests squelch. In the former case the line goes low and resets flip-flop U22B. The status of squelch can then be read by the Controller via gates U21B and U21C. The Controller can reset squelch by clocking a low into U22B which pulls the FM SQUELCH (L) line low. (For a discussion of the readback operation, see Direct Control Special Functions, page 8-8).

8-78. Voltmeter (A5)—Service Sheet 9

General. The Voltmeter Assembly contains two ac-to-dc converters: the Peak Detector and the Average Detector. The input to the detectors is the output of the audio system and is a voltage proportional to AM depth, frequency deviation, or phase deviation.

Peak Detector Circuits. The peak-detecting circuitry consists of the Peak Detector, the Sample-and-Hold Switch, and the Buffer Amplifier. U3 and Q1 comprise a high-gain comparison amplifier. The inverting (−) input of U3 is the non-inverting input of the overall comparator. If the inverting input of U3 is equal to or more positive than the voltage at the non-inverting (+) input, the output drives the collector of Q1 to follow the inverting input of U3. In doing this Q1 must charge C23. When the inverting input of U3 lowers, the output of U3 goes high and shuts off Q1. Since C23 has no path to rapidly discharge, it remains at its previous potential which was the peak value of the input voltage.

Q8 is a Sample-and-Hold Switch which is periodically switched on (every 100 ms) to transfer the voltage across C23 on to C24. U5 is a high-impedance, unity-gain buffer amplifier which minimizes bleeding of C24 when Q8 is off (in its hold mode). Astable multivibrator U7 controls the switching of Q8. Q8 is switched on by Q9 when the output of U7 goes low. The transfer frequency is determined primarily by R14 and C7. The transfer time is determined by C7 and either R13 (when Q10 is off) or R13 in parallel with R10 (when Q10 is on). Also, when U7 goes high, Q3 is momentarily turned on to rapidly discharge C23 (at this time Q8 is off). Thus, C23 must be recharged by the Peak Detector after each charge-transfer cycle.

The result of the sample-and-hold sequence is to control the response time of the peak-detector circuit and to make it respond equally well to an increasing or decreasing input level. This is illustrated in Figure 8-50 where the response to a step increase and decrease in input level is shown.

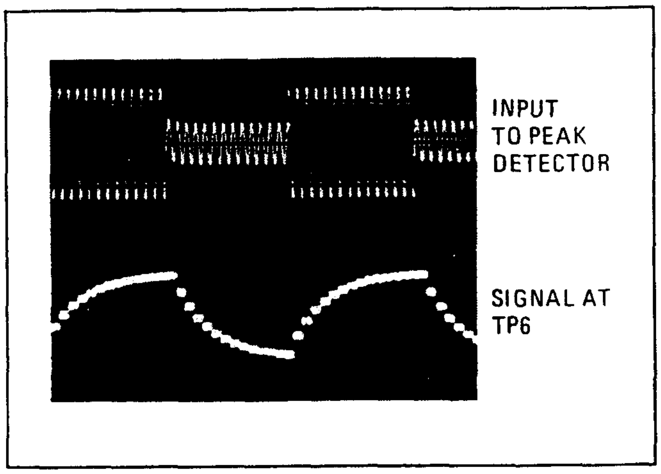


Figure 8-50. Action of the Peak Detector Sample-and-Hold Filter

Normally, Q10 is off and the charge-transfer time is long enough for C23 to be charged completely. This gives the fastest response time. To slow down the peak-detector response, Q10 is switched on (by issuing 5.1 SPCL). R10 then is switched in parallel with R13 which shortens the time U7 is low. (See schematic Note 4 for timing information.) R46 now prevents C23 from charging completely in one sample period. This slows down the response time and smooths the output for a noisy signal. When DETECTOR is set to PEAK HOLD, U7 is reset to switch Q8 into a permanent sample (on) mode. The voltage across C24 is then equal to the peak of the peaks. (In this mode the Controller also digitally holds the peak of the peaks read by the Voltmeter.)

Offset resistor R49 for U5 is adjusted under a no-signal condition to produce an output equal to the typical peak-detected noise level.

Average Detector. The Average Detector consists of the Half-Wave Rectifier followed by the Summer and Filter. The voltages and currents in the detector, for a sine wave input, are shown in Figure 8-51. The input voltage produces a current in R22. This current

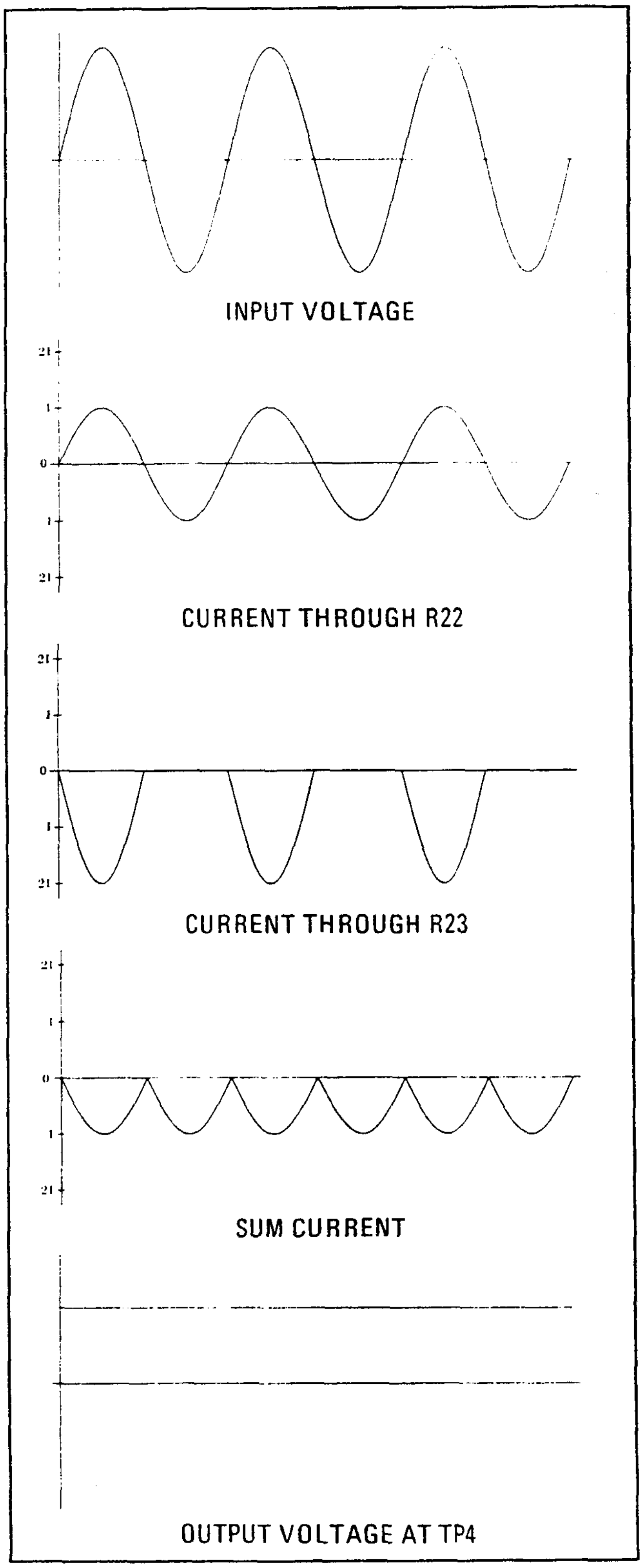


Figure 8-51. Waveforms in the Average Detector

is summed with the current in R23, also produced by the input voltage, which has been half-wave rectified and inverted. Since R23 is approximately half the value of R22 (and has a very stable resistance), the half-wave current is weighted by a factor of two when summed. The sum current, then, is proportional to the full-wave-rectified input voltage. After filtering, the sum current produces a dc voltage equal to the "absolute" average value of the input voltage. (The "actual" average of a sine wave is, of course, always zero.)

U2 and Q7 form an inverting amplifier with two feedback paths (one for each direction of current flow). For a positive input voltage, current flows through R8, R12, and CR6. Since the values of R8 and R12 are equal, the output of R12 is opposite and equal to the input voltage. For a negative input voltage, the current flows through R8 and CR7. Since no current flows through R12 (because CR6 is shut off), the output from R12 is zero. Q4 is a constant current source. Q7 is a common-base stage; its collector is a current source whose output current is determined by the output of U2. For a positive input voltage, Q7 must sink the current from Q4 and the load current through CR6. For a negative input voltage, Q7 sinks only the portion of the current from Q4 that does not flow through CR7. The effect of Q7 and Q3 is to enhance the ability of the circuit to rectify small input voltages by increasing the forward gain of the amplifier.

U1 sums the current in R22 and R23. The sum current flows through the feedback resistors R32 and R35 and filter capacitor C17 to produce a negative dc voltage proportional to the sum current. R37, C20, R38, and C21 add further filtering. The Average Detector has two offset adjustments. R29 is adjusted under a no-signal condition so that the detector output is zero with the Half-Wave Rectifier R7 adjusted to shut it off. R7 is then adjusted for a detector output equal to one half of the least significant digit normally displayed. (This compensates for the fact that this undisplayed digit is dropped and not rounded off.)

8-79. Voltmeter (A5)—Service Sheet 10

General. The Voltmeter Assembly contains the Input Clamps, Input Selectors, the Voltage-to-Time Converter portion of a digital dc voltmeter, and a Parity Check circuit.

Input Selectors and Input Clamps. Multiplexers U10, U11, and U12 form a 24 pole, single-throw switch. The individual multiplexers are enabled by a low on the F input. U10 or U11 is enabled when the code esd=1C0 is issued on the Instrument Bus. After that, a code of the form esd=1Fd is issued to select a given input line. If d3=1, U11 is enabled. If d3=0, U10 is enabled. The code esd=1C0 need not be re-issued to change the switching of U10 or U11. U12 is enabled when the code esd=1C4 is issued. After that, a code of the form esd=1Fd is issued to select a given input line (d3=0 is not allowed here, for it would also enable U11). The selecting of U11 or U10 and U12 is via register U13B and exclusive-OR gate U9D. On the significance of the Instrument Bus codes, see Instrument Bus, page 8-48. Most analog inputs to the multiplexers are protected by two clamp diodes and a series resistor.

Voltage-to-Time Converter. The dc voltage at the Voltmeter input is converted to a pulse, with a duration proportional to the magnitude of the voltage, by the Voltage-to-Time Converter. The pulse length is then measured by the Counter (see Service Sheet 17), digitally processed by the Controller, and displayed. The converter consists of the Comparator, Ramp Generator, and Voltage Reference.

The Voltage Reference supplies a voltage of known temperature stability to the input to the Ramp Generator. The basic reference is a temperature-stable reference diode VR4. The reference is fed from current source Q2, which itself is temperature stable because its base-emitter junction and its reference VR3 have similar thermal behavior. The negative reference supplies current to the inverting (−) input of U4 through R76 and R77. CR14, R71 and R72 add a slight temperature coefficient to the current to cancel the effect of the temperature coefficient of C30. The Voltmeter sensitivity is adjusted by means of R76.

U4 (with C30) integrates the negative input current to produce an increasing ramp. The ramp is generated only when Q6 is off (when the Ramp Gate (H) line is high). This is initiated by the Controller. When on, Q6 supplies a positive current to the inverting input of U4 which overrides the current from the reference and turns on CR15. The output of U4 is thus clamped one junction drop below ground. Since the ramp begins at a rather imprecise voltage, each voltage measurement includes a measurement of ground which is then subtracted out.

The ramp begins when the Ramp Gate (H) line goes high. The output of comparator U6 at this time is low because the positive (or zero) voltage at its inverting (−) input is higher than the voltage at its non-inverting (+) input. The Counter now begins clocking the duration of the ramp. When the ramp reaches the voltage at the inverting input, the output of U6 goes high and inhibits the clocking of the Counter. R79 and R81 add a small amount of hysteresis to the Comparator to assure a complete transition of the output once it begins to change.

Parity Check. The Parity Check circuit allows the Controller to test the integrity of the data lines of the Instrument Bus. To check parity, the Controller sends out the sixteen codes (esd=1F0 to esd=1FF). For each code, the output of exclusive-OR gate U9C is read back by the Controller. The output of U9C is low when d0+d1+d2+d3 is even, or high when it is odd. On the significance of the Instrument Bus codes, see Instrument Bus, page 8-48. Parity is checked only during instrument power up (see Power Up Checks, page 8-17).

Digital Circuits. For a general discussion of instrument control, see Instrument Bus, page 8-48. For a discussion of the readback operation, see Direct Control Special Functions, page 8-8.

8-80. LO Divider (A19)—Service Sheet 11

General. The LO Divider Assembly converts the nominal 320 to 650 MHz signal from the High Frequency VCO to the appropriate range required to down-convert an RF input signal to the IF frequency. The circuits consist of one frequency doubler, one through path, and eight binary dividers (i.e., divide-by-two's) for a total of ten ranges. The first two dividers and a separate third divider are always enabled to provide a 40 to 81.25 MHz signal for the Counter. Figure 8-52 shows the divider scheme.

Input Buffer and Doubler Circuits. U2 is a non-saturating, high-frequency limiter which interfaces the High-Frequency VCO with the dividers and Frequency Doubler. The non-inverted output drives the first divider (U8). When in Band 0, the inverted output (the DIV 0 line) drives the LO output jack (J3) via U10, U5, and CR9. The inverted output also drives the Frequency Doubler through the Doubler Input Filter.

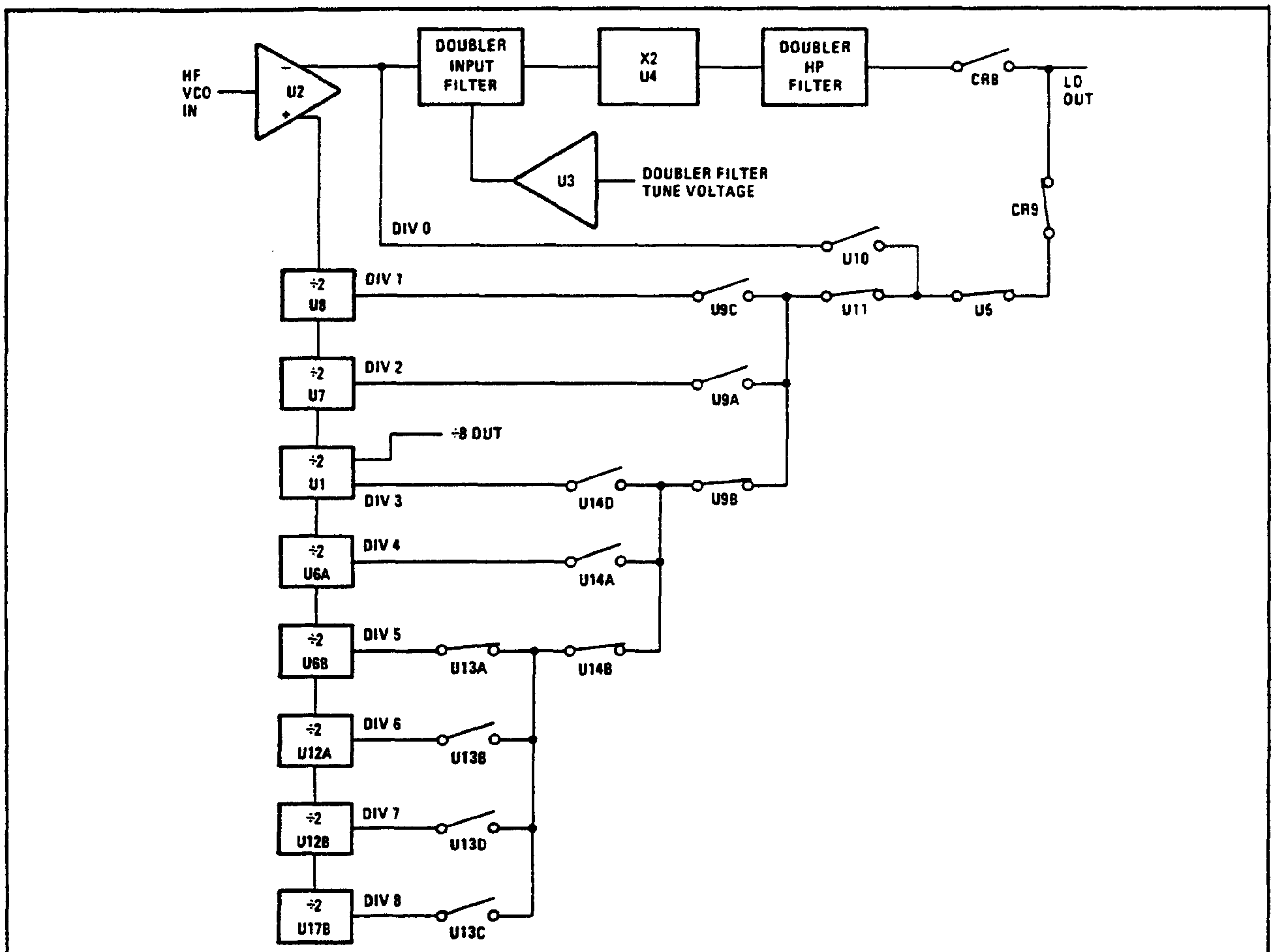


Figure 8-52. LO Divider Scheme (Shown for Band 5)

The Doubler Input Filter is a five-pole, tuneable, low-pass filter which removes the odd-ordered harmonics of the High Frequency VCO input to maximize the signal output and minimize subharmonics which could cause spurious IF responses. The filter is tuned by varactor diodes CR2 to CR5 which are driven by the same voltage that tunes the High Frequency VCO (see Service Sheet 12). The tune voltage is filtered by R1 and C1, attenuated by R1, R20, R22, and R23, then offset and buffered by U3.

The Frequency Doubler (U4) is an active, full-wave rectifier. The input transformer (U4T1) produces two out-of-phase signals in its secondary windings which drive the two inputs of differential amplifier (U4Q1 and Q2). The two differential output amplifiers (U4Q3 and Q4) conduct current flowing only in one direction; their outputs are wired-OR and produce a train of negative, full-wave rectified pulses. R41 can be adjusted to improve the balance (i.e., minimize the fundamental and odd-harmonic feedthrough) and minimize the possibility of the 1/2 and 3/2 harmonics of the doubled signal causing an IF response.

The Doubler Output Gate and High-Pass Filter aids in further eliminating the 1/2 harmonic of the doubled signal. PIN diodes CR7, CR8, and CR9 switch the signal either from the doubler or the dividers to the LO output jack. For the Band Doubler, CR7 and CR8 are on and CR9 is off.

Divider Circuits. The first two dividers (U8 and U7) are EECL devices; all others are ECL. Signal routing is done via gates, switchable limiters (e.g., U10 and U11), and PIN diodes. Except for Bands Doubler (Dblr), 0, and 1, the divider following the output divider is turned off to eliminate subharmonics which would be generated by leaving all dividers on. In the case of Band 2, U1A only is disabled. (This is not apparent in Figure 8-52.) Figure 8-52 does show that on Band 5, for example (where the output is taken from Divider 5, U6B); U8, U7, U1A, U6A, and U6B are all enabled and U12A is disabled (by setting it). The output of U6B is routed to the LO output jack via U13A, U14B, U9B, U11, U5, and CR9.

Divider and Gate Decoders. Band enabling and signal routing is controlled by the Divider-Disable/Gate-Enable Decoder (U15 and U18). The decoder simply demultiplexes the esd=00d code generated by the Instrument Bus and latched by the LO Control circuitry (see Service Sheet 15). The d is unique for each band. Further decoding for the added switching complexity that arises on the higher-frequency bands is accomplished by the Gate-Enable Decoders and Divider Output and Doubler Gate Drive circuits. For a general discussion of instrument control, see Instrument Bus, page 8-48.

8-81. Sampler (A23)—Service Sheet 12

General. The Sampler Assembly contains the Sampler and the HF VCO Tune Integrator and Amplifier. The assembly's output tunes the HF VCO and the Doubler Input Filter (see Service Sheet 11). Except for the track tune mode, the Sampler is used to phase lock the HF VCO to a tuneable, low-noise reference oscillator (the Low Frequency VCXO) when the LO has been tuned to the proper frequency. The Sampler is the phase detector of the phase lock loop. For principles of operation of the High Frequency VCO (A24), see page 8-69.

Sampler. The Sampler consists of the 2 MHz Limiter Amplifier, Impulse Generator, Sampling Bridge, and Sampler Amplifier. The Sampling Bridge is driven from the LF VCXO through the Impulse Generator. Once each cycle of the LF VCXO, the Impulse Generator produces a pulse which turns on the diodes of the Sampling Bridge for about 1 ns. At that time the signal from the HF VCO is sampled, and the sampled voltage is stored on a capacitor. If the HF VCO is frequency-coherent with a harmonic of the LF VCXO, the HF VCO will be sampled at the same point each time, and the output from the Sampling Bridge will be a dc voltage equal to the signal amplitude at the sample point. If the two signals are not frequency coherent, the output from the Sampling Bridge will be a sine wave with a frequency equal to the difference between the HF VCO and the nearest harmonic of the LF VCXO. This is illustrated in Figure 8-53.

The nominal 2 MHz signal from the LF VCXO is first squared by the 2 MHz Limiter Amplifier. The limiter keeps the drive level to the Impulse Generator constant to keep the sample time of the Sampling Bridge constant. The limiter consists of Q1 and Q2—a non-saturating, differential amplifier.

The limiter drives switch Q6. When Q6 is off (i.e., when Q2 is off), step-recovery diode CR3 is forward biased by R16, L7 and L8. When Q6 goes on, it quickly reverse biases CR3. CR3 then begins to conduct current in the reverse direction until the minority carriers, which had accumulated near the diode junction when forward biased, have been removed. The diode current then snaps off. Since this same current is flowing in L7 and L8, a large pair of impulses (or flyback voltages) are produced when the current ceases. C16 is a high-frequency ac

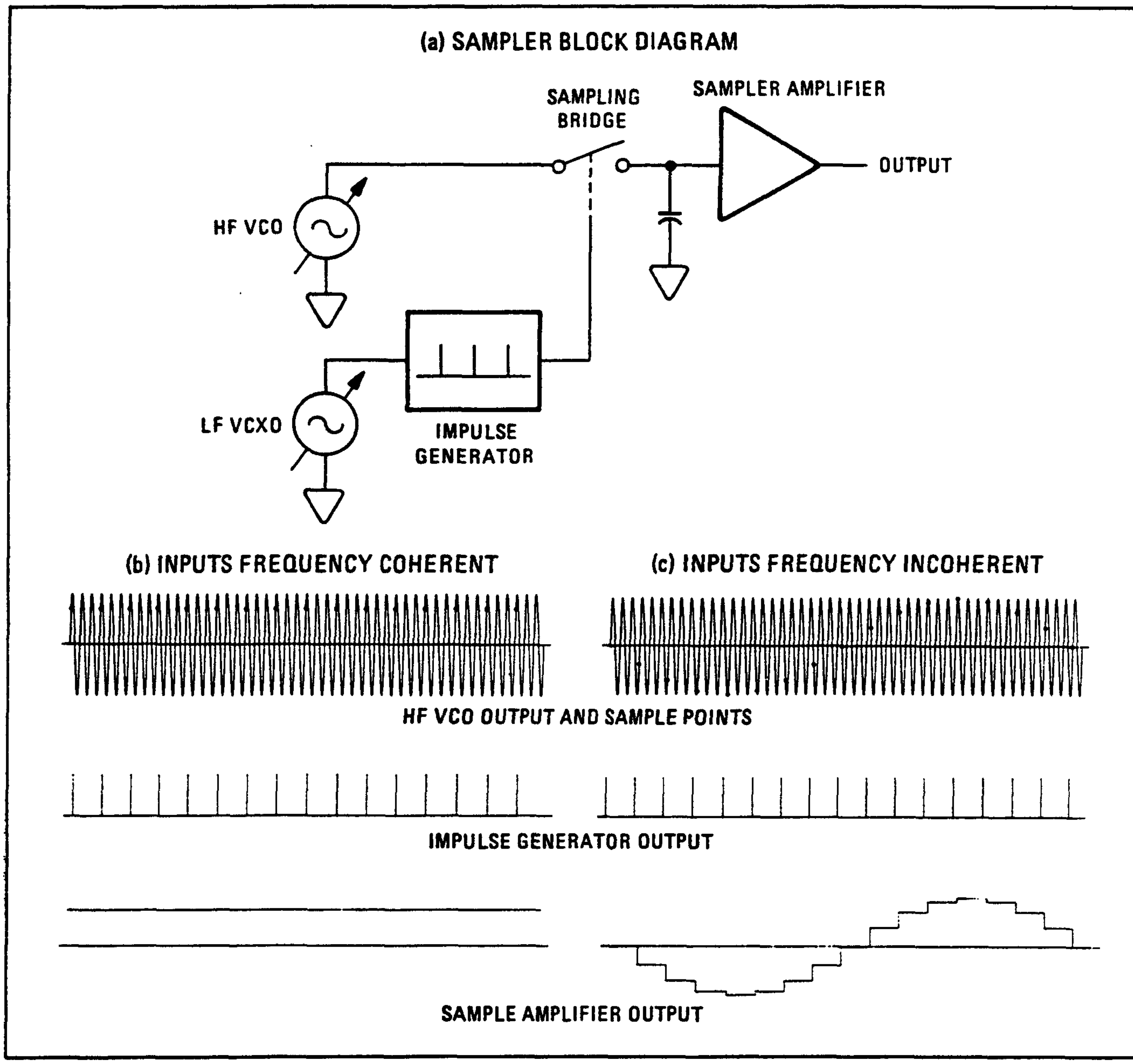


Figure 8-53. Sampler Operation

short. L7, L8, R19, R20, and the capacitance of CR3 form a carefully damped parallel resonant circuit to control the ringing of the impulses. C18, L10, and C21 and C19, L11, and C22 form two high-pass filters to pass the impulse pair but filter out any low-frequency 2 MHz signal. T1 is a balun which forces the impulse currents going to the Sampling Bridge to be opposite and equal to maintain balance in the bridge.

The Sampling Bridge consists of four matched, hot carrier diodes (CR6 to CR9). Normally, the diodes are reverse biased at approximately 4V (through R27 and R28). When a sample pulse occurs, the current impulses from T1 simultaneously forward bias all four diodes. This momentarily closes the signal path from the HF VCO to the gate of Q9B and charges C25 to the level of the waveform at that instant. The 700 MHz Low-Pass Filter removes the third harmonic of the HF VCO which influences the gain of the phase lock loop by altering the slope of the waveform at the zero crossing.

The Sampler Amplifier is a dc to 5 MHz follower with feedback to automatically maintain a reverse bias of 4V on the Sampling Bridge diodes regardless of the output from the bridge itself. A simplified schematic of the Sampler Amplifier is shown in Figure 8-54. Zener diodes VR2 and VR3 (represented as batteries in Figure 8-54), produce the bias refer-

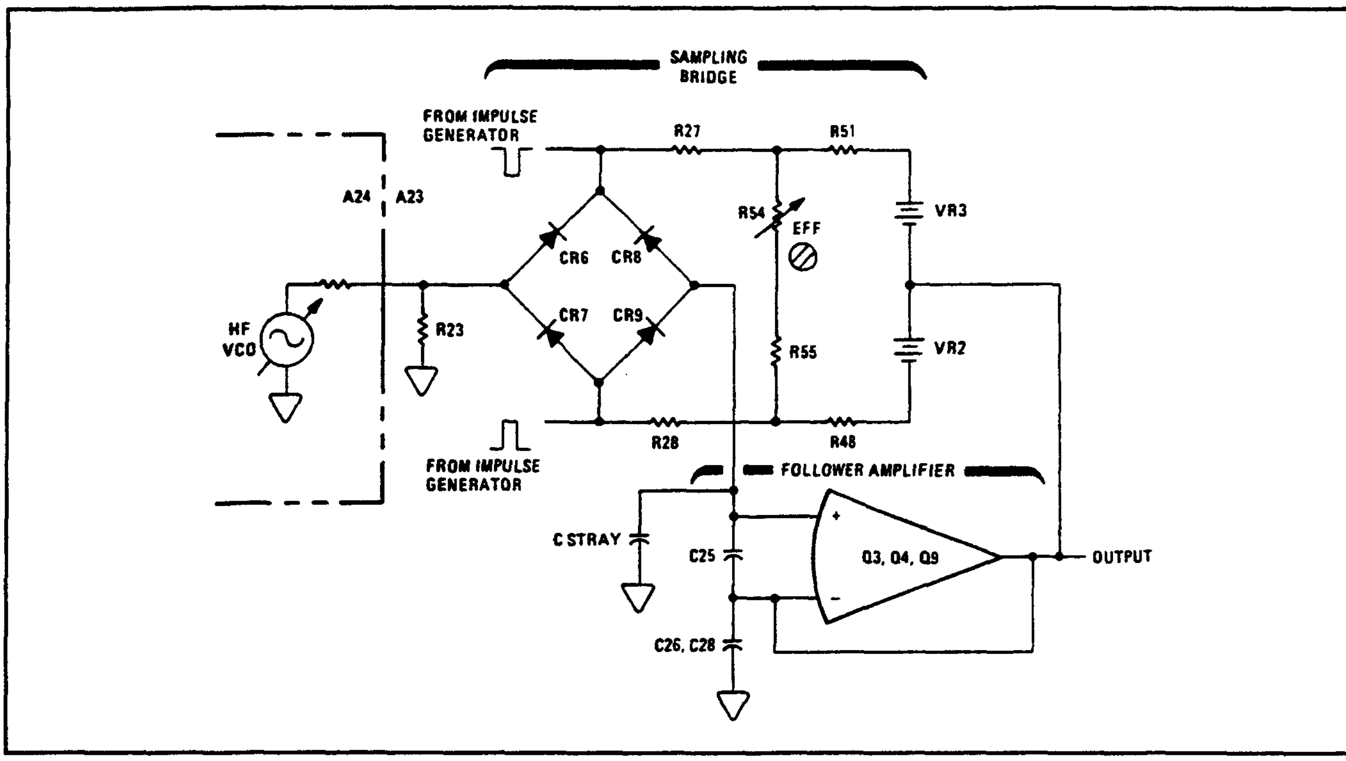


Figure 8-54. Simplified Schematic of Sampler Amplifier

ence which is divided by R51, R54, R55, and R48. The junction of VR2 and VR3 is driven from the output of the unity-gain amplifier whose input is the output from the Sampling Bridge. Thus, as the level of the sampled voltage moves, the top and bottom of the Sampling Bridge move along with it, but the bias across the bridge is unchanged. The bias across the bridge is adjusted by R54.

Because of the short duration of the sampling pulse and the finite drive impedance of the HF VCO, the capacitance at the input to the Sampler Assembly normally fails to charge completely to the level of the HF VCO in one sample. (The input capacitance is the parallel combination of the stray capacitance and C25. C26 and C28 together are much larger than C25 and can be considered an ac short.) During the sample period, however, a voltage develops across C25 and thus across the differential input of the follower amplifier. This large differential error causes the output of the amplifier to rapidly discharge C25 to zero and, in doing so, it continues to charge the stray capacitance (and C26 and C28). The additional charging created by C25 thus compensates for the inefficiency of the Sampling Bridge. R54 adjusts the sampling efficiency (by altering the bias across the bridge diodes) to match the sampling compensation and produce the optimum frequency response. R33 is adjusted to produce an output of zero volts when the phase error is zero.

HF VCO Tune Integrator and Amplifier and Bandwidth Loop Switching. The HF VCO Tune Integrator and Amplifier tunes the HF VCO and the Doubler Input Filter. It is configured in one of four different ways depending on the LO tune mode and the state of the mode. For a detailed discussion of the tuning modes, see Service Sheet BD1.

When the LO is configured with the DAC connected to the HF VCO, Q11 is off. (Q12 is on, but this is of little consequence here.) The HF VCO Tune Integrator and Amplifier and the DAC-to-VCO Loop Amplifier (A20U4B) of Service Sheet 14 form a unity-gain feedback amplifier. See Figure 8-55.

When the LO is configured as a phase lock loop, with the DAC connected to the LF VCXO, Q11 is on. While phase lock is being acquired and while tuning the LF VCXO, Q12 is on to provide a wide (fast) tuning bandwidth. Initially, the LF VCXO is low in frequency. R46 produces a small current which causes the HF VCO to drift down into lock. After the HF VCO is locked and tuned, Q12 is turned off to narrow the bandwidth of the loop. The configuration is shown in Figure 8-56.

When the LO is configured for HF VCO sweep, Q11 is off. (Q12 is on, but this is of little consequence here.) The input to the HF VCO Tune Integrator and Amplifier is the Sweep Up and Sweep Down Current

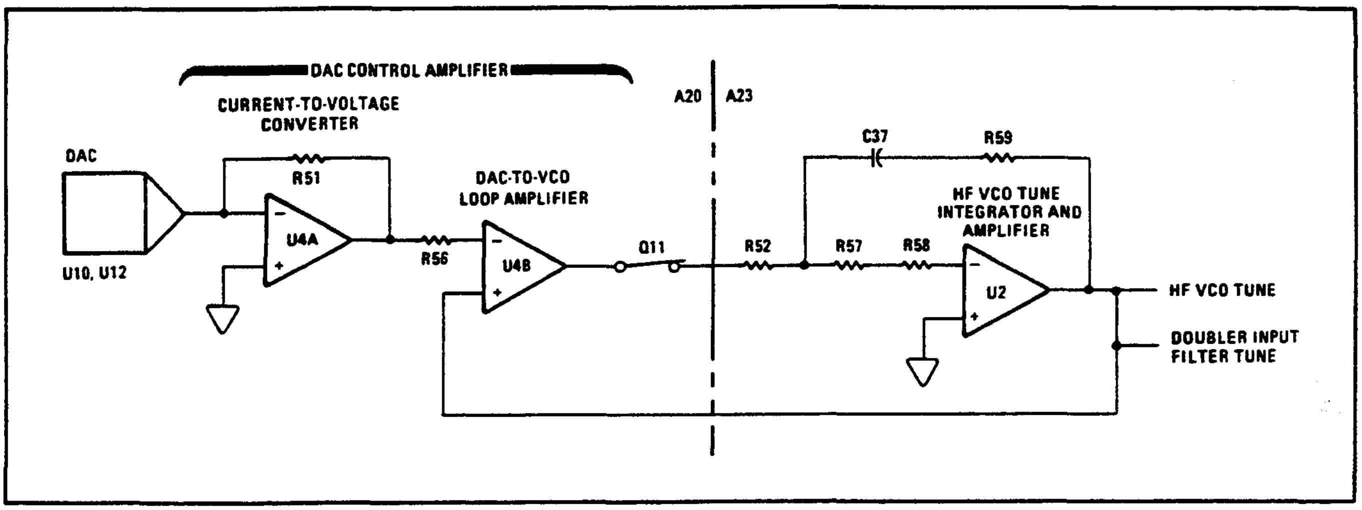


Figure 8-55. Simplified Schematic of LO Configuration: DAC to HF VCO

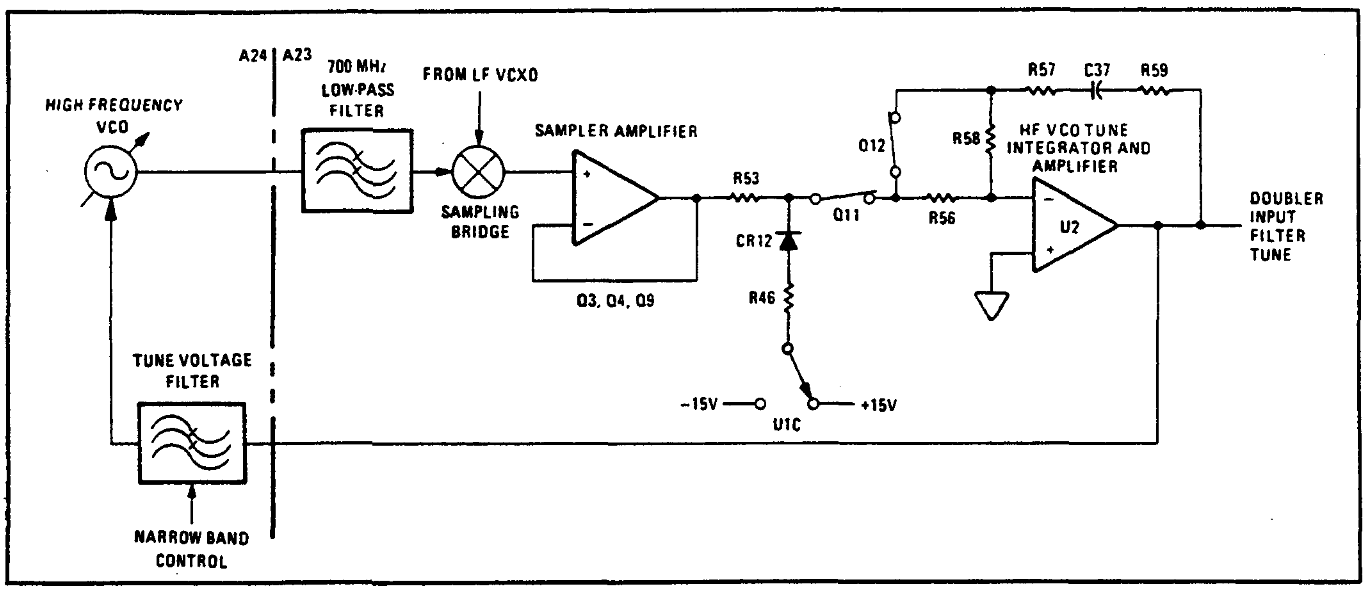


Figure 8-56. Simplified Schematic of LO Configuration: DAC to LF VCXO (DAC Connection Not Shown)

Sources (see Service Sheet 14). The current is integrated and produces a voltage ramp down (for sweep down) or up (for sweep up) at the output of U2.

When the LO is configured for track tuning, Q11 and Q12 are off. The input to the HF VCO Tune Integrator and Amplifier is the Track Loop Amplifier (see Service Sheet 14). The configuration forms a frequency lock loop with a dc voltage (proportional to the IF frequency) from the FM Demodulator tuning the HF VCO.

Q10 shorts the output of the Sampler Amplifier when not connected to U2. Since the Sampler is always on, Q10 prevents any beat frequency from leaking into U2 and frequency modulating the HF VCO.

No-HF-VCO and Out-of-Lock Detectors. CR15 peak detects the RF signal from the HF VCO. If the detected level goes below the reference set by CR4 at the inverting input of U1A, the output of U1A goes low and turns on the NO HF VCO annunciator (DS1).

CR5 will peak detect an ac beat frequency on the output of the Sampler Amplifier. The beat frequency represents an out-of-lock condition. If the detected level exceeds the reference at the non-inverting input of U1B, the output of U1B goes low and turns on the OUT OF LOCK annunciator (DS2). When the Narrow Band control line is high (i.e., not narrow band), the high output of U1C causes DS2 to light. The phase lock loop is not considered to be locked in its final state until the narrow band filter has been switched in.

Power Supply Decoupling. Q5 multiplies the effect of C12 to assist in decoupling RF on the +15V supply. Q7 and Q8 multiply the effect of C13 to assist in decoupling the −15V supply.

8-82. High Frequency VCO (A24)— Service Sheet 12

General. The High Frequency Voltage Controlled Oscillator (VCO) is tuneable over the minimum range 320 to 650 MHz. It drives the LO Divider which produces the LO signal and the high-frequency input to the Sampler when the LO is locked to the LF VCXO. For principles of operation of the Sampler (A23), see page 8-65.

High Frequency VCO and Output Buffer Amplifiers. The High Frequency VCO is a negative-resistance oscillator. At the frequency of operation, the inductor (L9) in the base of Q1, together with the collector-base capacitance of Q1, creates a negative resistance at the emitter port which is in parallel with a parallel-resonant Tank Circuit (L7 and the capacitance of the series-connected varactor diodes CR3 and CR4). The negative resistance cancels the losses in the Tank Circuit and sets up RF oscillations at the tank circuit's resonant frequency.

Varactor diodes CR3 and CR4 permit voltage tuning of the oscillator. Increasing the reverse bias on CR3 and CR4, decreases the junction capacitance and increases the resonant frequency. L6 and L8 are RF chokes.

U1 and U2 are limiter amplifiers that buffer the HF VCO output and drive the LO Divider and Sampler respectively.

Tune Voltage Filter and Filter Switch. The Tune Voltage Filter is switched in when the LO is tuned to the RF input signal and the HF VCO has been locked to the LF VCXO. It is also switched in the track-tune mode. The filter prevents noise in the tuning circuits from frequency modulating the HF VCO. It must be switched gently so as to not perturb the tune voltage.

The filter is out when current source Q4 is on (which switches Q2 and Q3 on). The input voltage is sensed by follower amplifier U3B which drives the varactor diodes through switch Q3. R3 has no filtering effect.

To switch the filter in, Q2 and Q3 are switched off by Q4 (which is now off). U3B has no effect, but it has pre-charged C10 to the present dc level. The filter is formed by R3, R17, and C10 in a lead-lag configuration. C9, which is charged by Q4, controls the turn on rate so that the filter switches in slowly without causing phase lock to break. C31, C32, and C33 are RF decoupling capacitors.

VCO Tune Voltage Clamp. The VCO Tune Voltage Clamp prevents the tune voltage from forward biasing the varactor diodes (CR3 and CR4) whose anodes are biased at approximately −7.5 Vdc. The clamp reference is supplied by follower amplifier U3A which is referenced approximately one diode junction drop (CR6) above the varactor anode voltage. Clamp diode CR2 comes on when the tune voltage drops one junction drop below the output of U3A. If U3B were in the tune circuit, U3A would be supplying current to its output also. CR1 limits the current into the output of U3B by creating a current mirror—the current through CR1 and R2 is "mirrored" in CR2 and R3 since U3B is a voltage follower. CR5 sharpens the turn on characteristic of CR2. CR5 begins to conduct slightly when CR2 begins to conduct. The feedback action of U3A then causes its output to go more positive, which turns CR2 on harder.

Power Supply Decoupling. Q7 and Q8 multiply the effect of C7 and C8 respectively to assist in decoupling the +15 and −15V supplies.

8-83. Low Frequency VCXO (A22)— Service Sheet 13

General. The output of the Low Frequency VCXO Assembly is a tuneable, but frequency-stable, 2 MHz signal used as a reference to stabilize the HF VCO. The 2 MHz signal is obtained by mixing the output of two higher frequency, voltage controlled crystal oscillators (VCXOs), one at a nominal 9.26 MHz, the other at 11.26 MHz. The oscillators tune in opposite directions. The resultant difference frequency from the mixer is a 2 MHz signal with a tuning range of ±6.25 kHz. This tuning scheme permits a wide tuning range (at least for a crystal oscillator) and yet retains the high stability inherent in a crystal source. On the other hand, great care must be taken to filter out spurious mixing products which can result in residual FM tones if they appear on the LO.

9.26 and 11.26 MHz Crystal Oscillators. The two crystal oscillators are similar in design. The 9.26 MHz oscillator will be discussed here in detail. L2, C15, and C16 shift the phase at the collector of Q8 by 180°. The divider formed by R17 and the resistance of CR1 and CR5 routes the in-phase signal (positive feedback) to the base of Q8 to reinforce oscillation. L1 is an RF choke which biases the collector of Q8.

The emitter of Q8 contains the crystal (Y1) and a tuneable, series resonant LC circuit (L3, CR9, and CR11). The high Q circuit in the emitter of Q8 resonates near the resonant frequency of its collector circuit. Since the gain of Q8 is highest and the phase shift of the emitter is zero when the emitter circuit goes series resonant, the emitter resonator determines the frequency of oscillation. Varactor diodes CR9 and CR11 are in ac parallel and dc series. Changing the reverse bias on the diodes tunes the oscillator. Increasing the reverse bias, increases the frequency. The varactor diodes (CR10 and CR12) in the emitter circuit of Q7 tune the 11.26 MHz oscillator in the direction opposite to 9.26 MHz oscillator.

The amplitude of the oscillators is stabilized in a manner that prevents the transistor from either saturating or cutting off at any time during the cycle of oscillation to maintain optimum Q and noise. The positive and negative peaks of each cycle are limited by passive diodes—CR6 limits the positive peak at the collector of Q8, CR2 limits the negative peak. In addition when the diodes conduct, C10 and C6 are charged to the value of the positive and negative peak respectively. The peak-to-peak voltage across the two capacitors then slowly leaks off through CR5 and CR1. The leakage current determines the resistance of the diodes and, hence, the amount of positive feedback to the base of Q8. The action of the peak-to-peak detector is to stabilize the amplitude of oscillation and maintain it at a level that is optimum for good noise performance.

Double Balanced Mixer. The output of the 9.26 MHz Crystal Oscillator is amplified and limited by Q5 and Q6 and drives the L (or high-level) port of the Double Balanced Mixer. T1 provides a dc return for the collectors of Q5 and Q6 and a return for the X (or broadband) port of the mixer. The output of the 11.26 MHz Crystal Oscillator drives the R (or low-level) port of the mixer through amplifier Q4. Both amplifiers minimize loading of the respective oscillators. The High-Frequency Termination (C21, L7, and R29) maintains a constant 50Ω impedance at frequencies where the 2 MHz Low-Pass Filter appears as a high impedance and provides a place for high-frequency spurious signals to dissipate.

2 MHz Low-Pass Filter and Output Amplifier. The 2 MHz Low-Pass Filter is one of two filters that eliminate spurious mixing products from the LF VCXO. The other filter is in a separate housing (A21 Low Frequency VCXO Filter Assembly). The Output Amplifier isolates the two filters. It is a low-noise amplifier with an active input impedance created by the feedback resistor R31.

8-84. Low Frequency VCXO Filter (A21)—Service Sheet 13

The Low Frequency VCXO Filter is a 2 MHz bandpass filter. In conjunction with the 2 MHz Low-Pass Filter on the A22 Low Frequency VCXO Assembly, the filter eliminates spurious mixing products on the LF VCXO. This filter is in an isolated compartment to minimize pickup from the other assembly. The first two elements of the filter are at the output of the other assembly (A22L10 and C28).

8-85. LO Control (A20)—Service Sheet 14

General. The LO Control Assembly contains various circuits related to the tuning of the LO. The circuits include: the Digital-to-Analog Converters with associated amplifiers, the Sweep Up and Sweep Down Current Sources, and the Track Loop Amplifier. The interaction of these circuits to accomplish tuning of the LO is most easily understood by referring to the discussion for Service Sheet BD1.

Digital-to-Analog Converters. The Digital-to-Analog Converters (DACs) tune the HF VCO and the LF VCXO. U10 and U12 convert the binary code on the inputs to an output current with a magnitude proportional to the weight of the bits. Conventional current flows in the direction indicated by the arrow in the current source of the DAC symbol. The DACs are referenced from a common Voltage Reference (Q9) through current-setting resistors R17 and R33 which have the same value. U19 and U12 thus produce equal outputs for equal digital inputs. R29, R30 and R31 form a current divider which attenuates the current from U12 before being summed with the current from U10. The weighting given to the current from U12 by the attenuator is such that a change in the most significant bit (input 128) has the same effect as a change in the second least significant bit (input 2) of U10. Thus the outputs of the two DACs overlap by two bits.

The summed currents from the converter are routed either through switch Q18 into the LF VCXO Tune Amplifier or through switch Q13 into the DAC Control Amplifier (which tunes the HF VCO). Normally, the voltage at the output of the DACs is near ground potential but is clamped by CR8 and CR11 if an abnormal condition occurs (such as both Q18 and Q13 off).

LF VCXO Tune Amplifier and Filter. Transistors Q19 to Q25 form a transresistance amplifier which converts the negative input current from the DACs (through switch Q18) into a positive voltage which tunes the LF VCXO. Its output range is 0 to +40V. The input stage is the differential pair Q19 and Q21. Q20 is an intermediate stage. Complementary pair Q22 and Q23 is the output driver stage. Q25 is a current source which very slightly biases on Q22 and Q23 with the voltage drop across CR20. The current in Q25 is approximately equal to the current flowing in Q24 (which is a current mirror to Q25). Q24 is connected as a diode. C14 is for frequency compensation.

The tune voltage to the LF VCXO is filtered by a 0.7 Hz low-pass filter. The filter reduces the phase noise caused by the tuning circuits and determines the response time of the LO when locked. The filter is normally not switched in until lock has been acquired. The filter consists of R68 and C18. C18 is switched in by opto-isolator switch U14. When C18 is not in, it is being pre-charged through R62 and opto-isolator switch U13 to the level present on the output node of R68. This prevents a transient on the tune voltage which would cause a frequency error with a long settling time when C18 is switched in. R64, R65, R66, and R67 simulate the bias condition of the varactor diodes which tune the LF VCXO (see Service Sheet 13), but the components are scaled down by a factor of ten because R62 is one-tenth the resistance of R68.

DAC Control Amplifier. The DAC Control Amplifier is used during the preliminary tuning of the LO when the DAC tunes the HF VCO. During that time, both Q13 and Q11 are switched on and the DAC Control Amplifier is configured as part of a feedback loop (see Figure 8-54). The DAC Control Amplifier consists of transresistance amplifier (Current-to-Voltage Converter) U4A and comparison amplifier (DAC-to-VCO Loop Amplifier) U4B. The negative current from the DACs generates a positive voltage at the output of U4A. In addition R46 adds a negative offset to center the output range about 0V.

Track Loop Amplifier. The Track Loop Amplifier is used principally in the track tune mode. It receives a dc voltage from the FM Demodulator which is proportional to the IF frequency. The voltage is buffered by U1 and attenuated by the resistor (R19 through R26) selected by demultiplexor U2. The variable attenuation compensates for the difference in LO tuning sensitivity caused by the different bands of the LO Divider. The Track Loop Amplifier couples onto the tune line via switch Q10.

Sweep Up and Sweep Down Current Sources. In the automatic signal seeking tune mode, the LO is swept down over each band. The Sweep Down Current Source supplies a current that is integrated by the HF VCO Tune Integrator and Amplifier (see Service Sheet 12) to produce a voltage ramp which tunes the HF VCO. The Sweep Up Current Source produces a quick retrace ramp.

The Sweep Down Current Source is designed to produce a constant current which can be stopped abruptly when an IF response is produced. The Stop Sweep signal comes from the IF Present Detector (see Service Sheet 4). The current source (Q7) is biased from divider R52 and R53 through buffer Q6 which also thermally compensates the base-emitter junction of Q7. When sweeping, Q4 is off. When Q4 goes on, it diverts the emitter current of Q7 and shuts Q7 off. Q5 is normally off, but when Q4 is switched on, it too is switched on momentarily by the pulse of current through C12. Q5 then discharges the capacitance on the tune line.

To retrace the sweep, Q1 is switched on. This essentially connects R77 to the −15V supply and discharges the integrating capacitor on the HF VCO Tune Integrator and Amplifier.

Power Supply Decoupling. Q26 and Q27 multiply the effect of Q5 to assist in decoupling the +40V supply.

8-86. LO Control (A20)—Service Sheet 15

The LO Control Assembly contains the Instrument Bus decoders and latches for the entire RF Section. The enable code for the section is e=1. For a general discussion of the operation and decoding of the Instrument Bus, see Instrument Bus, page 8-48. The Overpower Protect Status is read back on the Instrument Bus via Q16. CR26 prevents Q16 from becoming an active transistor in an inverted mode (i.e., the roles of collector and emitter are reversed) when the emitter is high and the collector is low. For a discussion of the readback operation, see Direct Control Special Functions, page 8-8. An overpower condition resets register U15 which opens the Overpower Relay (see Service Sheet 1), since the Overpower line goes high, and switches in maximum input attenuation. This is done without intervention of the Controller. Since the Overpower Detector follows the Overpower Relay, the overpower condition is removed immediately after U15 is reset. U15 remains reset until the Instrument Bus sends out the code esd=0.04d, where data bit d3=0 (i.e., d3(H) is low) provided that the overpower condition does not reset U15 again. U23A permits the Instrument Bus to either close the Overpower Relay or leave it in its present state, but not to open the relay.

8-87. Counter (A11)—Service Sheet 16

General. The Counter Assembly contains the 10 MHz Time Base Reference Oscillator (except for Option 002), the Time Base Select Switch, and the Time Base Dividers. The circuits provide a 2 MHz signal for the Controller clock, a 6.25 kHz signal for the Counter time base, and (for Option 002 only) a 10 MHz external time base output.

10 MHz Time Base Reference Oscillator and ECL-to-TTL-Level Translator. Except for instruments with Option 002, the clock and time base signals are derived from the 10 MHz Time Base Reference Oscillator. The ECL complementary OR gate (U2A) is used as the active device for the oscillator. The OR output of U2A is fed back to one input through the 10 MHz crystal (Y1). R12D holds the other input low. The circuit oscillates at the frequency at which the phase shift through the feedback path is zero (namely, the series resonant frequency of Y1) to produce positive feedback. The resonant frequency can be adjusted slightly with C14. C17 and L2 form a parallel resonant circuit in the negative-feedback path which biases the input in the active region and prevents oscillation at harmonics of the crystal. C15 supplies a return path for ac currents; it is chosen to provide a low reactance under all operating conditions.

For instruments with Option 002, Y1 is not present and U2A acts as a buffer for the 10 MHz signal which comes from the high-stability reference oscillator (see Service Sheet 23).

The time base reference is buffered by U2B and converted to logic levels which are compatible with TTL by Q4 and Q3. For instruments with Option 002, the output from Q3 is available at the rear-panel TIME BASE 10 MHz OUTPUT jack.

External Time Base Buffer and Time Base Select Switch. The Time Base Select Switch senses when a reference signal has been applied to the rear-panel TIME BASE 10 MHz INPUT jack and switches the reference over. The external reference is buffered and converted into sharp-transition, TTL-compatible pulses by the External Time Base Buffer. CR1 and CR2 are input protection diodes. R20 normally pulls the input to U4F high. When an external reference is present, C26 is discharged through CR3 by the lows present at the output of U4A. The result is that output of U4F goes high and the output of U4E goes low; DS1 turns on; and the output of U3B goes high (which shuts off the input from the internal reference). U3C and U3D are now enabled to gate the external reference.

When the output of U4E goes low, U3B is immediately disabled; at the same time, when the output of U4F goes high, CR4 and C28 delay the enabling of U3D. This prevents the possibility of the last internal reference pulse and the first external pulse from triggering U10A in rapid succession, which could cause the Controller to false trigger (the Controller receives its clock from U10A). CR5 and C29 perform a similar task when the reference is switched from external to internal. R10 increases the sensitivity of U21 when the reference switches to external to assure that U21 will continue to trigger even though the input level should drop slightly. This provides hysteresis to the external level sensing circuits.

Time Base Dividers. U10A divides the selected (i.e., internal or external) 10 MHz reference by 5. The 2 MHz, buffered by U4B, is used as the clock to the Controller. U9, U8, and U10B divide the 2 MHz signal by 320. The 6.25 kHz output is the time base for the Counter.

8-88. Counter (A11)—Service Sheet 17

NOTE

The following discussions require understanding of the operation of the Instrument Bus (see Instrument Bus, page 8-48) and of Instrument Bus readback (see Direct Control Special Functions, page 8-8).

General. The Counter Assembly contains the first four counter stages, the Input Selector, gating circuits, and Count Transfer Logic. The final counter stages are in the Controller itself. Normally, the Counter counts the frequency of the input, but in the case of the Voltmeter it counts the 10 MHz Selected Time Base Reference as gated under control of the Voltmeter. When an input frequency is being counted, the Controller, as synchronized by the Time Base, enables and disables the counter stages. The duration of the count (i.e., the number of Time Base cycles per count cycle) depends on the input and resolution selected.

Stage 1. Stage 1 is the input stage to the Counter when counting the HF VCO ÷ 8 input; its output drives input 0 of the Input Selector (U7). When any other input is selected, the Input Selector routes it directly to Stage 2. Stage 1 consists of an ECL Divide-by-Two stage (U1A) followed by a TTL Divide-by-Four stage (U6A and U6B). In each case, divide-by-two functions are created by feeding the active-low (reset) output from a D-type flip-flop back to the D input. The ECL-to-TTL Level Translator (Q1 and Q2) shifts the logic level from U1A to make it compatible with the requirements of U6A. The outputs from U1A (via Q2), U6A, and U6B are fed to the D inputs of U5A for readback by the Controller at the end of a count sequence.

The Controller enables and disables the input to U1A by Counter Gate Control No. 1 flip-flop (U1B). To enable U1A, the Controller waits until the Time Base(L) line goes low and then issues and holds esd=363 on the Instrument Bus. The D input of U1B (which had been high) now goes low. When the Time Base(L) line (which had been high) goes low, the low at the D input of U1B is clocked into the active-high output and enables U1A. This synchronizes the enabling of U1A with the Time Base. If the HF VCO ÷ 8 input is also high, it too must go low before U1B is clocked. The RC circuit (R23 and C27) at the output of U1B delays the enable input to U1A to insure that U1A will not be clocked until the next negative transition of the HF VCO ÷ 8 input.

To disable the count, the Controller issues esd=360 or 362 to the Instrument Bus. The D input to U1B now goes high. When the Time Base(L) input goes low, U1A is disabled in the manner described above for its enabling. Note that several cycles of the Time Base may have occurred during the count sequence, but that the Controller knows that Time Base(L) is high when it issues esd=360 to the Instrument Bus. After disabling the count, the Controller reads the count then issues esd=370 to reset Stage 1 and set U1B.

Input Selector and Stages 2, 3, and 4. The Input Selector (U7) multiplexes the input into Stage 2 of the Counter under direction of the Controller. It is also the enable and disable gate (via the G8 input) to Stage 2. To enable Stage 2, the Controller issues esd=362 or 363 to the Instrument Bus. This puts a low on the D input of U16B. When the Time Base(H) line (which had been low) goes high, it clocks the active-high output of U16B to a low and enables the selected input of U7. The enabling of Stage 2 is thus synchronized with the Time Base.

To disable Stage 2, the Controller issues esd=360 to the Instrument Bus. The D input of U16B now goes high. When the Time Base(H) input goes high, U7 is disabled. Note that several cycles of the Time Base may have occurred during the count sequence, but that the Controller knows that Time Base(H) is low when it issues esd=360 to the Instrument Bus. After disabling the count, the Controller reads the count then issues esd=370 to reset Stages 2, 3, and 4.

During the actual count, Counter Output Gate U14B is enabled and output 4 (the Counter Carry Output) of Stage 4 (U19A) is read onto the Controller via line d2(L) of the Instrument bus. Similarly, the Time Base is read by the Controller via U14D and line d3(L).

Counter Output Gating. To read back the outputs of the counter stages after completion of a count sequence, the Controller issues esd=350 to the Instrument Bus. The output of U14C (which had been low) goes high and enables Counter Output Gates U15A, U15B, U15C, and U15D. The outputs of Stage 4 are inverted and placed on the readback data lines of the Instrument Bus. Next, the Controller issues esd=340 to the Instrument Bus. U20A goes high and U12C low. This causes Stage 4 to be loaded with the output of Stage 3 and also enables the Counter Output Gates since the output of U14C is high. The output of Stage 3 is thus placed on the Instrument Bus through Stage 4. In a similar manner the Controller issues esd=330 and esd=320 to copy the outputs of Stages 2 and 1 into the subsequent stages and onto the Instrument Bus.

Voltmeter Gate. The Voltmeter Gate routes the (10 MHz) Selected Time Base (TB) Reference into the Input Selector. The signal, however, is gated by the Stop Count output from the Voltmeter's Comparator (see Service Sheet 10). The sequence is as follows: The Controller issues esd=362 to the Instrument Bus. After that, when the Time Base(H) line goes high, the active-low output of U16B goes high and initiates a ramp in the Voltmeter's Ramp Generator. At this time U7 is also enabled, and the 10 MHz Selected Time Base Reference is counted. After a period of time dependent upon the input voltage into the Comparator, the Stop Count line (which was low) goes high. This high causes U20C to block the input into U7 and stop the count. Some time later, the Controller issues esd=360 to the Instrument Bus and begins the process of reading back the count and clearing the counter stages.

Signature Analyzer Initialization. The Signature Analyzer (SA) Initialization circuit forces the Counter (including the Time Base) into a known, initial state when the Counter signature analysis routine is invoked. The Controller then exercises the counter circuitry in a repeatable sequence which produces a repetitive data pattern at each circuit node. The pattern is read by a signature analyzer which produces a signature unique to each data pattern. If the pattern agrees with that documented for the node, the circuits responsible for generating the pattern can be assumed to be working properly.

Select Decoder, Data Latch, and Oven Warm Readback Circuit. For a general discussion of operation and decoding of the Instrument Bus, see Instrument Bus, page 8-48. The Oven Warm Readback Circuit allows the status of the Option 002 high-stability crystal oscillator to be read back by the Controller. It is called by Special Function 15. Q5 is enabled when a low is put on its emitter. It then acts as an inverter. Schottky diode CR6 prevents Q5 from becoming an active transistor in the inverted mode (i.e., the roles of collector and emitter are reversed) when the emitter is high and the collector is low. For a discussion of the readback operation, see Direct Control Special Functions, page 8-8.

8-89. Controller (A13)—Service Sheets 18 and 19

General. The Controller Assembly controls the entire automated portion of the operation of the instrument. The Controller consists of a microprocessor, ROMs, a RAM, and input/output circuits. The microprocessor, RAM, and I/O circuits are shown on Service Sheet 18, the ROMs on Service Sheets 19 and 22. For a general discussion of how the Controller and the Instrument Bus control the operations of the instrument, see page 8-8.

Microprocessor. The microprocessor is divided into two ICs, the Central Processing Unit (CPU) and the Static Memory Interface (SMI). In addition a third IC, the Peripheral Input/Output (PIO) located on the Remote Interface Assembly (Service Sheet 22), is considered a part of the microprocessor. The PIO is used when it is necessary to interface the CPU with the HP-IB. The CPU (U14) is an eight-bit parallel processor. LC network L1, C10, and C11 determines the frequency of the CPU's internal clock. It is normally overridden by the 2 MHz signal on the Clock line from the Counter. If the Counter Assembly is removed, the internal clock takes over to keep the Controller functioning. The CPU inputs and outputs are described in Table 8-12.

The SMI provides most of the interface logic needed to address up to 65 536 bytes of memory in the microprocessor system. In response to control signals from the CPU, the SMI generates the address and control signals needed by the memory devices. The SMI inputs and outputs are described in Table 8-13.

Table 8-12. Inputs and Outputs of the CPU (U14)

Pin Name	Description	Type
I/O00 thru I/O07	I/O Port Zero	Input/Output
I/O10 thru I/O17	I/O Port One	Input/Output
DB0 thru DB7	Data Bus Lines	Bi-directional (3-state)
ROMC0 thru ROMC4	Control Lines	Output
Φ, WRITE	Clock Lines	Output
EXT RES	External Reset	Input
INT REQ	Interrupt Request	Input
ICB	Interrupt Control Bit	Output
RC	RC Network	Input
XTLX	Crystal Clock Line	Output
XTLY	External Clock Line	Input

Table 8-13. Inputs and Outputs of the SMI (U11)

Pin Name	Description	Type
DB0 thru DB7	Data Bus Lines	Bi-directional (3-state)
ADDR0 thru ADDR15	Address Lines	Output
ROMC0 thru ROMC4	Control Lines	Input
Φ, WRITE	Clock Lines	Input
INT REQ	Interrupt Request	Output
PRI IN	Priority In Line	Input
RAM WRITE	Write Line	Output
EXT INT	External Interrupt Line	Input
REGDR	Register Drive Line	Input/Output
CPU READ	CPU Read Line	Output

The PIO provides most of the interface logic needed to interface the CPU with the HP-IB. The PIO is described in Service Sheet 22.

Memory. The instrument's memory consists of nine 2048-bit ROMs (1 through 8 and 11), a RAM, and some small memory capability within the CPU itself. Eight of the ROMs (U3 through U10) are on the Controller Assembly. These ROMs are addressed as 1 through 8. The ninth ROM is located on the Remote Interface Assembly (A14) and is addressed as a decimal 11 (not hexadecimal as is the case with some special functions). The RAM is the CPU External Register (U15) and is a 256-address, 4-bit scratch pad memory used to read and write 4 bits (DB0-DB3) to and from the CPU. The Memory Decoders (U12 and U13) control which memory IC on the Controller Assembly is enabled. In addition, there is a Memory Select Decoder (A14U18) on the Remote Interface Assembly that is used to enable ROM 11.

To illustrate how a ROM address is accessed for data, assume that the CPU wants to read information from address 255 of ROM 3 (U5). First, the CPU places the necessary information on the ROM Control (ROMC) and the data lines of the Control Bus. The SMI decodes this information from the CPU and outputs the required address information on lines A0(H) through A15(H) and then sets CPU READ(H) high. When the CPU READ(H) input to Schmitt trigger U1A goes high, the output goes low, and the output of U1B goes high. Note that the MEMORY DISABLE(L) line is held high because the input at the edge connector (shown on Service Sheet 19) is normally not connected.

Note that this is a read operation and the RAM WRITE(L) line from the SMI is high. Lines A14(H) and A15(H) are low thus enabling U12. The A11(H) and A12(H) lines are high, and the A13(H) line is low, therefore, the ROM 3(L) output line is low. On Service Sheet 19 the ROM 3(L) line is low and ROM 3 (U5) is enabled because the other two inputs to the AND portion of the control block are always enabled.

Since A0(H) through A7(H) are high and A8(H) through A10(H) are low, the data at address 255 is read out of the ROM. The 8 bits of information are placed on lines DB0(H) through DB7(H). This information is then read into the CPU (U14).

The RAM read and write functions are similar to the ROM function. The CPU READ(H) and RAM WRITE(L) lines are used to determine which function of the CPU External Register (U15) is activated. The U13 demultiplexer is used to enable U15. Note that by changing the position of the jumper between U13 and U15 to the position between U12 and U15, U15 could be enabled with the ROM 8(L) line. As it is, RAM resides in the address space of what would be ROM 16.

TEST LEDs and Test Points. The TEST LEDs DS1 through DS4 are controlled by the CPU as described on page 8-17. The test points (TP4 through TP7) are used to modify the power-up routine as described on page 8-17 and are also used when performing signature analysis.

Select and Data Buffers. The Select and Data Buffers (U16 and U18) invert and buffer the I/O 00 through I/O 07 input/output lines from the CPU to the Instrument Bus. For a general discussion of the Instrument Bus, see page 8-48. In addition data lines d0(L) through d3(L) are input to the CPU from the Instrument Bus.

Enable Decoder. The Enable Decoder (U17) decodes the e0(H) through e3(H) lines from the CPU into the eight individual enable lines e=0(L) through e=7(L). These are distributed throughout the instrument to enable the desired select decoder.

Power On Reset. The Power On Reset circuit (Q1 and U1C) is used to apply a momentary low on the EXT RES line of the CPU when power is applied to the instrument. When EXT RES is pulled low and then released, a program originating at memory address 0 is executed.

8-90. Keyboard (A1)—Service Sheet 20

NOTE

The following discussion requires understanding of the operation of the Instrument Bus (see Instrument Bus, page 8-48) and of Instrument Bus readback (see Direct Control Special Functions, page 8-8).

General. The Keyboard and Display Assembly interrupts the Controller when a key has been pressed and provides the circuitry that enables the Controller to determine which key was pressed.

Keystroke Detector. The Keystroke Detector pulses the External Interrupt line low when a key is pressed. When no key is down (i.e., key switches S1 through S41 open), the inverting (−) input to U39A is pulled low by R8B and R8C. The outputs of the Key Row Scanner U38 are normally in the high or off state (the outputs are open-collector). The non-inverting (+) input of U39A is biased at approximately +1.4V. Thus for the condition when no key is pressed, the output of U39A is high, the output of U39B is low, and the output of U21A is high (i.e., no interrupt, see Service Sheet 18).

Pressing any key (e.g., the % key S20) pulls the inverting input of U39A above +1.4V (via R4E and R2F for the % key). This causes U21A to go low and creates a Controller interrupt. U39A has an open-collector output. When U39A goes low, C5 is rapidly discharged to produce a low on the input to U39B. However, when U39A goes high, C5 can only charge via R10. This action holds the input to U39B low for at least 50 ms regardless of key bounce. R11 adds hysteresis to U39B to improve noise immunity and shorten the transition time of the input to U21A.

Key Scanners and Front-Panel Keys. When the Controller receives an interrupt, it immediately initiates a key scan routine. The scan must identify the pressed key before the key has been released even in the presence of key bounce. Consider the example of pressing the % key (S20). The scan begins by the Controller issuing esd=7F0 to the Instrument Bus. This puts an active low on pin 4 of demultiplexor U38. More specifically, e=7 and s=F. Both 1 and 2 inputs are high since s0=1 and s1=1. A 3 is demultiplexed. e=7(L) is low and enables inputs G4 and G5. The 4 input is enabled since s2=1; the 5 input is disabled since s2=1. Thus only the 3 output of the lower half of the demultiplexor (U38) enabled by input 4 is low.

The same Instrument Bus code enables the readback gates of U22 but not U23. More specifically, s3=1. Thus, the input to U21D is high. The two inputs to U21B are low. The NAND gates of U22 are enabled and function as inverters. U21C is low and the outputs of the NAND gates of U23 are high, i.e., off. The Controller reads back the data (d) lines and scans the data giving priority to the highest number decoded. Since all columns are held high by pull-up resistors, the Controller reads d=F. The % key has no effect because the output at pin 7 of U38 is off at this time.

The Controller next issues esd=7E0. Pin 5 of U38 is now low. U22 is still enabled and U23 is still disabled. d=F is read back. The sequence then continues with the issuance of esd=7D0 and 7C0 with the result that d=F is read back each time until esd=7C0 when d=B will be read back; i.e., d2=0 (d2(L) is high). The Controller has now learned that the % key was pressed.

If no key had been found in the first four columns, the sequence continues until the issuance of esd=770. With this code, the s3(H) input to U21C and U21D goes low, and U22 is disabled, and U23 is enabled. The Controller now starts reading the data lines from U23 to determine if one of the keys in the second four columns is closed.

If no key was found (i.e., d=F always) due to key bounce, the scan repeats until 50 ms have elapsed and then the instrument reverts back to its previous mode of operation. Whether the key was found or not, the measurement cycle that was interrupted is aborted and a new software cycle is initiated.

8-91. Display (A1)—Service Sheet 21

The Keyboard and Display Assembly contains the front-panel displays, annunciators, and key lights and the decoders and latches that control them. Lighting of a display is accomplished by straightforward decoding of the Instrument Bus. For example, to display the digit 3 in display U2, the Controller issues esd=613 to the Instrument Bus. Output 1G of Select Decoder U24 goes low (uniquely) and enables the seven-segment coder U11. U11 decodes the data code d=3 and puts lows on segment-control lines a, b, c, d, and g. The corresponding segments of U2 light to display a "3". The segment information is latched in U11 when a different e, s, or es code is issued to the Instrument Bus. For a discussion of the Instrument Bus, see Instrument Bus, page 8-48.

8-92. Remote Interface (A14)—Service Sheet 22

General. The Remote Interface Assembly interfaces the Controller with the HP-IB. It performs the necessary handshake operation, interprets the HP-IB control lines, and is both an input and output peripheral to the Controller. The Remote Interface Assembly consists of three basic elements: the HP-IB I/O, the Handshake Logic, and the Interface Control circuits. In addition, other miscellaneous circuits are used on the assembly. The operation of the three basic elements is explained first. Then, a detailed explanation of how the bus controller (e.g., a computing controller) addresses the instrument to talk or to listen is presented. The miscellaneous circuits are then briefly discussed. Table 8-14 lists and identifies the mnemonics used in the Remote Interface and should be referred to while reading the principles of operation.

Figure 8-14. Mnemonics for Remote Interface

Mnemonic	Signal Name
AAD	Acceptor Accepted Data
ACD	Accepted Data
ADS	Addressed
AFC	Address Flip-Flop Clock
ARD	Accepted Received Data
ATL	Addressed to Listen
ATN	Attention
ATT	Addressed to Talk
AVD	Accept Valid Data
CLF	Clear Listen Flip-Flop
CTF	Clear Talk Flip-Flop
DAR	Disable ROM
DAV	Data Valid
DIO1	Data Input/Output 1
DIO8	Data Input/Output 8
DFC	Data Accepted Flip-Flop Clock
EAH	Enable Acceptor Handshake
EIC	Enable Interface Control
ENR	Enable ROM
EOI	End Or Identify
ICP	Interrupt CPU
IFC	Interface Clear
LAD	Listener Accepted Data
LRD	Listener Ready for Data
NDAC	Not Data Accepted
NRFD	Not Ready for Data
RAS	Read Address Selector
RAT	Read Addressing Type
RDR	Reset DAC/RFD
REN	Remote Enable
RFC	REN Flip-Flop Clock
RFL	REN Flip-Flop Latched
RSL	Read Switch Lower
RSU	Read Switch Upper
RTR	Ready to Receive
RVD	Receive Valid Data
SDA	Set Data Accepted
SDV	Set Data Valid
SLF	Set Listen Flip-Flop
SRQ	Service Request
STF	Set Talk Flip-Flop
UUA	Universal Unlisten Address

HP-IB I/O Circuits. The HP-IB I/O circuits provide bidirectional interface between the Remote Interface assembly and the HP-IB. The circuit consists of U1, U2, U5, and U6. When the TALK(L) line is low, the interface is configured to send data to the HP-IB. In this state, U2 and U6 are disabled, and since they are open collector devices, they are essentially out of the circuit. U1 and U5 provide a direct path from the Peripheral Input/Output (U13) to the HP-IB. When the TALK(L) line is high, the Remote Interface is configured to receive data from the HP-IB. In this mode, U2 and U6 are enabled, and the path through U1 and U5 is reversed. This allows data from the HP-IB to be applied to the Peripheral Input/Output (U13), the Address Decoder (U8), and the Interface Control ROM (U17). Depending upon the function being performed, this data is either sent to the Controller or used to decode the talk or listen address.

Handshake Logic Circuits. Information is communicated over the HP-IB by means of handshakes between instruments. It is assumed in this discussion that you are familiar with the use of the DAV, NDAC, and NRFD signals as they are used on the HP-IB. The instrument can operate as either a talker or a listener when so directed by the bus controller. The primary control circuits in the Handshake Logic are the DAC Flip-Flop (U15B) and gates U12A, U12B, and U19B.

When the instrument is a listener, the ATL(L) line is low, and the high output from U19B enables U12A and U12B. This condition is also true when ATN(L) goes low and is discussed in detail later. In either case, the DAC Flip-Flop (U15B) controls the handshake. If U15B is set, the RTR(L) line from the reset output is low, and the NRFD(L) line from U12B is high indicating that the instrument is ready to receive data. The ACD(L) line from the active-high output of U15B is high, and (since the other input to U12A is also high), the NDAC(L) line is low. When the bus controller sees all of the required NRFD(L) lines high (more than one instrument can be addressed to listen), it sets DAV(L) low. When DAV(L) goes low (indicating the data on the HP-IB is valid), the Interface Control ROM either sets EXT INT low or resets U15B by setting SDA(L) low, depending on whether or not the CPU must be interrupted. (See Table 8-15 for a complete list of the Interface Control ROM input and output signals.) If the CPU is interrupted, it will reset U15B using the DCF(L) line. In either case, ACD(L) goes low and the NDAC(L) line from U12A goes high. When the bus controller sees all of NDAC(L) lines go high, it sets DAV(L) high. The DAV(L) signal is applied through gates U4B, U20B, and U21B to set the DAC Flip-Flop (U15B). Gates U20B and U21B are used to slow down the handshake and prevent a possible race condition. When the DAC Flip-Flop is set, the instrument is returned to a ready-for-data condition.

When the instrument is a talker, the output from U19B is low because both the ATL(L) and the ATN(L) lines are high. The low output from U19B disables U12A and U12B. This prevents the DAC Flip-Flop from driving the NDAC(L) and NRFD(L) HP-IB lines. The Controller (A13) now reads the NDAC(L) line through U4C and U21C and the NRFD(L) line through U4D and U21D. Both of these signals are routed to the Controller through the Peripheral Input/Output (U13). The DAV(L) signal is driven by the Controller through U13 and U12C

Table 8-15. Inputs and Outputs of Interface Control ROM

Address: Binary Bit Value 16 (Pin 14)	8 (Pin 13)	4 (Pin 12)	2 (Pin 11)	1 (Pin 10)	Hex	Data: Bit 7 (Pin 9)	6 (Pin 7)	5 (Pin 6)	4 (Pin 5)	3 (Pin 4)	2 (Pin 3)	1 (Pin 2)	0 (Pin 1)	Remarks**
L	L	L	L	L	00	H	*	H	H	H	H	*	L	SCG so AHS only.
L	L	L	L	H	01	H	*	L	H	H	H	*	L	OTA so CTF and AHS.
L	L	L	H	L	02	H	*	H	H	H	H	*	L	OLA so AHS only.
L	L	L	H	H	03	L	*	H	H	H	H	*	H	UBC so INT only.
L	L	H	L	L	04	H	*	H	H	H	H	*	L	SCG so AHS only.
L	L	H	L	H	05	H	*	L	H	H	H	*	L	UNT so CTF and AHS.
L	L	H	H	L	06	H	*	H	H	L	H	*	L	UNL so CLF and AHS.
L	L	H	H	H	07	H	*	H	H	H	H	*	L	NRC so AHS only.
L	H	L	L	L	08	H	*	H	H	H	H	*	L	SCG so AHS only.
L	H	L	L	H	09	H	*	H	L	L	H	*	L	MTA so STF, CLF, and AHS.
L	H	L	H	L	0A	L	*	L	H	H	L	*	H	MLA so SLF, CTF, and INT.
L	H	L	H	H	0B	L	*	H	H	H	H	*	H	UBC so INT only.
L	H	H	L	L	0C	H	*	H	H	H	H	*	L	SCG so AHS only.
L	H	H	L	H	0D	H	*	L	H	H	H	*	L	UNT so CTF and AHS.
L	H	H	H	L	0E	H	*	H	H	L	H	*	L	UNL so CLF and AHS.
L	H	H	H	H	0F	H	*	H	H	H	H	*	L	NRC so AHS only.
H	L	L	L	L	10	L	*	H	H	H	H	*	H	DATA so INT only.
H	L	L	L	H	11	L	*	H	H	H	H	*	H	DATA so INT only.
H	L	L	H	L	12	L	*	H	H	H	H	*	H	DATA so INT only.
H	L	L	H	H	13	H	*	H	H	H	H	*	L	CDATA so AHS only.
H	L	H	L	L	14	L	*	H	H	H	H	*	H	DATA so INT only.
H	L	H	L	H	15	L	*	H	H	H	H	*	H	DATA so INT only.
H	L	H	H	L	16	L	*	H	H	H	H	*	H	DATA so INT only.
H	L	H	H	H	17	H	*	H	H	H	H	*	L	CDATA so AHS only.
H	H	L	L	L	18	L	*	H	H	H	H	*	H	DATA so INT only.
H	H	L	L	H	19	L	*	H	H	H	H	*	H	DATA so INT only.
H	H	L	H	L	1A	L	*	H	H	H	H	*	H	DATA so INT only.
H	H	L	H	H	1B	H	*	H	H	H	H	*	L	CDATA so AHS only.
H	H	H	L	L	1C	L	*	H	H	H	H	*	H	DATA so INT only.
H	H	H	L	H	1D	L	*	H	H	H	H	*	H	DATA so INT only.
H	H	H	H	L	1E	L	*	H	H	H	H	*	H	DATA so INT only.
H	H	H	H	H	1F	H	*	H	H	H	H	*	L	CDATA so AHS only.

* Don't care condition.

** The outputs are active low. The functions of each output are:
Bit 7: INT, interrupts CPU.
Bit 6: Don't Care (NC).
Bit 5: CTF, clear Talk Flip-Flop.
Bit 4: STF, set Talk Flip-Flop.
Bit 3: CLF, clear Listen Flip-Flop.
Bit 2: SLF, set Listen Flip-Flop.
Bit 1: Don't care (NC).
Bit 0: AHS, automatic handshake.

Mnemonics used:
CDATA: DATA from Control group.
DATA: DATA (interface responds).
MLA: My Listen Address.
MTA: My Talk Address.
NRC: Non-Recognized Command.
OLA: Other Listen Address.
OTA: Other Talk Address.
SCG: Secondary Group Command.
UBC: Universal Bus Command.
UNL: Un-Listen.
UNT: Un-Talk.

by the SDV(H) line. U21C is enabled by U20A when the TALK(L) line is low. In the talker mode, the handshaking is entirely controlled by the instrument's firmware and Controller.

Interface Control Circuits. The primary control element in the Interface Control circuits is the Interface Control ROM (U17). U17 is enabled when all the following conditions are satisfied:

1. RTR(L) is low. This indicates the instrument is ready to receive data or commands.
2. EAH(L) is low. This enables an acceptor handshake. It is decoded from the ATL and ATN lines by U20D. Therefore, if the instrument is addressed to listen or if attention is true, the gate is enabled.
3. U19C pin 8 is low. This indicates that the Controller (A13) has enabled the interface to receive data. This state is latched by the flip-flop consisting of U19C and U19D. This flip-flop is also used to disable the Interface Control ROM (U17) when the Remote Interface is preparing to talk. U17 is disabled so that its control circuits do not respond to the data that the instrument itself is sending.
4. AVD(L) is low. This indicates that the bus controller is asserting that the data on the HP-IB is valid by putting DAV(L) low.

When all of these conditions are true, U17 is enabled by setting the EIC(L) line from U20C low. The outputs of U17 are then dependent upon the decoded address line inputs. Depending upon the selected output, the Interface Control ROM will set or clear the appropriate flip-flops, complete a handshake, or interrupt the Controller. The 32 possible states of the output lines are listed and defined in Table 8-15.

How the Remote Interface Handshakes with the HP-IB. The Remote Interface circuits control the asynchronous transfer of bytes over the HP-IB. The following three conditions require that the instrument complete the handshake requirements:

1. When it is a bystander.
2. When the ATN(L) line is low (true). For example, when the bus controller is addressing the instrument to set it to the talk or listen modes. There are also universal commands that can be sent when ATN(L) is low.
3. When it is already addressed to talk or listen.

The instrument handshakes as a bystander whenever ATN(L) is high and it is not addressed to listen. Actually, this handshake is not an interchange of information because under these conditions the instrument never pulls the NRFD(L) and NDAC(L) output lines low. These lines are held high because ATL(L) and the ATN(L) inputs to U19B remain high. ATL(L) remains high because the instrument is not currently addressed to listen. ATN(L) remains high because it is high at the HP-IB and the signal is applied through two inverters (U4E and U21A) to the input of U19B. The resulting low output is applied to U12A and U12B and the NRFD(L) and NDAC(L) lines are always high. In this mode, the Modulation Analyzer is essentially "off the bus". Note that the DAC Flip-Flop (U15B) is also applied to these gates and depending upon its output state would also hold one of the gate outputs high if ATN were true or ATL were true.

When the bus controller wants to address the instrument to talk, ATN(L) is set low. The output of U19B goes high and the status of the NRFD(L) line (U12B) and the status of the NDAC(L) line are controlled by the DAC Flip-Flop (U15B). (The DAC Flip-Flop is already set by DAV(L) being high through U4B, U20B, and U21B). This causes the RTR(L) line from the DAC Flip-Flop to set NRFD(L) high. The bus controller has already placed the instrument's talk address on the bus and it now pulls DAV(L) low indicating that it is valid data.

Since the instrument is not yet addressed to talk, the TALK(L) input to the HP-IB I/O circuits (U1, U5, U2, and U6) is high. The talk address on lines DIO1(L) through DIO5(L) is applied through U1 and U5 to the Address Decoder comparator U8. U8 compares the incoming address with the setting of the first five address switches (S1). If they are the instrument's correct address, the M=N output of U8 goes high. The data on DIO7(L) and DIO6(L) is applied to the Interface Control ROM (U17) to determine whether the instrument is being addressed to talk or to listen. If it is being addressed to talk DIO7(L) is low and DIO6(L) is high (i.e., 10). If it is being addressed to listen, DIO7(L) is high and DIO6(L) is low (i.e., 01). These two bits are the only difference between the DIO inputs from the bus controller to the instrument when it is being set to talk or listen.

The EIC(L) from U20C is low to enable U17 and the other inputs to the address lines of U17 select the memory locations that will set output pin 5 to low. The STF(L) line sets the Talk flip-flop U16A. At the same time, the SDA(L) output at pin 1 of U17 is low and resets the DAC Flip-Flop (U15B). The low output from pin 9 of U15B is applied to U12A and the NDAC(L) line goes high, indicating that the handshake is complete. Note that the CPU did not need to be interrupted.

Remote Enable Flip-Flop. When the instrument is addressed to listen, the CPU is interrupted and must determine whether or not it has been enabled to the remote mode (or whether it is already in the remote mode). The Controller does this by attempting to set the Remote Enable Flip-Flop (U15A). If the REN(L) line on the HP-IB is low (true), it is inverted by U4F and the reset input to U15A pin 1 is high. In this case U15A can be set by the Controller. Conversely, if REN(L) is high, the reset input is low and U15A is held reset. The Controller checks the set output of U15A RNL(H) through inverter U22A and the Peripheral Input/Output (U13). If the instrument receives its listen address and if the output of U15A is high, it enters remote mode and lights the REMOTE annunciator on the front panel.

Serial Poll Enable Flip-Flop. When the Controller recognizes the SPE (Serial Poll Enable) bus command, the CPU is interrupted and attempts to set the Serial Poll Flip-Flop (U3B). IFC(L) from the HP-IB is applied through U4A and U22D to the reset input of U3B. If IFC(L) is high the Serial Poll Flip-Flop can be set; if it is low, U3B is held reset. If U3B is set, the instrument enters the serial poll mode, and this information is read back via the Instrument Bus to the Controller through U9D. When the instrument is subsequently addressed to talk, it again reads back the output of U3B to determine what information to output to the HP-IB: measurement results or the status byte. If it is still in the serial poll mode, the status byte is output. When the SPD (Serial Poll Disable) bus command is received, the Controller resets U3B.

Other Control Lines. The remaining HP-IB control lines to the instrument are EOI(L), SRQ(L), and IFC(L). EOI(L) is not used by the instrument and is terminated in R7N and R7P. SRQ(L) is output to the HP-IB under Controller direction through U13. IFC(L) is used to clear all talkers and listeners off the HP-IB. IFC(L) is buffered into four lines. At the output of U4A, after CR1, one line is applied to the Address Comparator (U8) to disable it. This keeps the Interface Control ROM (U17) from affecting either the Talk or Listen Flip-Flop while IFC is true. Two additional lines (from U21E and U21F) clear the Talk and Listen Flip-Flops (U16A and U16B). The fourth line (from U22D) clears the Serial Poll Flip-Flop.

Address Readback Circuit. When so directed by the operator, the Controller sequentially reads back the status of the Address Switches (S1A through S1E) and the talk-only and listen-only switches (S1G and S1F). This information is processed through gates U9 and U10 under control of the RSU(L) and RSL(L) lines from the Select Decoder (U11). The Controller's internal RAM is also read for service request (SRQ) status. The front-panel display shows not only the HP-IB address and the talk-only or listen-only status but also whether or not it is issuing a Service Request (SRQ). (See Special Function 21.0 in the Detailed Operating Information section of the Operating Manual.)

Peripheral Input/Output. The Peripheral Input/Output (U13) provides the required I/O interface between the Controller and the HP-IB. Refer to Table 8-16 for a description of inputs and outputs of U13.

P/O Controller. The P/O (part of) Controller circuit consists of Memory Select Decoder (U18) and ROM 11 (U14). This circuit is part of the Controller firmware and contains the HP-IB and limit programs. The instrument will operate with the Remote Interface Assembly removed. However, the HP-IB and limit capabilities are lost when ROM 11 is not present. The instrument will indicate this condition by displaying a check sum error after power up or upon interrogation. For an explanation of how the Controller ROMs are decoded, refer to Service Sheet 18.

Select Decoder. For a general discussion of instrument control, see Instrument Bus, page 8-48.

Table 8-16. Inputs and Outputs of the PIO (U13)

Pin Name	Description	Type
I/O A0 thru I/O A7	I/O Port A	Input/Output
I/O B0 thru I/O B7	I/O Port B	Input/Output
DB0 through DB7	Data Bus Lines	Bi-directional (3-state)
ROMC0 through ROMC4	Control Lines	Input
Φ, WRITE	Clock Lines	Input
EXT INT	External Interrupt	Input
PRI IN	Priority In	Input
PRI OUT	Priority Out	Output
INT REQ	Interrupt Request	Output
DBDR	Data Bus Drive	Output

8-93. Power Supply Regulators (A10)— Service Sheet 23

General. The Power Supply Regulators Assembly (A10) and the Power Supply Mother Board Assembly (A26) contain the circuitry for the +15 and −15V supplies. The two supplies are nearly exact complements (i.e., all polarities reversed, NPN transistors interchanged for PNP, etc.) except that the −15V supply is referenced from the +15V supply (via R26 and R27) and is not adjustable. Also, the +15V supply remains on when the instrument is in standby and its output is switched to drive only the high-stability crystal reference oscillator in Option 002. Only the +15V supply will be discussed.

+15V Supply. The +15V supply is a series-type regulator. A29Q2 is the series-pass transistor which is configured as a Darlington pair. The series-pass transistor is suppled from a full-wave rectifier (chassis part T1 and A26CR7 and CR8) and filter capacitor A26C3. The Input Over-Voltage Protection circuit (or crowbar), consisting of triac A26Q1, reference diodes A26VR1 and VR2, and A26R1, protects the instrument against improper line selection. The reference diodes cause the triac to fire (i.e., short-circuit) when the secondary voltage exceeds approximately 70V of either polarity. The shorted secondary then causes the line fuse to blow.

The output of the supply is divided down by R23, R24, and R25 and compared to the voltage across a reference diode (VR1) by the differential amplifier Q7 and Q9. Q8 is an intermediate stage that drives the series-pass regulator. CR1 and CR4 protect the base-emitter junctions of Q7 and Q9. C4 filters the noise from the reference diode.

Q12 senses the voltage drop across R7. If the voltage is too large (because of too much output current), Q12 biases on Q13 which reduces the base-to-emitter drive of the series-pass transistor. The supply voltage drops to zero and the output current drops (or folds back) to a safe level. C1 prevents the supply from oscillating when it has folded back.

Q10 switches the supply sense line from the output side of relay A26K1 to the input side when the relay opens. The relay is energized by the unregulated +15V supply through the ON/STBY switch (chassis part S1 on Service Sheet 20). VR2 and Q1 form an Over-Voltage Protection circuit for the +15V supply. Should the output of the supply exceed approximately +16V, VR2 conducts and fires SCR Q1 which shorts the supply. The supply then folds back. CR6 protects the supply should the output connect to a negative-polarity supply. VR4 conducts and lights LED DS1 when the supply is at approximately the right voltage.

8-94. Power Supply Regulators (A10)— Service Sheet 24

General. The Power Supply Regulators Assembly (A10) and the Power Supply Mother Board Assembly (A26) contain the circuitry for the +40, +5, and −5V supplies. The +5 and −5V supplies are nearly exact complements (i.e., all polarities reversed, NPN transistors interchanged for PNP, etc.). Both supplies are referenced from the +15V supply and are not adjustable. Only the +40 and the +5V supplies will be discussed.

+40V Supply. The +40V supply is a series-type regulator. Q15 is the series-pass transistor. The series-pass transistor is supplied from a half-wave rectifier (chassis part T1 on Service Sheet 23 and CR8) and filter capacitor C11. The output of the supply is divided down by R39 and R40 and compared to the +15V supply by the differential amplifier Q16 and Q17. Q14 is an intermediate stage that drives the series-pass regulator. CR9 and CR10 protect the base-emitter junctions of Q16 and Q17. C12 filters the noise from the +15V supply. R38 and CR11 bring up the supply when the instrument is turned on.

VR6 and Q3 form an Over-Voltage Protection circuit for the +40V supply. Should the output of the supply exceed approximately +47V, VR3 conducts and fires SCR Q3 which shorts the supply and blows F3. CR14 protects the supply should the output connect to a negative-polarity supply. VR7 conducts and switches on Q4 to light LED DS3 when the supply is at approximately the right voltage.

+5V Supply. The +5V supply is a series-type regulator. A29Q1 is the series-pass transistor which is configured as a Darlington pair. The series-pass transistor is supplied from a full-wave rectifier (chassis part T1 and A26CR2 and CR3 on Service Sheet 23) and filter capacitor A26C1 on Service Sheet 23. The output of the supply is compared to the voltage of the +15V supply (divided down by R50 and R51) by the Comparison Amplifier (U1C) which drives the series-pass regulator.

Over-Current Protection amplifier U1D senses the voltage drop across R58. If the voltage is too large (because of too much output current), the output of U1D goes low which reduces the base-to-emitter drive of the series-pass transistor. The supply voltage drops to zero and the output current drops (or folds back) to a safe level. CR12 and CR15 prevent U1D from having an effect on the supply when the output current is at a normal level. C1 frequency compensates the supply.

VR8 and Q2 form an Over-Voltage Protection circuit for the +5V supply. Should the output of the supply exceed approximately +5.6V, VR2 conducts and fires SCR Q2 which shorts the supply. The supply then folds back. CR17 protects the supply should the output connect to a negative-polarity supply. VR10 conducts and lights LED DS4 when the supply is at approximately the right voltage.

8-95. FM Calibrator (Option 010, A51)— Service Sheet 28

General. The FM Calibrator provides a 10.1 MHz signal with an amount of FM which can be determined by the Controller. It also is the source of RF for the AM Calibrator (see Service Sheet 29).

10.1 MHz VCO and Output Amplifier. The 10.1 MHz Voltage Controlled Oscillator (VCO) is Colpitts type. Q7 provides the gain necessary for oscillation. The tank circuit is composed of the series combination of C16 and C17 in parallel with CR3, CR5, CR6, C20, and L7 in series with L6. Varactor diodes CR3, CR5, and CR6 tune the oscillator approximately 68 kHz peak-to-peak. Q8 is a temperature-compensated current source for the emitter of Q7. Q2 provides a regulated, positive supply for the oscillator and the varactor cathodes; it has a thermal characteristic which compensates for the frequency drift caused by the varactor diodes. C18 and C19 assure that the supply has a low ac impedance. Current source Q4 provides a stable reference voltage across R32 for the base of Q2.

The output from the oscillator, taken from the inductive divider L6 and L7, is buffered by differential pair Q6 and Q1 and drives the AM Calibrator. The base of Q1 is referenced to the output of the Oscillator Collector Supply. Q3 is a constant-current source for the emitters of Q1 and Q6. Q5 is a common-base isolation amplifier which drives the Counter Buffer (U9).

Trapezoid Generation Circuits. The trapezoid generation circuits create a 10 kHz trapezoidal waveform with rounded corners that drives the varactor diodes of the 10.1 MHz VCO. The waveform must rise and fall to full value with a transition time that causes no ringing when the FM signal is demodulated by the FM Demodulator and fed through the audio circuits which have been set for maximum bandwidth. In generating the trapezoidal waveform, a triangle wave is first generated then limited.

Several points in the triangle generation circuits require stable reference voltages. The basic reference is a temperature-stable reference diode VR2. The reference is fed from current source Q13, which itself is temperature stable because its base-emitter junction and its reference (VR1) have similar thermal behavior. The output of the Voltage Reference (taken with respect to the −15V(F) supply) is divided by two by R7 and R8 and converted into a constant current by Current Source U2 and Q11 and by U1 and Q10.

U1 produces a constant voltage across R14 which then generates a constant current. This current also flows through R11, R12, and R13 to produce a constant, but adjustable, voltage at the non-inverting (+) input of U3. U3 is a voltage follower which provides the reference (approximately −5 Vdc) to the non-inverting input of U4.

The Triangle Generator is an integrator configured as a relaxation oscillator. U4 and C11 form the integrator. When the active-high output of U5A is high (i.e., 0V), the 5V developed across R19 produces a constant current which, being integrated, produces a negative-slope ramp at the output of U4. Conversely, when the output of U5A goes low (i.e., −10V), the 5V of opposite polarity developed across R19 produces a positive-slope ramp at the output of U4.

The output of U4 is compared with two references; viz., ground by U6B and −10V by U6A. When the negative-slope ramp reaches −10V, U6A switches from low to high and resets (the formerly set) U5A. The ramp now slopes positively and U6A releases its reset on U5A. When the positive-slope ramp reaches 0V, U6B switches from low to high and sets U5A. The ramp now slopes negatively and U6B releases its set on U5A. Thus, a triangle wave is generated at the output of U4. If the non-inverting input of U6C or U6D is high, the effect of U6B or U6A is overridden and U5A is held either with a set or a reset. U4 falls or rises until CR7 and VR3 or CR8 and VR4 come on and clamp the output of U4 at approximately −10 or 0V.

The triangle wave from U4 is attenuated by a factor of 14 by R21 and R22 and then amplified and limited by the Trapezoid Generator. The Trapezoid Generator is a differential pair, Q9A and Q9B, which has a gain of 1.3 (i.e., one-half the ratio of R27 to the sum of R26 and the emitter resistance of Q9A) when both Q9A and Q9B are active. The triangle's positive-going slope turns on Q9B fully, which turns off Q9A. The resulting 0V on the collector of Q9A tunes the VCO to the low end of its range. The negative-going slope turns Q9B off, which allows all of the current from Q11 to flow through Q9A. This produces a negative voltage limit at the collector of Q9A. The resulting −0.33V tunes the VCO to the upper end of its range. The large emitter resistors (R23 and R26) round the waveform as the limits of the output voltage are reached.

–10V Regulator. The –10V Regulator drops the level of the –15V supply and is the negative supply for U5A.

Select Decoder and Data Latch. For a general discussion of instrument control, see Instrument Bus, page 8-48.

8-96. AM Calibrator (Option 010, A50)—Service Sheet 29

General. The AM Calibrator provides a 10.1 MHz signal with an amount of AM which can be determined by the Controller. The output of the calibrator appears at the CALIBRATION OUTPUT jack.

Input and Modulator Circuits. The source of RF for the AM Calibrator is a 10.1 MHz signal from the FM Calibrator (see Service Sheet 28). This signal is amplified and limited by differential pair Q1B and Q1D. C8 provides an ac short for the emitters of Q1B and Q1D. The emitter current, which is switched back and forth between Q1B and Q1D, is supplied by current source Q1A.

The limited RF signal is split into two nearly identical paths containing the two modulators. The outputs from the modulators are then summed together to produce the modulated signal. Using the path through Modulator A as an example, the RF signal is amplified by Q2 which switches CR1 and CR3 on and off at the RF rate. The node between the cathodes of CR3 and CR5 is supplied with a current from the A Current Source (Q11). When the output from Q2 switches CR1 and CR3 on, the current from the A Current Source is routed through CR1 and CR3. No current flows through CR5 and CR7, and thus, no voltage is developed at the emitter of Q4. When the output from Q2 switches CR1 and CR3 off, the current from the A Current Source flows through CR5 and CR7 and develops a voltage at the emitter of Q4. The voltage level depends on the magnitude of the current and the impedance at the anode of CR7. An RF square wave with a stable amplitude thus appears at the emitter of Q4.

When the AM Calibrator is producing AM, the A Current Source is held on and the B Current Source is switched on and off at a 10 kHz rate. The RF signal at the emitter of Q5 is thus a 10.1 MHz signal chopped at a 10 kHz rate. The signals from the two modulators are converted to currents by the common-base stages Q4 and Q5. Since the collectors of Q4 and Q5 share a common load (R66), the two collector currents are summed together, and an AM signal with a nominal modulation index of 1/3 is developed at the calibrator output. Before being applied to the CALIBRATION OUTPUT jack, the signal is bandpass-filtered by L7 and C28 and attenuated by the 10 dB Output Attenuator.

Amplifier/Detector. The method for accurately determining the AM depth requires accurate measurement of the relative levels from Modulator A alone and B alone. The Detector converts the RF signal into a dc voltage which can be measured by the instrument's internal Voltmeter.

Q20 and Q19 amplify the summed RF signal by 22 dB. The gain of the stage is 1+(R78/R75). Q17 converts the signal from Q19 to a current which drives the common-base amplifier Q16 into the active region during positive half-cycles and off during negative half-cycles. The current from Q16 develops a voltage across R95 which is a half-wave-rectified RF signal. CR11 is switched on and off out of phase with Q16. The detected signal is filtered by R97 and C45 and buffered by voltage follower U2. The output of U2 is the AM Calibration voltage measured by the Voltmeter. The detected signal is also amplified, inverted, and offset by the X10 DC Amplifier. The X10 amplification enhances the resolution of the calibrator in discerning the difference in levels between the outputs of Modulator A and B. The gain of U3 is –[R101/(R96+R98)] = –10. Q18 generates a current which, flowing through R101, generates an offset of about +22V. This offset, when added to the amplified and inverted input, produces a dc voltage at the output of U3 (X10 AM Calibration) which is within the measurement range of the internal Voltmeter. R105, C52, R106, and C54 filter the outputs from the detector amplifiers.

10 kHz Modulation Oscillator and Modulator Drive Circuits. A 10 kHz square wave is generated by a 20 kHz astable multivibrator whose output is divided by 2. The 20 kHz Modulation Oscillator (U6) is a timer circuit wired for astable operation. The Divide-by-2 circuit (U7A) is a D-type flip-flop with the active-low output driving the D input which creates a divide-by-two function. A resistive divider (R37, R39, and R41) is placed across the two outputs of U7A. The voltage at the adjustable center tap of the divider is a square wave whose amplitude and phase sense vary with the position of the tap and the symmetry (duty cycle) of the output from U7A. The output from the divider is fed back to the timing control input of U6 through voltage follower U5.

The voltage at the timing control of U6 determines the period of the output of U6. The half-frequency square wave, applied to timing control input, lengthens or shortens every other cycle from U6 and thus alters the symmetry of the output from the Divide-by-2.

The output from U7A switches the B Current Source on and off. The basic reference for the B Current Source is a temperature-stable reference diode VR1. The reference is fed from current source Q14, which itself is temperature stable because its base-emitter junction and its reference VR2 have similar thermal behavior. The output of the reference (taken with respect to the −15V(F) supply) is divided by two by R63 and R64 and converted into a constant current source by U4 and Q10. The 10 kHz signal driving the base of Q8 alternately switches the current from Q10 between Q7 and Q6.

The current from Q6 drives Modulator B through Q9. The current waveform, however, is modified (by U1 and its associated components) to give it a slower rise and fall time. When Q6 is off, there is no charge on C34 and no current flows through R81. When Q6 switches on, a constant current begins to charge C34. U1 senses this voltage and turns on Q9 to cause an equal voltage to develop across R81 (since the voltage across the inputs of U1 must always be zero). C34 charges exponentially until all the current from Q6 flows through Q9 and into Modulator B. The converse situation occurs when Q6 switches off.

The A Current Source is switched under command of the Controller. The current for the A Current Source originates in current source Q13. The reference for Q13 is also VR1. Q15, wired as a diode, thermally matches the base-emitter junction of Q13 to stablize it. R45 adjusts the current supplied to Modulator A so that the detected voltage from Modulator A can be set to the same value as that from Modulator B.

Power Supply Decoupling. Q22 and Q21 drop the level of the −15V supply to −10 and −5V respectively. They are the supplies for U6, U7A, and some of the bias references. Q23 multiplies the effect of C3 to assist in decoupling audio (e.g., line frequencies) on the +15V supply.

Select Decoder and Data Latch. For a general discussion of instrument control, see Instrument Bus, page 8-48. U8A, U8C, and U8D shift the logic levels from TTL register U9 to levels compatible with the particular devices being driven.

SERVICE SHEET BD1 — OVERALL BLOCK DIAGRAM

OTHER REFERENCES

- Principles of Operation .... Page 8-37

TROUBLESHOOTING

General

The troubleshooting checks that follow are a starting place for locating an instrument fault. They are easy to perform and give much key information in a short amount of time. In most instances they can differentiate between an instrument hardware failure and a Controller or software problem. The comments associated with each procedure summarize the information known as a result of passing or failing the check. The checks should be done in order.

⟨√1⟩ Line Check

Procedure: Remove instrument top cover (three screws) and switch LINE to ON.

Normal Indications:

1. The fan runs indicating power is present on the power transformer secondaries.

2. The five green LEDs on the A10 Power Supply Regulators Assembly are lighted indicating that the supplies are nominally operating.

If Indication Abnormal:

1. Check rear-panel line fuse and line voltage selector. Check Mains wiring. See Service Sheet 23.

2. Check individual regulators. See Service Sheet BD2.

⟨√2⟩ Power-Up Checks

Procedure: If there are any jumpers on the TEST test points on the A13 Controller Assembly, remove them. Switch LINE to STBY for five seconds and back to ON. Note the sequencing of the four TEST LEDs on the top of the Controller Assembly as the instrument powers up.

Normal Indication: The four TEST LEDs light in the following sequence:

1. Indeterminate for about ¼ second.

2. ( ) ( ) ( ) (1) for about ¼ second. This indicates the start of the power-up routines and the run of the Read Only Memory Check.

3. ( ) (4) ( ) ( ) for about ¼ second. This indicates the run of the Local Oscillator Check.

4. (8) (4) (2) (1) for about 10 seconds. This indicates that all power-up checks passed and that a visual front-panel check is in progress (see ⟨√3⟩ below).

5. ( ) ( ) ( ) (1), with (1) blinking indefinitely until a key is pressed. The behavior of the LED (1) is also affected by the presence of an input signal.

Any other sequence indicates a failure of the check. Passing this check indicates that the Controller is functioning properly and that there is no catastrophic failure in the following circuits:

Read Only Memory
Random Access Memory
Instrument Bus
Local Oscillator (except for level)
Keyboard (only that no key is down).

If Indication Abnormal: If the TEST LEDs come on and remain in the random state of step 1 above, check the Controller Kernel. See Service Sheet BD4. If other indications appear in or after step 2 above, consult Power-Up Checks, page 8-17, which discusses the individual checks, documents the error indications, and cross references to the service sheets.

⟨√3⟩ Front-Panel LED Check

Procedure: Disconnect all connections to INPUT. Switch LINE to STBY and back to ON.

Normal Indication: After less than one second, all front-panel LEDs and display segments and decimal points should light for about 10 seconds, then the display blanks for one second then shows "--" with the MHz annunciator and FREQ key light on. This indicates that the Controller is able to output to the front-panel LED and display latches which are all operative.

SERVICE SHEET BD1 (Cont'd)

If indication Abnormal: If one or more LEDs or display segments fail, check the respective components and drive circuits. See Service Sheet 21. Also check the CPU I/O port. See Service Sheet BD4.

√4 Measurement Error Check

Procedure: Key in 43.1 SPCL. This enables Service Errors. Make the measurement in which the fault appears.

Normal Indications: As the Special Function code is entered, 43.1 should appear in the display. This indicates that the Controller responds to keyboard interrupts. After pressing the SPCL key, measurements should proceed as normal.

If Indication Abnormal: If the keys have no effect, check the keyboard interrupt. See Service Sheet 20. If the keystrokes produce an erroneous display, check the Keyboard. See Service Sheet BD4. If the measurement is improper or error messages appear in the display, consult the error message tables (see Error Messages in the Detailed Operating Instructions of the Operating Manual and Error Messages, page 8-15, or consult the block diagram service sheet that documents the section of the instrument that appears to have the fault (see Service Sheets BD2 through BD4).

NOTE

For problems that are exclusive to the HP-IB, see Service Sheet BD4.

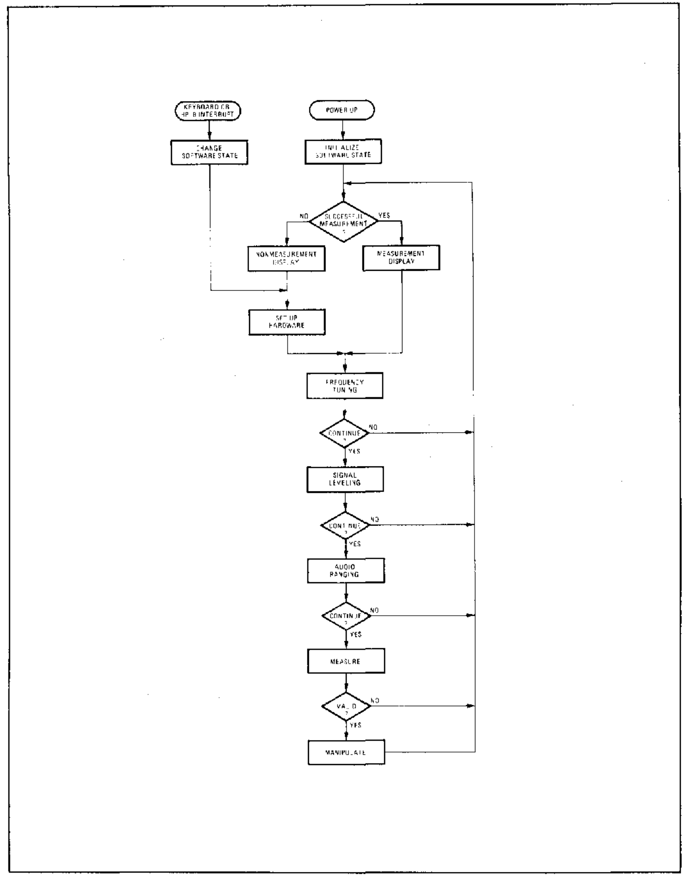
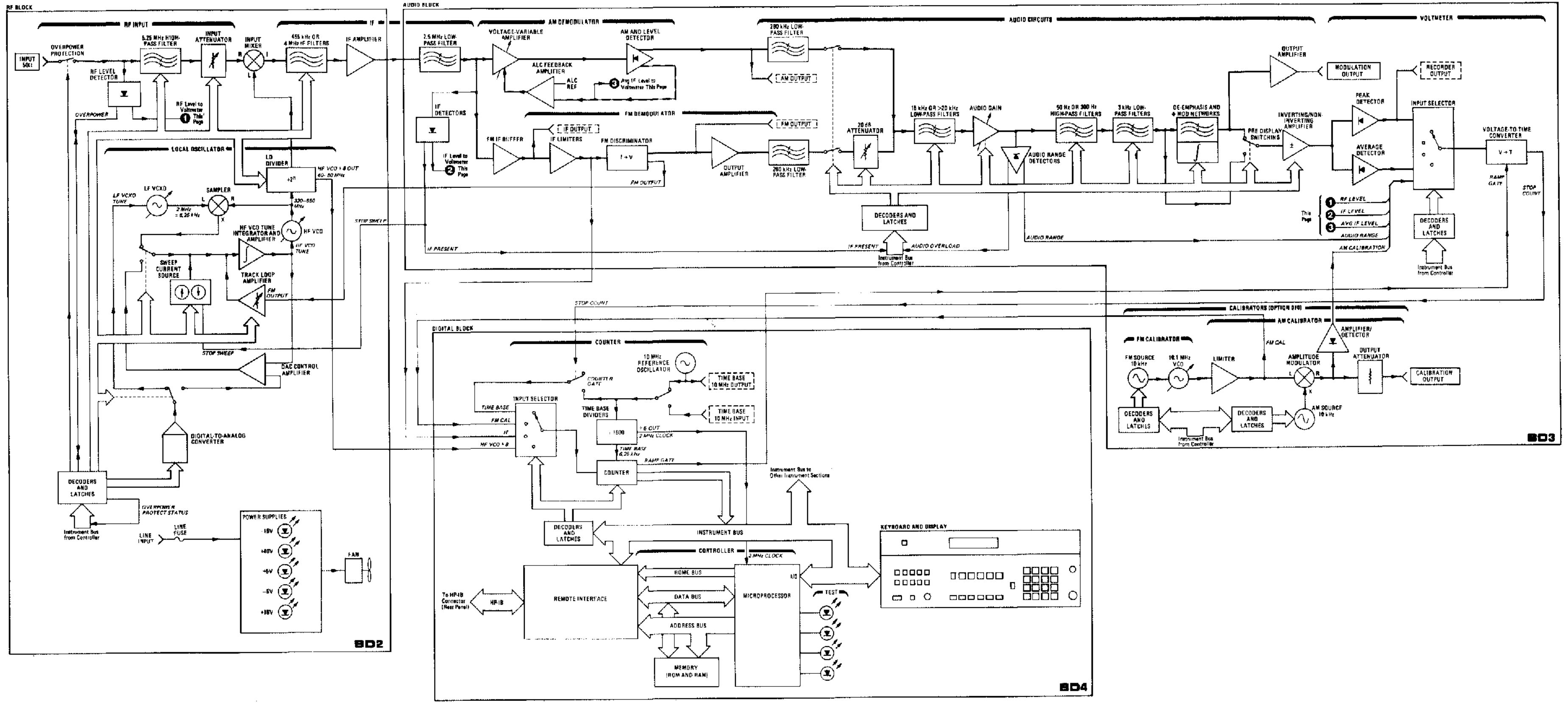


Figure 8-57. Modulation Analyzer Software Supervisor Flow Chart



BD1

Figure 8-58. Overall Block Diagram

SERVICE SHEET BD2 — RF AND POWER SUPPLY SECTIONS

OTHER REFERENCES

- Overall Block Diagram .... Service Sheet BD1
- Principles of Operation .... Page 8-42

TROUBLESHOOTING

General

Procedures for checking the RF and Power Supply Sections of the instrument are given below. The blocks or points to check are marked on the block diagram by a hexagon with a check mark and a number inside, e.g., (√3). Before performing any check perform all the checks on Service Sheet BD1.

CAUTION

Tightening SMC connectors to 0.6 N-m (5 in.lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope .... HP 1740A
Power Supply .... HP 6215A
Signal Generator .... HP 8640B
Spectrum Analyzer .... HP 8555A/8552B/141T
Voltmeter .... HP 3455A

(√1) Input Attenuator and Filter Check

1. Set signal generator to 5.25 MHz CW at −33 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

2. Connect ac coupled oscilloscope to A15J2 (RF OUT). Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

3. *Key in 41.0 SPCL to initialize the instrument.* Key in the Special Functions (to set the input attenuation) and set the signal generator level as listed below. For each setting, the 5.25 MHz signal should appear within the limits indicated. If out of limits, see Service Sheet 1 and check the Input Attenuator.

Special Function	Attenuation (dB)	Signal Generator Level (dBm)	Oscilloscope Display Limits (mVpp)	
			Minimum	Maximum
1.1 SPCL	0	−33	12	17
1.2 SPCL	10	23	12	17
1.3 SPCL	20	-13	12	17
1.4 SPCL	30	−3	12	17
1.5 SPCL	40	+7	12	17
1.6 SPCL	50	+17	12	17

SERVICE SHEET BD2 (Cont'd)

4. Key in 3.4 SPCL to insert the 5.25 MHz High-Pass Filter. The signal on the oscilloscope display should drop to between 8 and 12 mVpp. If out of limits, see Service Sheet 1 and check the High-Pass Filter.

(√2) Overpower Protection Check

1. Set power supply to 20 Vdc. Touch the +20V lead to the Modulation Analyzer's INPUT (the minus side should be at ground). The display should show Error E06. If faulty, see Service Sheet 1 and check the Overpower Protection.

NOTE

If step 1 is repeated, it is necessary to first perform step 2 in order to discharge the input dc blocking capacitor. Also, disconnect the supply from the INPUT before setting the voltage to 20 Vdc.

2. Set the supply to zero (without turning it off) and while still connected to the INPUT, press CLEAR. Error E06 should go away. If it doesn't, see Service Sheet 1 and check the Overpower Protection.

(√3) RF Detector Check

1. Perform the accuracy portion of the RF Level Performance Test, page 4-30. If the test fails, see Service Sheet 1 and check the Detector Amplifier.

(√4) Local Oscillator Tuning Check

1. Key in 54.0 SPCL. If the display shows other than 0, see Special Function 54.N, page 8-12.

(√5) Local Oscillator Level Check

1. Set RF spectrum analyzer to measure a 0 dBm, 0 to 1400 MHz signal. Connect its input to the end of the cable connected to A17J3 (LO IN).

2. Key in 57.0 SPCL to cause the LO to sweep sequentially across bands DBLR through 3. The LO signal should sweep slowly from above 1300 to below 40 MHz. The sweep will occur over five bands. As the low end of a band is reached, the sweep will stop, jump up slightly in frequency, then continue to sweep. Throughout the sweep, the LO should maintain an amplitude of at least 0 dBm. If it does not, see Service Sheet 11 and check the dividers and gates associated with the bad band.

NOTE

The sweep can be halted by pressing the SPCL key. If the power level is marginal at a particular frequency, halt the sweep at that frequency and make a more precise measurement with a power meter.

SERVICE SHEET BD2 (Cont'd)

3. Set the spectrum analyzer to view a 0 to 40 MHz signal.

4. Key in 56.0 SPCL to cause the LO to sweep sequentially across bands 4 through 8. The LO signal should sweep slowly from above 40 to below 1.25 MHz in the manner described in step 2 above. If the amplitude is not at least 0 dBm, see Service Sheet 11 and check the dividers and gates associated with the bad band.

NOTE

The low-frequency bands can also be viewed on an oscilloscope. The oscilloscope should have a 50Ω termination. The signal should be a square wave with an amplitude of 0.5 Vpp or greater.

(√6) Track Mode Check

NOTE

This check assumes that Local Oscillator checks (√4) and (√5) give positive results, but that track-mode tuning is suspected to be faulty.

1. Set signal generator to approximately 20 MHz CW at 0 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

2. Connect high-impedance, dc coupled oscilloscope to the rear-panel FM OUTPUT.

3. Key in 41.0 SPCL to initialize the instrument. After the *Modulation Analyzer is tuned, press MHz, then S (Shift)* FREQ ERROR. The oscilloscope should show −1 to +1 Vdc. If it does not, see Service Sheet 6 and begin by checking the Charge-Count Discriminator.

4. Adjust the oscilloscope to vertically center the trace. Adjust the signal generator's frequency until the displayed frequency error is 500 kHz. The oscilloscope display should move down to −3.2 to −2.8V. Adjust the signal generator's frequency until the displayed frequency error is −500 kHz. The oscilloscope display should move up to 2.8 to 3.2V. If faulty, see Service Sheet 6 and check the Charge-Count Discriminator. If not faulty, see Service Sheet 14 and check the Track Loop Amplifier.

(√7) Input Mixer and IF Check

NOTE

This check assumes that Local Oscillator checks (√4) and (√5) give positive results.

1. Set signal generator to approximately 20 MHz CW at 0 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

2. Connect ac coupled oscilloscope to rear-panel IF OUTPUT. Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

SERVICE SHEET BD2 (Cont'd)

3. Key in 41.0 SPCL to initialize the instrument. Key in 1.3 SPCL to set the attenuation range to 20 dB. The waveform should be a sine wave 80 to 126 mVpp with a period of between 645 and 690 ns (i.e., nominally 1.5 MHz). If faulty, see Service Sheets BD3 and 2 and check Input Mixer, IF Filters, and IF Amplifiers.

4. Key in 3.1 SPCL to set the IF to 455 kHz. The waveform should be a sine wave 67 to 106 mVpp with a period of 2.19 to 2.21 μs (i.e., nominally 455 kHz). If faulty, see Service Sheet 2 and check the 455 kHz Bandpass Filter.

(√8) Power Supply Check

1. Check test points A10TP2 through TP7 with a dc voltmeter. The voltages should be within the limits shown on Block Diagram 2. If a short on the supply is suspected, continue with step 2. If a regulator is suspected, see Service Sheets 23 and 24.

NOTE

The supplies are interdependent. Often a short on one supply will shut down another. All supplies are dependent on the +15V supply.

The switched +15V supply line is normally grounded when the instrument is off. The +15V supply (unswitched) LED should remain lighted when the LINE is set to STBY.

2. Remove the plugs connected to A26J6 (RF SECTION), A26J3 (DIGITAL SECTION), and A26J2 (AUDIO SECTION) one at a time and observe the five power supply LEDs. An extinguished LED will light when the short is removed from the supply. The assemblies in the faulty section can then be removed one at a time until the one with the short is discovered.

3. Remove the plug connected to A26J1 (KEY BD). Jumper pins 2 and 6 of A26J1 (where the green and black wires of W24 normally connect) to turn the instrument on. If the short is on the A1 Keyboard and Display Assembly, the extinguished LED will light. If the short still persists, see Service Sheets 23 and 24 and check the faulty regulator.

Overall Block Diagram SERVICE SHEET BD1

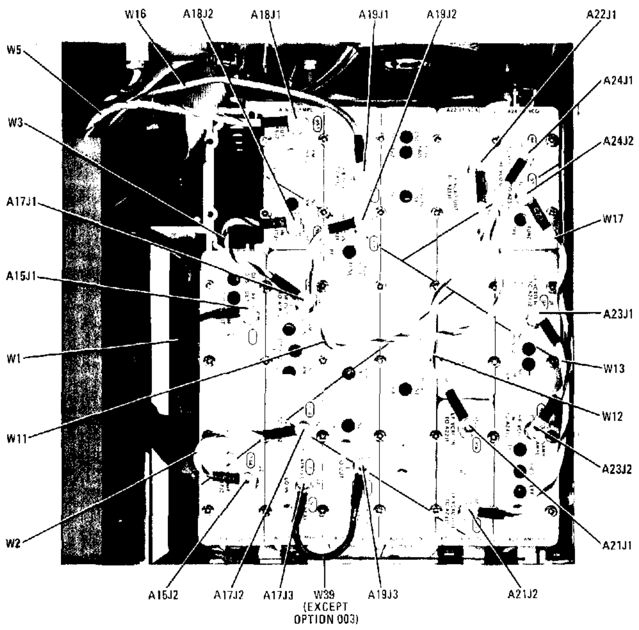
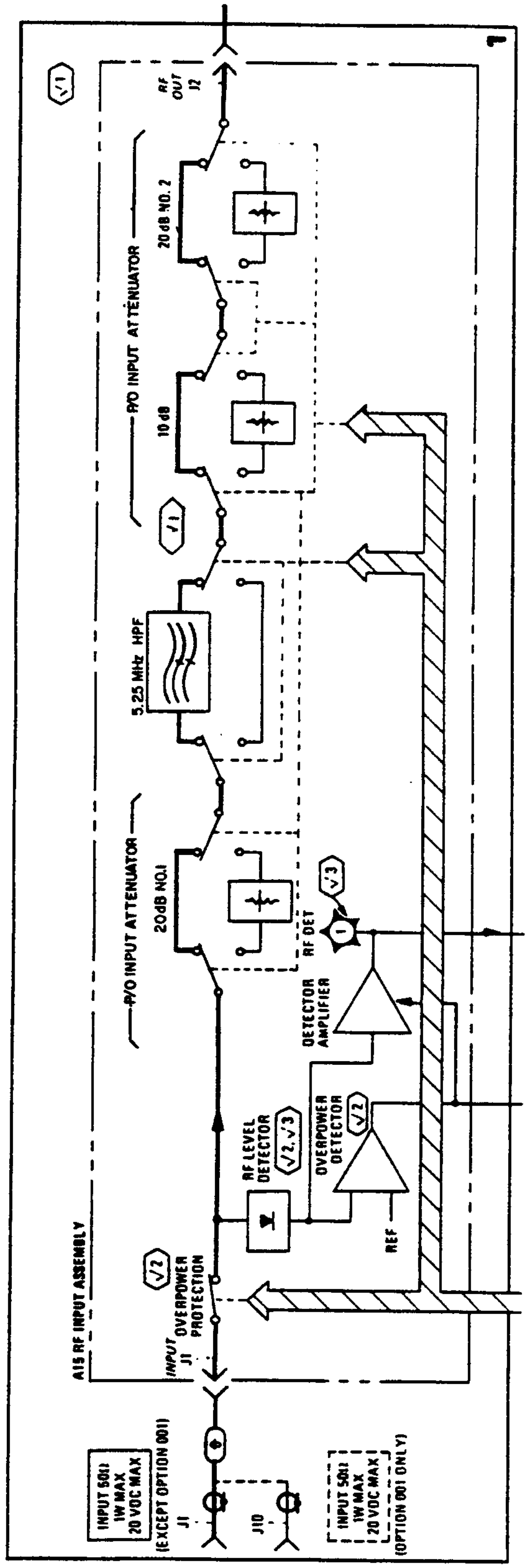


Figure 8-59. RF Section Component Locations

CHANGES

All serial prefixes	**On Figure 8–59:** • **MP65** - A cover has been added to the empty circuit board slot in the RF section. This cover has been assigned reference designator MP65.
2212A and above	**On the BD2 schematic:** • **A15** - In the upper left portion of the block diagram, replace the A15 input assembly schematic (block 1) with the figure, P/O Figure 8–61. RF and Power Supply Sections Block Diagram (2212A and above), on page 8–88.3.

Reserved for future changes.



P/O Figure 8–61. RF and Power Supply Sections Block Diagram (2212A and above)

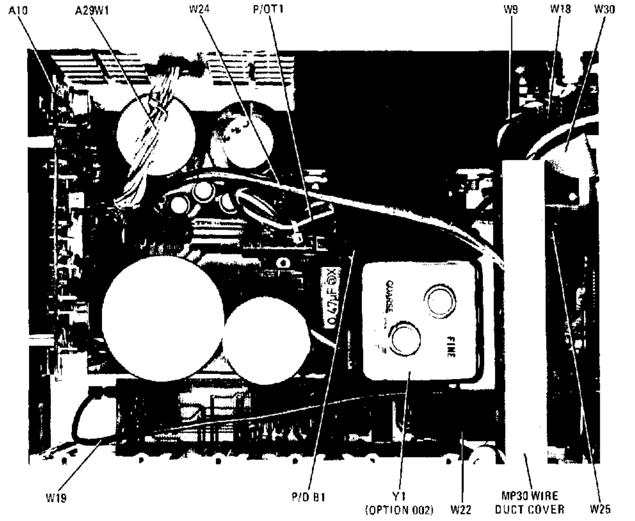
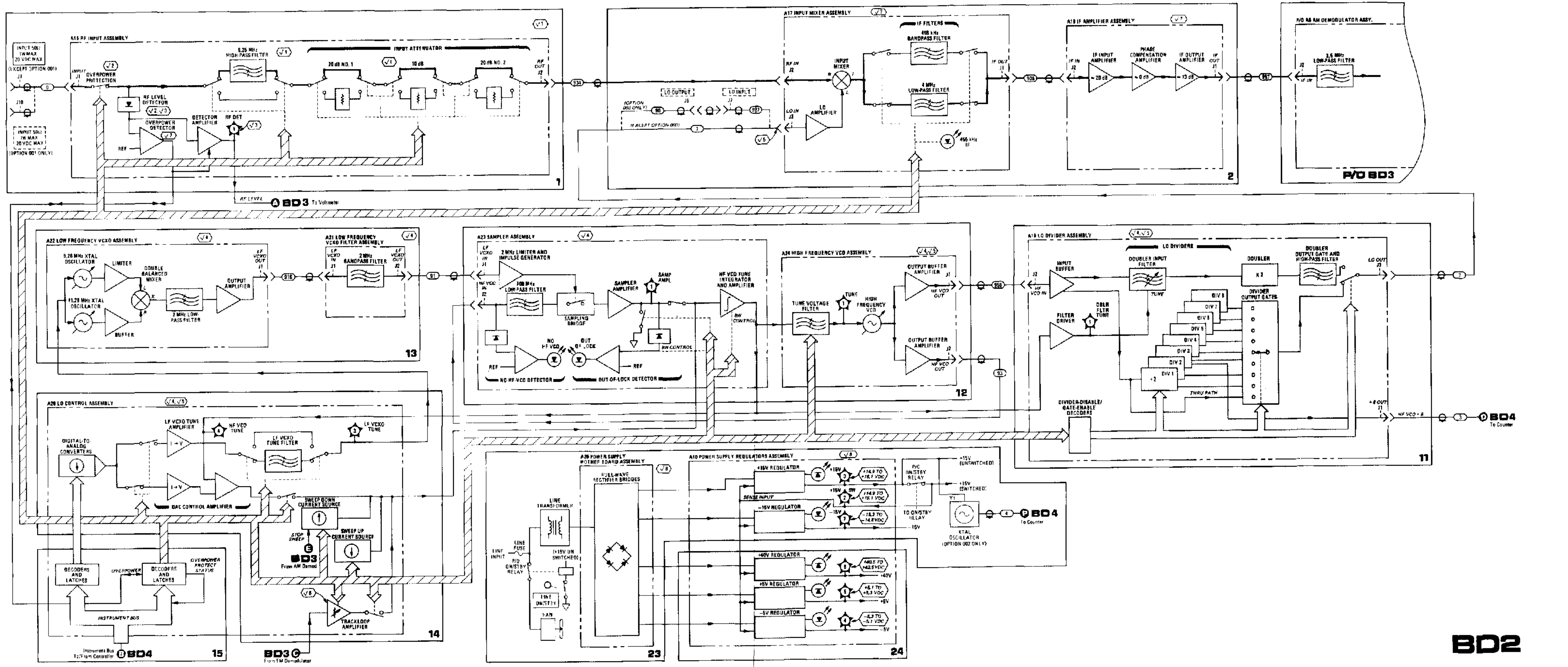


Figure 8-60. Power Supply Component Locations



BD2

Figure 8-61. RF and Power Supply Sections Block Diagram

SERVICE SHEET BD3 — AUDIO SECTION

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the Audio Section of the instrument are given below. The blocks or points to check are marked on the block diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. Before performing any check, perform all the checks on Service Sheet BD1.

CAUTION

Tighten SMC connectors to 0.6 N.m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Audio Synthesizer .... HP 3320B
Oscilloscope .... HP 1740A
Signal Generator .... HP 8640B

⟨√1⟩ IF Amplifier Check

1. Perform the Input Mixer and IF Check on Service Sheet BD2.

⟨√2⟩ IF Detector Check

NOTE

This check assumes that the ⟨√1⟩ IF Amplifier Check gives positive results.

1. Set signal generator to 20 MHz CW at 0 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

2. Connect ac coupled oscilloscope to rear-panel IF OUTPUT. Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

3. Key in 41.0 SPCL to initialize the instrument. Key in 20 MHz. If error message E01 appears, press MHz again. Key in 1.3 SPCL to set the attenuation range to 20 dB. Adjust the signal generator level for a 100 mVpp waveform on the oscilloscope.

4. Key in 49. S (Shift) 3 SPCL. This causes the IF level to be displayed. The display should read between 0.85 and 0.95. If it does not, see Service Sheet 4 and check the IF Level Detector.

5. *Switch signal generator's RF off.*

6. Key in 0.0 S (Shift) 4 SPCL. The display now reads the IF Present status. The display should read 0000.0000. If faulty, see Service Sheet 4 and check the IF Present Detector.

7. Switch the signal generator's RF on. The display should read 0001.0000 indicating that IF has been detected. If faulty, see Service Sheet 4 and check the IF Present Detector.

NOTE

To repeat steps 5 through 7, it is necessary to press CLEAR first to clear the IF Present Latch.

SERVICE SHEET BD3 (Cont'd)

⟨√3⟩ AM Demodulator Check

NOTE

This check assumes that the ⟨√1⟩ IF Amplifier Check gives positive results.

1. Set signal generator to approximately 20 MHz CW at 0 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

2. Key in 41.0 SPCL to initialize the instrument. Press AM. Key in 49. S (Shift) 1 SPCL. This causes the average IF level (which the ALC loop is supposed to hold constant) to be displayed. The display should read between 2.096 and 2.104. If only slightly out of limits, perform the ALC Reference Adjustment, page 5-13; otherwise, see Service Sheet 3.

3. Connect high-impedance, ac coupled oscilloscope to rear-panel AM OUTPUT.

4. Modulate the signal generator with 50% AM at a 1 kHz rate. The oscilloscope should show the demodulated AM with an ac amplitude of 750 to 850 mVpp. If faulty, see Service Sheet 3.

⟨√4⟩ FM Demodulator Check

NOTE

This check assumes that the ⟨√1⟩ IF Amplifier Check gives positive results.

1. Set signal generator to approximately 20 MHz CW at 0 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

2. Key in 41.0 SPCL to initialize the instrument. Press FM. Allow the instrument to tune then press MHz. Pressing the MHz key sets tuning to manual.

3. Connect high-impedance, dc coupled oscilloscope to A4J2 (IF OUT). The waveform should be TTL pulses with a period of approximately 670 ns. If faulty, see Service Sheet 5 and check the IF Limiters.

4. Reconnect the cable to A4J2. Connect the ac coupled oscilloscope to the rear-panel FM OUTPUT.

5. Modulate the signal generator with 100 kHz peak deviation FM at a 1 kHz rate. The oscilloscope should show the demodulated FM with an ac amplitude of 1.0 to 1.4 Vpp. If faulty, see Service Sheet 6 and check the Charge-Count Discriminator.

NOTE

A slight fuzziness on the waveform is normal. It is the doubled 1.5 MHz IF carrier.

6. Connect the oscilloscope to A4TP5 (FM OUT). The waveform should be 3.6 to 4.4 Vpp. If faulty, see Service Sheet 6 and check the FM Output Amplifier and Squelch.

NOTE

This waveform will have even more of the doubled 1.5 MHz carrier on it.

SERVICE SHEET BD3 (Cont'd)

⟨√5⟩ Audio Filters and Gain Check

1. Set audio synthesizer to 1 kHz at −17 dBm. (The synthesizer output impedance should be 50Ω.) Connect its output to A2J1 (AM IN).

CAUTION

If the Modulation Analyzer is to be turned off, disconnect the audio synthesizer first to prevent damage to the CMOS switches by the large signal present.

2. Connect a high-impedance, ac coupled oscilloscope (with 10:1 divider probe) to A2TP4 (AMPL 3 OUT).

3. Set signal generator to approximately 20 MHz CW at 0 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

4. Key in 41.0 SPCL to initialize the instrument. Press AM. Key in 2.1 SPCL to set the audio gain to maximum. The oscilloscope should show the 1 kHz sinusoidal waveform with an ac amplitude of 2.4 to 2.8 Vpp. If faulty, see Service Sheet 7 and check the audio path beginning at the 260 kHz Low-Pass Filter at the AM output.

5. Increase the synthesizer frequency to 260 kHz without altering the amplitude. The waveform should have an ac amplitude of 1.2 to 1.6 Vpp. If faulty, see Service Sheet 7 and check the 260 kHz Low-Pass Filter at the AM output as well as checking to see if the 15 kHz or >20 kHz are in the circuit (they should be out).

NOTE

This is not a valid measurement of the filter bandwidth since the source impedance is incorrect. It will, however, show up a severe problem. For a more precise test of bandwidth, see Service Sheet 7 or perform the Audio Filters Performance Test, page 4-27.

6. Set synthesizer level to −27 dBm and frequency to 1 kHz. Connect its output to A2J2 (FM IN). Press FM. The waveform should have an ac amplitude of 3.0 to 3.6 Vpp. If faulty, see Service Sheet 7 and check the 260 kHz Low-Pass Filter at the FM output.

7. Increase the synthesizer frequency to 260 kHz. The waveform should have an ac amplitude of 1.1 to 1.5 Vpp. If faulty, see Service Sheet 7 and check the 260 kHz Low-Pass Filter at the FM output.

NOTE

See previous note.

8. Set synthesizer level to −17 dBm and frequency to 1 kHz. Key in 2.2 SPCL to reduce the audio gain by 20 dB. The waveform should have an ac amplitude of 950 to 1150 mVpp. If faulty, see Service Sheet 7 and check 20 dB Attenuator 1.

9. Key in 2.3 SPCL to reduce the audio gain another 20 dB. The waveform should have an ac amplitude of 95 to 115 mVpp. If faulty, see Service Sheet 7 and check 20 dB Attenuator 2.

SERVICE SHEET BD3 (Cont'd)

10. Set synthesizer frequency to 110 kHz. Set LP FILTER to >20 kHz. The waveform should have an ac amplitude of 40 to 60 mVpp. If faulty, see Service Sheet 7 and check the >20 kHz Low-Pass Filter.

11. Set synthesizer frequency to 15 kHz. Set LP FILTER to 15 kHz. The waveform should have an amplitude of 60 to 90 mVpp. If faulty, see Service Sheet 7 and check the 15 kHz Low-Pass Filter.

⟨√6⟩ Audio Filters and De-emphasis Check

NOTE

This check assumes that the ⟨√5⟩ Audio Filters and Gain Check gives positive results.

1. Set audio synthesizer to 1 kHz at −17 dBm. (The synthesizer output impedance should be 50Ω.) Connect its output to A2J2 (FM IN).

2. Connect a high-impedance, ac coupled oscilloscope (with 10:1 divider probe) to A3TP3 (DE-EM OUT).

3. Set signal generator to approximately 20 MHz CW at 0 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

4. Key in 41.0 SPCL to initialize the instrument. Press FM. Key in 2.2 SPCL to set the audio gain to an intermediate range. The oscilloscope should show a sinusoidal waveform with an ac amplitude of 1.9 to 2.3 Vpp. If faulty, see Service Sheet 8 and check the audio path beginning at the high-pass filters.

5. Set synthesizer frequency to 300 Hz. Set HP FILTER to 300 Hz. The waveform should have an ac amplitude of 1.3 to 1.7 Vpp. If faulty, see Service Sheet 8 and check the 300 Hz High-Pass Filter.

6. Set synthesizer frequency to 50 Hz. Set HP FILTER to 50 Hz. The waveform should have an ac amplitude of 1.5 to 1.7 Vpp. If faulty, see Service Sheet 8 and check the 50 Hz High-Pass Filter.

7. Set synthesizer frequency to 3 kHz. Set HP FILTER off and the LP FILTER to 3 kHz. The waveform should have an ac amplitude of 1.2 to 1.8 Vpp. If faulty, see Service Sheet 8 and check the 3 kHz Low-Pass Filter.

8. *Set LP FILTER off and FM DE-EMPHASIS to PRE-DISPLAY.* Set the synthesizer frequency and FM DE-EMPHASIS as listed below. For each setting, the ac amplitude of the waveform should be as indicated. If faulty, see Service Sheet 8 and check the appropriate de-emphasis filter.

9. Key in 2.2 SPCL. Switch PRE-DISPLAY off. The waveform should have an ac amplitude of 1.9 to 2.3 Vpp. If faulty, see Service Sheet 8 and check the Pre-Display Switching

SERVICE SHEET BD3 (Cont'd)

Synthesizer Frequency (Hz)	FM DE-EMPHASIS (μs)	Waveform Amplitude Limits (Vpp)	
		Minimum	Maximum
6366	25	1.3	1.7
3183	50	1.3	1.7
2122	75	1.3	1.7
212.2	750*	1.3	1.7

*Key in 2.3 SPCL to reduce the gain by 20 dB.

10. Set synthesizer frequency to 1 kHz. Press ΦM. The waveform should have an ac amplitude of 1.9 to 2.3 Vpp. If faulty, see Service Sheet 8 and check the Phase Modulation Integrator.

11. Press PEAK−. The waveform should not noticeably change amplitude. *If faulty, see Service Sheet 8 and check the Inverting/* Non-Inverting Amplifier.

12. Press FM. Switch off all FM DE-EMPHASIS. Connect the oscilloscope to MODULATION OUTPUT. The waveform should have an ac amplitude of 1.9 to 2.3 Vpp. If faulty, see Service Sheet 8 and check the Output Amplifier.

13. Key in 49.6 SPCL. This causes the output of the audio range detector to be displayed. The display should read 0.4 to 0.6. If faulty, see Service Sheet 8 and check the Absolute Peak Detector.

14. Key in 0.15 SPCL. The display now shows the audio overvoltage status. The display should read 0000.0000. If faulty, see Service Sheet 8 and check the Audio Overvoltage Detector.

15. Increase the synthesizer level to +10 dBm. The display should read 0001.0000 indicating that an audio overload has been detected. If faulty, see Service Sheet 8 and check the Audio Overvoltage Detector.

NOTE

To repeat steps 13 and 14, it is necessary to press CLEAR first to clear the audio overvoltage latch.

⟨√7⟩ Average and Peak Detector Check

NOTE

This check assumes that the ⟨√6⟩ Audio Filters and De-emphasis Check gives positive results.

◀ RF and Power Supply Sections Block Diagram SERVICE SHEET **BD2**

SERVICE SHEET BD3 (Cont'd)

1. Set audio synthesizer to 1 kHz at −17 dBm. (The synthesizer output impedance should be 50Ω.) Connect its output to A2J2 (FM IN).

2. Connect a high-impedance, ac coupled oscilloscope (with 10:1 divider probe) to A3TP3 (DE-EM OUT).

3. Set signal generator to approximately 20 MHz CW at 0 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

4. Key in 41.0 SPCL to initialize the instrument. Press FM. Switch the HP FILTER and LP FILTER to ALL OFF and switch FM DE-EMPHASIS off. Key in 2.2 SPCL to set the audio gain to an intermediate range. Fine adjust the synthesizer level for an ac waveform of 2 Vpp.

5. Connect dc coupled oscilloscope to A5TP4 (AVG OUT). (Check the dc reference of the oscilloscope.) The level on the oscilloscope should be 660 to 760 mVdc. If faulty, see Service Sheet 9 and check the Average Detector.

6. Connect oscilloscope to rear-panel RECORDER OUTPUT. The level on the oscilloscope should be 0.9 to 1.1 Vdc. If faulty, see Service Sheet 9 and check the Peak Detector.

7. Remove then reconnect the synthesizer output. The waveform should drop and rise (in a step-like manner) in less than one second. If faulty, see Service Sheet 8 and check the Sample-and-Hold Switch.

8. Key in 5.1 SPCL to set the Audio Peak Detector time constant to slow. Repeat step 7 above. The decay and rise time should be about two seconds.

⟨√8⟩ Voltage-to-Time Converter Check

1. Key in 50.3 SPCL. This causes the +5V supply to be displayed. The display should read 2.88 to 3.16. If faulty, see Service Sheet 10 and begin troubleshooting with the Voltage-to-Time Converter.

2. Check the Input Selectors by keying in the Service Special Functions listed for 49.N and 50.N. Consult Service Special Functions in Special Functions, page 8-11,, for more information. If any reading seems faulty when the input is known to be good, see Service Sheet 10 and check the Input Selectors.

⟨√9⟩ FM Calibrator Check (Option 010)

1. Connect a high-impedance, ac coupled oscilloscope (with 10:1 divider probe) to A51TP2 (TRAPEZOID OUT).

2. Press FM and CALIBRATION. The waveform should be trapezoidal with round edges and an ac amplitude of 300 to 340 mVpp and period of 90 to 110 μs. (*Ignore the "——" in the display.*) If faulty, see Service Sheet 28 and check the trapezoid generation circuits.

3. Key in 12.1 SPCL and 46.3 SPCL. This sets the FM Calibrator to CW and causes the display to show its frequency. The display should read between 1009000 and 1011000. If only slightly out of limits, perform the FM Calibrator Adjustments, page 5-14. Otherwise, see Service Sheet 28 and check the 10:1 MHz VCO.

4. Key in 12.0 SPCL. This causes the display to read the computed peak deviation. The display should read between 31 and 37 kHz. If only *slightly out of limits, perform FM Calibrator* Adjustments, page 5-14. Otherwise, see Service Sheet 28 and check the VCO.

5. Key in 12.1 SPCL. Connect an ac coupled oscilloscope to CALIBRATION OUTPUT. Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee. The waveform should be approximately sinusoidal and have an ac amplitude of 35 to 45 mVpp. If faulty, see Service Sheet 28 and check the Output Amplifier. If it is good, see Service Sheet 29 and check the RF path through the AM Calibrator.

⟨√10⟩ *AM Calibrator Check (Option 010)*

1. Connect an ac coupled oscilloscope to CALIBRATION OUTPUT. Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

2. Key in 13.1 SPCL to set the AM Calibrator to CW. The waveform should be approximately sinusoidal with an ac amplitude of 35 to 45 mVpp. If faulty, see Service Sheet 29 and check the RF path beginning at the input of the FM Calibrator.

3. Key in 13.0. This causes the display to show the AM depth. The display should show between 33.0 and 33.7%. If faulty, see Service Sheet 29 and begin by checking the Modulators.

4. Press AM then CALIBRATION. The waveform should show the carrier with AM. The AM envelope should be a rounded square wave with a period of 90 to 110 μs. The amplitude of the peak should be twice that of the trough. If faulty, see Service Sheet 29 and check the 10 kHz Modulation Oscillator.

CHANGES

All serial prefixes	**On Figure 8–62:** • **MP66** - A cover has been added to the empty circuit board slot in the Audio section. The reference designator of this cover is MP66.

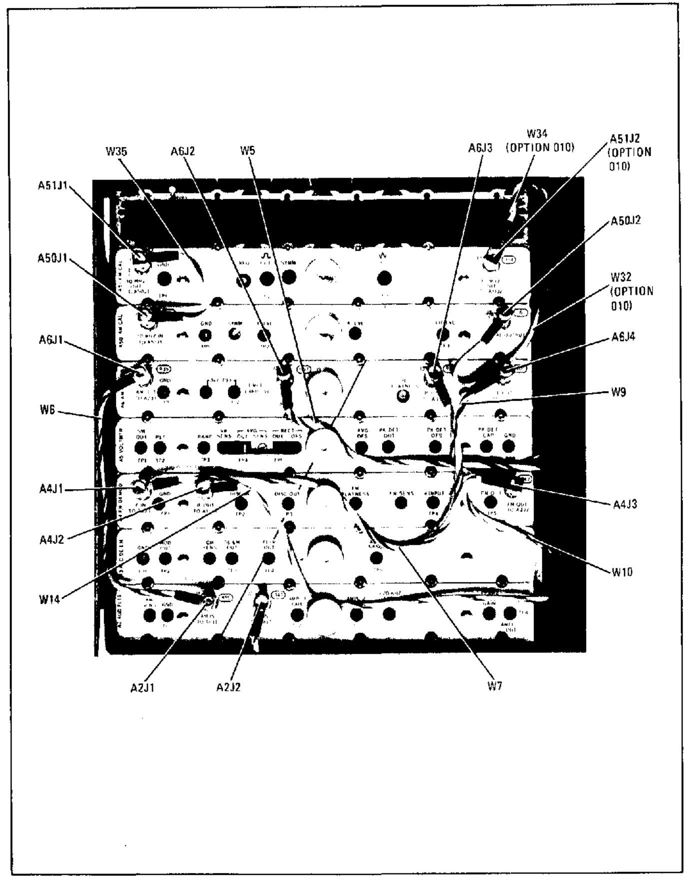


Figure 8-62. Audio Section Component Locations

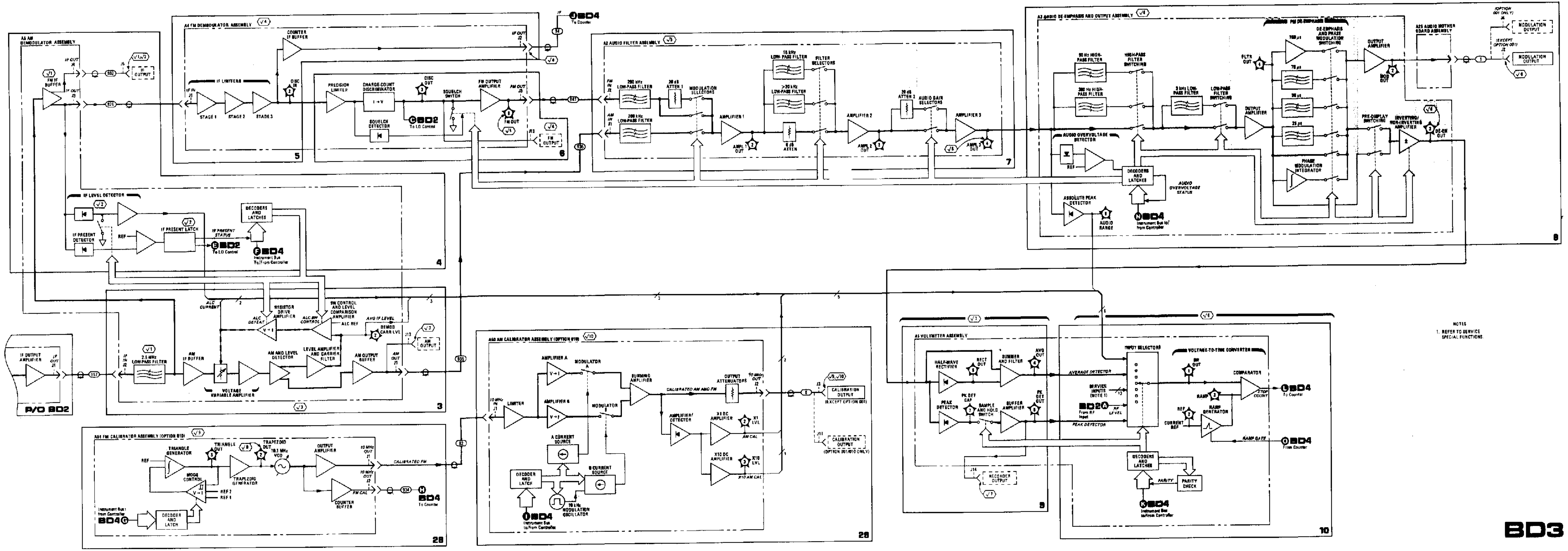


Figure 8-63. Audio Section Block Diagram

SERVICE SHEET BD4 — DIGITAL AND FRONT PANEL SECTIONS

OTHER REFERENCES

- Overall Block Diagram .... Service Sheet BD1
- Signature Analysis .... Page 8-18
- Principles of Operation .... Page 8-47

TROUBLESHOOTING

General

Procedures for checking the Digital Section of the instrument are given below. The blocks or points to check are marked on the block diagram by a hexagon with a check mark and a number inside, e.g., √3 . Before performing any check, perform all the checks on Service Sheet BD1.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Digital Test/Extender Board .... HP 08901-60081
Oscilloscope .... HP 1740A
Signature Analyzer .... HP 5004A
Voltmeter .... HP 3455A

√1 Time Base Reference Check

1. Disconnect any input to the rear-panel TIME BASE 10 MHz INPUT.

2. Connect high-impedance, dc coupled oscilloscope to A11J5 (INT 10 MHz OUT). The waveform should be a TTL square wave with a period of 100 ns. If faulty, see Service Sheet 16 and check the 10 MHz Time Base Reference Oscillator.

3. Check A11TP4 (TB) with an oscilloscope. The waveform should be TTL pulses with a period of 160 μs. If faulty, see Service Sheet 16 and check the Time Base Divider.

√2 Counter Check

NOTES

This check assumes that the √1 Time Base Reference Check gives positive results.

For Option 002, disconnecting the cable from the time base reference halts the Controller.

1. Connect a jumper cable between A11J5 (INT 10 MHz OUT) and A11J1 (÷8 IN). Key in 46.4 SPCL. This switches the Counter to measure the HF VCO divided by 8. The display should read 1000000±1. If faulty, see Service Sheet 17.

2. Disconnect jumper from A11J1 and connect to A11J3 (IF IN). Key in 46.1 SPCL. This switches the Counter to measure the IF. The display should read 1000000±1. If faulty, see Service Sheet 17 and check the Input Selector.

3. Disconnect jumper from A11J3 and connect it to A11J2 (10 MHz IN). Key in 46.3 SPCL. This switches the Counter to measure the output of the FM Calibrator. The display should read 1000000±1. If faulty, see Service Sheet 17 and check the Input Selector.

SERVICE SHEET BD4 (Cont'd)

4. Remove the jumper cable. Short A11TP1 (GND) to A11TP6 (VM GATE). Key in 46.2 SPCL. This switches the Counter to measure the 10 MHz time base reference via the Voltage-to-Time Converter input. The display should read 1000000±1. If faulty, see Service Sheet 17 and check the Input Selector and Voltmeter Gate logic.

√3 Controller Kernel Check

1. Switch LINE to STBY. Extend A13 Controller Assembly with the Digital Test/Extender Board. Switch LINE to ON.

2. Check A13TP9 (+12V) with dc voltmeter. The voltage should be between +11.4 and +12.6 Vdc. If faulty, see Service Sheet 19 and check the +12V Regulator.

3. Short A13TP2 (RESET) to A13TP1 (GND). This resets the Controller and forces a short write (instruction) cycle. Connect a high-impedance, dc coupled oscilloscope to the WRT test point on the extender board. The waveform should be TTL pulses with a period of 2 μs. If faulty, see Service Sheet 18 and check the clock and Φ lines.

4. Set ROMC switches on extender board to GND. This forces the SMI to step through its addresses. On the extender board, connect the signature analyzer clock to WRT, start and stop to ADDRESS 15, and ground to GND. Set the signature analyzer's start and stop to trigger on a falling edge and set clock to trigger on a rising edge. Check the following test points on the extender board with the signature analyzer probe:

Test Point	Signature
+5V	0001
GND	0000
ADDRESS 15	755U
ADDRESS 14	3827
ADDRESS 13	3C96
ADDRESS 12	HAP7
ADDRESS 11	1293
ADDRESS 10	HPP0
ADDRESS 9	2H70

Test Point	Signature
ADDRESS 8	HC89
ADDRESS 7	52F8
ADDRESS 6	UPFH
ADDRESS 5	0AFA
ADDRESS 4	5H21
ADDRESS 3	7F7F
ADDRESS 2	CCCC
ADDRESS 1	5555
ADDRESS 0	UUUU

If all signatures are bad except GND, see Service Sheet 18 and replace the SMI. If only one ADDRESS line is faulty, see Service Sheets 18, 19, and 22 and check the SMI and the address line.

5. Check the RAM WRT and CPU READ test points on the extender board with an oscilloscope. RAM WRT should be a TTL high, CPU READ should be a TTL square wave with a period of 2 μs. If faulty, see Service Sheet 18 and check the SMI and load on the first two lines.

6. Switch LINE to STBY. Remove A13U15 (CPU External Register — RAM) from its socket.

SERVICE SHEET BD4 (Cont'd)

CAUTIONS

MOS and CMOS ICs can be damaged by static charges and circuit transients. Do not remove the A13 Controller Assembly or the A14 Remote Interface Assembly from the instrument while power is applied. Discharge the board and replacement IC to the same potential. (Use the conductive foam pad provided in the Service Accessory Kit HP 08901-60089.) When unplugging ICs, place the board on a conductive pad. When the IC is unplugged, insert it into the foam also.

Several ICs on these assemblies are held in high-grip sockets. Both the socket and the device can be damaged if an attempt is made to remove the device with an IC extraction tool. The recommended procedure is to first ground the tip of a small blade-type screwdriver, then slide the tip between the IC and the socket and slowly pry up the IC one pin at a time.

7. Switch LINE to ON. Check the following CONTROL BUS test points on the extender board with the signature analyzer probe:

With A14 Plugged In	
Test Point	Signature
DATA 0	A466
DATA 1	2HPH
DATA 2	U4A0
DATA 3	36C1
DATA 4	821H
DATA 5	P24F
DATA 6	90A9
DATA 7	P160

With A14 Not Plugged In	
Test Point	Signature
DATA 0	0A7A
DATA 1	FUC4
DATA 2	5A59
DATA 3	A1FP
DATA 4	5HP8
DATA 5	6UPH
DATA 6	HUC5
DATA 7	UA51

Valid software date 284.1979. Valid ROM part numbers:

ROM Number	Part Number
1	08901-80032
2	08901-80030
3	1818-0920 or 08901-80011
4	1818-0921 or 08901-80012
5	1818-0922 or 08901-80013
6	1818-0926 or 08901-80014
7	1818-0923 or 08901-80015
8	1818-0925 or 08901-80025
11	1818-0924 or 08901-80023

If signatures are faulty, see Service Sheet 18 and check the Memory Select Decoders and ROMS.

SERVICE SHEET BD4 (Cont'd)

NOTES

The signatures above are valid only for the software with the specified date (or ROM part numbers). Consult Section VII BACKDATING or the Manual Changes Supplement for signatures corresponding to other software dates.

ROM 11 is located on A14 Remote Interface Assembly. If ROM 11 is suspected, switch LINE to STBY, unplug A14, switch LINE to ON, and check the signatures of the remaining ROMs.

√4 CPU I/O Port Check

1. If the Digital Test/Extender Board is not already extending A12 or A13, plug it into the empty slot in the Digital Section.

NOTE

Check that the ROMC switches on the extender board are in the OPEN position.

2. Key in 0.2 SPCL. Check the following INSTRUMENT BUS test points on the extender board with an oscilloscope or signature analyzer probe (used as a logic probe):

Test Point	Measured Signal
ENABLE 2	Low-going TTL Pulses, Period ≈7 ms
SELECT 0—3	TTL Low
DATA (H) 0—3	TTL Low
DATA (L) 0—3	TTL High

If faulty, see Service Sheet 18 and check the CPU and I/O port decoders and buffers.

3. Key in 0.2 S (Shift) 5 S (Shift) 5 SPCL. Recheck the following test points:

Test Point	Measured Signal
SELECT 0—3	TTL High
DATA (H) 0—3	TTL High
DATA (L) 0—3	TTL Low

If faulty, see Service Sheet 18 and check the CPU and I/O port decoders and buffers.

4. Key in the Special Functions listed below. For each entry, the indicated ENABLE test point on the extender board should show low-going TTL pulses with a period of approximately 7 ms. All other ENABLE test points should be TTL highs.

SERVICE SHEET BD4 (Cont'd)

Special Function	Test Point
0.0	ENABLE 0
0.1	ENABLE 1
0.3	ENABLE 3
0.4	ENABLE 4
0.5	ENABLE 5
0.6	ENABLE 6
0.7	ENABLE 7

If faulty, see Service Sheet 18 and check the Enable Decoder and CPU.

√5 Keyboard Key Check

1. Key in 60.0 SPCL. As the Special Function code is entered, 60.0 should appear in the display. This indicates that the Controller responds to keyboard interrupts. If faulty, see √7 Front-Panel LED Check. After pressing the SPCL key, 99 should appear in the display. If another number appears, continue on.

2. Jumper A13TP3 (INT) to A13TP1 (GND). This defeats the keyboard interrupt.

3. Press the keys one at a time and compare the display with the key codes shown in Figure 8-64. If a code other than 99 appears in the display with no key pressed, the key corresponding to the displayed key code is probably stuck down; see Service Sheet 20. If a wrong code appears for one or more keys, check the corresponding key and decoder; see Service Sheet 20.

√6 Keyboard Interrupt Check

1. Connect high impedance, dc coupled oscilloscope to A13TP3 (INT). The voltage should read a TTL high. Pressing any key should result in a TTL low which should remain low for 40 to 60 ms after the key is released. If faulty, see Service Sheet 20 and check the Keystroke Detector.

√7 Front-Panel LED Check

1. Perform √3 Front-Panel LED Check on Service Sheet BD1.

√8 HP-IB Check

1. See Service Sheet 22.

SERVICE SHEET BD4 (Cont'd)

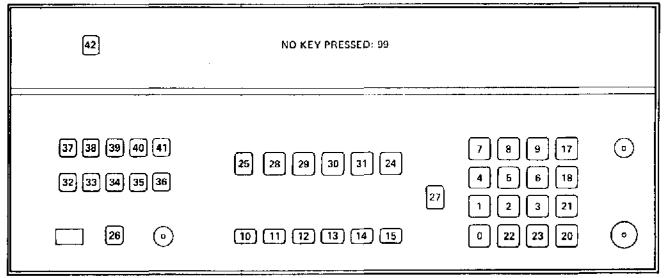


Figure 8-64. Key Codes for Service Special Function 60.0 Troubleshooting

Audio Section Block Diagram SERVICE SHEET BD3

CHANGES

2212A and above	**In the troubleshooting:** • **Check 3** - In ⟨√3⟩ Controller Kernel Check, replace the signature analysis and part number tables with those found on page 8–92.3.

Reserved for future changes.

Signatures for ⟨√3⟩ Controller Kernel Check, step 7

With A14 Plugged In		With A14 Not Plugged In	
Test Point	**Signature**	**Test Point**	**Signature**
DATA 0	9AUP	DATA 0	A50A
DATA 1	907U	DATA 1	7PH4
DATA 2	15F9	DATA 2	1756
DATA 3	H5FA	DATA 3	08FP
DATA 4	H2P8	DATA 4	H73C
DATA 5	A2C1	DATA 5	4C7P
DATA 6	A086	DATA 6	01U1
DATA 7	04C2	DATA 7	7097

ROM Part Numbers

ROM Number	Part Number
1	08901-80040
2	08901-80041
3	08901-80011
4	08901-80012
5	08901-80013
6	1818-0926 or 08901-80014
7	08901-80039 or 08901-80015
8	08901-80025
11	1818-1364

BD4

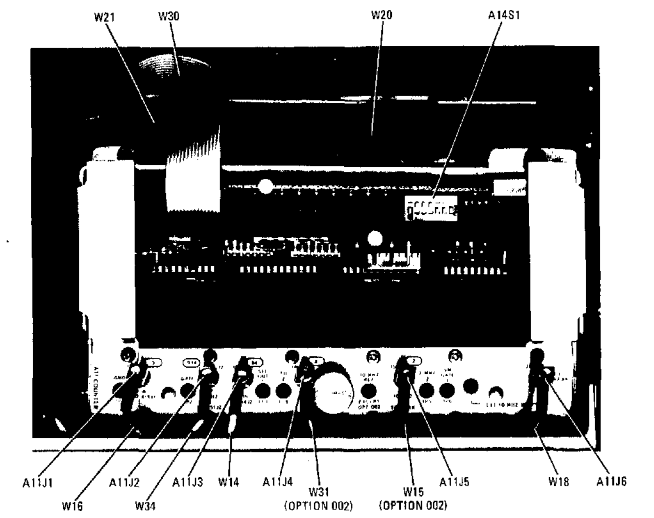


Figure 8-65. Digital Section Component Locations

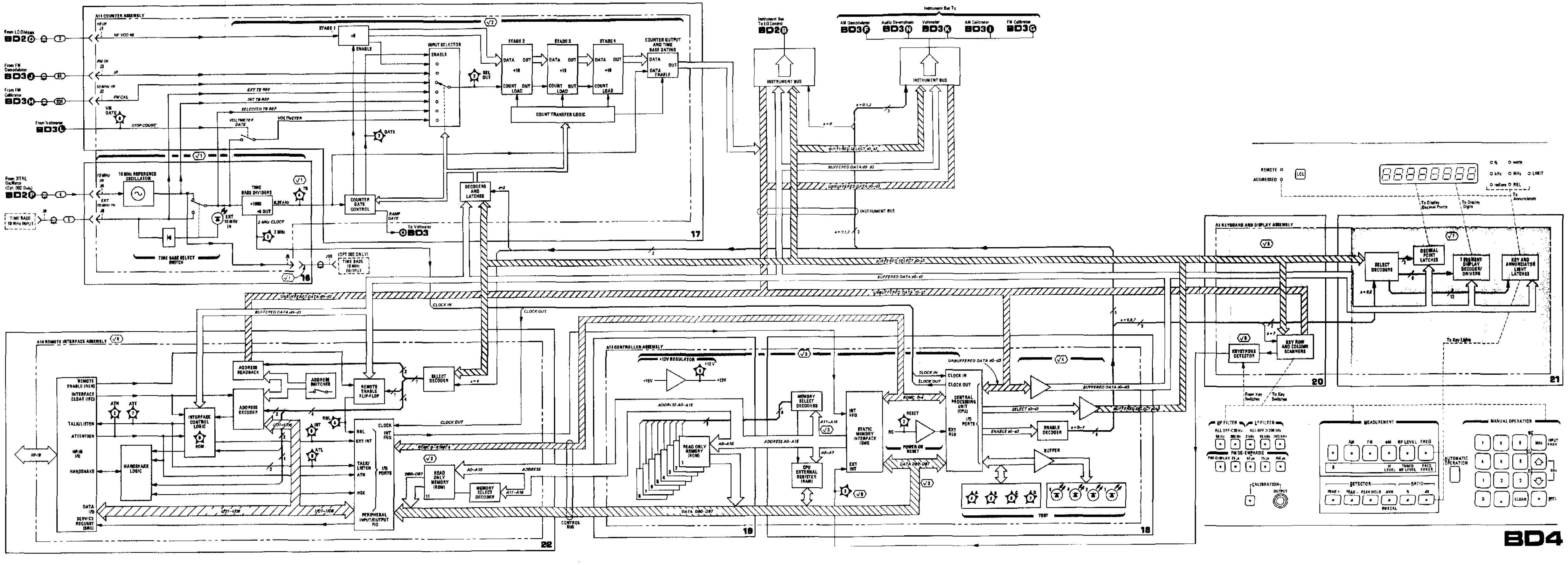


Figure 8-66. Digital Section Block Diagram

SERVICE SHEET 1 — RF INPUT (A15)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD2
- RF Level Performance Test .... Page 4-30
- RF Detector Offset Adjustment .... Page 5-6
- Parts List .... Page 6-28
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-51

TROUBLESHOOTING

General

Procedures for checking the RF Input Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly and its input and output cables where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope	HP 1740A
Power Supply	HP 6215A
Signal Generator	HP 8640B
Voltmeter	HP 3455A

⟨√1⟩ Input Attenuator Check

1. Set the signal generator to 11 MHz CW at +13 dBm. Connect its RF output to the input of an ac coupled oscilloscope. Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

2. Fine adjust the signal generator's level for an oscilloscope display of 3 Vpp.

3. Reconnect the signal generator's output to the Modulation Analyzer's INPUT. (The input cable, W1 or W36, should be connected to A15J2 with an extender cable.) Reconnect the oscilloscope to A15J2 (RF OUT).

4. Key in 41.0 SPCL to initialize the instrument. Key in the Direct Control Special Functions and check the signals indicated below.

SERVICE SHEET 1 (Cont'd)

Check	Direct Control Special Function	Level (TTL) at: A28XA15 Pin 18	A28XA15 Pin 19	A28XA15 Pin 20	Transistor Q6-c	Transistor Q7-c	Transistor Q8-c	Oscilloscope Display (Vpp)
Thru Path	0.047	L	L	L	H	H	H	2.75 to 3.00
10 dB	0.045	L	H	L	H	L	H	0.83 to 1.00
20 dB No. 1	0.043	H	L	L	L	H	H	0.26 to 0.31
20 dB No. 2	0.046	L	L	H	H	H	L	0.26 to 0.31

Hint: If the oscilloscope display reads low for all above conditions, check the 5.25 MHz High-Pass Filter, Overpower Protection, and input cable (W1 or W36).

⟨√2⟩ 5.25 MHz High-Pass Filter Check

1. Set the signal generator to 5.25 MHz CW at +3 dBm. Connect its RF output to the input of an ac coupled oscilloscope. Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

2. Fine adjust the signal generator's level for an oscilloscope display of 1 Vpp.

3. Reconnect the signal generator's output to the Modulation Analyzer's INPUT. (Connect the input cable, W1 or W36, to A15J1 with an extender cable.) Reconnect the oscilloscope to A15J2 (RF OUT).

4. Key in 41.0 SPCL and 0.047 SPCL to initialize the instrument and set the attenuator to the thru path. Key in the Direct Control Special Functions and check the signals indicated below.

Check	Direct Control Special Function	Level (TTL) at: A28XA15 Pin 28	Q2-c	Oscilloscope Display (Vpp)
Thru Path	0.024	L	H	0.76 to 1.00
5.25 MHz HPF	0.02C	H	L	0.59 to 0.73

Hint: If the oscilloscope display reads low for both above conditions, check the Input Attenuator, Overpower Protection, and input cable (W1 or W36).

⟨√3⟩ Overpower Protection Check

1. Set the signal generator to 11 MHz CW at +13 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

2. Connect an ac coupled oscilloscope to A15J2 (RF OUT). Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

SERVICE SHEET 1 (Cont'd)

3. Key in 41.0 SPCL to initialize the instrument. Key in 1.1 SPCL to set the input attenuation to 0 dB. Check the signals indicated below for the thru path only.

Check	Level (TTL) at: A28XA15 Pin 17	Q1-c	Oscilloscope Display (Vpp)
Thru Path	L	H	2.75 to 3.00
Overpower	H	L	0

Hint: If the oscilloscope display reads low, check the Input Attenuator, 5.25 MHz High-Pass Filter, and input cable (W1 or W36).

4. Remove signal generator from INPUT. Set power supply to 20 Vdc. Touch the +20V lead to the Modulation Analyzer's INPUT (the minus side should be at ground).

5. Reconnect the signal generator. Check the signals indicated in the table under step 3 for the condition of overpower. The display should also show E06.

6. Repeat step 3 to check the recovery from the overpower condition.

NOTE

If step 4 is repeated, it is usually necessary to first discharge the input dc blocking capacitor by connecting a 50Ω termination to the INPUT. Discharge it also after completing this check.

⟨√4⟩ Overpower Detector Check

1. Key in 41.0 SPCL to initialize the instrument.

2. Connect a high-impedance, dc coupled oscilloscope or a dc voltmeter to A28XA15 pin 21. The node should be a TTL high.

3. Induce an overpower transient by touching the +20V lead to the Modulation Analyzer's INPUT (the minus side should be at ground). The node should show a momentary low. The display should also show E06.

NOTE

If steps 1 to 3 are to be repeated, it is necessary to first discharge the input dc blocking capacitor by connecting a 50Ω termination to the INPUT. Discharge it also after completing this check.

⟨√5⟩ Detector Amplifier Check

1. Set the signal generator to 11 MHz CW at +13 dBm. Connect its RF OUTPUT to the Modulation Analyzer's INPUT. (Connect the input cable, W1 or W36, to A15J1 with an extender cable.)

SERVICE SHEET 1 (Cont'd)

2. Key in 41.0 SPCL to initialize the instrument. Press RF LEVEL.

3. Key in 0.024 SPCL and 49.31 SPCL to turn the detector on and to connect the internal voltmeter to the output of the Detector Amplifier. Change the level of the signal generator as indicated below and note the display. Alternatively, measure A15TP1 (RF DET) with a dc voltmeter.

RF Level (dBm)	Display Limits	Voltage Limits at A15TP1 (Vdc)
+13	1.05 to 1.25	1.05 to 1.25
+3	0.27 to 0.33	0.27 to 0.33
Off	−0.003 to +0.003	−0.008 to +0.008

Hint: If the off condition above is slightly out of limit, perform the RF Detector Offset Adjustment.

⟨√6⟩ RF Level Detector Offset Check

1. Remove the cable (W1 or W36) from A15J1. Key in 0.024 SPCL to turn the detector on.

2. Measure the dc voltage at the junction of CR4 and C13. It should be between −0.5 and −0.2 Vdc. (The input impedance of the voltmeter must be at least 10 MΩ.)

3. Measure the dc voltage at pin 2 of U2. It should be 50 to 70 mV more negative than the voltage read in step 2.

4. Key in 0.020 SPCL to turn the detector off.

5. Measure the dc voltage at the junction of CR4 and CR13. It should be between +8.5 and +10.0 Vdc.

6. Measure the dc voltage at pin 2 of U2. It should be between +13.0 and +14.5 Vdc.

⟨√7⟩ Detector Amplifier Discharge Check

1. Set the signal generator to 11 MHz CW at +13 dBm. Connect its RF output to the Modulation Analyzer's INPUT. (Connect the input cable, W1 or W36, to A15J1 with an extender cable.)

2. Key in 41.0 SPCL to initialize the instrument. Press RF LEVEL.

3. Key in 0.020 SPCL to turn the detector off. Key in 49.31 SPCL to connect the internal voltmeter to the output of the Detector Amplifier. The display should read between −0.0200 and 0.0200.

4. Key in 0.024 SPCL to turn the detector on. Key in 49.31 SPCL. The display should read between 1.0000 and 1.3000.

5. Set the signal generator for 50% AM at a 20 Hz rate. The display should vary no more than ±0.1V from its average value.

6. Press RF LEVEL. Switch the signal generator's AM off, then turn the RF off and note the Modulation Analyzer's display as the reading decreases. The reading should decrease to less than 0.010 −03 watts by the second reading after the RF is switched off.

⟨√8⟩ SWR Check

1. Perform the SWR portion of the RF Level Performance Test.

CHANGES

All serial prefixes	**On the A15 schematic:** • **CR4** - Reverse the polarity of the diode symbol for CR4. • **R10** - Change the value of R10 to 52.8 ohms.
2128A and above	**On the A28 schematic:** • **08901-60139** - Change the part number of A28 RF Motherboard Assembly to 08901-60139.
2212A and above	**On the A15 schematic:** • **08901-60183** - Use the new schematic foldout with revision date *rev.01NOV89.*
2212A to 2412A	**On the A15 component locator:** • **08901-60183** - Use the new component locations, Figure 8–67. A15 RF Input Assembly Component Locations (2212A to 2412A), on page 8–94.3.
2302A and above	**On the A15 schematic:** • **C4** - Change the value of C4 to 68 μF.
2421A and above	**On the A15 schematic:** • **08901-60256** - On the schemtic foldout with revision *rev.01NOV89* change the part number of the A15 schematic to 08901-60256. • **R10** - Change the value of R10 to 61.59 ohms and remove the asterisk (*). • **C29** - Add a capacitor C29 at the junction ot R46 and the anode of CR4. • **AT1, AT2, AT3, R15, R19, R20, R21** - Delete R15, R19, R20, and R21; replace with AT1. Delete R27, R29, and R30; replace with AT2. Delete R38, R40, and R41; replace with AT3.

CHANGES

2424A and above	**On the A15 component locator:** • **08901-60256** - Use the new component locations, Figure 8–67. A15 RF Input Assembly Component Locations (2424A and above), on page 8–94.4.
2543A and above	**On the A15 schematic:** • **W1** - On the line between K1 and Q1 (between the nodes of C6 and R49) insert wire jumper, W1. • **R62, L5** - Delete R62 and L5. • **U3A** - Change pin 1 to pin 12; pin 3 to pin 4; pin 4 to pin 5; pins 2, 5, 7 to pins 3, 6, 8; pin 10 to pin 11. • **U3B** - Change pin 6 to pin 7; pin 8 to pin 9; pin 9 to pin 10. Pins 1, 2, 13, and 14 are not connected.

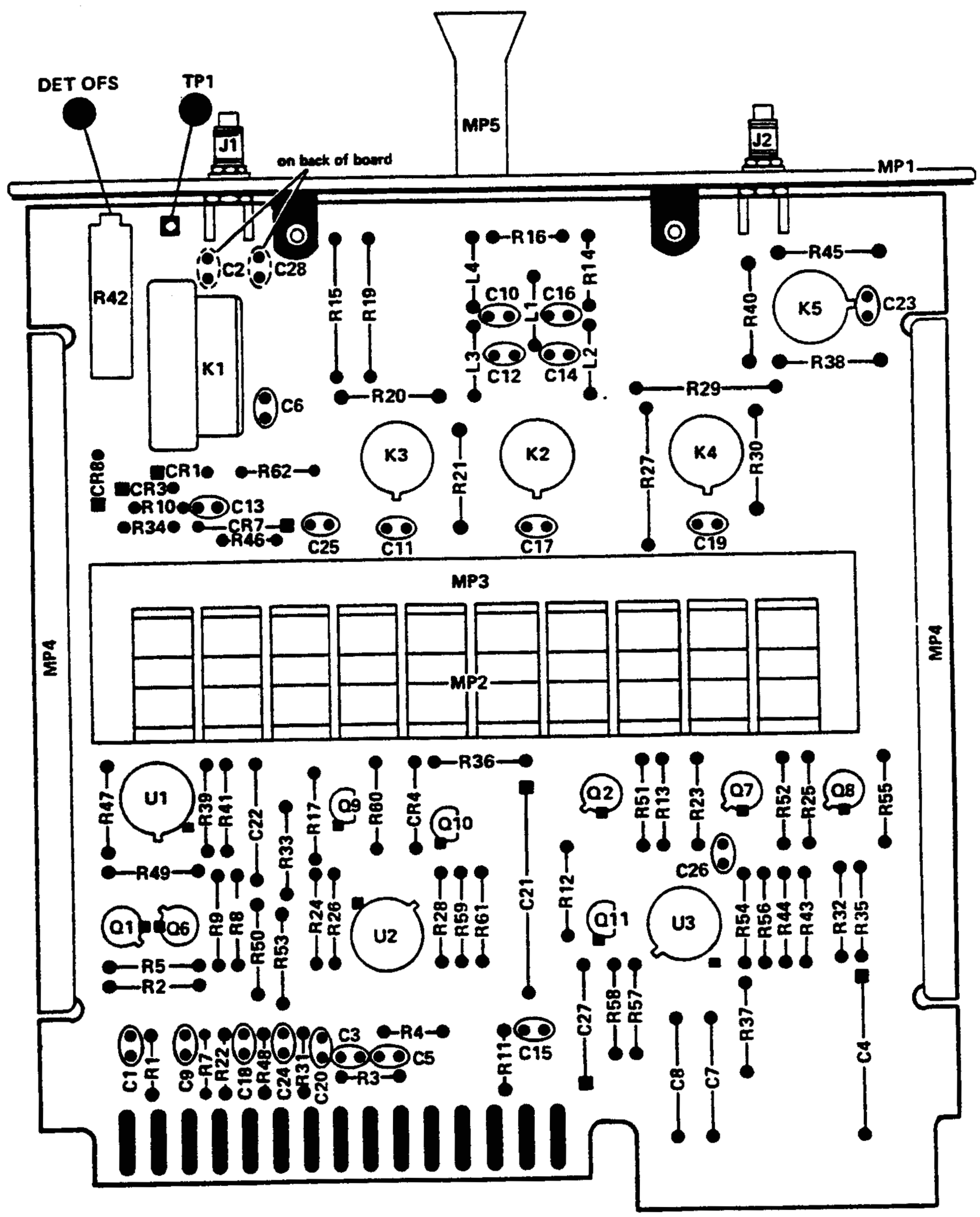


Figure 8–67. A15 RF Input Assembly Component Locations (2212A to 2412A)

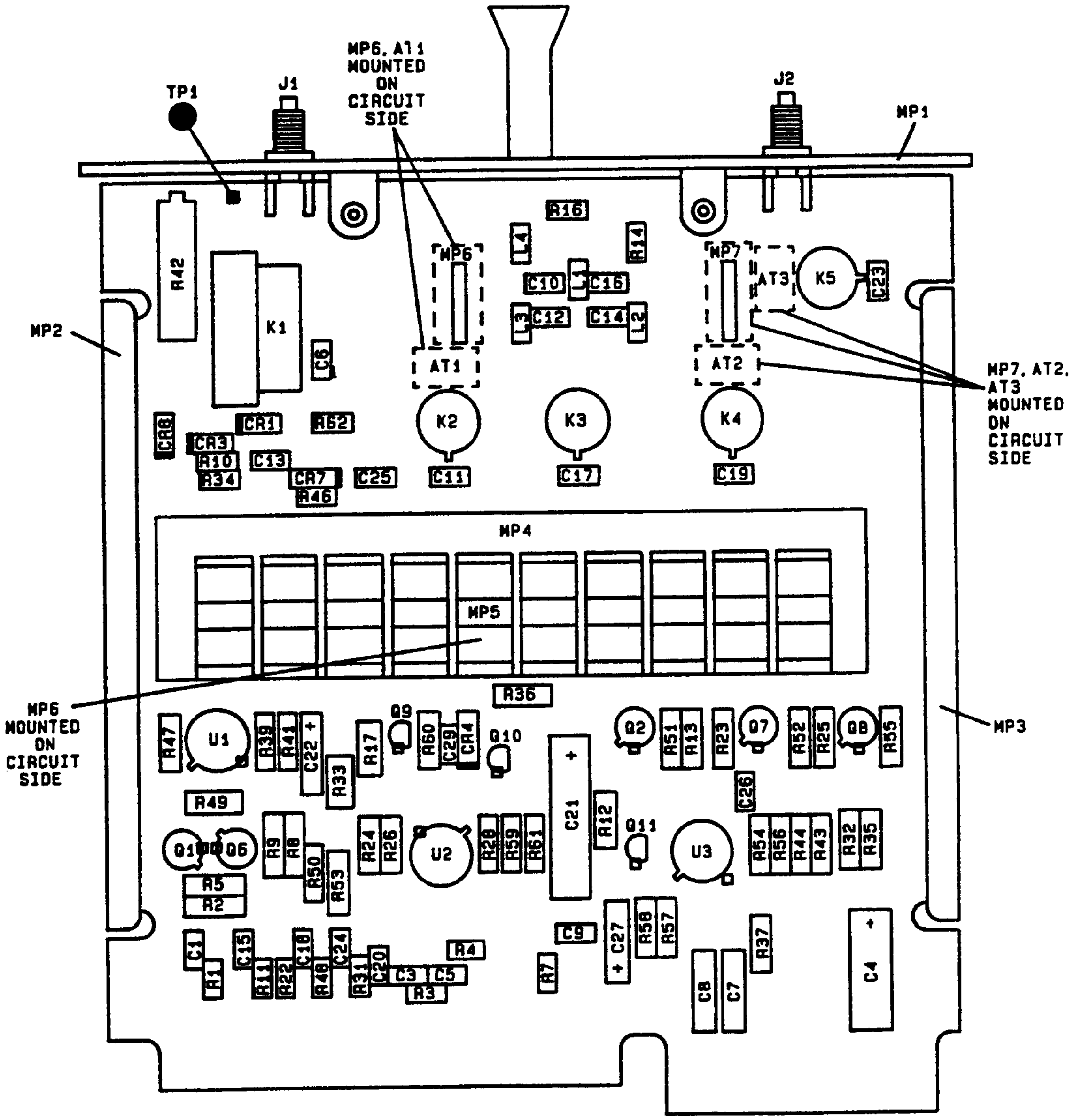


Figure 8–67. A15 RF Input Assembly Component Locations (2424A and above)

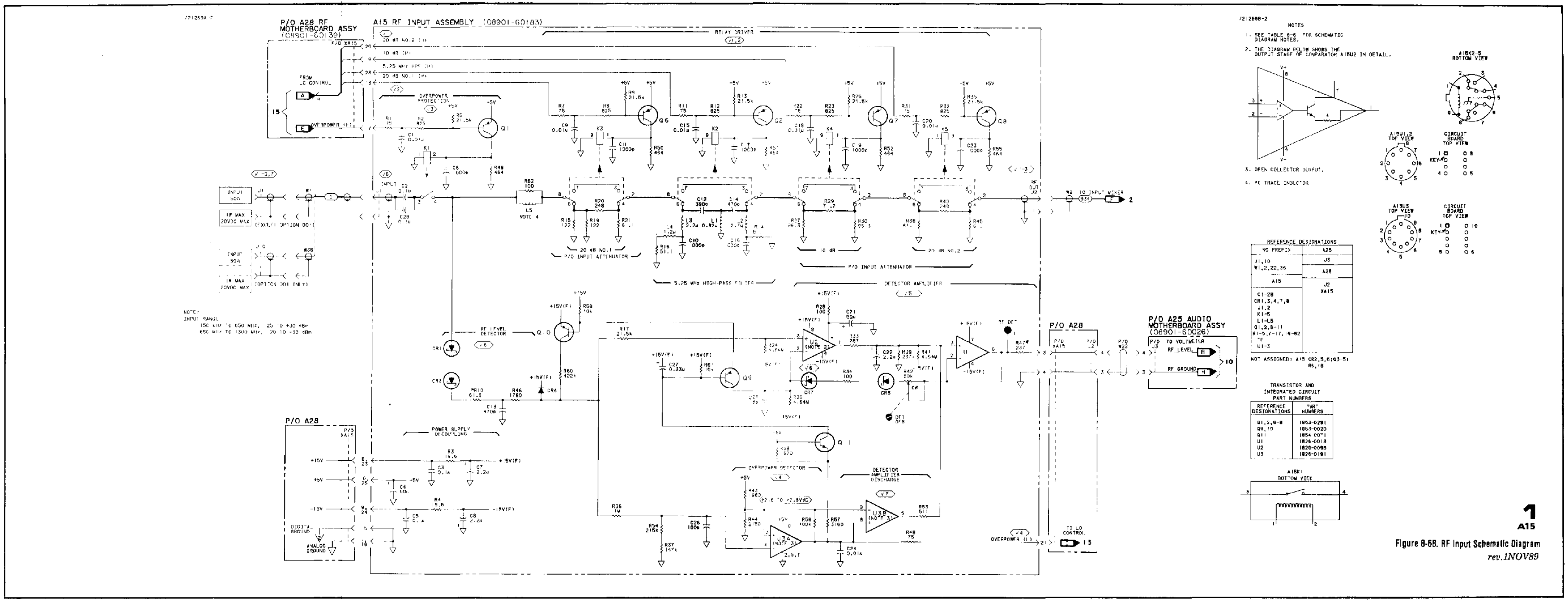


Figure 8-6B. RF Input Schematic Diagram

rev.1NOV89

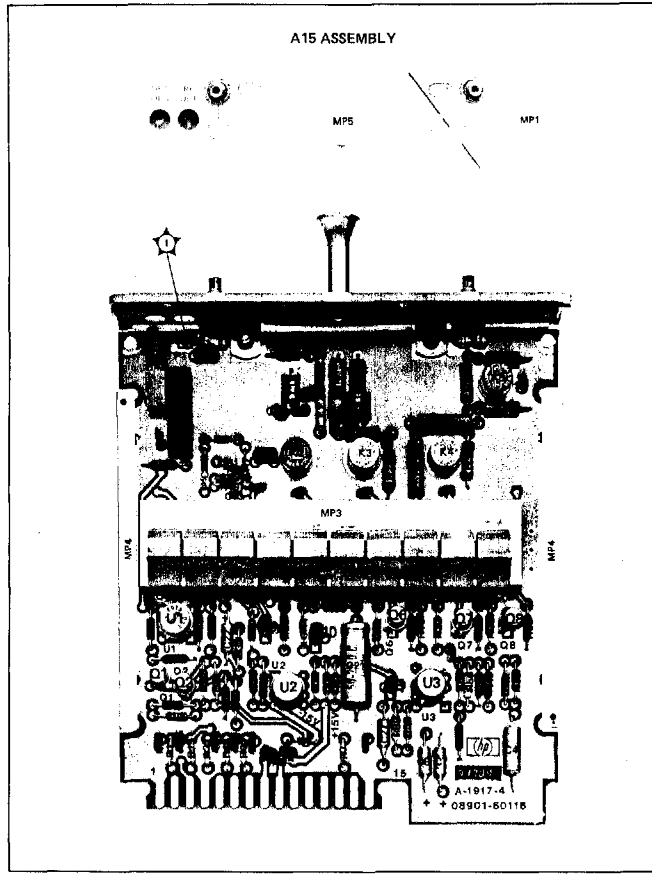


Figure 8-67. A15 RF Input Assembly Component Locations

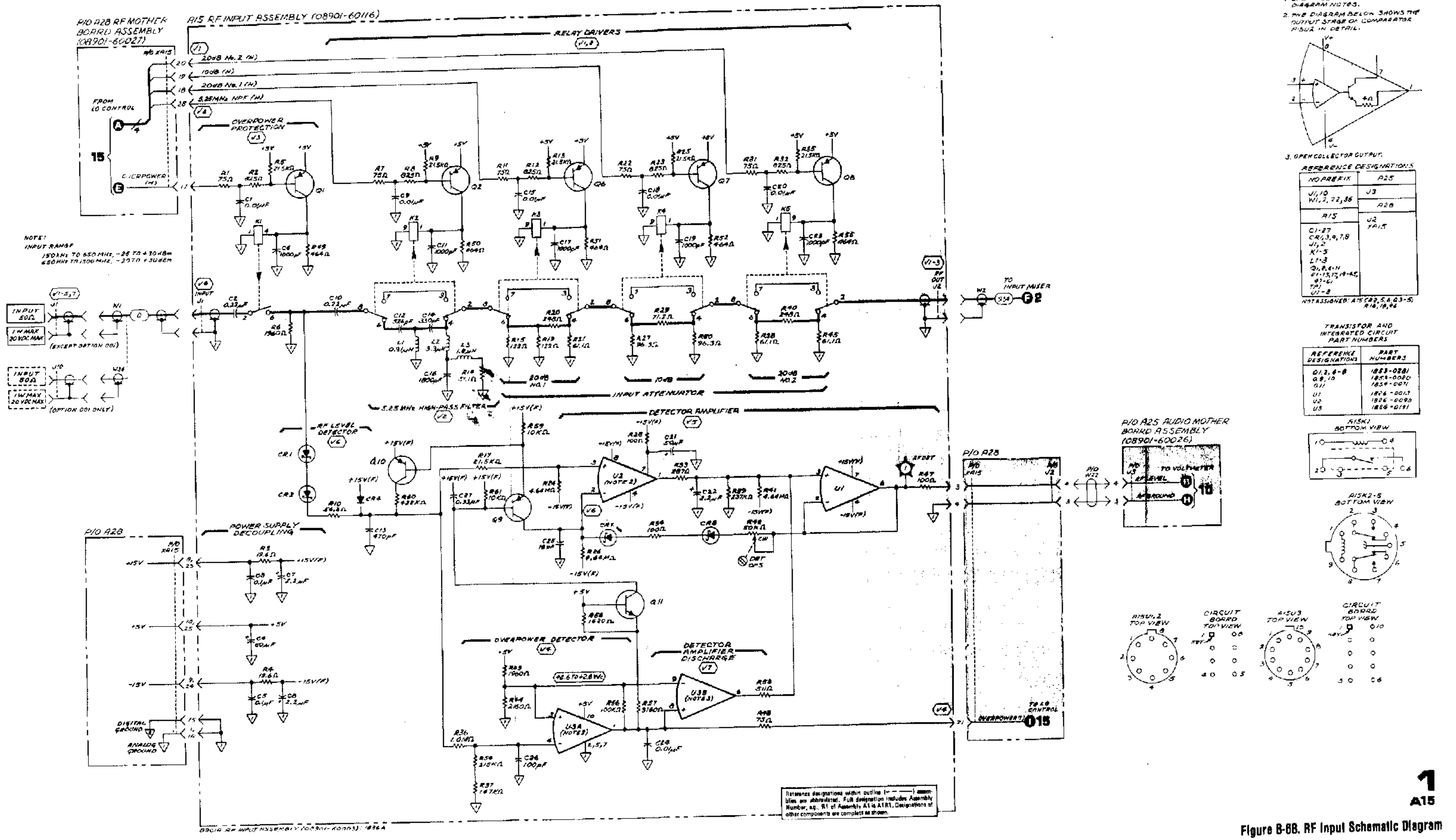


Figure 8-68. RF Input Schematic Diagram

SERVICE SHEET 2 — INPUT MIXER AND IF AMPLIFIER (A17, A18)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD2
- FM Distortion and Incidental AM Adjustments —1.5 MHz IF .... Page 5-18
- FM Distortion and Incidental AM Adjustments —455 kHz IF .... Page 5-24
- Parts List .... Pages 6-30 & 6-31
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-52

TROUBLESHOOTING

General

Procedures for checking the Input Mixer and IF Amplifier Assemblies are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assemblies and their input and output cables where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope .... HP 1740A
Signal Generator .... HP 8640B
Spectrum Analyzer .... HP 8555A/8552B/141T
Test Probe .... HP 1250-1598
Voltmeter .... HP 3455A

⟨√1⟩ LO Amplifier General Check

NOTE

This test checks only the LO Amplifier at a low frequency but will easily localize a catastrophic failure. ⟨√2⟩ LO Amplifier Check is more thorough and will detect more subtle failures; however, more time and equipment are required.

1. Key in 5 and press MHz to set the LO to 5.455 MHz.

2. Connect a high-impedance oscilloscope to the base of A17Q4. The waveform should be a square wave with a period of approximately 180 ns and an amplitude of 0.5 Vpp or greater excluding ringing.

SERVICE SHEET 2 — (Cont'd)

Hint: If the signal is faulty, check the output from the A19 LO Divider Assembly (see Service Sheet 11).

3. Connect the oscilloscope to the collector A17Q4. The waveform should be a square wave of 1.2 Vpp or greater excluding ringing.

4. Connect the oscilloscope to the collector of A17Q6. The waveform should be a square wave of 1 Vpp or greater excluding ringing overshoot on the falling edge.

⟨√2⟩ LO Amplifier Check

NOTE

To check for a catastrophic failure of the LO Amplifier, use the ⟨√1⟩ LO Amplifier General Check above.

1. Unplug A17U1 Mixer. Gently pry it from its socket with a screwdriver blade.

2. Set the spectrum analyzer to measure a +20 dBm, 0 to 1400 MHz signal. Connect its input to pins 8 and 9 of the Mixer socket using the test probe. The probe center goes on pin 9.

3. Key in 57.0 SPCL to cause the LO to sweep sequentially across bands DBLR through 3. The LO signal should sweep slowly from above 1300 MHz to below 40 MHz. The sweep will occur over five bands. As the low end of a band is reached, the sweep will stop, jump up slightly in frequency, then continue to sweep. Throughout the sweep, the fundamental of the LO should be between +7 and +15 dBm.

Hint: A faulty level may also be the result of a faulty output from the A19 LO Divider Assembly. The sweep can be halted by pressing the SPCL key. Use manual tune to manually set the LO frequency.

4. Set the spectrum analyzer to view a 0 to 40 MHz signal.

5. Key in 56.0 SPCL to cause the LO to sweep sequentially across bands 4 through 8. The LO should sweep slowly from above 40 to below 1.25 MHz in the manner described in step 3 above.

NOTES

The test probe will cause a low-frequency rolloff to about +4 dBm at 1.25 MHz.

The low-frequency bands can also be viewed on an oscilloscope. The oscilloscope should have a 50Ω termination. The signal should be a square wave with an amplitude of approximately 2 Vpp excluding ringing and the rolloff due to the probe.

⟨√3⟩ Input and Mixer Check

1. Set the signal generator to 18 MHz CW at 0 dBm. Connect its RF output to the input of an ac coupled oscilloscope. Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

SERVICE SHEET 2 (Cont')

2. Fine adjust the signal generator's level for an oscilloscope display of 800 mVpp.

3. Reconnect the signal generator's output to A17J2 (RF IN). Reconnect the oscilloscope to A17J1 (IF OUT).

4. Key in 41.0 SPCL to initialize the instrument. Key in 18 and press MHz to set the LO to 19.5 MHz. The waveform should be a sine wave with an amplitude of 70 to 110 mVpp and a period of approximately 670 ns. A slight fuzziness on the waveform is normal; it is the partially filtered sum frequency. The 455 kHz IF annunciator (A17DS1) should be off.

⟨√4⟩ Filter Switching Check

NOTE

The filters are tested along with the IF Amplifier; see ⟨√2⟩ IF Filter Check.

1. Disconnect any signal at the Modulation Analyzer's INPUT jack. Key in the Direct Control Special Functions indicated below. For each setting note the reading on the dc voltmeter connected to the points indicated. Also observe the 455 kHz IF annunciator (A17DS1).

Direct Control Special Function	Voltage Limits (Vdc) at		
	A17U2A-1	A17U2B-7	A17Q1-c and Q3-c
0.030 0.031	0 to +1 +12 to +15	+10 to +15 0 to +1	−5.4 to −4.5 +0.5 to +1

Direct Control Special Function	Voltage Limits (Vdc) at	A17DS1
	A17Q2-c	
0.030 0.031	+1 to +2 −5.4 to −4.5	Off On

⟨√5⟩ IF Amplifier Check

1. Set the signal generator to 1.5 MHz CW at −23 dBm. Connect its RF output to A18J2 (IF IN). Remove the cable from A18J1 (IF OUT).

2. Connect a high-impedance, ac coupled oscilloscope to the base of A18Q7. The oscilloscope should have a low-capacitance 10:1 divider probe.

3. Fine adjust the signal generator's level for an oscilloscope display of 100 mVpp.

4. Connect the oscilloscope to the emitter of A18Q5. The waveform of the 1.5 MHz signal should be sinusoidal with an amplitude of 0.9 to 1.1 Vpp.

SERVICE SHEET 2 (Cont'd)

5. If necessary, readjust the signal generator's level for an oscilloscope display of 1.0 Vpp.

6. Connect the oscilloscope to the collector of A18Q4. The waveform should be sinusoidal and have an amplitude of 4.6 to 5.0 Vpp.

Hint: The gain of the IF Output Amplifier is 4.8 open circuit. The Phase Compensation Amplifier has a gain of 1, but capacitive loading of the oscilloscope prevents measuring the gain separately.

7. Vary the signal generator frequency from 0.15 to 2.5 MHz. The amplitude of the waveform should remain constant within 200 mV.

Hint: The collectors of A18Q6 and Q1 should be flat with frequency also. The phase difference between the emitter of A18Q5 and collector of A18Q4 should be 180° at 4.4 MHz and 1.03 MHz and 0° at a frequency between 2.0 and 2.5 MHz and between 70 and 130 kHz. If the signal generator frequency does not extend to 70 kHz, use an audio source.

⟨√6⟩ IF Filters Check

NOTE

This check assumes that ⟨√5⟩ IF Amplifier Check gives positive results.

1. Set the signal generator to 18.00 MHz CW at −27 dBm. Connect its RF output to the Modulation Analyzer's INPUT.

2. Connect an ac coupled oscilloscope to A18J1 (IF OUT). Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

3. Key in 41.0 SPCL to initialize the instrument. Key in 18 and press MHz to set the LO to 19.5 MHz and generate a 1.5 MHz IF. The waveform should be a sinusoidal signal with a period of approximately 670 ns and an amplitude between 200 to 300 mVpp.

Hint: If the signal is faulty, perform the other checks above also.

4. Fine adjust the signal generator's level for an oscilloscope display of 200 mVpp. Key in 20.5 and press MHz to generate a 4 MHz IF. The waveform frequency should increase, and its amplitude drop to between 120 and 160 mVpp.

NOTE

The partially filtered sum signal will cause the waveform to appear slightly fuzzy.

5. Key in 18 and press MHz. Key in 3.1 SPCL to set the IF to 455 kHz. The waveform should be a sinusoidal signal with a period of approximately 2.2 μs and an amplitude between 150 and 190 mVpp.

SERVICE SHEET 2 (Cont'd)

6. If necessary, fine adjust the signal generator's level for an oscilloscope display of 200 mVpp. Key in 18.1 and press MHz to generate a 355 kHz IF. The waveform should have an amplitude between 120 and 160 mVpp.

7. Key in 17.9 and press MHz to generate a 555 kHz IF. The waveform should have an amplitude between 120 and 160 mVpp.

Hint: If the amplitude in steps 6 or 7 is only slightly out of limit, perform the FM Distortion and Incidental AM Adjustments — 455 kHz IF.

RF Input
A15
SERVICE SHEET 1

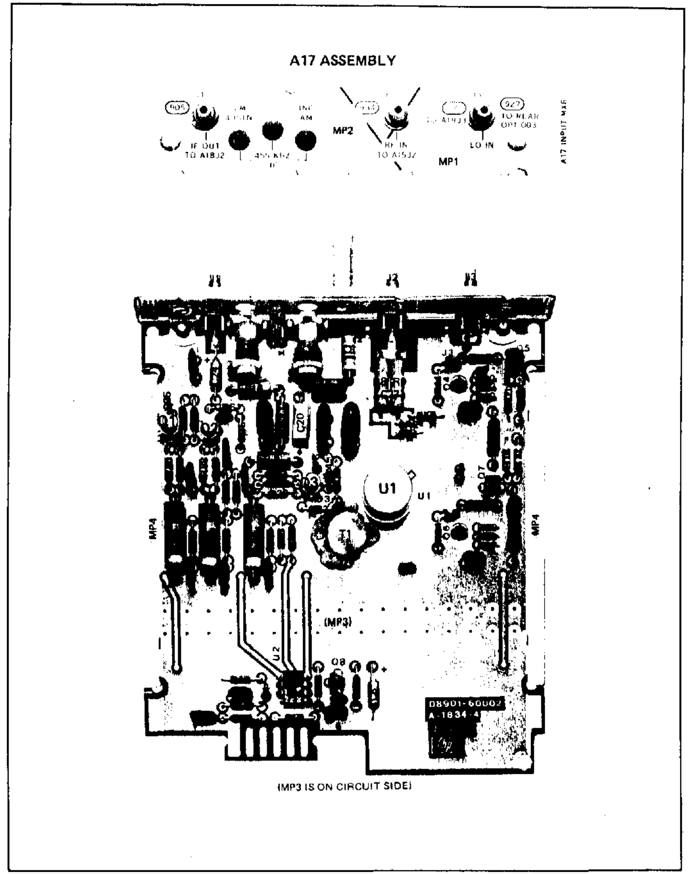


Figure 8-69. A17 Input Mixer Assembly Component Locations

CHANGES

All serial prefixes	**On the A17 schematic:** • <u>L5</u> - Change the value of L5 to 240 μH.
2128A and above	**On the A28 schematic:** • **<u>08901-60139</u>** - Change the part number of A28 RF Motherboard Assembly to 08901-60139.
2227A and above	**On the A18 schematic:** • **<u>Q4</u>** - Under IF OUTPUT AMPLIFIER GAIN 13 dB, delete the transistor ground connection. In the table of Transistor and Ingrated Circuit Part Numbers, change Q4 to 1854-0477.
2302A and above	**On the A18 schematic:** • **<u>R23, R24</u>** - Under INVERTING AMPLIFIER, change the value of R23 to 500 ohms and R24 to 383 ohms.
2443A and above	**On the A18 schematic:** • **<u>Q7</u>** - Add a ferrite bead, E1, to the base of Q9.
2609A and above	**On the A17 component locator:** • **<u>08901-60104</u>** - Use the new component locator, Figure 8–69. A17 Input Mixer Assembly Component Locations (2609A and above), on page 8-96.3. **On the A17, A18, and A28 schematics:** • **<u>08901-60104, 08901-60004, and 08901-60139</u>** - Use the new schematic foldout with revision date, *rev.01NOV89.*

Reserved for future changes.

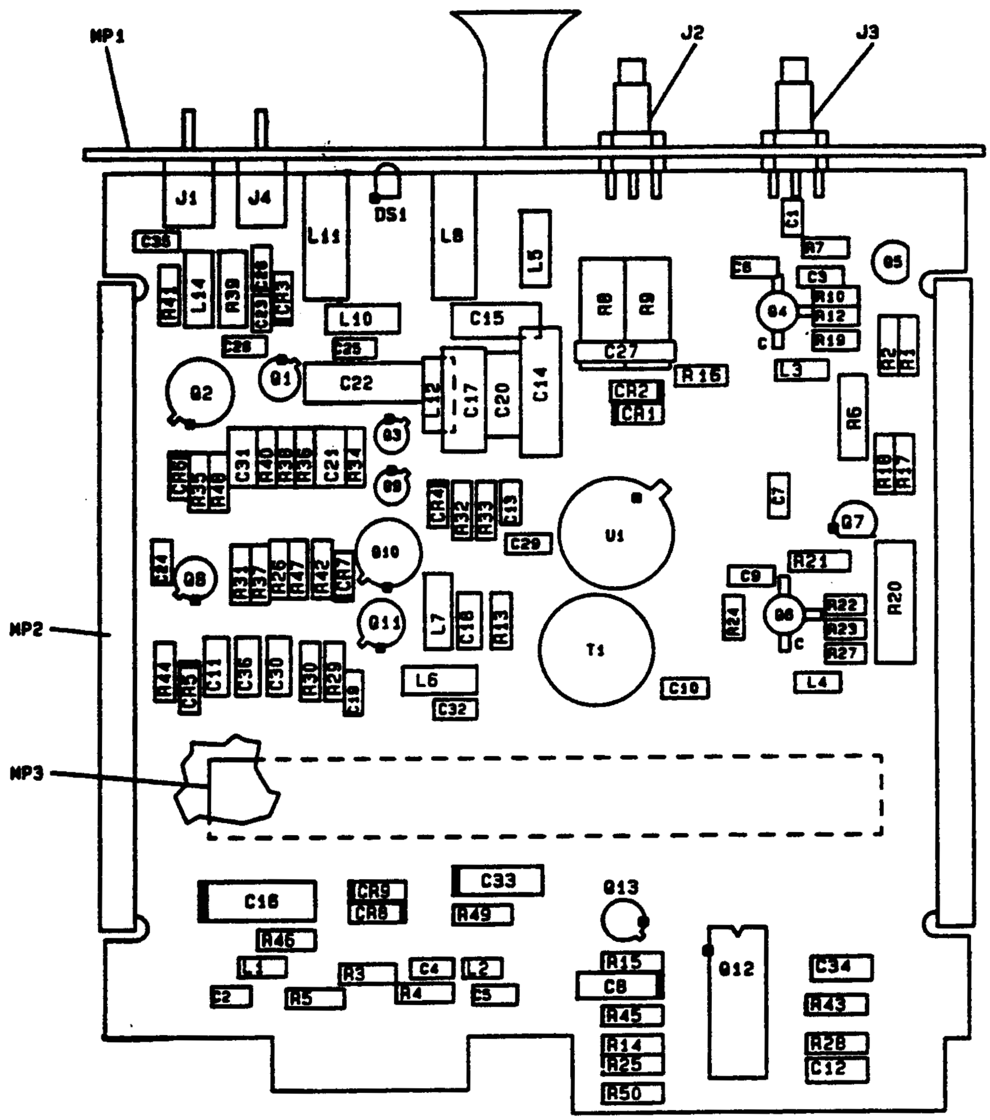
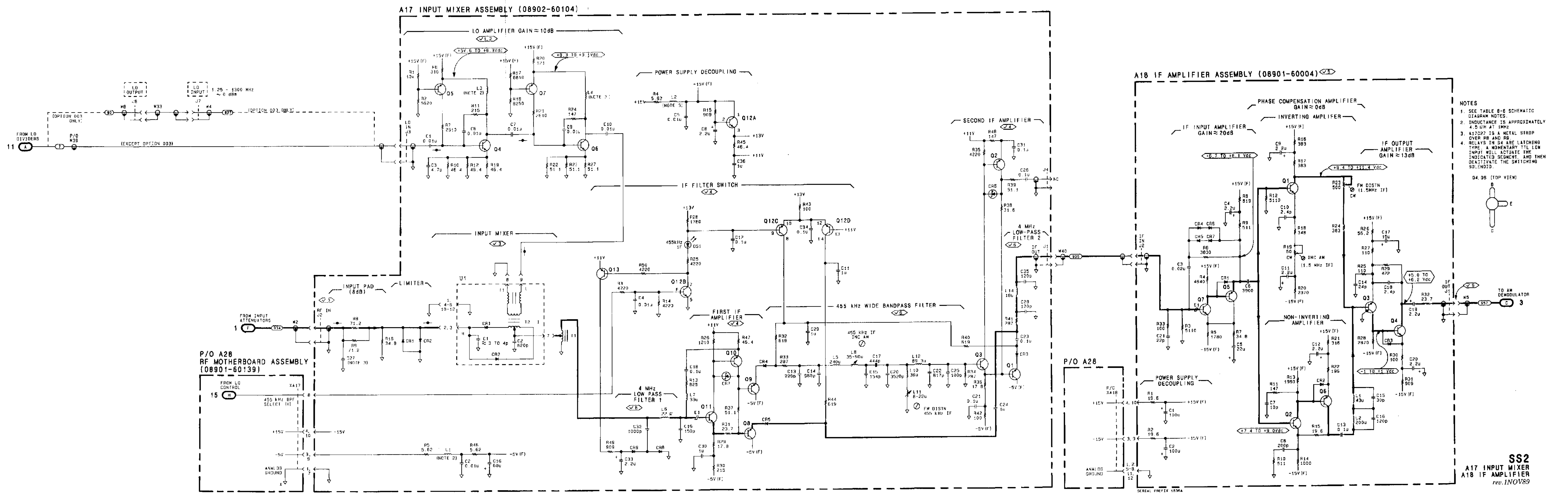


Figure 8–69. A17 Input Mixer Assembly Component Locations (2609A and above)


A17 INPUT MIXER ASSEMBLY (08902-60104)
LO AMPLIFIER GAIN ≈ 10dB
POWER SUPPLY DECOUPLING
IF FILTER SWITCH
INPUT MIXER
INPUT PAD (8dB)
LIMITER
FIRST IF AMPLIFIER
4 MHz LOW PASS FILTER 1
455 kHz WIDE BANDPASS FILTER
SECOND IF AMPLIFIER
4 MHz LOW-PASS FILTER 2
FROM LO DIVIDERS
(EXCEPT OPTION 003)
OPTION 003 ONLY
LO OUTPUT
LO INPUT
1.25 - 1300 MHz ~0 dBm
FROM INPUT ATTENUATORS
P/O A28 RF MOTHERBOARD ASSEMBLY (08901-60139)
FROM LO CONTROL
455 kHz BPF SELECT (H)
ANALOG GROUND
P/O A28
A18 IF AMPLIFIER ASSEMBLY (08901-60004)
POWER SUPPLY DECOUPLING
IF INPUT AMPLIFIER GAIN ≈ 20dB
PHASE COMPENSATION AMPLIFIER GAIN ≈ 0dB
INVERTING AMPLIFIER
NON-INVERTING AMPLIFIER
IF OUTPUT AMPLIFIER GAIN ≈ 13dB
TO AM DEMODULATOR
NOTES
1. SEE TABLE 8-6 SCHEMATIC DIAGRAM NOTES.
2. INDUCTANCE IS APPROXIMATELY 4.5 uH AT 1MHz
3. A17C27 IS A METAL STRIP OVER R8 AND R9
4. RELAYS IN S4 ARE LATCHING TYPE. A MOMENTARY TTL LOW INPUT WILL ACTUATE THE INDICATED SEGMENT, AND THEN DEACTIVATE THE SWITCHING SOLENOID.
Q4,Q6 (TOP VIEW)
SERIAL PREFIX 1836A
SS2
A17 INPUT MIXER
A18 IF AMPLIFIER
rev.1NOV89

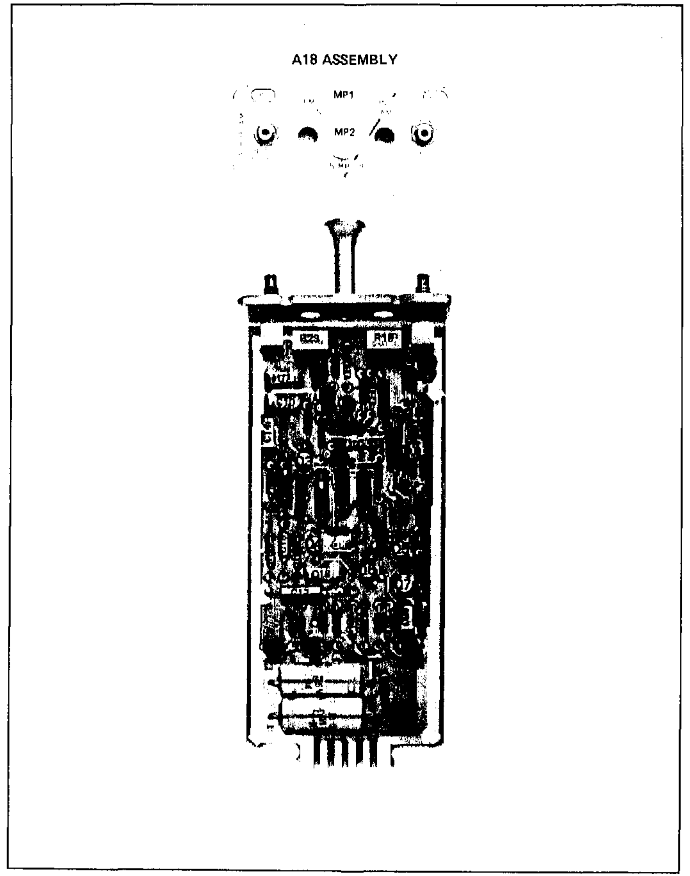


Figure 8-70. A18 IF Amplifier Assembly Component Locations

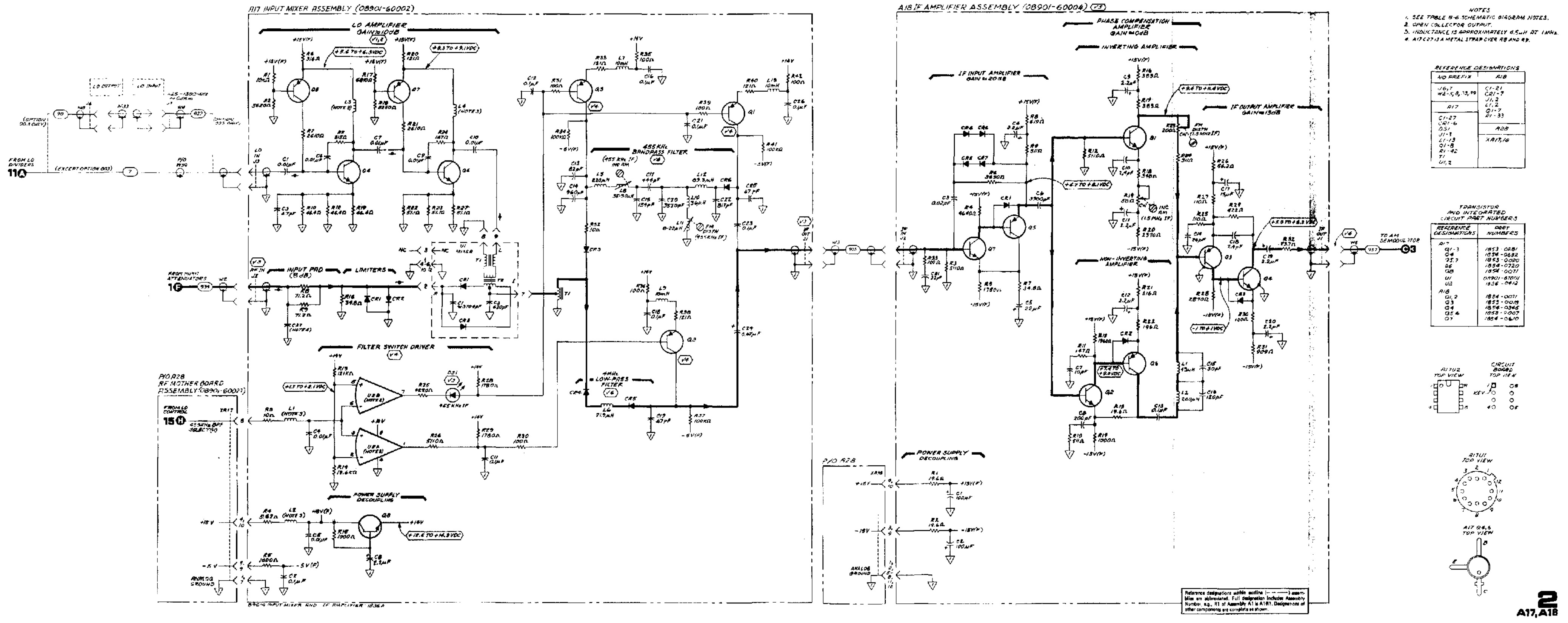


Figure 8-71. Input Mixer and IF Amplifier Schematic Diagram

SERVICE SHEET 3 — AM DEMODULATOR — ALC LOOP (P/O A6)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the AM Demodulator Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., (√3). In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., (+1.9 to +2.1 Vdc). Extend the board assembly and its input and output cables where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope	HP 1740A
Signal Generator	HP 8640B
Voltmeter	HP 3455A

(√1) 2.5 MHz Low-Pass Filter and IF Buffer Amplifiers Check

1. Set the signal generator to 1.5 MHz CW at −7 dBm. Connect its RF output to A6J2 (IF IN).

2. Connect an ac coupled oscilloscope to A6J3 (IF OUT). (A6J3 is shown on Service Sheet 4.) Switch the input impedance of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee. The waveform of the 1.5 MHz signal should be sinusoidal with an amplitude of 300 to 360 mVpp.

Hint: If the signal is faulty, trace the signal from A6J1 through Q9. (See Service Sheet 4 for the schematic.)

3. Connect the oscilloscope to A6J4 (IF OUT). (A6J4 is shown on Service Sheet 4.) The waveform should be sinusoidal with an amplitude of 50 to 60 mVpp.

SERVICE SHEET 3 (Cont'd)

Hint: If the signal is faulty, check Q10 (see Service Sheet 4 for the schematic).

4. Connect a high-impedance, ac coupled oscilloscope to the emitter of Q8. The oscilloscope should have a low-capacitance 10:1 divider probe. The waveform should be sinusoidal with an amplitude of 180 to 200 mVpp.

5. If necessary, fine adjust the signal generator level for an oscilloscope display of 200 mVpp.

6. Set the signal generator to 3 MHz. The waveform should have an amplitude of 120 to 160 mVpp.

Hint: The 3 dB frequency of the 2.5 MHz Low-Pass Filter is approximately 3 MHz.

(√2) Voltage-Variable Amplifier Check

1. Set the signal generator to 1.5 MHz CW at −7 dBm. Connect its RF output to A6J2 (IF IN).

2. Connect a high-impedance, ac coupled oscilloscope to the emitter of Q8. The oscilloscope should have a low-capacitance 10:1 divider probe. Adjust the signal generator level for a waveform of 200 mVpp.

3. Key in 0.0D0 SPCL to switch the ALC off.

4. Measure the collector of Q26 with a dc voltmeter. The voltage should be between −15 and −13 Vdc.

Hint: Q26 and Q28 should be on. Q25 should be off.

5. Measure the collector of Q22 with a dc voltmeter. The voltage should be between +1.65 and +1.69 Vdc.

6. Connect the oscilloscope (with divider probe) to the collector of Q4. The waveform of the 1.5 MHz signal should be sinusoidal with an amplitude between 400 to 600 mVpp.

Hint: Pin 2 of U5 should be between −0.60 and −0.55 Vdc. To test the action of the Voltage-Variable Amplifier, short the collector of Q6 to its emitter. The waveform should be 6 Vpp or more and may be distorted (the resistor of U4 is at minimum resistance and the Voltage-Variable Amplifier is at maximum gain). Remove the short and then short pins 1 and 4 of U4. The amplitude should drop into the noise (the LED of U4 is off, resistance is maximum, and gain is minimum).

CAUTION

Inadvertently connecting pin 1 of U4 to pin 2 or 3 may cause a failure of Q8.

SERVICE SHEET 3 (Cont'd)

7. If necessary, fine adjust the signal generator level for a waveform of 500 mVpp.

8. Connect the oscilloscope to the collector of Q20. The waveform should be sinusoidal with an amplitude between 450 to 550 mVpp.

(√3) AM and Level Detector and Level Amplifier and Carrier Filter Check

1. Set the signal generator to 1.5 MHz CW at 0 dBm. Connect its RF output to A6J2 (IF IN).

2. Key in 0.0D0 SPCL to switch the ALC off.

3. Connect a high-impedance, ac coupled oscilloscope to the collector of Q20. The oscilloscope should have a low-capacitance 10:1 divider probe. Adjust the signal generator level for a waveform of 1 Vpp.

Hint: If the level is unadjustable, see (√2) Voltage-Variable Amplifier Check.

4. Connect the oscilloscope to the anode of CR9. The waveform should be a negative, half-wave rectified sine wave with an amplitude of 2.3 to 2.7 Vpp. Some distortion of the waveform and droop of the no-conduction voltage is normal.

5. Connect the oscilloscope to the cathode of CR10. The waveform should be a positive, half-wave rectified sine wave with an amplitude between 2.3 to 2.7 Vpp. Some distortion of the waveform is normal.

6. Measure the dc voltage between the emitter of Q13 and the gate of Q17. Multiply that voltage by 2.63. Now measure the dc voltage at TP2 (DEMOD CARR LVL) which should be within ±7% of the calculated voltage (ignoring the polarity).

(√4) ALC Reference, BW Control and Level Comparison Amplifier, Inverting Amplifier, and Control Current Source Check

NOTE

This test assumes that the (√3) AM and Level Detector and Level Amplifier and Carrier Filter Check above gives positive results.

1. Measure pin 3 of U1 with a dc voltmeter. The voltage should be between 2.095 and 2.105 Vdc. Record the voltage for future reference.

Hint: If the voltage is only slightly out of limits and if the AM Demodulator is only slightly in error, perform the ALC Reference Adjustment.

Input Mixer and IF Amplifier A17, A18 SERVICE SHEET 2

SERVICE SHEET 3 (Cont'd)

2. Set the signal generator for 1.5 MHz CW at 0 dBm. Connect its RF output to A6J2 (IF IN).

3. Key in 0.0D2 SPCL to switch the ALC off and set the response time to fast (200 Hz bandwidth).

4. Connect a high-impedance, dc coupled oscilloscope to pin 6 of U1.

5. Connect the dc voltmeter to TP2 (DEMOD CARR LVL).

6. Slowly vary the signal generator level such that the voltage at TP2 varies between +2.0 and +2.2 Vdc. When the voltage at TP2 approaches +2.2 Vdc, the voltage at pin 6 of U1 should rapidly drift to a level that is between −15 and −12 Vdc. When the voltage at TP2 approaches +2.0 Vdc, the voltage at pin 6 of U1 should rapidly drift to a level that is between +9 and +11 Vdc.

7. Adjust the signal generator level until the voltage at pin 6 of U1 holds steady at 0 Vdc. The voltage at TP2 should be within ±20 mV of the voltage measured in step 1.

8. Key in 0.0D0 SPCL to set the ALC response time to slow. Vary the signal generator level as in step 6. The drift rate should be about ten times slower. It should take about 8 seconds for the level at TP2 to drift from the negative to the positive extreme when the signal level is rapidly switched from −3 to −1 Vdc at pin 6 of U1.

Hint: Q27 and Q3 should be on. Q2 should be off. The collector of Q3 should be between −15 and −14 Vdc.

9. Set the oscilloscope to view two channels. Connect the second channel of the oscilloscope (dc coupled with a divider probe) to pin 6 of U2. Set its input to invert the signal. Set both channels to the same range. Check that the 0V reference is the same for both channels. Repeat step 6 and verify that the two channels track. The voltage at pin 6 of U2 should be larger in magnitude by about 10% as the signals drift.

10. Key in 0.0D1 SPCL to close the ALC loop with slow ALC response time. Set the signal generator level to 0 dBm.

11. Measure the dc voltage at the collector of Q26. The voltage should be greater than +5 Vdc.

Hint: Q26 and Q28 should be off. Q25 should be on.

12. Measure the dc voltage at TP2 with a dc voltmeter. The voltage should equal the voltage measured in step 1 within ±20 mV.

Hint: Checks (√1) to (√3) above and this check up to step 9 verify all the circuits which demodulate the AM without the ALC loop being closed. Step 10 above closes the loop. If the loop is working properly, the voltage at TP2 should equal the ALC Reference present at pin 3 of U1. The 1.5 MHz signal at the collector of Q4 should be between 900 and 1100 mVpp.

13. Set the signal generator level to −17 dBm. Measure TP2 with a dc voltmeter. The voltage should equal the voltage of step 1 within ±20 mV.

Hint: This verifies the dynamic range of the ALC loop. If the range is inadequate, the fault probably is with U4 or the R-Setting Loop.

(√5) AM Output Buffer Check

NOTE

This check assumes that all checks above give positive results (in other words, the AM Demodulator is known to work).

1. Set the signal generator to 1.5 MHz at 0 dBm. Set up 50% AM at a 1 kHz rate. Connect its RF output to A6J2 (IF IN).

2. Key in 41.0 SPCL to initialize the instrument.

3. Connect a high-impedance, ac coupled oscilloscope to the gate of Q17. Note the amplitude of the half-wave rectified signal.

4. Connect the oscilloscope to the collector of Q19. The amplitude should be the same within ±5%.

CHANGES

All serial prefixes	**On the A6 schematic:** • **C46, C51, L8** - Add an asterisk (*) to C46, C51, and L8 to indicate factory selected components. • **Q17, U2, U4** - On the new SS3 foldout *rev.01NOV89*, in the Table of Transistor and Integrated Circuit Part Numbers, change Q17 to 1855-0597, U2 to 1826-0989, and U4 to 1990-0643. **In the Troubleshooting:** • **OTHER REFERENCES** - Under Other References, in the fourth line from the top, change 1.5 MHz to 455 kHz, and change "Page 5–18" to "Page 5–24." • **Check 4** - In √4, ALC Reference and Level Comparison Amplifier, Inverting Amplifier, and Control Current Source Check, step 8, replace the last sentence with the following: It should take about 8 seconds for the level at pin 6 of U1 to drift from the negative to the positive extreme when the signal level is rapidly switched from +1 to +3 V dc at TP2. In step 12, Hint, delete the word "present" from the sentence, "Reference present at pin 3 of U1." Change "input bytes" to "input bits."
2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the A25 assembly part number to 08901-60120.
2239A to 2308A	**On the A6 schematic:** • **C51** - Change the value of C51 to 560 pF.
2244A to 2308A	**On the A6 schematic:** • **U4** - In the Table of Transistor and Integrated Circuit Part Numbers, change U4 to 1990-0643.

CHANGES

2309A and above

On the A6 component locator:

- **08901-60240** - Use the new component locator, Figure 8–72. P/O A6 AM Demodulator Assembly Component Locations (ALC Loop) (2309A and above), on page 8-98.5.

On the A6 schematic:

- **08901-60240** - Use the schematic foldout with revision date *rev.01NOV89.*

In the A6 Troubleshooting:

- **Check 2** - In ⟨√2⟩ Voltage Variable Amplifier Check, delete the caution message.
  Replace steps 1 through 8 with the new ⟨√2⟩ Voltage Variable Amplifier Check on page 8–98.6 to 8–98.7.
- **Check 4** - In ⟨√4⟩ ALC Reference BW Control and Level Comparison Amplifier, Inverting Amplifier, and Control Current Source Check, in step 8, Hint, delete the sentence "Q27 and Q3 should be on." Change Q2 to U5B. Replace the sentence, "The collector of Q3 should be between −15 and −14 V dc," with "Pin 8 of U5B should be a TTL high."

  In step 11, change the phrase, "the collector of Q26" to "Pin 3 of U5A." Change +5 V dc" to +12 V dc. Delete the existing hint, and add the following: "Hint: U5A should be on with a TTL low at pin 1. U5C should be off."

  In the last sentence of step 13, Hint, delete "U4 or" and change the "Loop" to "Circuit."

CHANGES

2313A and above	**On the A6 schematic:** • **08901-60246** - On the schematic foldout with revision date *rev.01NOV89*, change the part number of the A6 AM Demodulator Assembly to 08901-60246. • **CR22** - Add CR22 (use a schottkey diode symbol) parallel to R79; anode to ground 1, cathode to U3 pin 3.
2342A and above	**On the A6 schematic:** • **C51** - On the new SS3 foldout *rev.01NOV89*, change the value of C51 to 560 pF.
2432A and above	**On the A6 schematic:** • **Q6** - On the new SS3 foldout *rev.01NOV89*, in the Table of Transistor and Integrated Circuit Part Numbers, change Q6 to 1855-0265.
2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.

Reserved for future changes.

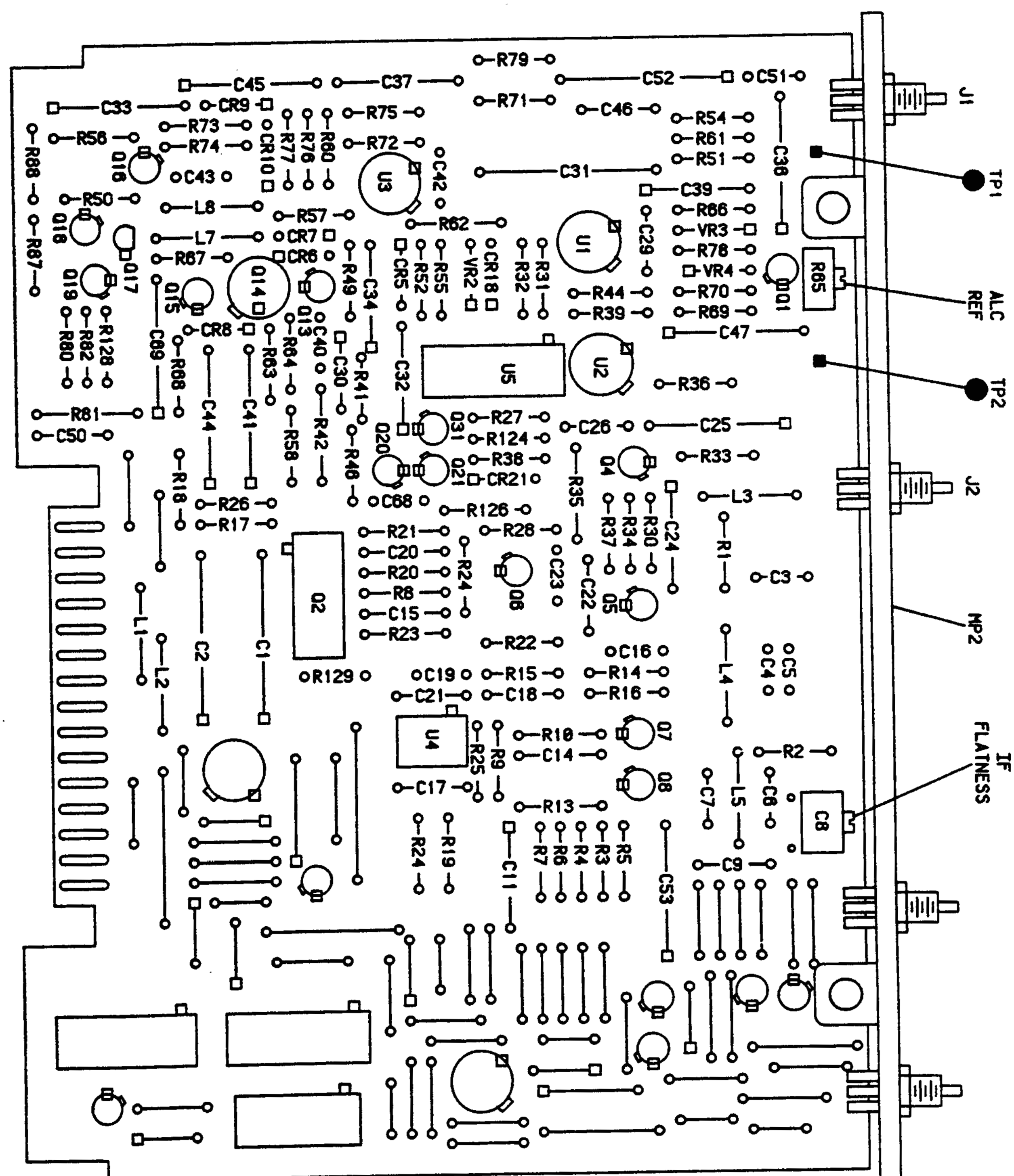


Figure 8-72. P/O A6 AM Demodulator Assembly Component Locations (ALC Loop) (2309A and above)

SS3

</2> Voltage Variable Amplifier Check (P/O CHANGE 28)

1. Set the signal generator to 1.5 MHz CW at -7 dBm. Connect its RF output to A6J2 (IF IN).

2. Connect a high-impedance, ac coupled oscilloscope to the emitter of Q8. The oscilloscope should have a low-capacitance 10:1 divider probe. Adjust the signal generator level for a waveform of 200 mVpp.

3. Key in 0.0D0 SPCL to switch the ALC off.

4. Measure pin 11 of U5C with a dc voltmeter. The voltage should be between -15 and -13 Vdc.

Hint: U5C should be on. U5A should be off. Pin 9 of U5C should be a TTL low.

5. Measure pin 7 (the collector) of Q2B with a dc voltmeter. The voltage should be between +1.66 and +1.69 Vdc.

6. Connect the oscilloscope (with divider probe) to the collector of Q4. The waveform of the 1.5 MHz signal should be sinusoidal with an amplitude between 400 and 600 mVpp.

Hint: If this step fails, check the R-Setting Circuits as follows:

a. Measure the drains of Q6 and Q7 with a dc voltmeter. The voltages should be within the limits shown in the schematic.

Hint: The voltage at pins 2 and 6 of U4 should be within the limits shown in the schematic. The polarity at the output of U4A (pin 1) should conform to the polarity of its differential inputs. (For example, if pin 3 is more positive than pin 2, pin 1 should be positive and may be as high as +15V.) Similarly for U4B.

b. Connect the oscilloscope (with divider probe) to the base of Q5 and observe the ac waveform on the oscilloscope. Momentarily ground pin 8 (the collector) of Q2C and observe the waveform. Then momentarily place a 1k ohm resistor in parallel with R8 and observe the waveform. The amplitude of the waveform should be as follows:

Condition	Waveform Amplitude Limits (mVpp)	
	Minimum	Maximum
Unmodified circuit	20	50
Pin 8 of Q2C grounded	10	30
1 k@ resistor in parallel with R8	150	200

</2> (cont'd)

c. Connect the oscilloscope to the collector of Q4 and observe the ac waveform on the oscilloscope. Momentarily ground pin 14 (the collector) of Q2D and observe the ac waveform on the oscilloscope. Momentarily place a 1k ohm resistor in parallel with R20 and observe the waveform. The amplitude of the waveform should be as follows:

Condition	Waveform Amplitude Limits (mVpp)	
	Minimum	Maximum
Unmodified circuit	200	400
Pin 14 of Q2D grounded	30	70
1 k@ resistor in parallel with R20	2000	3000

Hint: Check the bias of Q4 and Q5.

7. If necessary, fine adjust the signal generator level for a waveform of 500 mVpp.

8. Connect the oscilloscope to the collector of Q20. The waveform should be sinusoidal with an amplitude between 450 and 550 mVpp.

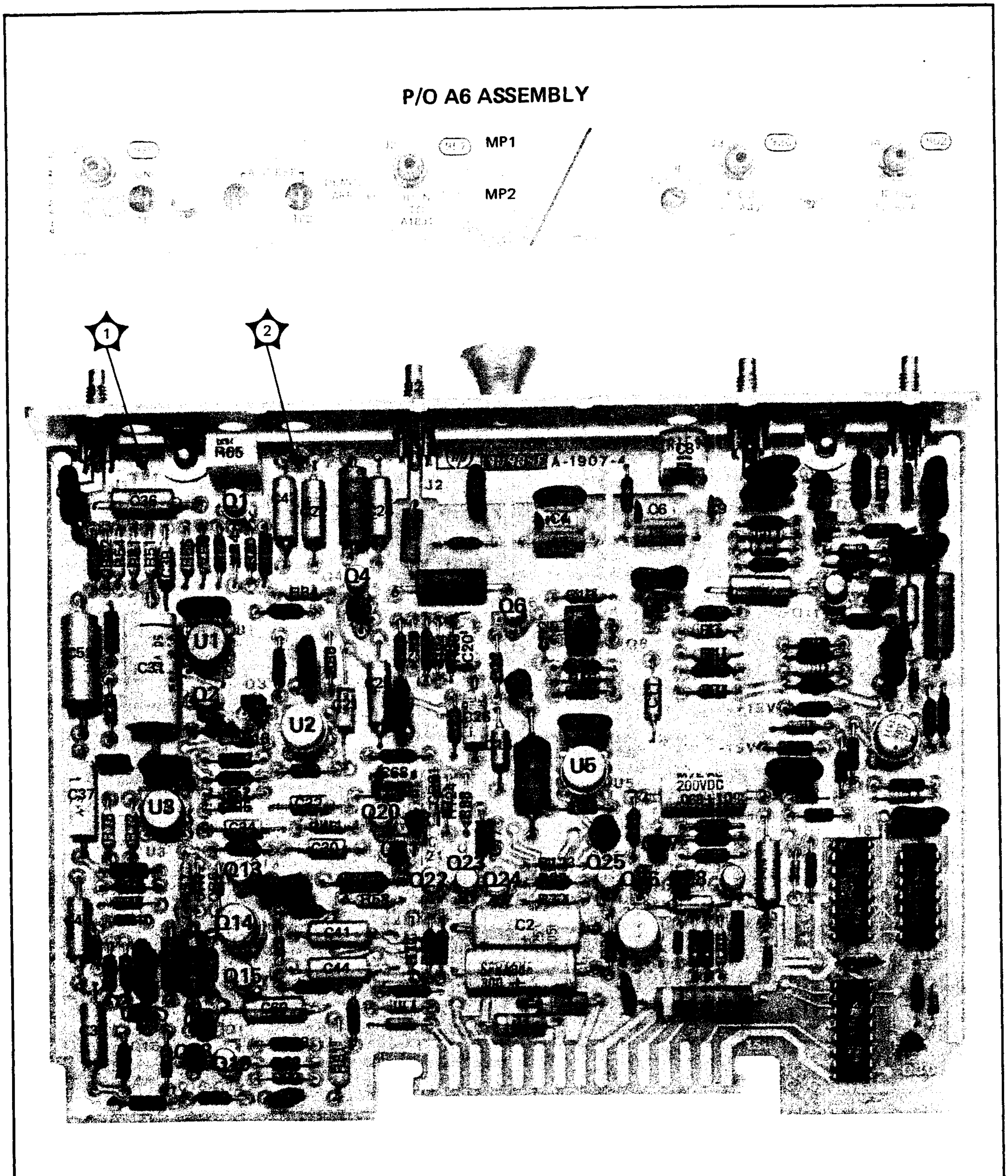
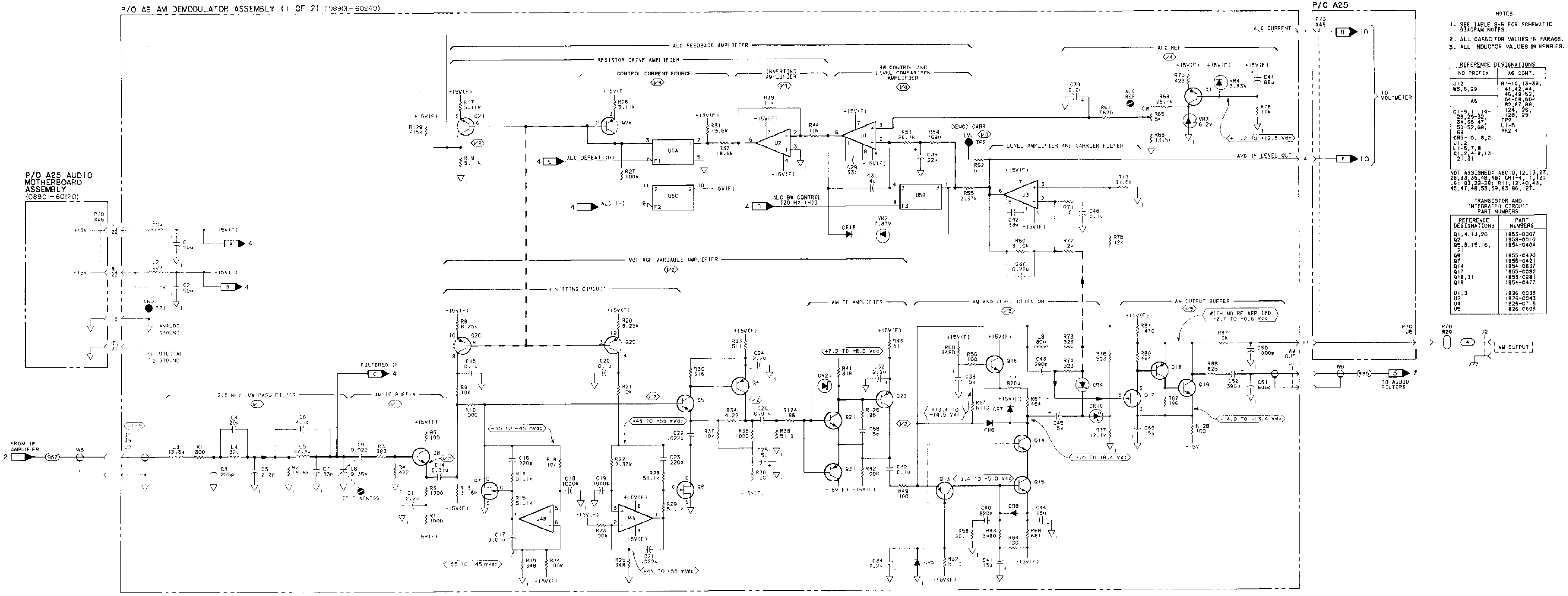


Figure 8-72. P/O A6 AM Demodulator Assembly Component Locations (ALC Loop)



NOTES

1. SEE TABLE 8-6 FOR SCHEMATIC DIAGRAM NOTES.
2. ALL CAPACITOR VALUES IN FARADS.
3. ALL INDUCTOR VALUES IN HENRIES.

REFERENCE DESIGNATIONS

NO PREFIX	A6 CONT.
J12 W5,6,29	R1-10,13-39, 41,42,44, 46,49-52, 54-58,60- 82,87,88, 124,126, 128,129 TP2 U1-5 VR2-4
A6	
C1-9,11,14- 26,29-32, 34,36-47, 50-52,68, 69 CR5-10,18,21 J1,2 L1-5,7,8 Q1,2,4-8,13- 21,31	

NOT ASSIGNED: A6C10,12,13,27,28,33,35,48,49; CR1-4,11,12; L6; Q3,22-28; R11,12,40,43,45,47,48,53,59,83-86,127.

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1,4,13,20	1853-0007
Q2	1858-0010
Q5,8,15,16,21	1854-0404
Q6	1855-0420
Q7	1855-0421
Q14	1854-0637
Q17	1855-0082
Q18,31	1853-0281
Q19	1854-0477
U1,3	1826-0035
U2	1826-0043
U4	1826-07.6
U5	1826 0606

3

P/O A6

Figure 8-73. AM Demodulator—ALC Loop Schematic Diagram

rev.1NOV89

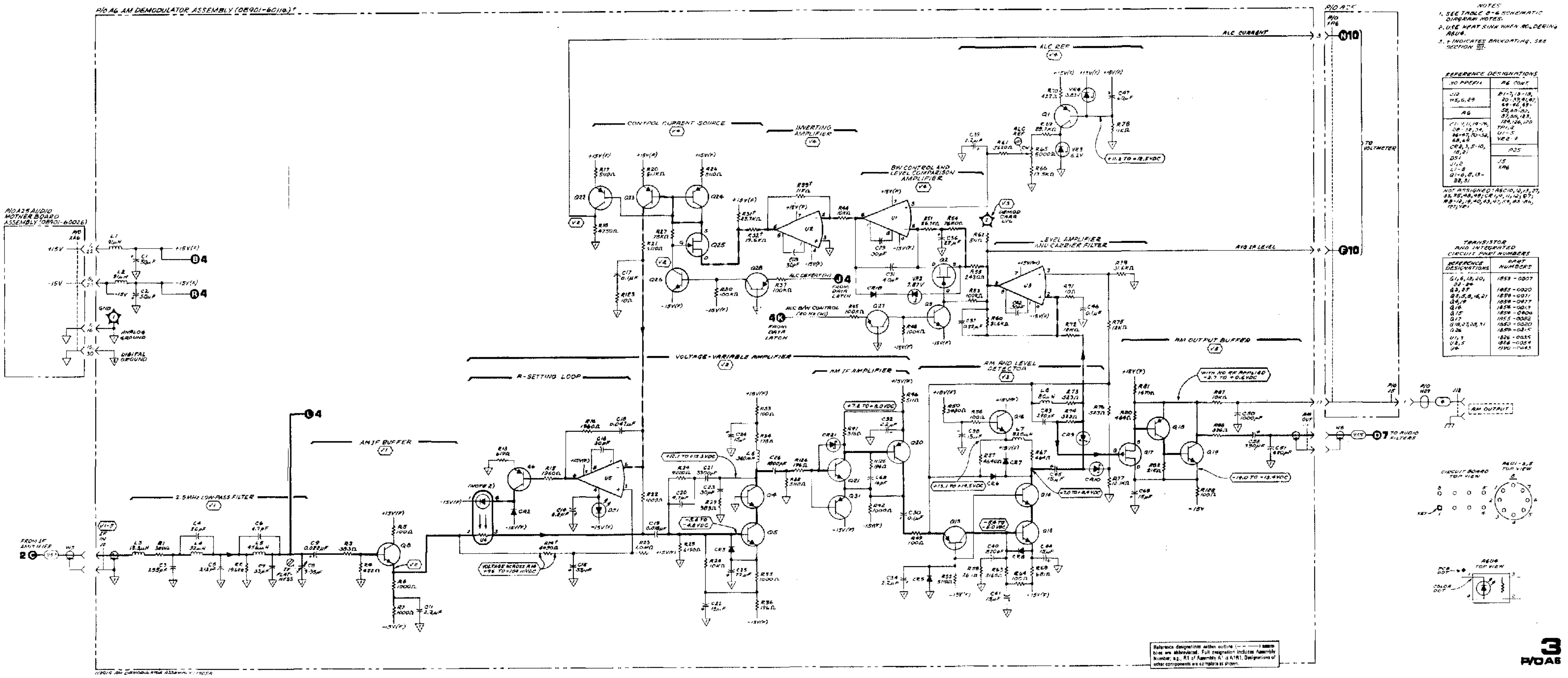


Figure 8-73. AM Demodulator — ALC Loop Schematic Diagram

SERVICE SHEET 4 — AM DEMODULATOR — CONTROL (P/O A6)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the AM Demodulator Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals also are shown on the schematic inside a hexagon, e.g., ⟨−1.9 to +2.1 Vdc⟩. Extend the board assembly and its input and output cables where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope ....HP 1740A
Signal Generator...................HP 8640B
Voltmeter ....HP 3455A

⟨√1⟩ FM IF Buffer Check

1. See 2.5 MHz Low-Pass Filter and IF Buffer Amplifiers Check on Service Sheet 3.

⟨√2⟩ IF Detectors and IF Present Latch Check

1. Set the signal generator to 1.5 MHz CW at 0 dBm. Connect its RF output to A6J2 (IF IN). (A6J2 is shown on Service Sheet 3.)

2. Key in 41.0 SPCL to initialize the instrument. Press RF LEVEL to halt automatic tuning.

3. Connect an ac coupled, high-impedance oscilloscope to the emitter of Q9. The oscilloscope should have a low-capacitance 10:1 divider probe. Adjust the signal generator level for a waveform of 1 Vpp.

Hint: If the level is unadjustable, see the 2.5 MHz Low-Pass Filter and IF Buffer Amplifiers Check on Service Sheet 3.

AM Demodulator — ALC Loop P/O A6 SERVICE SHEET 3

SERVICE SHEET 4 (Cont'd)

4. Connect the oscilloscope to the collector of Q11. The 1.5 MHz waveform should be sinusoidal with an amplitude between 6.0 and 7.2 Vpp. A small amount of distortion is normal.

5. If necessary, adjust the signal generator level for a waveform of 6 Vpp. Measure the voltage at pin 2 of A25XA6 with a dc voltmeter. The voltage should be between +1.1 and +1.3 Vdc.

6. Connect the voltmeter to pin 7 of U7. The voltmeter should read a TTL low.

7. Slowly decrease the signal generator level until the voltmeter reading jumps to a TTL high. The amplitude of the waveform should be between 800 and 1000 mVpp when the voltmeter level switches.

8. Slowly increase the signal generator level until the voltmeter reading jumps to a TTL low. The amplitude of the waveform should be between 1000 and 1200 mVpp.

9. Key in 0.0F0 SPCL and 0.0E0 SPCL to disable resetting of the IF Present Latch to enable readback of it. The display should read 0001.0000.

10. Reduce the signal generator level until the voltmeter reads a TTL high. The display should read 0000.0000.

11. Key in 0.0F1 SPCL and 0.0E0 SPCL to reset the IF Present Latch and enable readback of it. The display should read 0000.0000.

12. Increase the signal generator level until the voltmeter reads a TTL low. The display should read 0001.0000.

13. Reduce the signal generator level until the voltmeter reads a TTL high. The display should remain 0001.0000.

14. Connect the oscilloscope to the collector of Q29. Adjust the signal generator level for approximately +2 Vdc on the oscilloscope display.

15. Key in 0.0F0 to momentarily activate Q29. The voltage on the oscilloscope should momentarily discharge to 0V then recharge to its previous level within a few milliseconds.

⟨√3⟩ Select Decoder and Data Latch Check

1. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated on U9 with a high-impedance, dc coupled oscilloscope.

Direct Control Special Function	Level (TTL) at U9 Pin		
	7	9	10
0.0D0	H	H	*
0.0E0	H	*	H
0.0F0	*	H	H

*Low-going TTL pulses, ≈7 ms period.

2. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated on U8.

Direct Control Special Function	Level (TTL) at U8 Pin	
	1	14
0.0D0	H	H
0.0D3	L	L

3. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated on U8.

Direct Control Special Function	Level (TTL) at U8 Pin	
	8	9
0.0F0	H	L
0.0F3	L	H

CHANGES

All serial prefixes	**On the A6 schematic:** • **U7** - In the Table of Transistor and Integrated Circuit Part Numbers, change U7 to 1826-0065.
2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the A25 assembly part number to 08901-60120.
2309A and above	**In the Troubleshooting:** • **Check 3** - In ⟨√3⟩ Select Decoder and Data Latch Check, add the pin check shown on page 8–100.3. **On the A6 component locator:** • **08901-60240, 08901-60246** - Use the new component locator, Figure 8–74. P/O A6 AM Demodulator Assembly (Control) (2309A and above), on page 8–100.4. This component locator can also be used for 08901-60246 (2313A and above). **On the A6 schematic:** • **C54, C57, R98, R92, R93** - In the FM IF BUFFER, change the value of C54 and C57 to 0.022 μF, R89 to 100 ohms, R92 to 464 ohms, R93 to 196 ohms. • **R102** - In the IF DETECTOR BUFFER, change the value of R102 to 26.1 ohms. • **R122** - In the IF PRESET LATCH, change the value of R122 to 5.11 k. • **Bullets** - In the upper left portion of the schematic, change the off-page indicator bullet from L to C. Change the bullet at U8 pin 1 to E, and at U8 pin 14 to D. Change U8 pin 16 from NC to a bullet labeled H, 3.
2313A and above	**On the A6 schematic:** • **08901-60246** - Change the A6 assembly part number to 08901-60246.
2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.

Reserved for future changes.

Pin Check for U8B (√3) Select Decoder and Data Latch Check

Direct Control Special Function	TTL Level at U8 pin 16
0.0D0	L
0.0D3	H

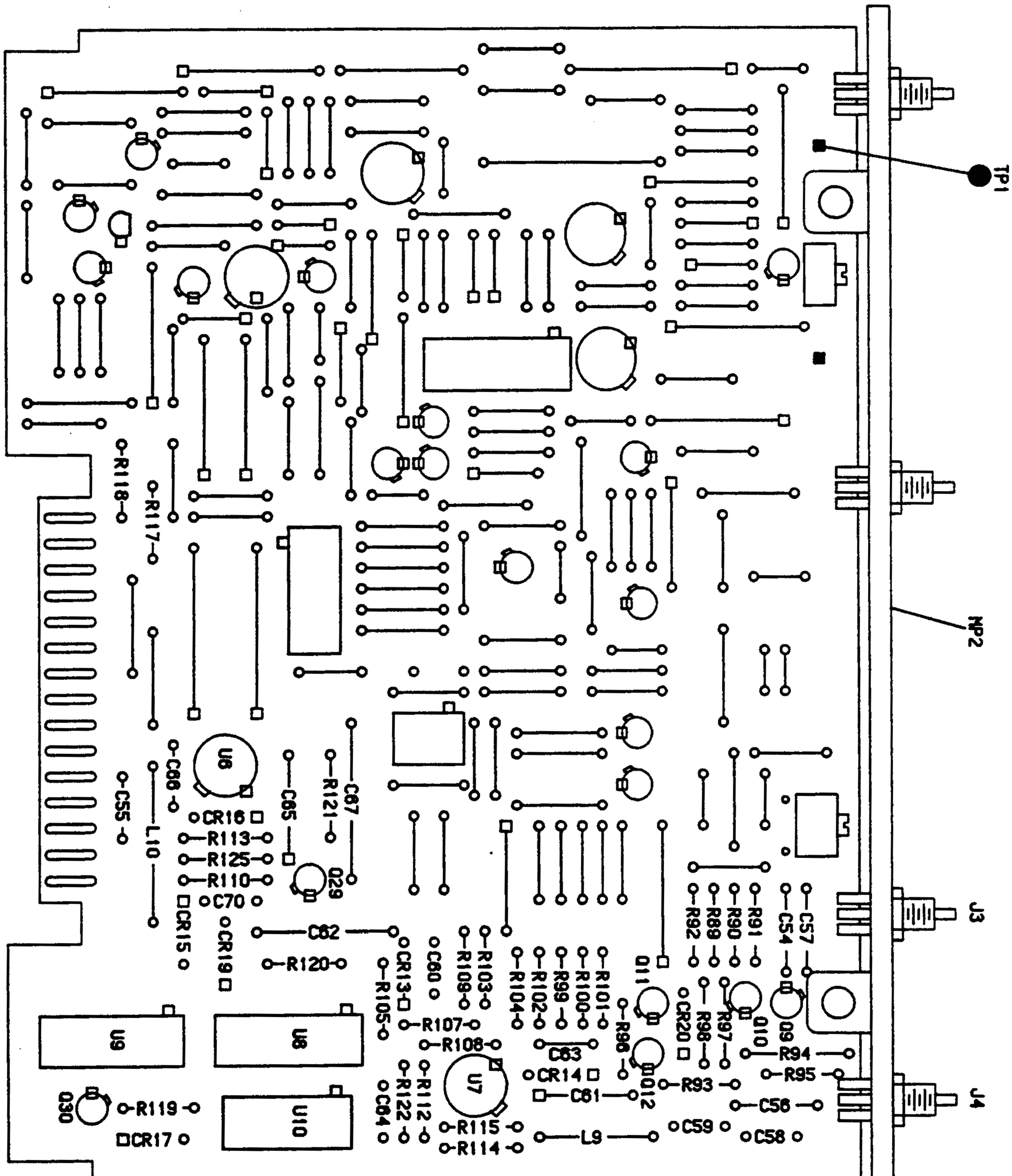
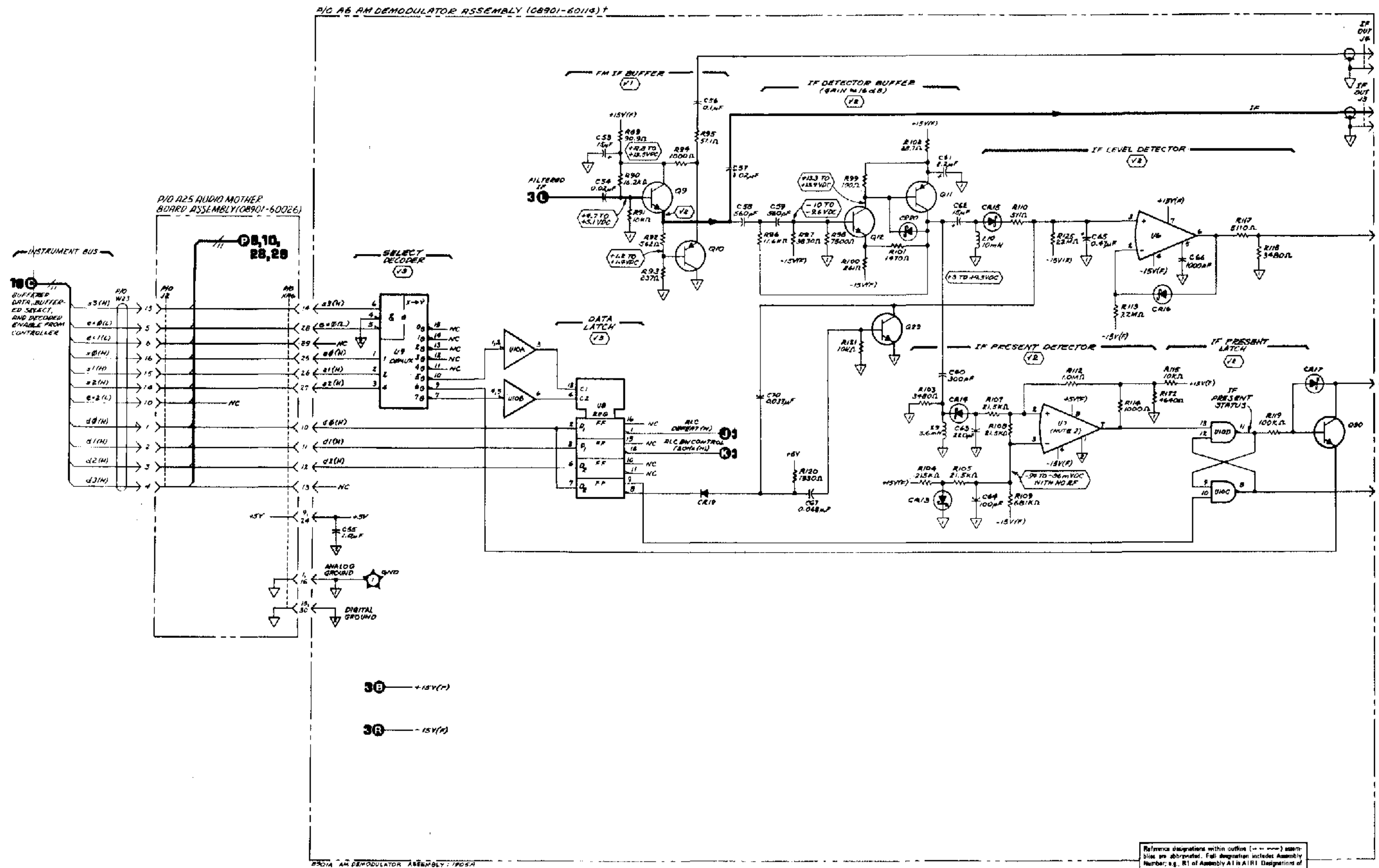
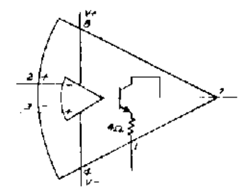


Figure 8-74. P/O A6 AM Demodulator Assembly Component Locations (Control) (2309A and above)



NOTES

1. SEE TABLE 8-6 SCHEMATIC DIAGRAM NOTES.
2. THE DIAGRAM BELOW SHOWS THE OUTPUT STAGE OF COMPARATOR A6U7 IN DETAIL.



3. † INDICATES BACKDATING. SEE SECTION VII.

REFERENCE DESIGNATIONS

NO PREFIX	A6 CONT.
IF W7, 9, 22, 24	R89-105, 107-110, 112-115, 117-122, 125 TP1 U6-10
A6	A25
C53-67, 70 CR13-17, 19, 20 J3, 4 L9, 10 Q9-12, 29, 30	J2, 3 XA6

NOT ASSIGNED: A6R106, 111, 116

LOGIC LEVELS

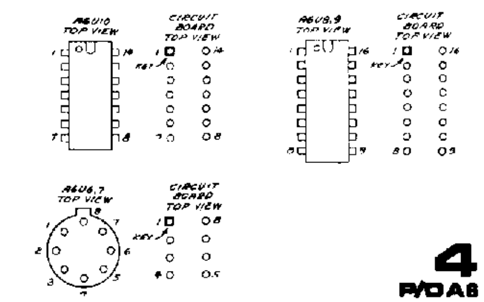
	TTL
HIGH	> 2V
LOW	< 0.8V
< IS MORE NEG. THAN > IS MORE POS. THAN	
OPEN	HIGH
GROUND	LOW

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q9, 30	1854-0071
Q10	1853-0020
Q11	1853-0007
Q12	1854-0215
Q29	1853-0477
U6	1826-0102
U7	1826-0026
U8	1820-1911
U9	1820-1216
U10	1820-1197

DIGITAL INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U8	+5V - 5
	⏚ - 12
U9	+5V - 16
	⏚ - 8
U10	+5V - 14
	⏚ - 7



Reference designations within outline (— — —) are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

4
P/O A6

Figure 8-75. AM Demodulator — Control Schematic Diagram

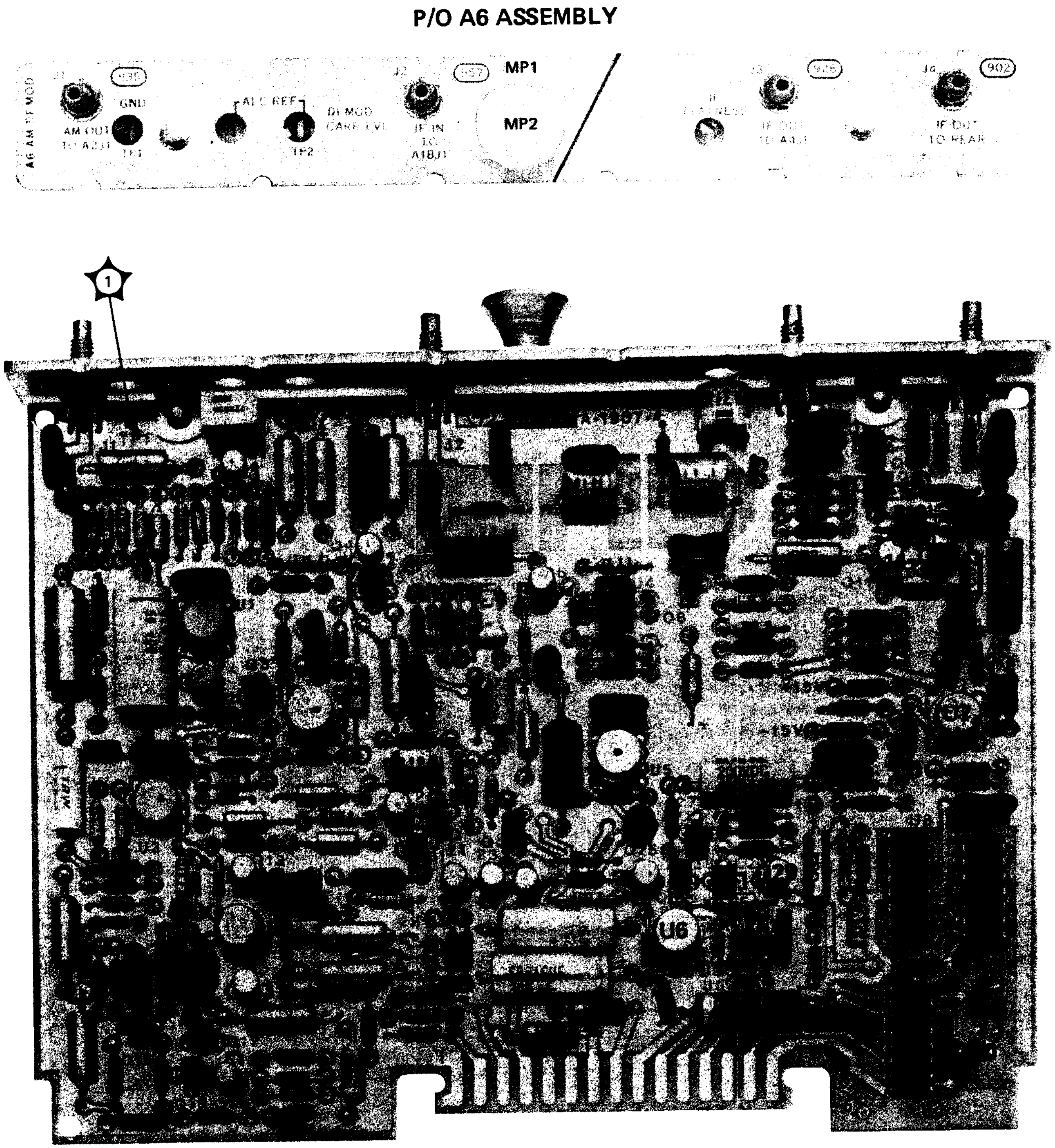


Figure 8-74. P/O A6 AM Demodulator Assembly Component Locations (Control)

SERVICE SHEET 5 — FM LIMITERS (P/O A4)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the FM Demodulator Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly and its input and output cables where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope .... HP 1740A
Signal Generator .... HP 8640B
Voltmeter .... HP 3455A

⟨√1⟩ IF Limiters and Counter IF Buffer Check

1. Set the signal generator to 1.5 MHz CW at −60 dBm. Connect its RF output to A4J1 (IF IN) with a 50Ω termination in parallel with it.

2. Connect oscilloscope to A4TP2 (DISC IN). The oscilloscope input should have a low-capacitance 10:1 divider probe. The waveform of the 1.5 MHz signal should be sinusoidal with an amplitude of 0.17 to 0.34 Vpp and an offset of +9.6 to +10.0 Vdc.

Hint: Each limiter has a gain of 22 dB.

3. Increase the signal generator level to 0 dBm. The waveform shoud be a square wave with an amplitude of 0.9 to 1.1 Vpp and an offset of +9.6 to +10.0 Vdc.

4. Check A4J2 (IF OUT). The waveform should be slightly asymmetrical "square wave" with an amplitude of 3 to 4 Vpp.

CHANGES

2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the A25 assembly part number to 08901-60120.
2426A and above	**On the A4 schematic:** • **08901-60184** - Change the part number of the A4 FM Demodulator Assembly to 08901-60184.
2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.

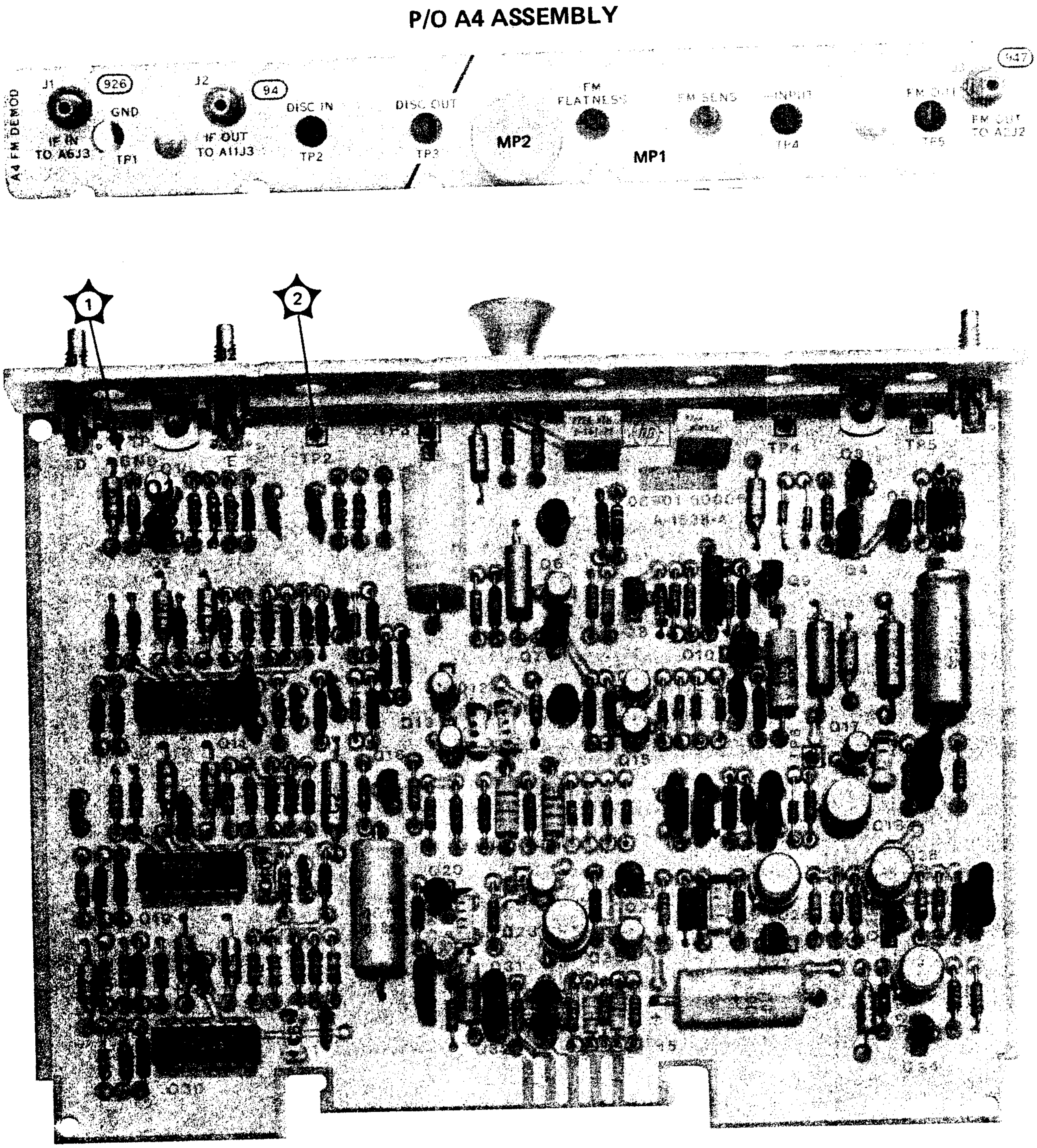
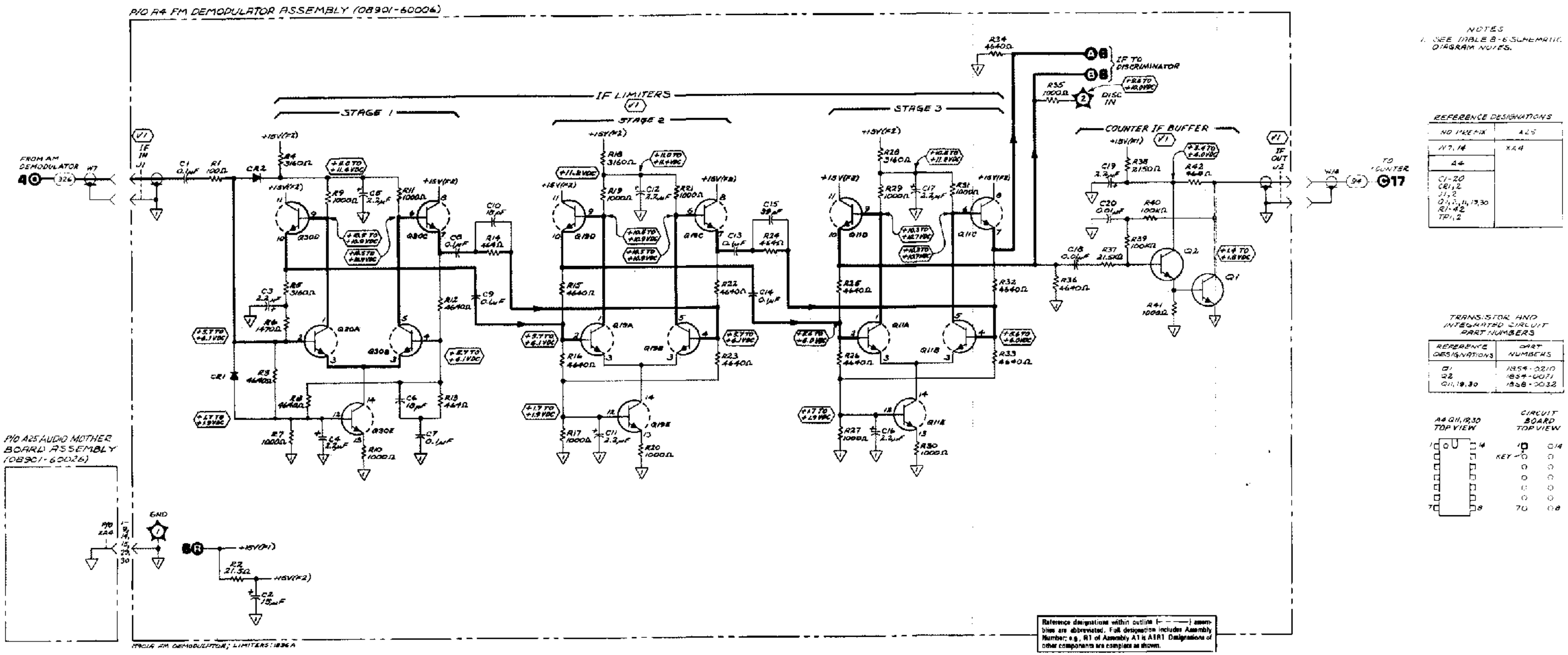


Figure 8-76. P/O A4 FM Demodulator Assembly Component Locations (FM Limiters)



5
P/O A4

Figure 8-77. FM Limiters Schematic Diagram

SERVICE SHEET 6 — FM DISCRIMINATOR (P/O A4)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD3
- FM Sensitivity Adjustment .... Page 5-15 or 5-16
- FM Flatness Adjustment......................... Page 5-17
- Parts List .... Page 6-11
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-57

TROUBLESHOOTING

General

Procedures for checking the FM Demodulator Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., √3. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., +1.9 to +2.1 Vdc. Extend the board assembly and its input and output cables where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope ....HP 1740A
Signal Generator...................HP 8640B
Voltmeter.........................HP 3455A

√1 Squelch Detector Check

NOTE

This check assumes that the IF Limiters and Counter IF Buffer Check on Service Sheet 5 gives positive results.

1. Set the signal generator to 1.5 MHz CW at −51 dBm. Connect its RF output to A4J1 (IF IN) with a 50Ω termination in parallel with it. (A4J1 is shown on Service Sheet 5.)

2. Check the gate (can) of Q21 with a dc voltmeter. The voltage should be −0.1 to +0.1 Vdc (i.e., squelched).

3. Key in 0.152 SPCL to unsquelch. The voltage should not change. (It is still squelched by the lack of adequate signal.)

4. Increase the signal generator's level to −45 dBm. The gate of Q21 should be −15 to −14 Vdc (i.e., unsquelched).

FM Limiters
P/O A4
SERVICE SHEET 5

SERVICE SHEET 6 (Cont'd)

5. Key in 0.150 SPCL to squelch. The gate of Q21 should be −0.1 to +0.1 Vdc.

√2 Precision Limiter Check

NOTE

This check assumes that the IF Limiters and Counter IF Buffer Check on Service Sheet 5 gives positive results.

1. Set the signal generator to 1.5 MHz CW at 0 dBm. Connect its RF output to A4J1 (IF IN) with a 50Ω termination in parallel with it. (A4J1 is shown on Service Sheet 5.)

2. Check the collectors (cans) of Q12, Q13, Q14, and Q15 with an oscilloscope. The oscilloscope input should have a low-capacitance 10:1 divider probe. The 1.5 MHz waveform should be a trapezoidal wave with an amplitude of 15 to 19 Vpp.

√3 Charge-Count Discriminator Check

NOTE

This check assumes that the √2 Precision Limiter Check gives positive results.

1. Set the signal generator to 1.5 MHz CW at 0 dBm. Connect its RF output to A4J1 (IF IN) with a 50Ω termination in parallel with it. (A4J1 is shown on Service Sheet 5.)

2. Check A4TP3 (DISC OUT) with an oscilloscope. The oscilloscope input should have a low-capacitance 10:1 divider probe. The waveform should be a 3 MHz (i.e., a doubled 1.5 MHz) triangle wave with an amplitude of 3 to 4 Vpp and an offset of −1 to +1 Vdc. The triangle may be slightly asymmetrical and adjacent cycles may be uneven.

3. Check A4TP4 (+ INPUT) and A4TP6 (− INPUT) with an oscilloscope. The offset voltages should be the same within ±10 mVdc. In addition, A4TP6 will have a superimposed 3 MHz "square wave" with an amplitude of 25 to 40 mVpp. The square wave may be asymmetrical and adjacent cycles may be uneven.

4. Decrease the signal generator frequency to 500 kHz. Check A4TP3 again. The offset level should be −7 to −5 Vdc.

√4 FM Output Amplifier Check

NOTE

This check assumes that the √3 Charge-Count Discriminator Check gives positive results.

1. Set the signal generator to 1.5 MHz CW at 0 dBm. Connect its RF output to A4J1 (IF IN) with a 50Ω termination in parallel with it. (A4J1 is shown on Service Sheet 5.)

2. Key in 0.152 SPCL to unsquelch. Check A4TP5 (FM OUT) with an oscilloscope. The waveform should be a 3 MHz (i.e., a doubled 1.5 MHz) sine wave with an amplitude of 0.4 to 0.8 Vpp and an offset of −1.9 to −1.3 Vdc. The waveform will be distorted and adjacent cycles may not be even.

3. Key in 0.150 SPCL to squelch. The ac component of the signal should decrease markedly.

Hint: Pin 10 of A25XA4 should be a TTL low.

CHANGES

2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the A25 assembly part number to 08901-60120.
2426A and above	**On the A4 schematic:** • **A4** - In the upper left corner of the schematic, change the part number of the A4 FM Demodulator Assembly to 08901-60184. • **R80, R81** - In the CHARGE-COUNT DISCRIMINATOR, change the value of R80 and R81 to 26.1 ohms. • **C50, C51, R105** - In the lower, right corner of the schematic, add C51 (2200 pF) to ground to the right of and in parallel with C50. Add R105 (4.64 k) between C50 and C51. • **Q35, R106** - On the CHARGE-COUNT DISCRIMINATOR output path, to the right of C39, add Q35 (and N-channel FET). Connect Q35's drain between C39 and R86 through a new resistor R106 (215 ohms), connect its gate to the gate of Q21, and connect its source to ground. • **Q23, Q26, Q28, Q33** - In the table of Transistor and Integrated Circuit Part Numbers, change Q23, Q26, Q28, Q33 to 1854-0637.
2543A and above	**On the schematic:** • **Q18** - In the table of Transistor and Integrated Circuit Part Numbers, change Q18 *to* 1854-0830.
2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.

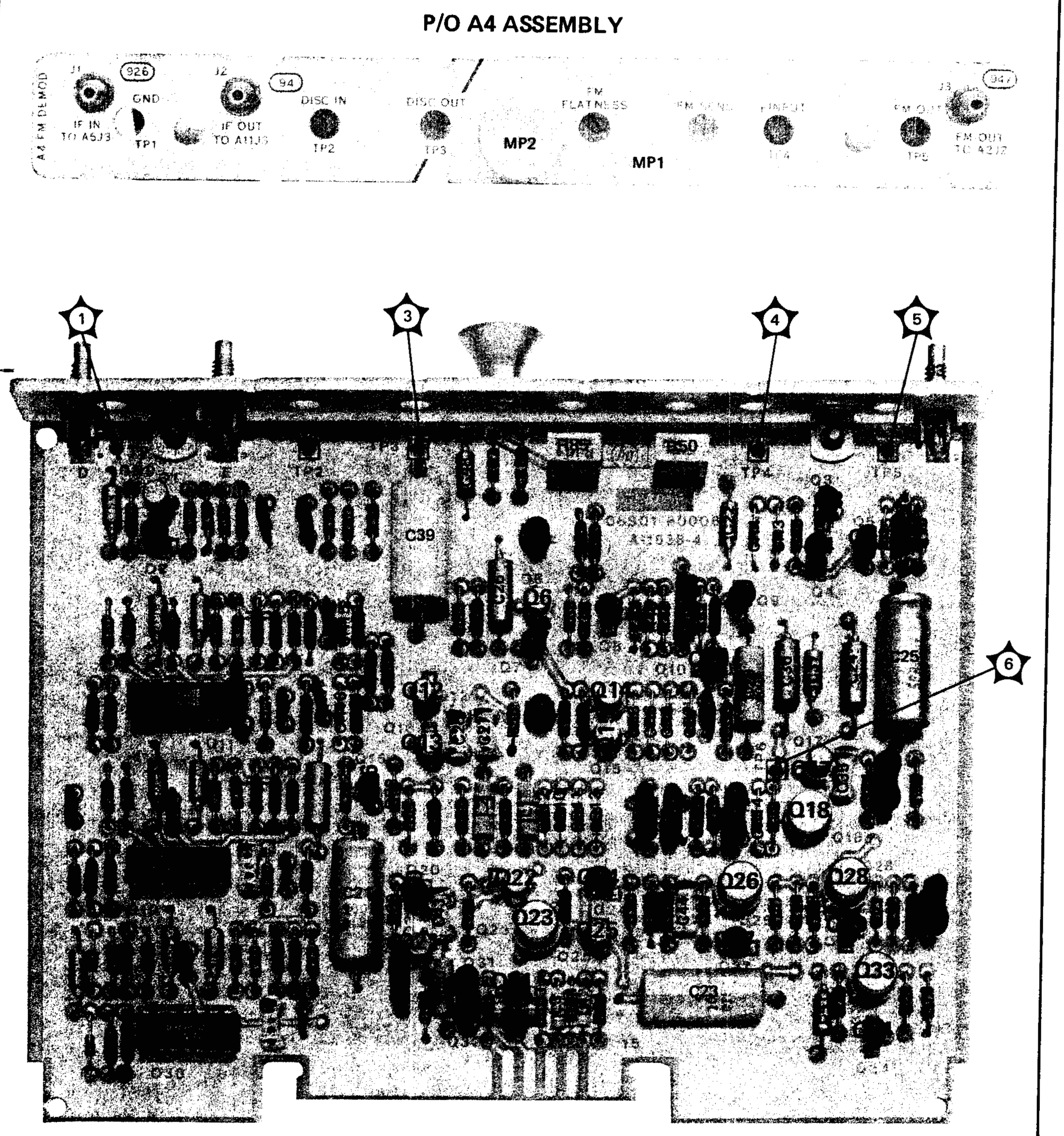


Figure 8-78. P/O A4 FM Demodulator Assembly Component Locations (FM Discriminator)

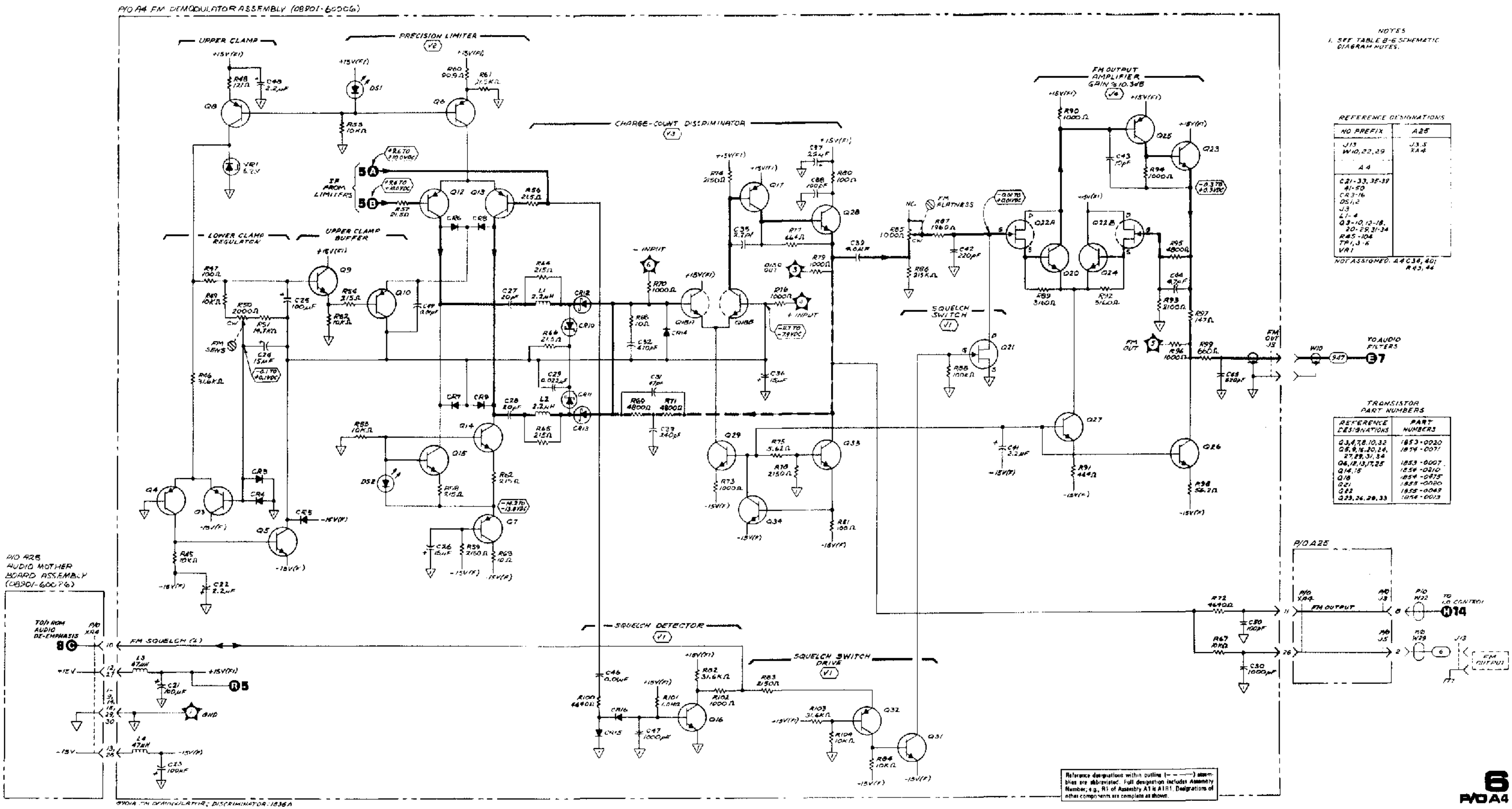


Figure 8-79. FM Discriminator Schematic Diagram

SERVICE SHEET 7 — AUDIO FILTER (A2)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the Audio Filter Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., √3. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., +1.9 to +2.1 Vdc. Extend the board assembly and its input cables where necessary to make measurements.

CAUTIONS

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

If the Modulation Analyzer is to be turned off, disconnect the audio synthesizer first to prevent damage to the FET switches by the large signal present.

Equipment

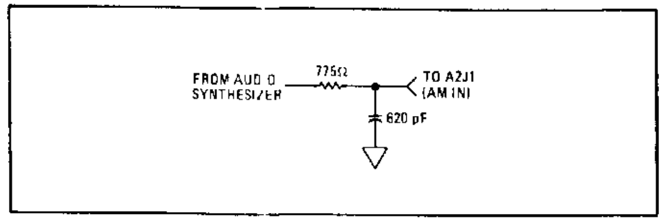
Audio Synthesizer	HP 3320B
Capacitor, 620 pF	HP 0160-3536
Oscilloscope	HP 1740A
Resistor, 909Ω	HP 0757-0422
Resistor, 1210Ω	HP 0757-0274
Resistor, 2150Ω	HP 0698-0084
Resistor, 4640Ω	HP 0698-3155
Voltmeter	HP 3455A

√1 260 kHz Low-Pass Filters and Modulation Selectors Check

1. Disconnect the cables from A2J1 (AM IN) and A2J2 (FM IN). Extend the A2 Audio Filter Assembly. Jumper a lead between chassis ground and the cover of the A2 assembly.

2. Construct the following input load for the AM input. The 775Ω resistor can be constructed from a 2150Ω resistor in parallel with a 1210Ω resistor.

SERVICE SHEET 7 (Cont'd)



3. Set the audio synthesizer to 1 kHz at +13 dBm. Connect its 50Ω output to the input of the load. Connect the output of the load directly to A2J1 (AM IN). An intervening cable will add too much capacitance to the load.

4. Key in 0.120 SPCL and 0.111 SPCL to select low audio gain and AM.

5. Connect a high-impedance, ac coupled oscilloscope to the input of the load. The oscilloscope should have a low-capacitance 10:1 divider probe. Adjust the synthesizer level for a waveform of 5 Vpp.

6. Connect the oscilloscope to pin 3 of U1A. The 1 kHz waveform should have an amplitude between 450 and 500 mVpp.

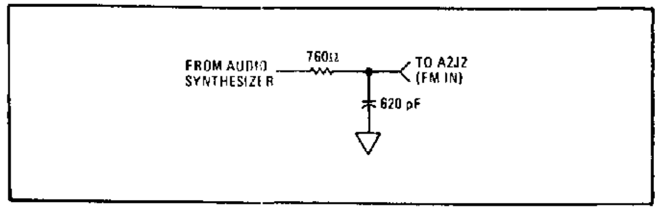
Hint: Pin 1 of U1A should be a TTL low. If for any reason the signal into the Audio Overvoltage Detector is too high, the Modulation Selectors will be latched open (see Service Sheet 8).

7. If necessary, adjust the synthesizer level for a waveform of 500 mVpp. Increase the synthesizer frequency to 50 kHz. The 50 kHz waveform should have an amplitude between 500 and 530 mVpp.

8. Increase the synthesizer frequency until the waveform amplitude is 355 mVpp. The synthesizer frequency should be between 240 and 280 kHz.

9. Increase the synthesizer frequency to 1.5 MHz. The waveform should drop into the noise.

10. Construct the following input load for the FM input. The 760Ω resistor can be constructed from a 909Ω resistor in parallel with a 4640Ω resistor.



11. Set the synthesizer to 1 kHz. Connect its 50Ω output to the input of the load. Connect the output of the load directly to A2J2 (FM IN).

12. Key in 0.118 SPCL to select high-gain FM.

SERVICE SHEET 7 (Cont'd)

13. Connect the oscilloscope to the input of the load. Adjust the synthesizer for a waveform of 5 Vpp.

14. Connect the oscilloscope to pin 14 of U1D. The 1 kHz waveform should have an amplitude between 1.8 and 2.0 Vpp.

Hint: Pin 16 of U1D should be low.

15. Adjust the level for a waveform of 2Vpp. Increase the synthesizer frequency to 150 kHz. The 150 kHz waveform should have an amplitude between 1.95 and 2.05 Vpp.

16. Increase the synthesizer frequency until the waveform amplitude is 1.4 Vpp. The synthesizer frequency should be between 240 and 280 kHz.

17. Increase the synthesizer frequency to 1.5 MHz. The waveform should drop into the noise.

18. Set the synthesizer frequency to 1 kHz.

19. Key in 0.112 SPCL to select low-gain FM. The waveform should have an amplitude between 195 and 205 mVpp.

Hint: Pin 9 of U1C should be a TTL low.

√2 Amplifiers 1, 2, and 3, 15 kHz and >20 kHz Low-Pass Filters, and Audio Gain Selectors Checks

NOTE

This check assumes that the √1 260 kHz Low-Pass Filters and Modulation Selectors Check above gives positive results.

1. Disconnect the cables from A2J1 (AM IN) and A2J2 (FM IN). Extend the A2 Audio Filter Assembly. Jumper a lead between chassis ground and the cover of the A2 assembly.

2. Construct the input load for the FM input as described in step 10 of the √1 260 kHz Low-Pass Filters and Modulation Selectors Check above.

3. Set the audio synthesizer to 1 kHz at +10 dBm. Connect its 50Ω output to the input of the load. Connect the output of the load directly to A2J2 (FM IN). An intervening cable will add too much capacitance to the load.

4. Key in 0.120 SPCL and 0.118 SPCL to select low audio gain and high-gain FM.

5.. Connect a high-impedance, ac coupled oscilloscope to the base of Q1A. Adjust the synthesizer level for a waveform of 1.5 Vpp.

SERVICE SHEET 7 (Cont'd)

Hint: If for any reason the signal into the Audio Overvoltage Detector is too high, the Modulation Selectors will latch open (see Service Sheet 8).

6. Connect the oscilloscope to A2TP2 (AMPL 1 OUT). The 1 kHz waveform should have an amplitude between 4.1 and 4.3 Vpp.

7. Adjust the synthesizer level for a waveform of 4 Vpp.

8. Key in 0.139 SPCL to select the 6 dB Attenuator. Connect the oscilloscope to pin 14 of U4D. The 1 kHz waveform should have an amplitude between 1.9 and 2.1 Vpp.

Hint: Pin 1 of U2A should be a TTL low.

9. Key in 0.13C SPCL to select the 15 kHz Low-Pass Filter. The waveform should have an amplitude between 1.9 and 2.1 Vpp.

Hint: Pin 16 of U4D and pins 8 and 16 of U2 should be a TTL low.

10. Increase the synthesizer frequency to 10 kHz. The waveform should have an amplitude between 1.9 and 2.1 Vpp.

11. Increase the synthesizer frequency until the waveform amplitude is 1.4 Vpp. The synthesizer frequency should be between 14 and 16 kHz.

12. Increase the synthesizer frequency to 150 kHz. The waveform should drop into the noise.

13. Set the synthesizer frequency to 1 kHz. Key in 0.13A to select the >20 kHz Low-Pass Filter. The 1 kHz waveform should have an amplitude between 1.9 and 2.1 Vpp.

Hint: Pin 9 of U2C should be a TTL low.

14. Increase the synthesizer frequency to 10 kHz. The waveform should have an amplitude between 1.9 and 2.1 Vpp.

15. Increase the synthesizer frequency until the waveform amplitude is 1.4 Vpp. The synthesizer frequency should be between 100 and 120 kHz.

16. Increase the synthesizer frequency to 450 kHz. The waveform should drop into the noise.

17. Key in 0.139 SPCL to set all filters off. Set the synthesizer frequency to 1 kHz. If necessary, adjust the level for a waveform amplitude of 2 Vpp.

18. Connect the oscilloscope to A2TP3 (AMPL 2 OUT). The 1 kHz waveform should have an amplitude between 9.5 and 9.9 Vpp.

19. Adjust the synthesizer level for a waveform of 10 Vpp.

20. Connect the oscilloscope to A2TP4 (AMPL 3 OUT). The 1 kHz waveform should have an amplitude between 9.9 and 10.1 Vpp.

Hint: Pin 8 of U4B should be a TTL low.

21. Reduce the synthesizer level by exactly 20 dB.

22. Key in 0.121 SPCL to set audio gain to high. The waveform should have an amplitude between 9.9 and 10.1 Vpp.

Hint: Pin 9 of U4C should be a TTL low.

23. Increase the synthesizer frequency until the waveform amplitude is 7.1 Vpp. The synthesizer frequency should be between 240 and 280 kHz.

CHANGES

All Serial Prefixes	**On the A2 schematic:** • **L5** - In 260 KHZ LOW-PASS FILTER, change the value of L5 to 910 μH. • **C14** - Under AMPLIFIER I, change C14 to 820 pF. • **Q1** - In the table of Transistor and Integrated Circuit Part Numbers, change Q1 to 1854-0830.
2009A and above	**On the A2 schematic:** • **C32, C33, L10, L12, L13, L14** - Under > 20 KHZ LOW-PASS FILTER, change the value of C32 to 750 pF, C33 to 620 pF, L10 to 2 mH, L12 to 1.1 nH, L13 to 750 μH, and L14 to 560 μH.
2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the A25 assembly part number to 08901-60120.
2705A and above	**On the A2 schematic:** • **R51** - Under 15 KHZ LOW-PASS FILTER, change the value of R51 to 100 ohms.
2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.

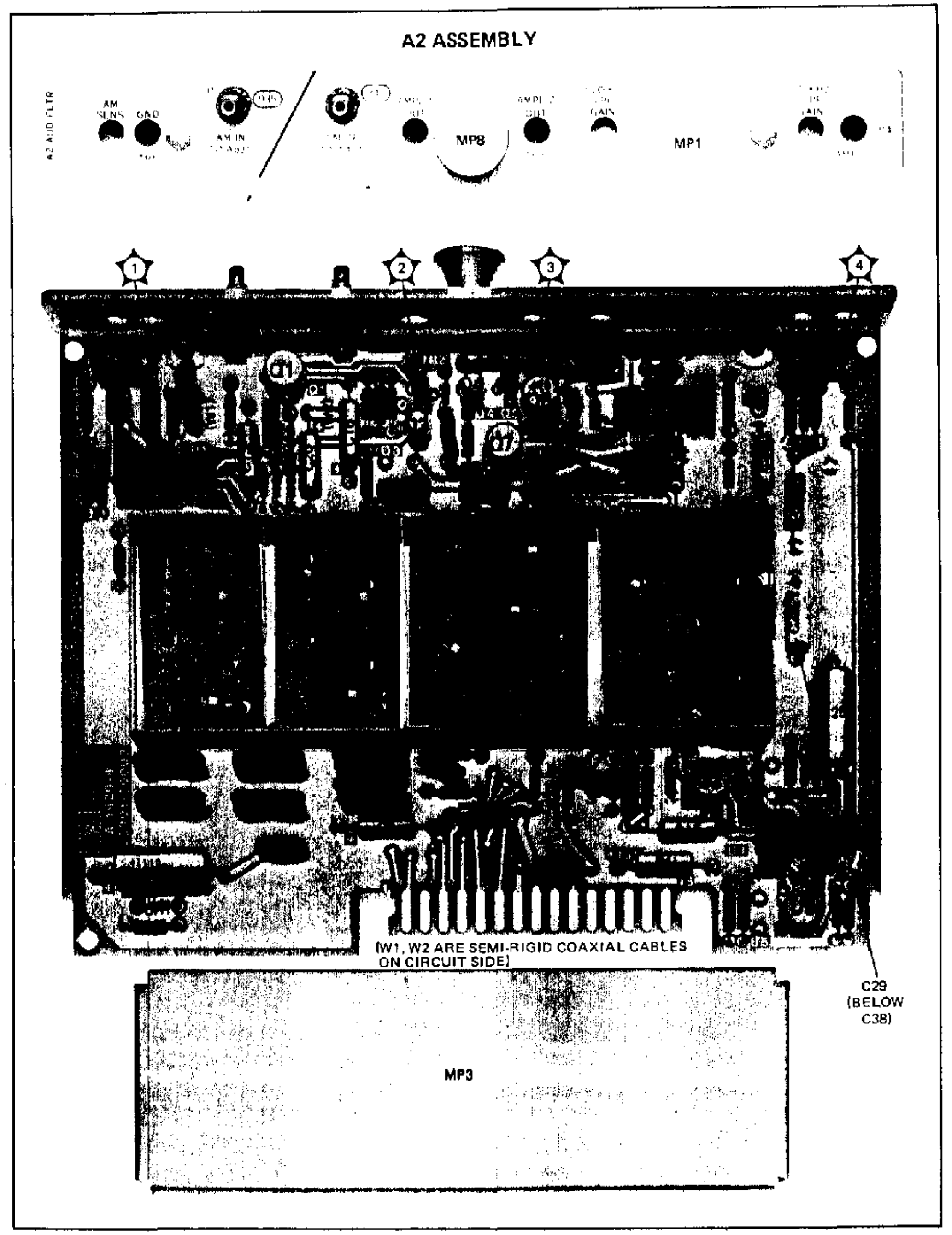


Figure 8-80. A2 Audio Filter Assembly Component Locations

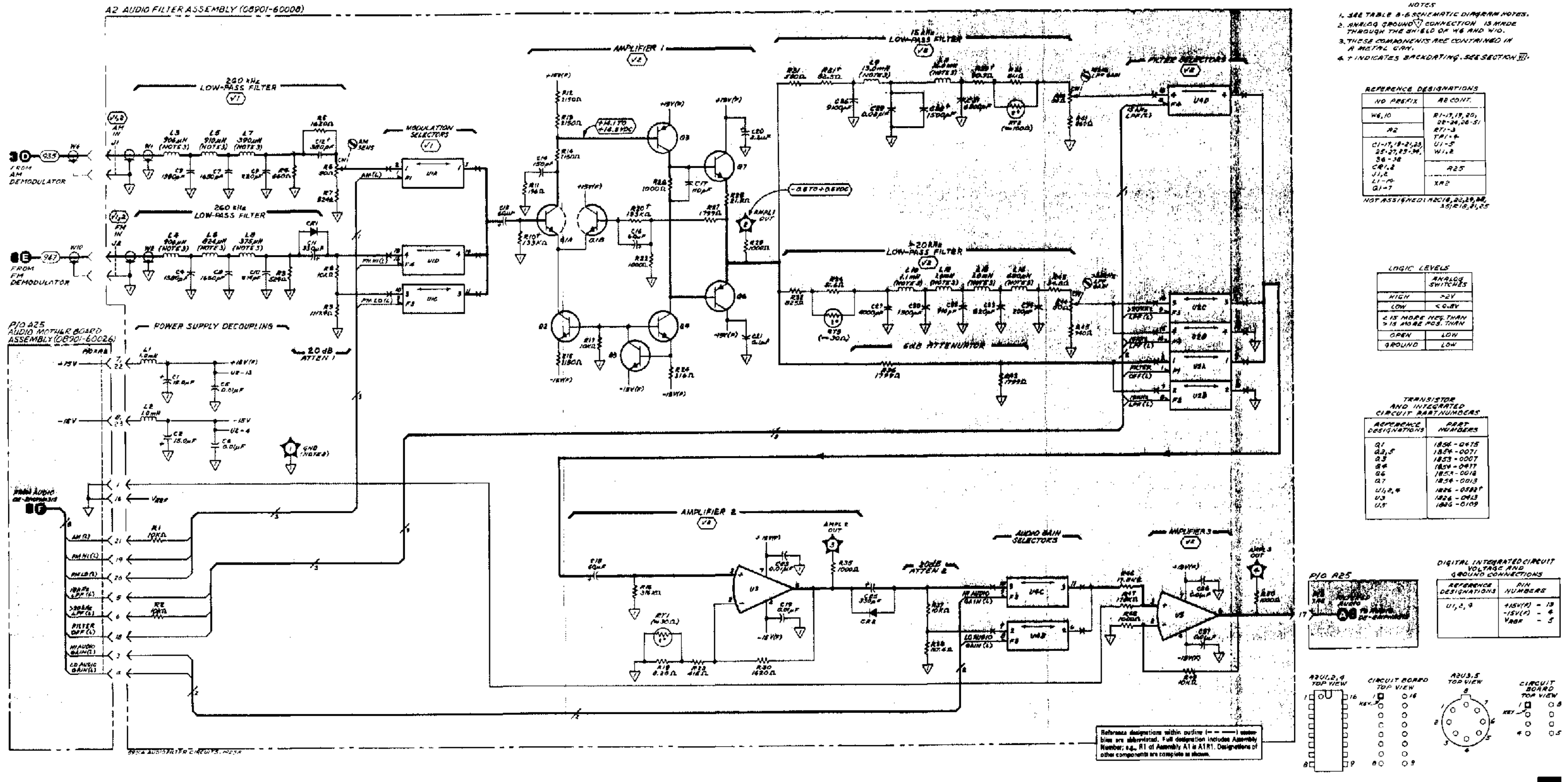


Figure 8-81. Audio Filters Schematic Diagram

SERVICE SHEET 8 — AUDIO DE-EMPHASIS AND OUTPUT (A3)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD3
- ΦM Sensitivity Adjustment .... Page 5-20
- Parts List .... Page 6-9
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-59

TROUBLESHOOTING

General

Procedures for checking the Audio De-emphasis and Output Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTION

If the Modulation Analyzer is to be turned off, disconnect the audio synthesizer first to prevent damage to the FET switches by the large signal present.

Equipment

Audio Synthesizer .... HP 3320A
Oscilloscope .... HP 1740A

⟨√1⟩ High-Pass and Low-Pass Filters and Filter Switching Check

1. Unplug the A2 Audio Filter Assembly.

2. Set the audio synthesizer to 1 kHz at +4 dBm. Connect its 50Ω output to pin 2 of A25XA3.

3. Connect a high-impedance, dc coupled oscilloscope to pin 2 of A25XA3. Adjust the synthesizer level for a waveform of 2 Vpp.

4. Key in 0.141 SPCL to select no high-pass filter.

5. Connect the oscilloscope to pin 2 of U12A. The 1 kHz waveform should be between 1.95 and 2.05 Vpp.

Hint: Pin 8 of U12B should be a TTL low.

6. Key in 0.144 SPCL to select the 300 Hz High-Pass Filter. The waveform should be between 1.95 and 2.05 Vpp.

Hint: Pin 9 of U12C should be a TTL low.

7. Decrease the synthesizer frequency to 300 Hz. The waveform should be between 1.3 and 1.5 Vpp.

SERVICE SHEET 8 (Cont'd)

8. Increase the synthesizer frequency to 1 kHz. Key in 0.142 SPCL to select the 50 Hz High-Pass Filter. The waveform should be between 1.95 and 2.05 Vpp.

Hint: Pin 1 of U12A should be a TTL low.

9. Decrease the synthesizer frequency to 50 Hz. The waveform should be between 1.3 and 1.5 Vpp.

10. Key in 0.141 SPCL and 0.139 SPCL to select no high- or low-pass filters.

11. Increase the synthesizer frequency to 1 kHz. Connect the oscilloscope to A3TP4 (FLTR OUT). The waveform should be between 1.95 and 2.05 Vpp.

Hint: Pin 16 of U12D should be a TTL low.

12. Key in 0.134 SPCL to select the 3 kHz Low-Pass Filter. The waveform should be between 1.95 and 2.05 Vpp.

Hint: Pin 1 of U13A should be a TTL low.

13. Increase the synthesizer frequency to 3 kHz. The waveform should be between 1.3 and 1.5 Vpp.

⟨√2⟩ De-emphasis and Output Amplifiers Check

1. Unplug the A2 Audio Filter Assembly.

2. Set the audio synthesizer to 1 kHz at +4 dBm. Connect its 50Ω output to pin 2 of A25XA3.

3. Key in 0.139 SPCL, 0.149 SPCL and 0.100 SPCL to select no high-pass or low-pass filters or FM de-emphasis.

4. Connect a high-impedance, dc-coupled oscilloscope to A3TP4 (FLTR OUT). Adjust the synthesizer level for a waveform of 2Vpp.

Hint: If the level is faulty, see ⟨√1⟩ High-Pass and Low-Pass Filters and Filter Switching Check.

5. Connect the oscilloscope to A3TP2 (MOD OUT). The waveform should be between 3.9 and 4.1 Vpp.

Hint: Pin 1 of U15A should be a TTL low. The gain of the Output Amplifier should be +2 followed by −1.

6. Key in the Direct Control Special Functions indicated below. For each setting, set the synthesizer frequency as indicated. The waveform amplitude at A3TP2 should be as indicated.

Direct Control Special Function	Synthesizer Frequency (Hz)	Waveform Amplitude (Vpp)	Level (TTL) at		
			U13-16	U13-9	U15-9
0.101	6366	2.6 to 3.0	H	H	L
0.104	3183	2.6 to 3.0	H	L	H
0.102	2122	2.6 to 3.0	L	H	H

7. Set the synthesizer frequency to 212.2 Hz and reduce its level exactly 20 dB.

SERVICE SHEET 8 (Cont'd)

8. Key in 0.103 SPCL to select 750 μs de-emphasis. The waveform should be between 2.6 and 3.0 Vpp.

Hint: Pin 8 of U13B should be a TTL low. The in-band gain of the 750 μs amplifier is 10.

9. Key in 0.105 SPCL to select ΦM.

10. Set the synthesizer frequency to 1 kHz and increase its level exactly 20 dB. The waveform should be between 3.8 and 4.2 Vpp.

Hint: Pin 8 of U15B should be a TTL low. If the waveform is only slightly out of limits, perform the ΦM Sensitivity Adjustment.

11. Increase the synthesizer frequency to 10 kHz and increase its level exactly 20 dB. The waveform should be between 380 and 420 mVpp.

12. Key in 0.100 SPCL.

13. Decrease the synthesizer frequency to 2122 Hz. Connect the oscilloscope to A3TP3 (DE-EM OUT). Set the oscilloscope to trigger on the synthesizer output. The waveform should be between 3.9 and 4.1 Vpp.

Hint: Pin 8 of U14B and pin 16 of U14D should be a TTL low.

14. Key in 0.108 SPCL to select a non-inverting output. The waveform should invert and have an amplitude between 3.9 and 4.1 Vpp.

Hint: Pin 9 of U14C should be a TTL low.

15. Key in 0.102 SPCL and 0.141 SPCL to select 75 μs de-emphasis with pre-display on. The waveform should be between 2.6 and 3.0 Vpp.

Hint: Pin 1 of U14A should be a TTL low.

16. Key in 0.100 SPCL. Increase the synthesizer frequency to 311 kHz. The waveform should be between 2.5 and 3.1 Vpp.

Hint: This rolloff is due to R18 and C42. No other device should contribute to the rolloff.

⟨√3⟩ Detectors Check

1. Unplug the A2 Audio Filter Assembly.

2. Set the audio synthesizer to 1 kHz at +4 dBm. Connect its 50Ω output to pin 2 of A25XA3.

3. Key in 0.141 SPCL to select no high-pass filters and to assure that Q1 is off.

4. Connect a high-impedance, dc coupled oscilloscope to pin 2 of A25XA3 also. Adjust the synthesizer for a waveform of 2 Vpp.

5. Connect the oscilloscope to A3TP5 (AUDIO RANGE). The voltage should be between +0.9 and +1.1 Vdc.

SERVICE SHEET 8 (Cont'd)

6. Reduce the synthesizer level by 10 dB. The voltage at A3TP5 should discharge to 0.3V in about 2s.

7. Key in 0.160 SPCL to enable the discharge of the Absolute Peak Detector.

8. Increase then decrease the synthesizer level by 10 dB. The voltage at A3TP5 should discharge to 0.3V in about 0.5s.

Hint: Low-going TTL pulses should appear at pin 16 of U15D.

9. Key in 0.111 SPCL and 0.150 SPCL to select AM and reset the Audio Overvoltage Detector and to enable readback of the audio overvoltage.

10. Connect the oscilloscope to pin 3 of U19. It should be a TTL low. The display should show 0000.0000.

Hint: Low-going TTL pulses should appear at pin 12 of U21D. Pin 11 of U21D should be a TTL high. Pin 10 of U21C should be a TTL high.

11. Set the synthesizer to +24 dBm or, if the synthesizer cannot deliver +24 dBm, set it to +19 dBm and connect its output to the anode of CR3. The voltage at pin 3 of U19 should be a TTL high. The display should show 0001.0000.

Hint: Pin 11 of U21D should be a TTL low. Low-going TTL pulses should appear at pin 10 of U21C.

12. Reduce the synthesizer level by 10 dB. The voltage at pin 3 of U19 and the display should remain unchanged.

13. Connect the oscilloscope to pin 12 of U9D. The voltage should be between +3.4 and +3.8 Vdc.

⟨√4⟩ Select Decoder, Data Latches, and FM Squelch Checks

1. Key in the Direct Control Special Functions indicated below. For each setting, check the pins on U20 indicated.

Direct Control Special Function	Level (TTL) at U20 Pin							
	7	9	10	11	12	13	14	15
0.100	H	H	H	H	H	H	H	*
0.110	H	H	H	H	H	H	*	H
0.120	H	H	H	H	H	*	H	H
0.130	H	H	H	H	*	H	H	H
0.140	H	H	H	*	H	H	H	H
0.150	H	H	*	H	H	H	H	H
0.160	H	*	H	H	H	H	H	H
0.170	*	H	H	H	H	H	H	H

*Low-going TTL pulses, ~7 ms period.

SERVICE SHEET 8 (Cont'd)

2. Key in the Direct Control Special Functions indicated below. For each setting, check the indicated pins.

Direct Control Special Function	Level (TTL) at U18 Pin					Level (TTL) at U17 Pin					
	2	7	10	14	15	1	2	3	4	5	6
0.100	L	L	L	H	L	L	H	H	H	H	H
0.101	H	L	L	H	L	H	L	H	H	H	H
0.102	L	H	L	H	L	H	H	L	H	H	H
0.103	H	H	L	H	L	H	H	H	L	H	H
0.104	L	L	H	H	L	H	H	H	H	L	H
0.105	H	L	H	H	L	H	H	H	H	H	L
0.108	L	L	L	L	H	H	H	H	H	H	H

3. Key in the Direct Control Special Functions Indicated below. For each setting, check the pins indicated on U19.

Direct Control Special Function	Level (TTL) at U19 Pin			
	3	6	11	15
0.111	L	H	H	H
0.112	H	L	H	H
0.114	H	H	H	H
0.118	H	H	L	H

4. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated on U22A.

Direct Control Special Function	Level (TTL) at U22A Pin	
	5	6
0.120	L	H
0.121	H	L

5. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated on U23.

Direct Control Special Function	Level (TTL) at U23 Pin			
	3	6	11	15
0.131	L	H	H	H
0.132	H	L	H	H
0.134	H	H	L	H
0.138	H	H	H	L

Audio Filter A2 SERVICE SHEET 7

SERVICE SHEET 8 (Cont'd)

6. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated on U16.

Direct Control Special Function	Level (TTL) at U16 Pin				
	3	6	11	14	15
0.141	L	H	H	H	L
0.142	H	L	H	H	L
0.144	H	H	L	H	L
0.148	H	H	H	L	H

7. Unplug the A4 FM Demodulator Assembly.

8. Key in 0.152 SPCL and 0.170 SPCL to unsquelch then read squelch. The display should read 0000.0000.

Hint: Pin 9 of U22B should be a TTL high. Pin 4 of U21B should be a TTL low. Pin 10 of U21C should be a TTL high.

9. Key in 0.150 SPCL and 0.170 SPCL to squelch then read squelch. The display should read 0001.0000.

Hint: Pin 9 of U22B should be a TTL low. Pin 4 of U21B should be high-going TTL pulses. Pin 10 of U21C should be low going TTL pulses.

10. Key in 0.152 SPCL and 0.170 SPCL, then momentarily ground pin 13 of U22B. The display should go from 0000.0000 to 0001.0000.

CHANGES

All serial prefixes	**On the A3 component locator:** • **C12, C14, C4, C6, L2, L3** - Change L2 to L3 and L3 to L2. Change C12 to C14 and C14 to C12. Change C4 to C6 and C6 to C4. **On the A3 schematic:** • **U23, U13A, U12D** - Change the following Signal names: U23 pin 15 to 3 kHz LPF(L), U23 pin 14 to 3 kHz LPF(H), U13A pin 1 to 3 kHz LPF(L), U12D pin 16 to 3 kHz LPF(H).
2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the A25 assembly part number to 08901-60120.
2105A and above	**On the A3 schematic:** • **R49** - Change the value of R49 to 26.1 k. • **U7, U8, U10, U11** - In the Table of Transistor and Integrated Circuit Part Numbers, change U7, U8, U10, and U11 to 1826-0783.
2239A and above	**On the A3 schematic:** • **R1, R4** - Change the value of R1 to 19 k. Change the value of R4 to 9 k.
2518A and above	**On the A3 schematic:** • **C4, C6, C47, C48, C53** - Change the value of C4, C6, and C47 to 0.03 μF. Change C48 and C53 to 3900 pF. • **R1, R29, R4, R36** - Change the value of R1 and R29 to 25 k. Change the value of R4 to 12.5 k. Change the value of R36 to 7.4 k.
2324A and above	**On the A3 schematic:** • **U4, U9** - In the Table of Transistor and Integrated Circuit Part Numbers, change U4 and U9 to 1826-0753.

CHANGES

2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.
Errata	**On the A3 schematic:** • **R51, R55** - Under INVERTING/ NON-INVERTING AMPLIFIER, change the value of R51 and R55 to 1 k.

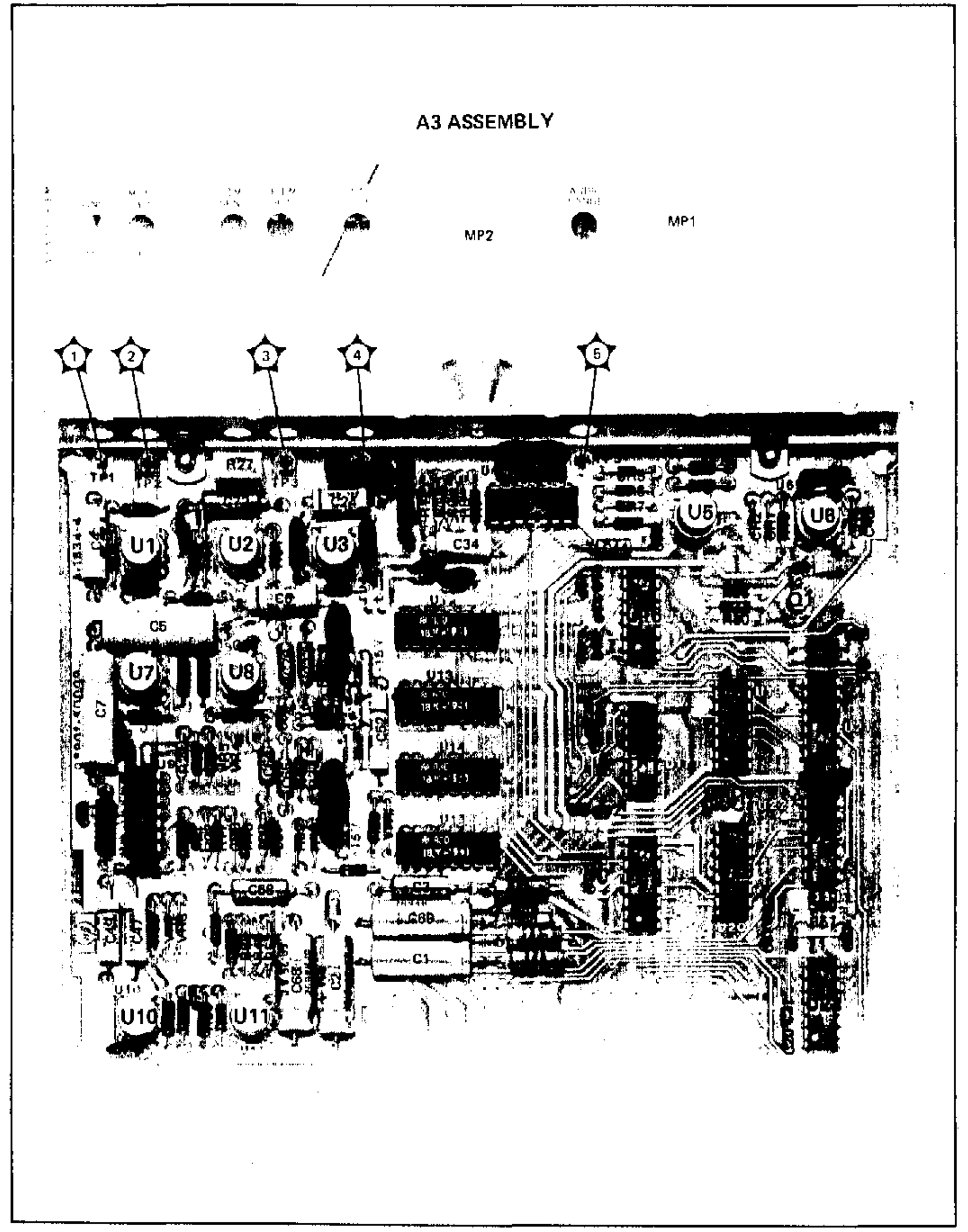


Figure 8-82. A3 Audio De-emphasis And Output Assembly Component Locations

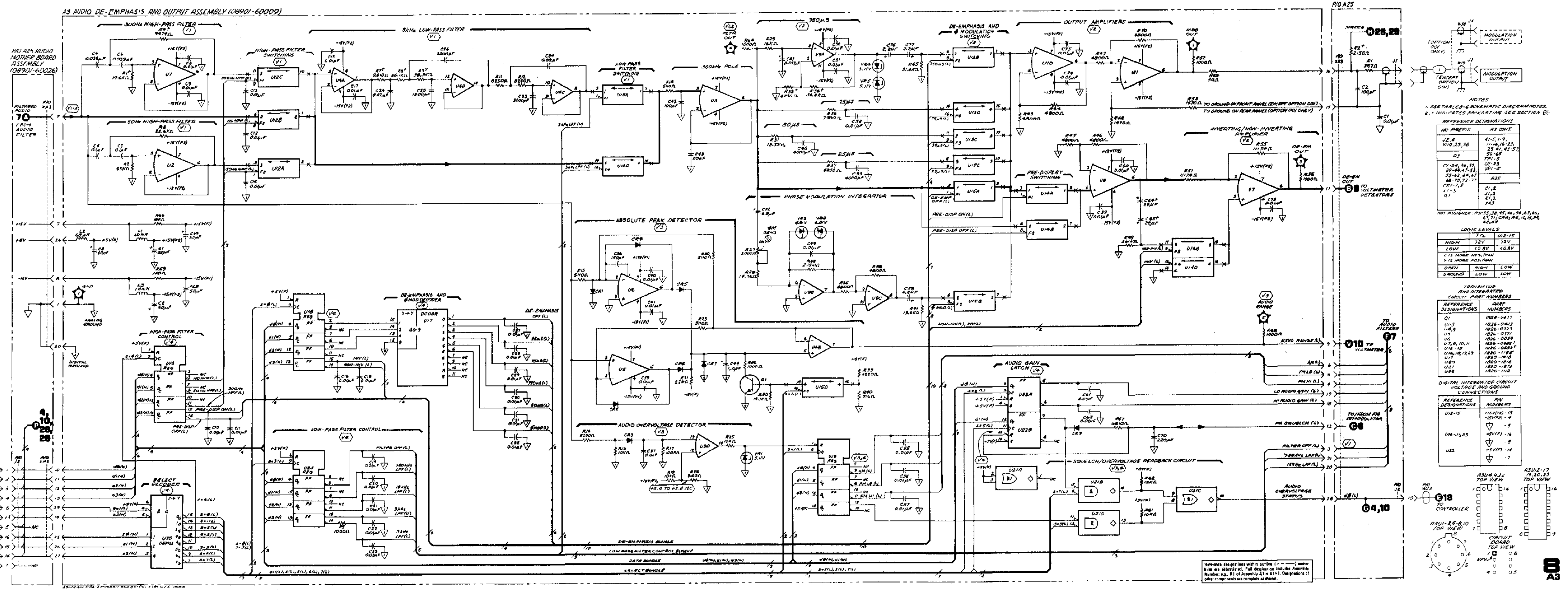


Figure 8-83. Audio De-Emphasis and Output Schematic Diagram

SERVICE SHEET 9 — VOLTMETER — AUDIO DETECTORS (P/O A5)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD3
- Voltmeter Offset and Sensitivity Adjustments .... Page 5-10
- Parts List .... Page 6-15
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-61

TROUBLESHOOTING

General

Procedures for checking the Voltmeter Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTION

CMOS circuits can be damaged by static charges and circuit transients. Do not remove this assembly from the instrument while power is applied. Discharge the board, replacement device, and soldering iron to the same potential. (Use the conductive foam pad provided in the Service Accessory Kit HP 08901-60089.)

Equipment

Audio Source	HP 339A
Oscilloscope	HP 1740A
Voltmeter	HP 3455A

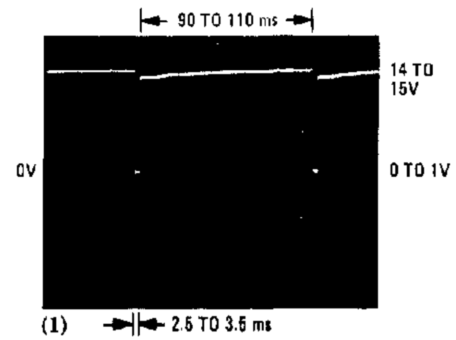
⟨√1⟩ Sample and Hold Drive Check

1. Key in 49.0 SPCL to set up the Voltmeter to measure ground.

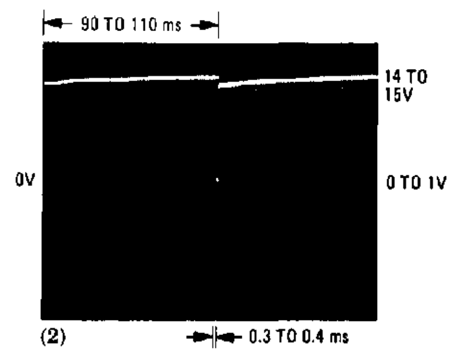
2. Key in the Direct Control Special Functions indicated below. For each setting, check the points indicated with a high-impedance, dc coupled oscilloscope. For each setting, the oscilloscope should read as indicated.

SERVICE SHEET 9 (Cont'd)

Direct Control Special Function	Level (TTL) on U13A		Voltage Limits (Vdc) on U7 Pin 3
	Pin 15	Pin 16	
0.1E1	L	H	See (1)
0.1E3	H	H	See (2)
0.1E0	L	L	0 to 1



(1)



(2)

⟨√2⟩ Peak Detector Check

1. Unplug the A3 Audio De-Emphasis and Output Assembly.

2. Set the audio source to 1 kHz at 0.7 Vrms. Connect its output to pin 9 of A25XA5.

3. Connect an ac voltmeter also to pin 9 of A25XA5. Adjust the level of the source to 707.1 mVrms.

SERVICE SHEET 9 (Cont'd)

4. Key in 0.1E0 SPCL to set the peak detector discharge mode to hold.

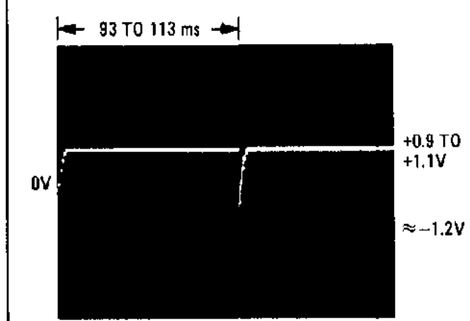
5. Connect the voltmeter to A5TP7 (PK DET CAP). Set the voltmeter to measure dc. The voltmeter should read between +990 and +1010 mVdc or if the level of step 3 could not be set exactly, 1.414 times the reading of step 3 ±1%.

6. Connect the voltmeter to A5TP6 (PK DET OUT). The voltmeter should read within ±1% of the reading in step 5.

Hint: The collector of Q9 should be between +14 and +15 Vdc. Q8 should be on. If the reading is only slightly in error, perform the Voltmeter Offset and Sensitivity Adjustments. In normal operation the Peak Detector should be accurate to ±0.1% ±1 mV from 20 Hz to 200 kHz and to 4 Vpk. When testing the detector, the distortion of the source must be less than −70 dB.

7. Key in 0.1E1 SPCL to set the peak detector discharge mode to fast.

8. Connect a high-impedance, dc coupled oscilloscope to A5TP7. The waveform should be as follows:



Hint: If the waveform is faulty, see ⟨√1⟩ Sample and Hold Drive Check.

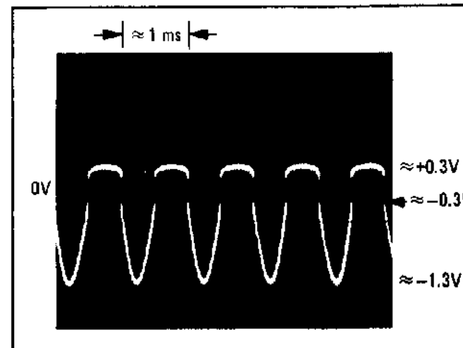
⟨√3⟩ Average Detector Check

1. Unplug the A3 Audio De-emphasis and Output Assembly.

2. Set the audio source to 1 kHz at 0.7 Vrms. Connect its output to pin 9 of A25XA5.

3. Connect an ac voltmeter also to pin 9 of A25XA5. Adjust the level of the source to 707.1 mVrms as read by the voltmeter.

4. Connect a high-impedance, dc coupled oscilloscope to A5TP5 (RECT OUT). The waveform should be as follows:



5. Increase the source frequency to 100 kHz (or preferrably 150 kHz) without altering the amplitude. The waveform should appear as in step 4 except for the increase in frequency and the level of the negative peak should be unchanged.

6. Decrease the source frequency to 1 kHz.

7. Connect a dc voltmeter to A5TP4 (AVG OUT). The voltage should be between +700 and +714 mVdc.

Hint: If the reading is only slightly in error or if the Average Detector is known to be inaccurate at low levels, perform the Voltmeter Offset and Sensitivity Adjustments. In normal operation the Average Detector should be accurate to ±0.1% ±1 mV from 20 Hz to 200 kHz and to 2.83 Vrms. When testing the detector, the distortion of the source must be less than −70 dB.

Audio De-emphasis and Output A3 SERVICE SHEET 8

CHANGES

All serial prefixes	**On the A5 schematic:** • U1 - In the Table of Transistor and Integrated Circuit Part Numbers, change A5U1 to 1826-1048. **On the A5 Component Locator:** • CR10, CR11 - Change CR10 to CR11 and CR11 to CR10. • R7, R29 - Change R7 to R29 and R29 to R7.
1933A to 2545A	**On the A5 schematic:** • U2, U3, U5 - If A5U2, U3, or U5 are replaced, change the part number of A5R85 as written under serial prefix 2227A.
2012A to 2545A	**On the A5 schematic:** • R27 - Change R27 to VR6, a 3.3V zener diode with the cathode connected to the +15V supply.
2021A to 2609A	**On the A25 schematic:** • 08901-60120 - Change the A25 assembly part number to 08901-60120.
2051A and above	**On the A5 Component Locator:** • R84, R85 - Use the partial component locator on page 8-110.5. **On the A5 schematic:** • R84, R85 - Use the partial schematic, P/O Figure 8-85. A5 Voltmeter Schematic Diagram (2051A and above), on page 8-110.5.
2052A and above	**On the A5 schematic:** • U5 - In the Table Transistor and Integrated Circuit Part Numbers, change the part number of U5 to 1826-0266.
2142A and above	**On the A5 schematic:** • U1 - In the table of Transistor and Integrated Circuit Part Numbers, change U1 to 1826-0471.

CHANGES

2201A and above	**On the A5 schematic:** • **C8** - Under HALF-WAVE RECTIFIER change the value of C8 to 75pF. • **C9, C11, U2** - Under HALF-WAVE RECTIFIER delete C9 and C11 and their connection to U2. Change U2 pin 1 output to NC. • **Notes** - In the table of Transistor and Integrated Circuit Part Numbers, change U2 to 1826-0371.
2201A to 2447A	**On the A5 schematic:** • **R9** - Under HALF-WAVE RECTIFIER change the value of R9 to 15M ohms. • **R24** - Under SUMMER AND FILTER change the value of R24 to 15M ohm.
2227A and above	**On the A5 schematic:** • **U4** - On the Table of Transistor and Integrated Circuit Part Numbers, change the part number of U4 to 1826-0371.
2227A to 2545A	**On the A5 schematic:** • **R85** - On the partial schematic on page 8-110.5, locate R85 under BUFFER AMPLIFIER and change its value to 147k ohms.
2302A and above	**On the A5 schematic:** • **C2, C4, C5** - In the lower left corner of the schematic, change the value of C2, C4, and C5 to 68 μF.
2450A and above	**On the A5 schematic:** • **R9** - Under HALF-WAVE RECTIFIER change the value of R9 to 10M ohms. • **R24** - Under SUMMER AND FILTER change the value of R24 to 10M ohms.
2606A and above	**On the A5 schematic:** • **08901-60293** - Change the A5 Voltmeter Assembly to 08901-60293.
2629A and above	**On the A5 schematic:** • **Service Sheet 9** - Use the new SS9 schematic foldout on page with the revision date of *rev.01NOV89*. • **A5 Component Locator** - Use the new A5 Component Locator, Figure 8–84. A5 Component Locator (2629A and above), on page 8-110.6.

CHANGES

2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.

Reserved for future changes

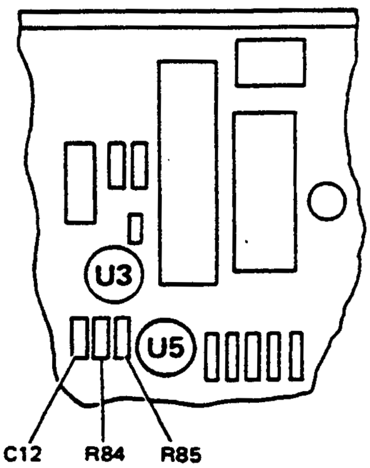
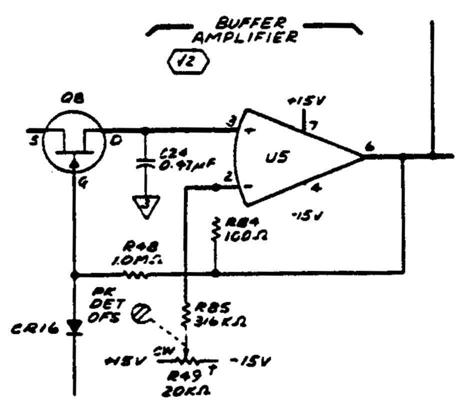


Figure 8–84. A5 Component Locator (2051A to 2623A)



P/O Figure 8–85. A5 Voltmeter Schematic Diagram (2051A to 2623A)

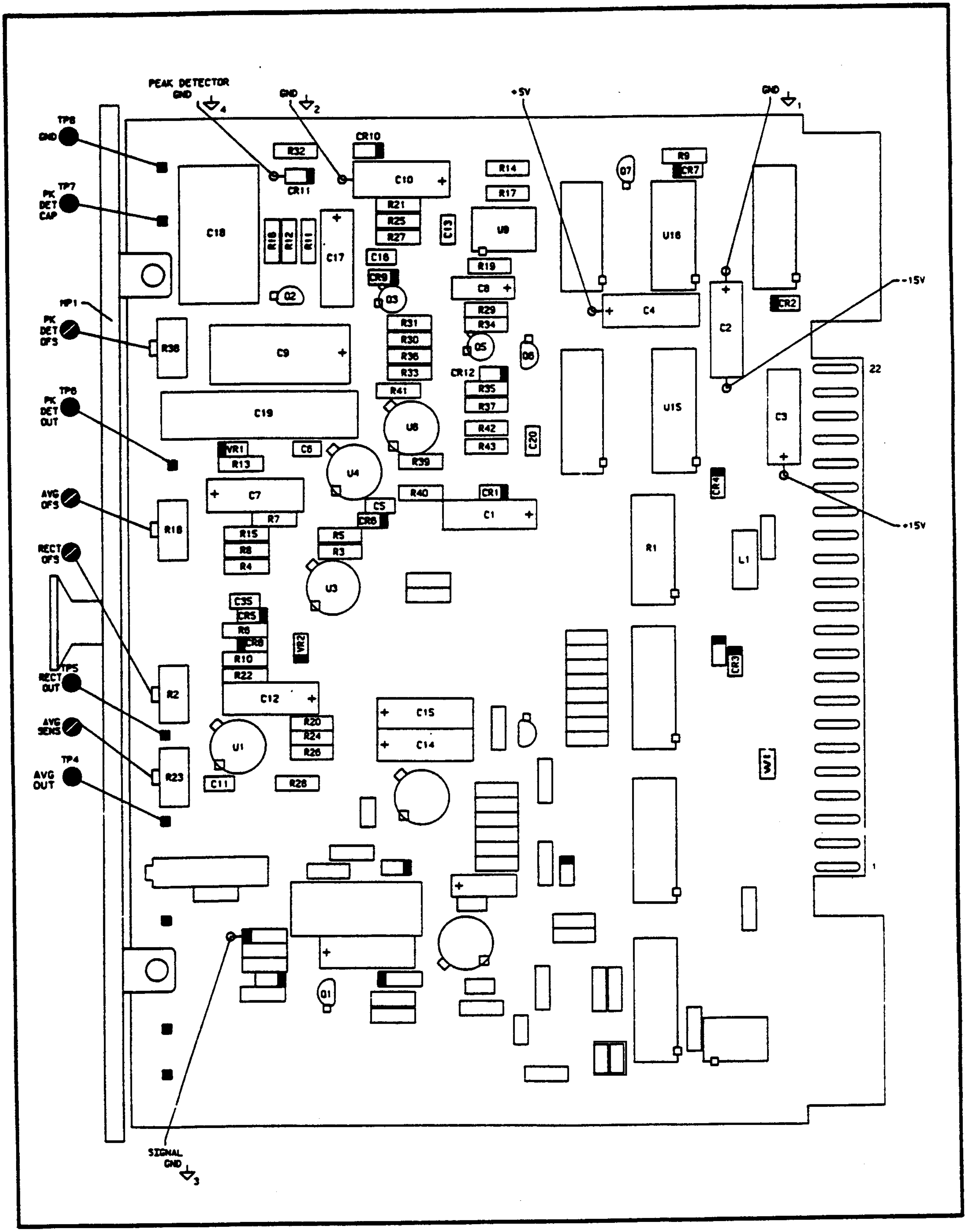
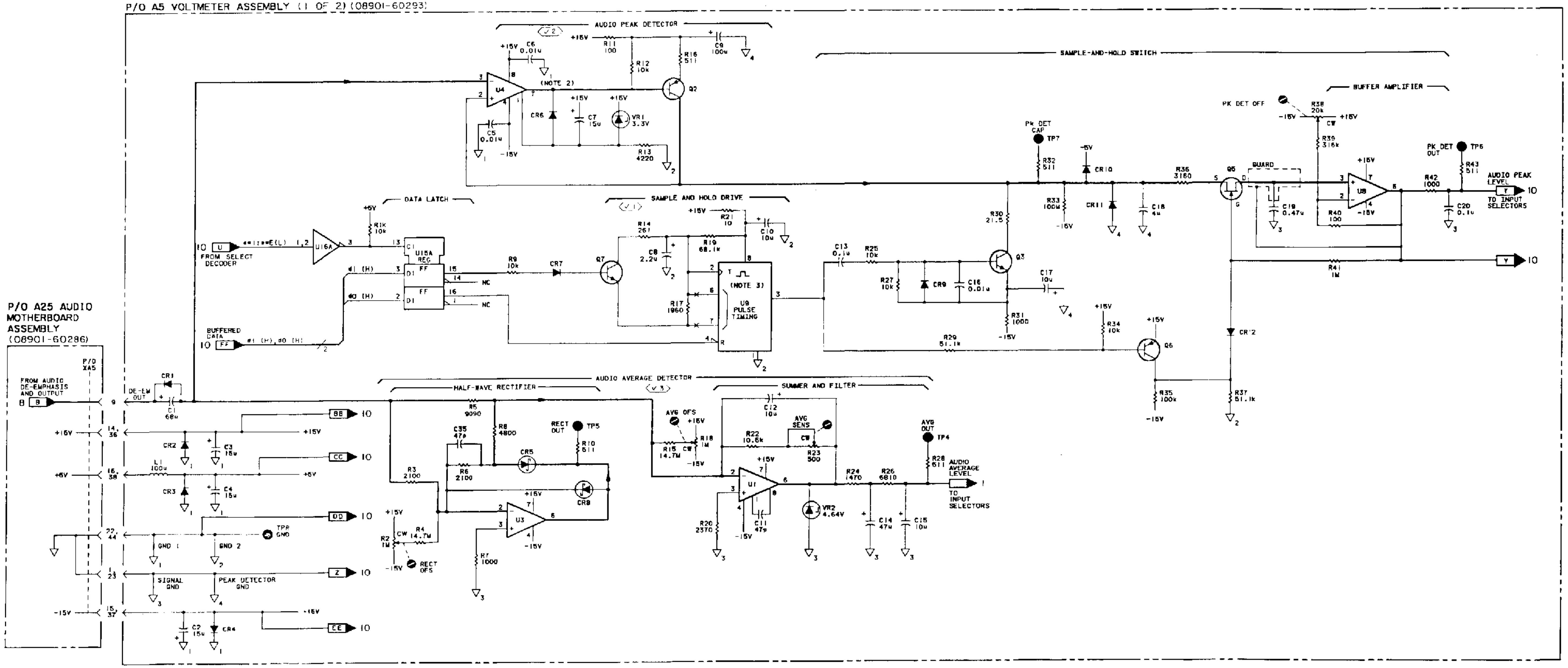
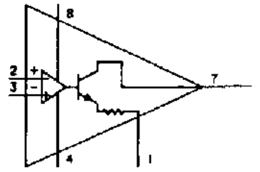


Figure 8–84. A5 Component Locator (2629A and above)

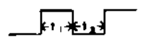


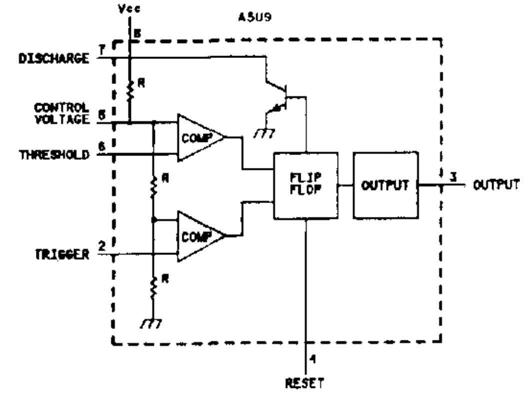
NOTES

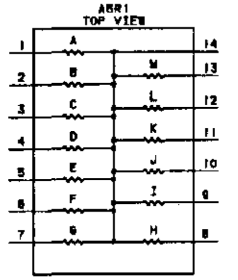
1. SEE TABLE 8-8 SCHEMATIC DIAGRAM NOTES.
2. THE DIAGRAM BELOW SHOWS THE OUTPUT STAGE OF COMPARATOR A5U4 IN DETAIL.



3. PULSE TIMING FOR MONOSTABLE MULTIVIBRATOR A5U9 (SHOWN BELOW) IS AS FOLLOWS:
Q7 OFF: t_1 = 131ms t_2 = 9.4ms
Q7 ON : t_1 = 106ms; t_2 = 2.4ms







DIGITAL INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U15	+5V - 5
	∇_2 - 12
U16	+5V - 14
	∇_2 - 7

Figure 8-85. Voltmeter-AUDIO Circuits
rev.1NOV89

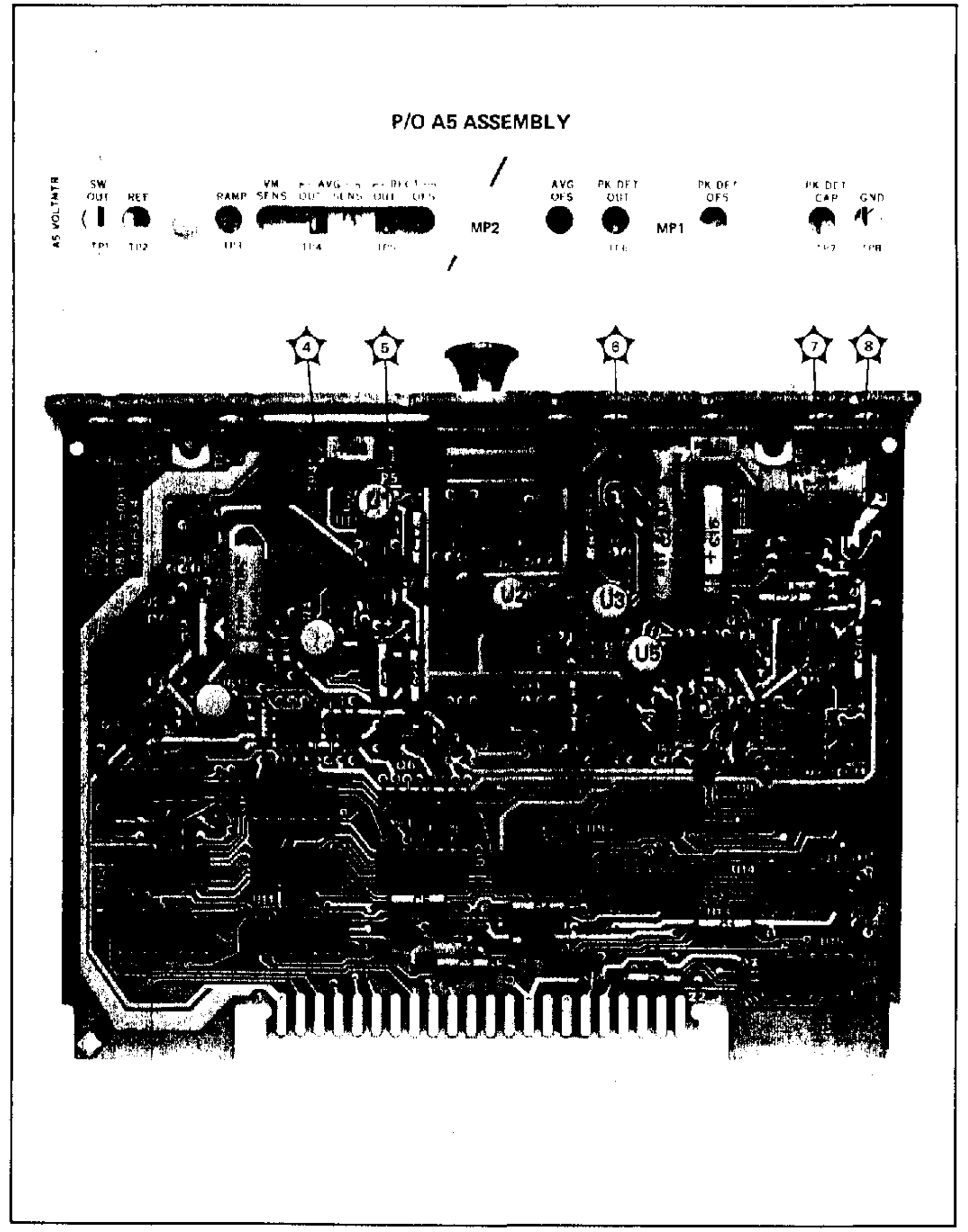


Figure 8-84. P/O A5 Voltmeter Assembly Component Locations (Audio Detectors)

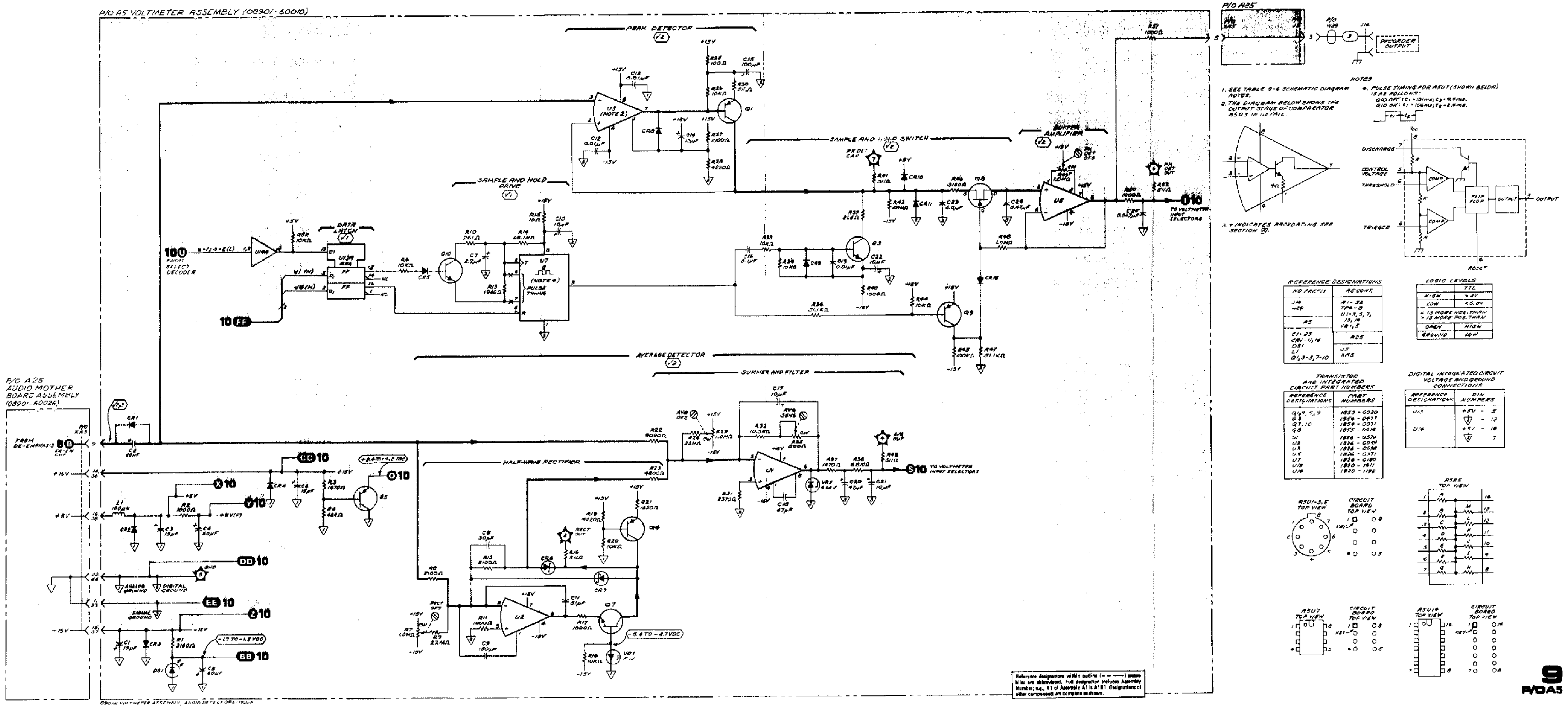


Figure 8-85. Voltmeter — Audio Detectors Schematic Diagram

SERVICE SHEET 10 — VOLTMETER — VOLTMETER CIRCUITS (P/O A5)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD3
- Voltmeter Offset and Sensitivity Adjustment .... Page 5-10
- Parts List .... Page 6-15
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-63

TROUBLESHOOTING

General

Procedures for checking the Voltmeter Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTION

CMOS circuits can be damaged by static charges and circuit transients. Do not remove this assembly the instrument while power is applied. Discharge the board, replacement device, and soldering iron to the same potential. (Use the conductive foam pad provided in the Service Accessory Kit HP 08901-60089.)

Equipment

Oscilloscope .... HP 1740A
Voltmeter .... HP 3455A

⟨√1⟩ Input Selectors Check

1. Key in 0.1C0 SPCL to enable U10 or U11.

2. Key in the Direct Control Special Functions indicated below. For each setting, compare the dc voltage at A5TP1 (SW OUT) to the pin on U11 or U10 indicated. The two voltages should be the same to within the repeatability of the voltmeter. If faulty, also check the logic level of the pins indicated.

SERVICE SHEET 10 (Cont'd)

Direct Control Special Function	Check Voltage at	Level (TTL) at				
		U11-11	U11-10	U11-9	U11-6	U10-6
0.1F0	U10-13	L	L	L	H	L
0.1F1	U10-14	H	L	L	H	L
0.1F2	U10-15	L	H	L	H	L
0.1F3	U10-12	H	H	L	H	L
0.1F4	U10-1	L	L	H	H	L
0.1F5	U10-5	H	L	H	H	L
0.1F6	U10-2	L	H	H	H	L
0.1F8	U11-13	L	L	L	L	H
0.1F9	U11-14	H	L	L	L	H
0.1FA	U11-15	L	H	L	L	H
0.1FB	U11-12	H	H	L	L	H
0.1FD	U11-5	H	L	H	L	H
0.1FE	U11-2	L	H	H	L	H

Hint: Pin 10 of U13B should be a TTL low, pin 11 a high. The logic level of pin 13 of U9D should be the same as pin 6 of U11. If a selector is stuck shut and another line is selected, pulses will usually appear on the selected line. (Use 49.N and 50.N Special Functions to select the desired line.)

3. Key in 0.1C4 SPCL to enable U12.

4. Key in the Direct Control Special Functions indicated below. For each setting, compare the dc voltage at A5TP1 to the pin on U12 indicated. The two voltages should be the same within the repeatability of the voltmeter. If faulty, also check the logic level of the pins indicated.

Direct Control Special Function	Check Voltage at U12 Pin	Level (TTL) at U12 Pin			
		11	10	9	6
0.1F8	13	L	L	L	L
0.1F9	14	H	L	L	L
0.1FA	15	L	H	L	L
0.1FB	12	H	H	L	L
0.1FC	1	L	L	H	L
0.1FD	5	H	L	H	L

Hint: Pin 10 of U13B should be a TTL high, pin 11 a low.

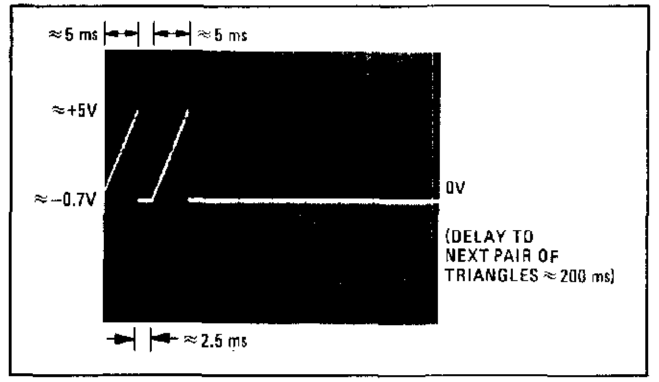
SERVICE SHEET 10 (Cont'd)

⟨√2⟩ Voltage-to-Time Converter Check

1. Measure A5TP2 (REF) with a dc voltmeter. The voltage should be between −6.5 and −5.9 Vdc.

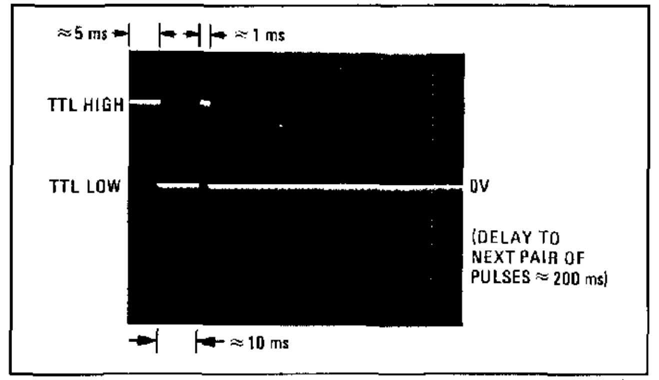
2. Key in 50.4 SPCL to set the instrument to measure the +15V Supply.

3. Connect a high-impedance, dc coupled oscilloscope to A5TP3 (RAMP). The waveform should be as follows:



Hint: Pin 2 of U4 should be between ±10 mV. The base of Q6 should be approximately +4V except for a pair of pulses which raise it to +5V approximately each 20 ms.

4. Connect the oscilloscope to A11TP6 (VM GATE). (A11TP6 is shown on Service Sheet 17.) The waveform should be as follows:



Hint: Step 4 assumes that the Input Selectors are able to select the input for the +15V Check.

SERVICE SHEET 10 (Cont'd)

⟨√3⟩ Parity Check

1. Key in the Direct Control Special Functions indicated below, then key in 0.1D0 SPCL to enable parity readback. The display should be as indicated. If faulty, also check the logic level of the pins indicated.

Direct Control Special Function	Display	Level (TTL) at			
		U9A-3	U9B-6	U9C-8	U14D-11
0.1F0	0000.0000	L	L	L	H
0.1F1	0001.0000	H	L	H	*
0.1F2	0001.0000	H	L	H	*
0.1F3	0000.0000	L	L	L	H
0.1F4	0001.0000	L	H	H	*
0.1F5	0000.0000	H	H	L	H
0.1F6	0000.0000	H	H	L	H
0.1F7	0001.0000	L	H	H	*
0.1F8	0001.0000	L	H	H	*
0.1F9	0000.0000	H	H	L	H
0.1FA	0000.0000	H	H	L	H
0.1FB	0001.0000	L	H	H	*
0.1FC	0000.0000	L	L	L	H
0.1FD	0001.0000	H	L	H	*
0.1FE	0001.0000	H	L	H	*
0.1FF	0000.0000	L	L	L	H

*Low-going TTL pulses, ≈7 ms period.

⟨√4⟩ Select Decoder and Data Latch Check

1. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated.

Direct Control Special Function	Level (TTL) at					
	U15-11	U15-10	U15-9	U15-7	U14B-6	U14C-8
0.1C0	*	H	H	H	**	L
0.1D0	H	*	H	H	L	**
0.1E0	H	H	*	H	L	L
0.1F0	H	H	H	*	L	L

*Low-going TTL pulses, ≈7 ms period.
**High-going TTL pulses, ≈7 ms period.

SERVICE SHEET 10 (Cont'd)

2. Key in the Direct Control Special Functions indicated below. For each setting, check the pins on U8 indicated.

Direct Control Special Function	Level (TTL) at U8 Pin				
	2	3	7	10	15
0.1F0	L	H	L	L	L
0.1FF	H	L	H	H	H

CHANGES

All serial prefixes	**On the A5 schematic:** • CR13J - Change the voltage values next to CR13J to "+2.85 to +3.13 V dc".
1933A to 2545A	**On the A5 schematic:** • U10, U11, U12 - In the Table of Transistor and Integrated Circuit Part Numbers, change U10, U11 and U12 to 1820-1547.
2012A and above	**On the A5 schematic:** • R59, R63 - On the schematic, change the value of R59 to 10 k ohms, and R63 to 2.5 k ohms.
2021A to 2609A	**On the A25 schematic:** • 08901-60120 - Change the part number of the A25 Audio Motherboard Assembly to 08901-60120.
2026A and above	**On the A5 schematic:** • R73, R75 - Under RAMP GENERATOR, change the value of R73 to 681 ohms and R75 to 162 ohms.
2302A and above	**On the A5 schematic:** • C29 - Under VOLTAGE REFERENCE change the value of C29 to 68uF.
2606A and above	**On the A5 schematic:** • 08901-60293 - Change the part number of the A5 Voltmeter Assembly to 08901-60293.
2629A and above	**On the A5 component locator:** • A5 Component Locator - Use the new A5 Component Locator, Figure 8–87. A5 Component Locator (2629A and above), on page 8-112.3. **On the A5 schematic:** • Service Sheet 10 - Use the new SS10 schematic foldout on page with the revision date of *rev.10NOV89*.

CHANGES

2616A and above	**On the A25 schematic:** • **08901-60286** - Change the part number of the A25 Audio Motherboard Assembly to 08901-60286.

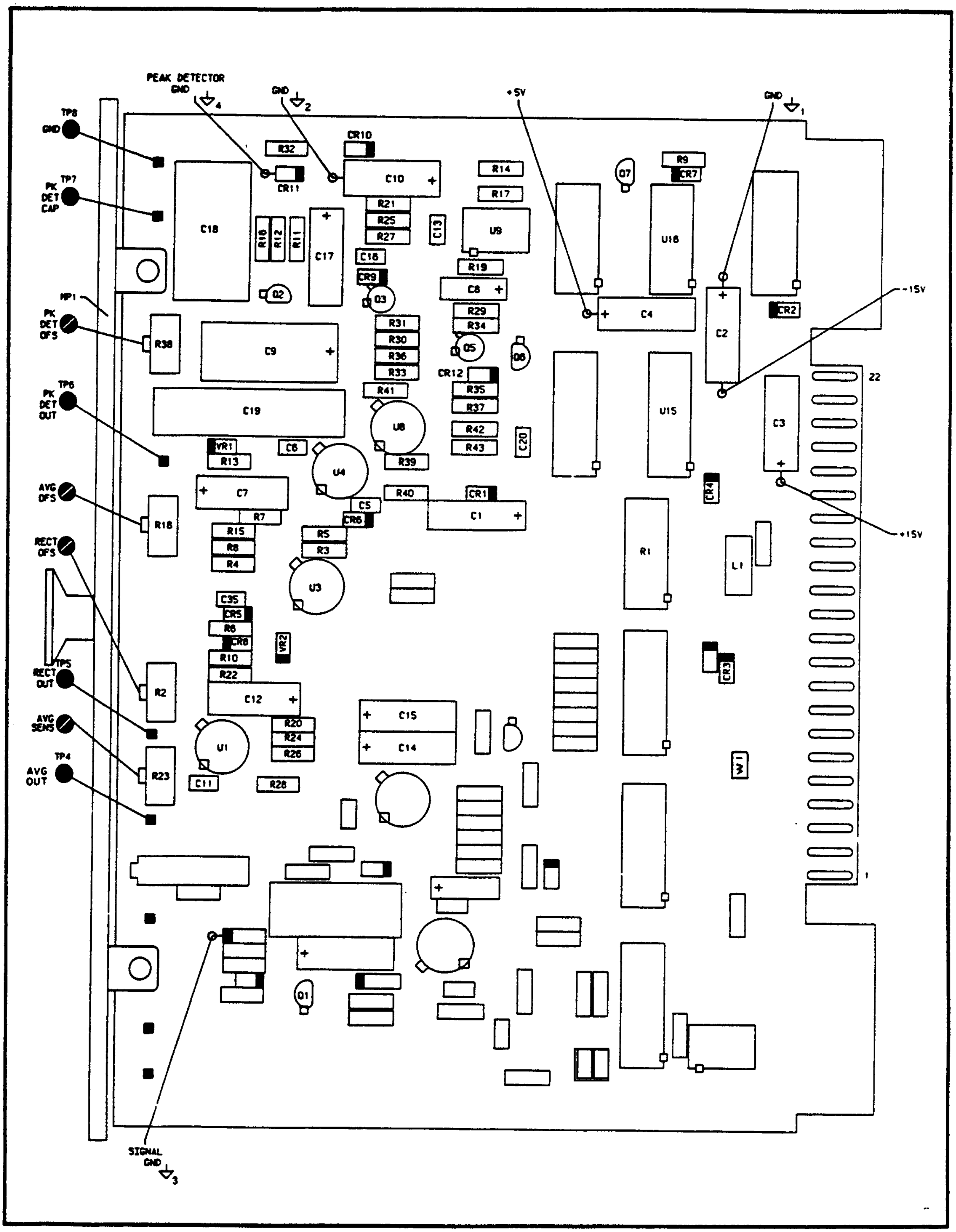
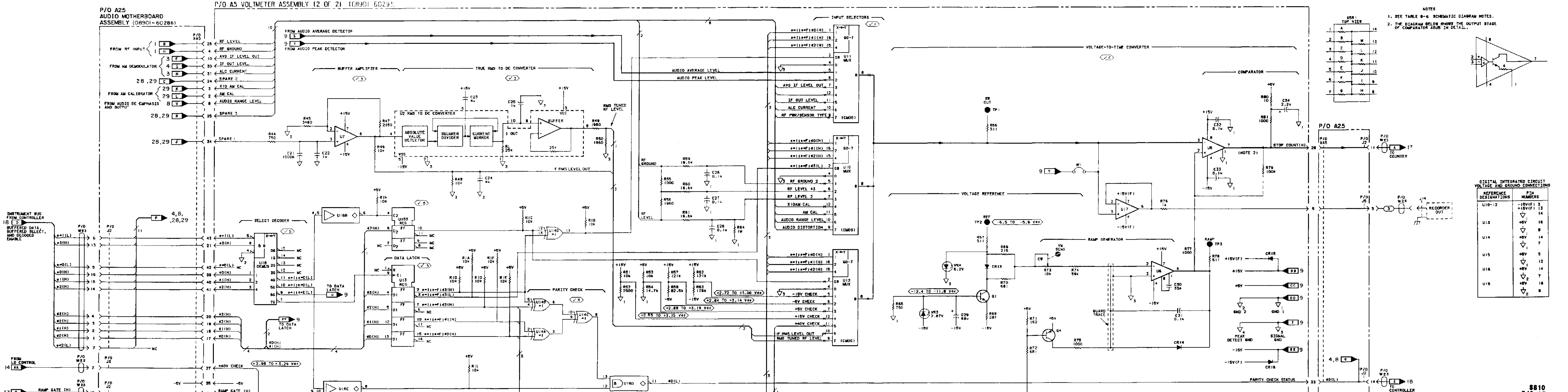


Figure 8–87. *A5 Component Locator (2629A and above)*



8510
P/O A5

Figure 8-87. Voltmeter-Voltmeter Circuits

rev.1NOV89

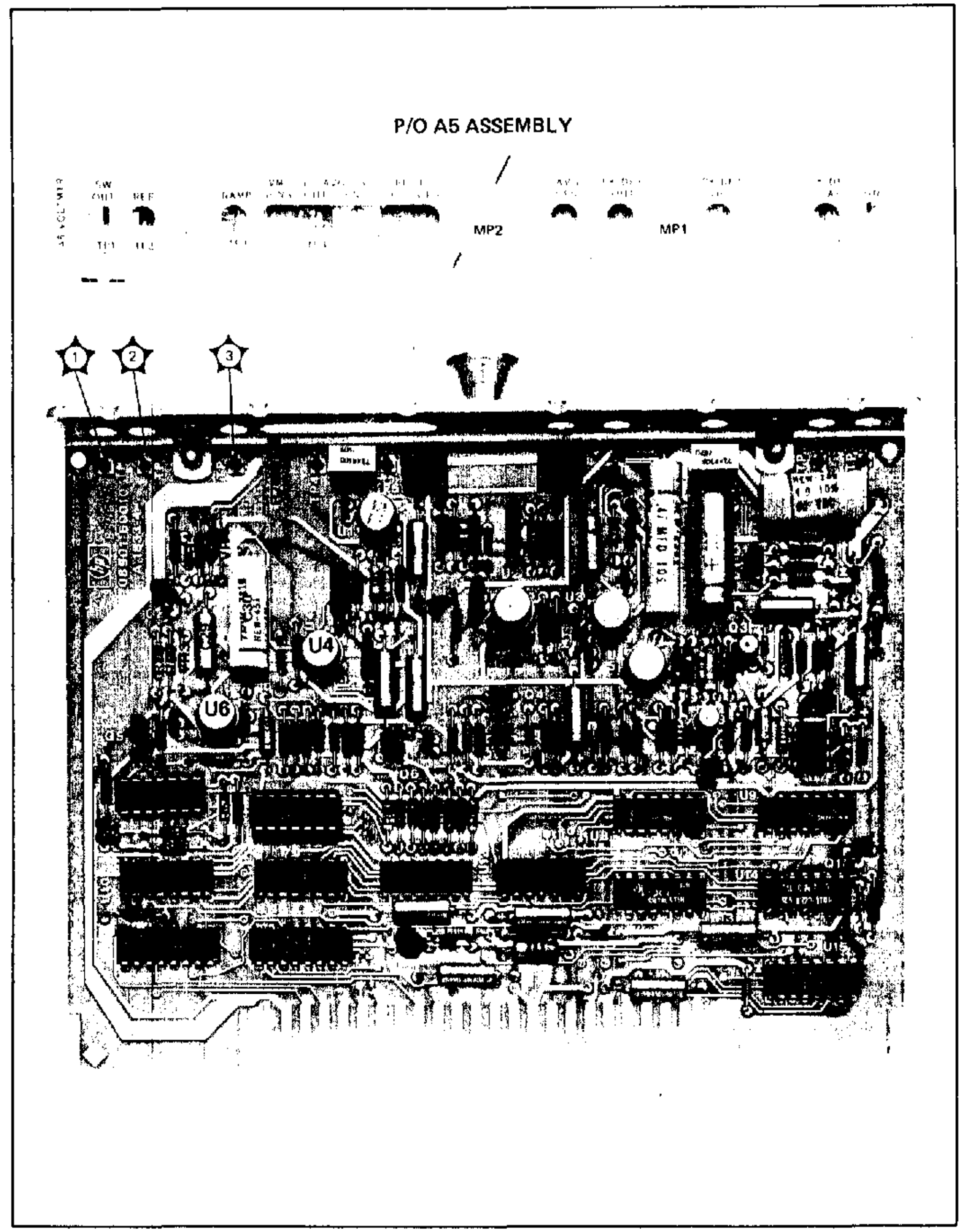


Figure 8-86. P/O A5 Voltmeter Assembly Component Locations (Voltmeter Circuits)

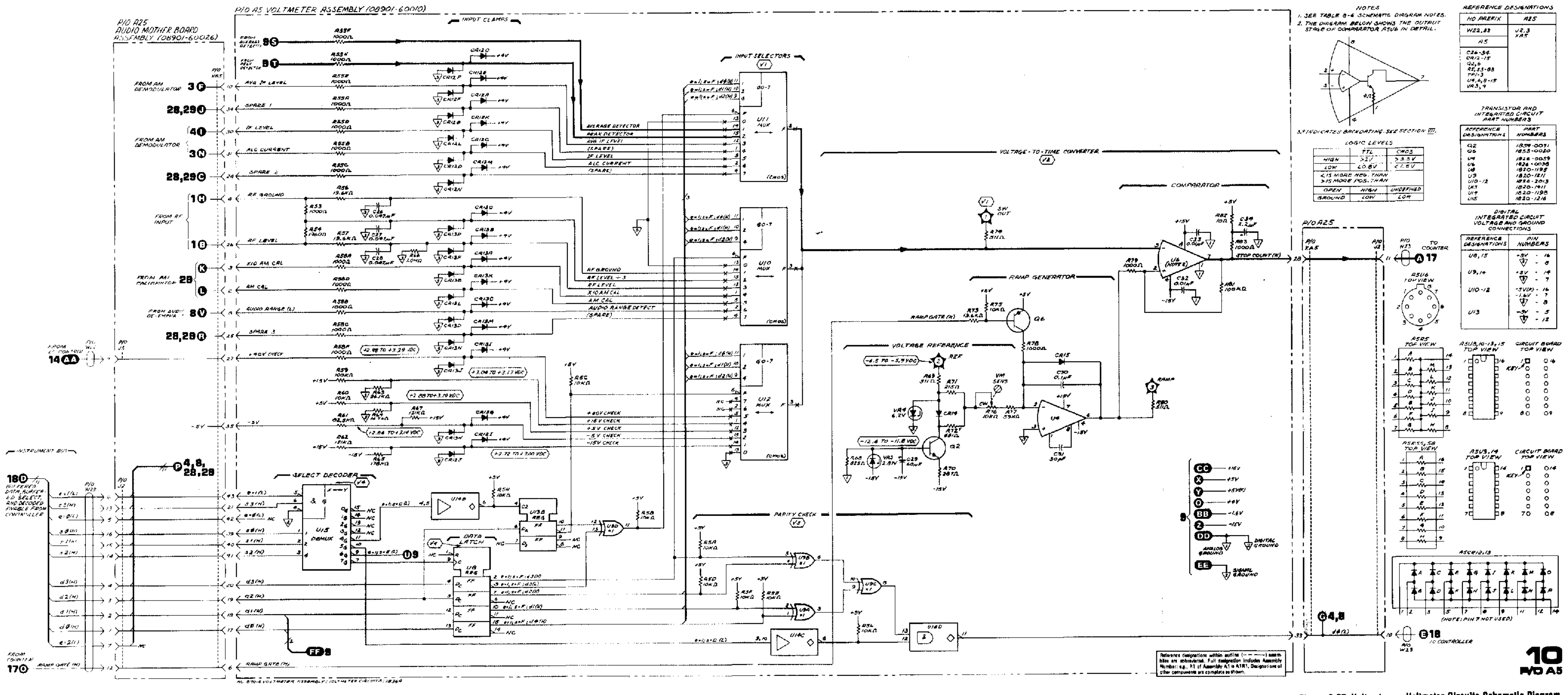


Figure 8-87. Voltmeter — Voltmeter Circuits Schematic Diagram

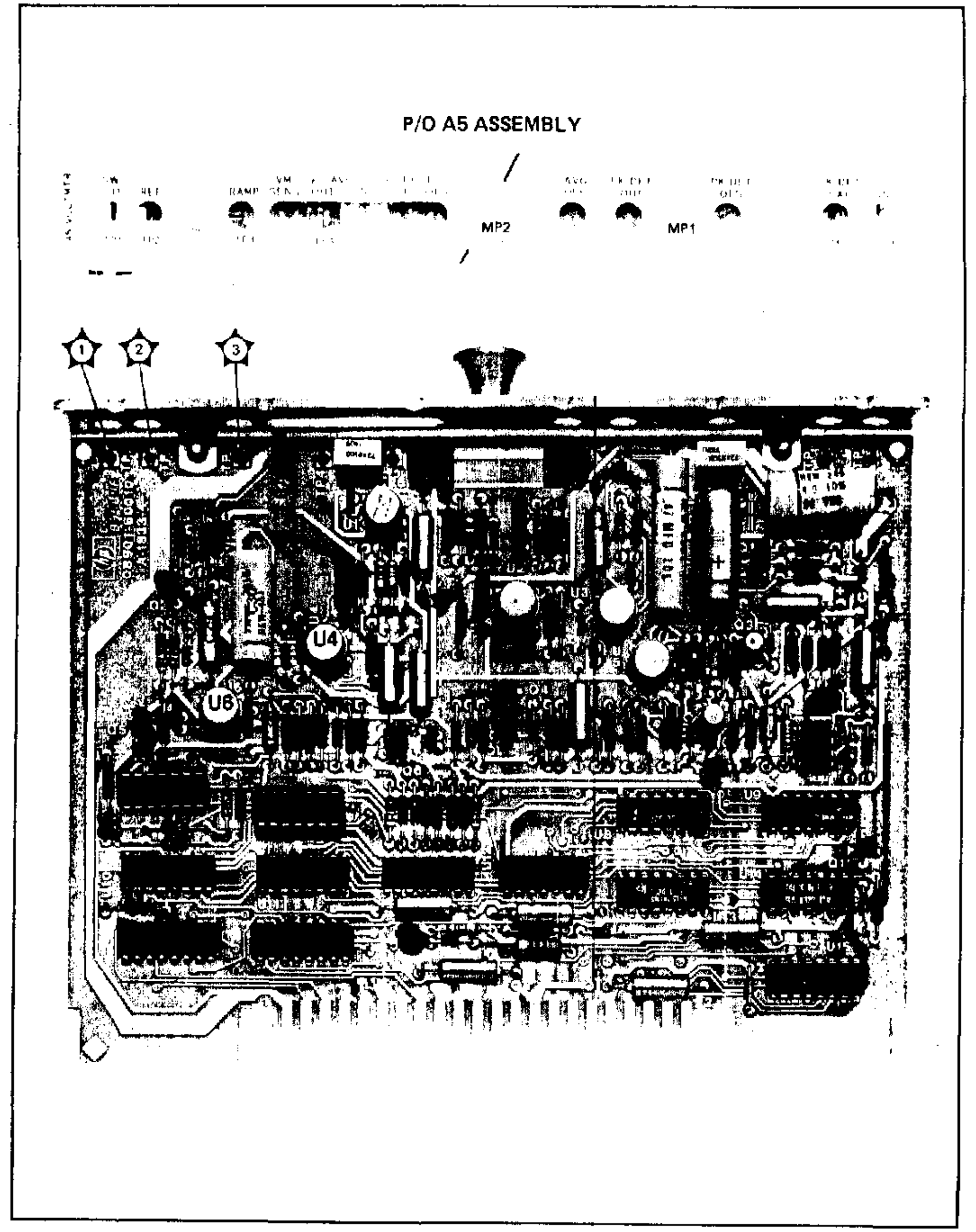


Figure 8-86. P/O A5 Voltmeter Assembly Component Locations (Voltmeter Circuits)

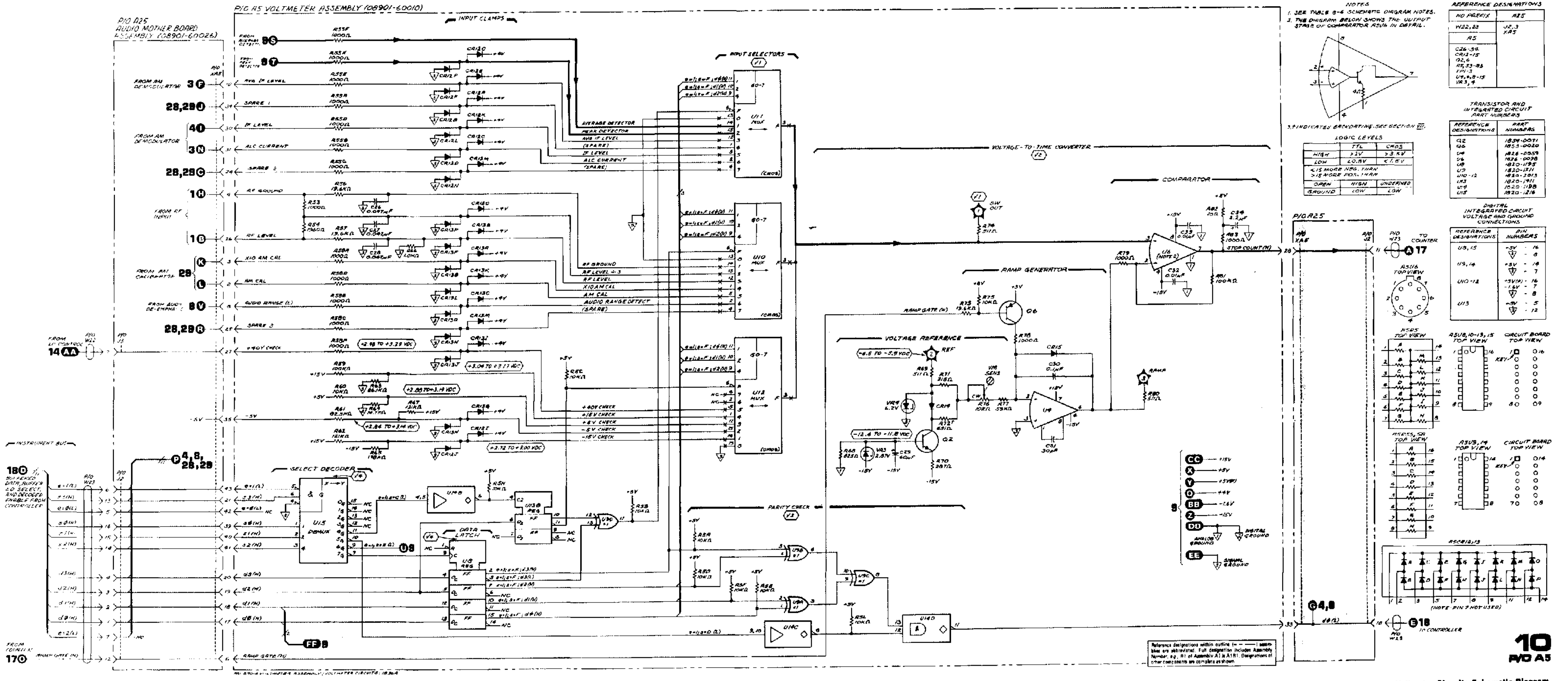


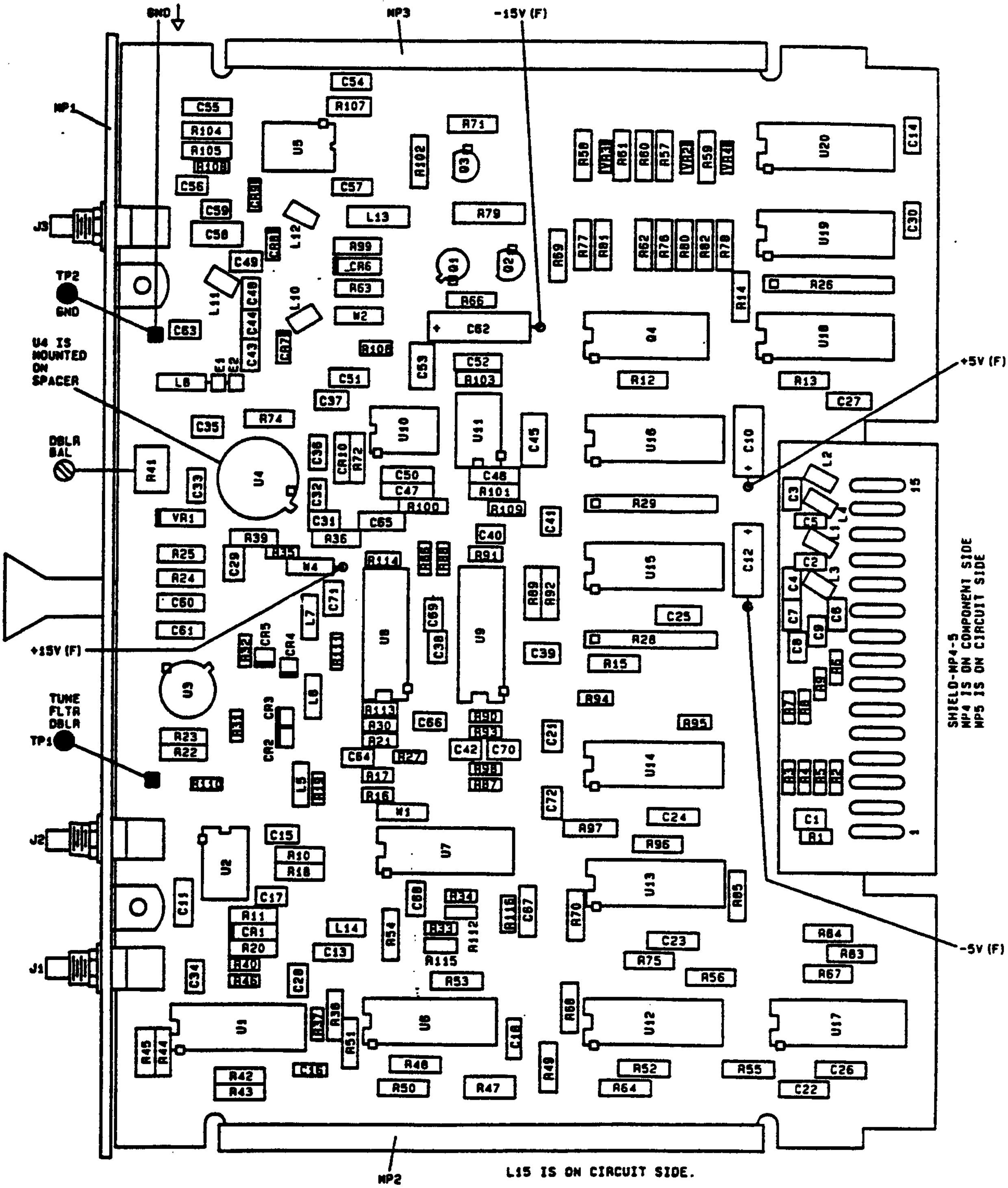
Figure 8-87. Voltmeter — Voltmeter Circuits Schematic Diagram

CHANGES

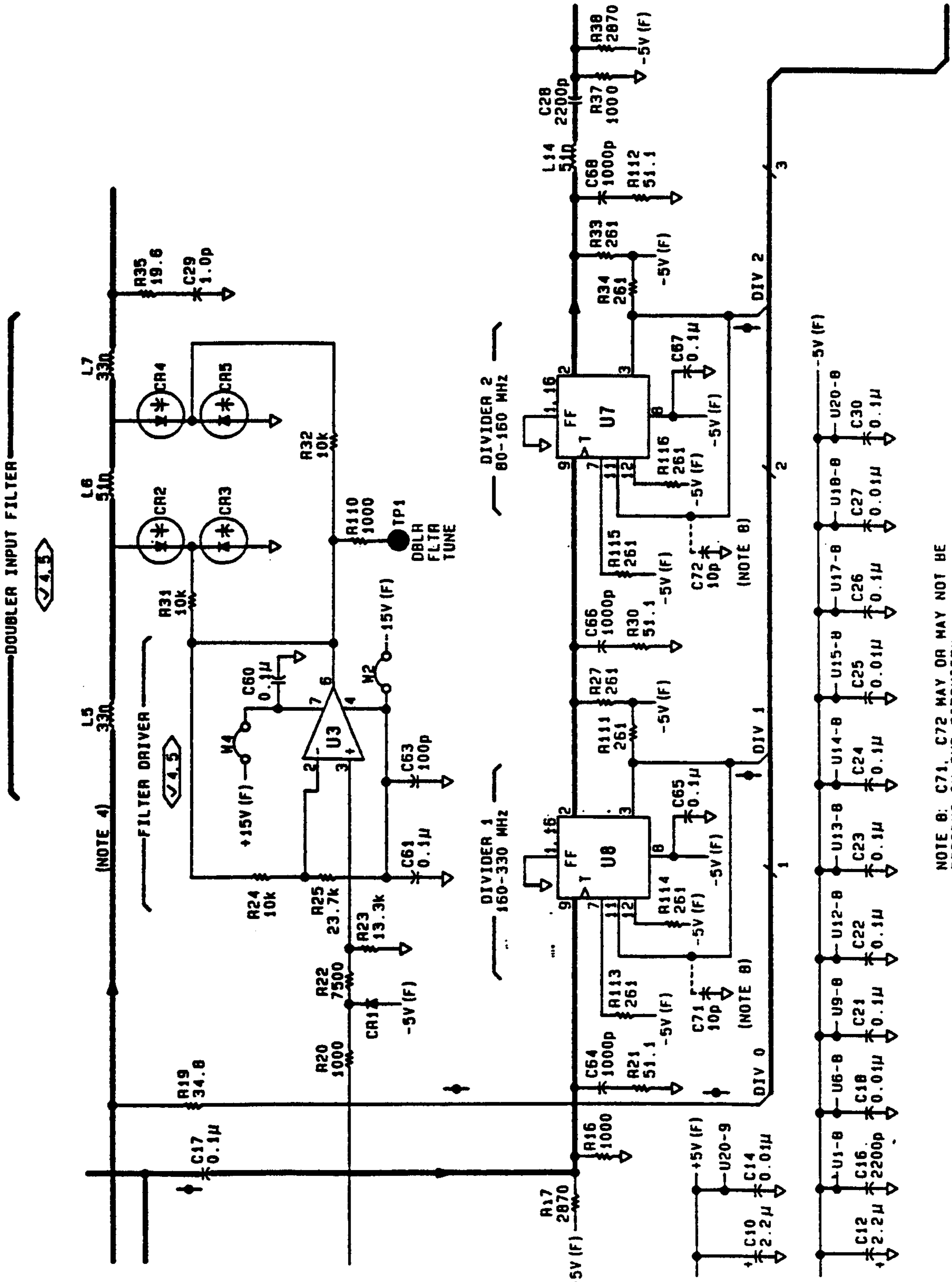
1933A to 2751A	**On the A19 schematic:** • **C43, R63, R72, R74** - Change the value of C43 to 8.2 pF, and add an asterisk (*) to indicate a factory selected component. Change the value of R63 to 75 ohms, and R72 and R74 to 909 ohms. Add asterisks (*) to R63, R72 and R74 to indicate factory selected components.
2128A and above	**On the A28 schematic:** • **08901-60139** - Change the part number of A28 RF Motherboard Assembly to 08901-60139.
2350A to 2751A	**On the A19 schematic:** • **C38, R86** - Change the value of C38 to 100 pF. Change the value of R86 to 51.1 ohms.
2350A to 2617A	**On the A19 schematic:** • **R21, R27** - Change the value of R21 to 121 ohms, and R27 to 51.1 ohms.
2618A to 2751A	**On the A19 component locator:** • **08901-20274** - Use the new component locator, A19 LO Divider Assembly Component Locations (2618A to 2751A), on page 8–114.3. **On the A19 schematic:** • **08901-60274** - Change the part number of the A19 LO Divider Assembly to 08901-60274. Use the schematic partials, P/0 A19 LO Divider Assembly (2618A to 2751A), on pages 8–114.4 and 8–114.5. • **R21, R27, R87** - Change the value of R21 and R87 to 51.1 ohms, and R27 to 261 ohms. • **U7, U8** - In the Table of Transistor and Integrated Circuit Part Numbers, change U7 and U8 to 1820-3485.

CHANGES

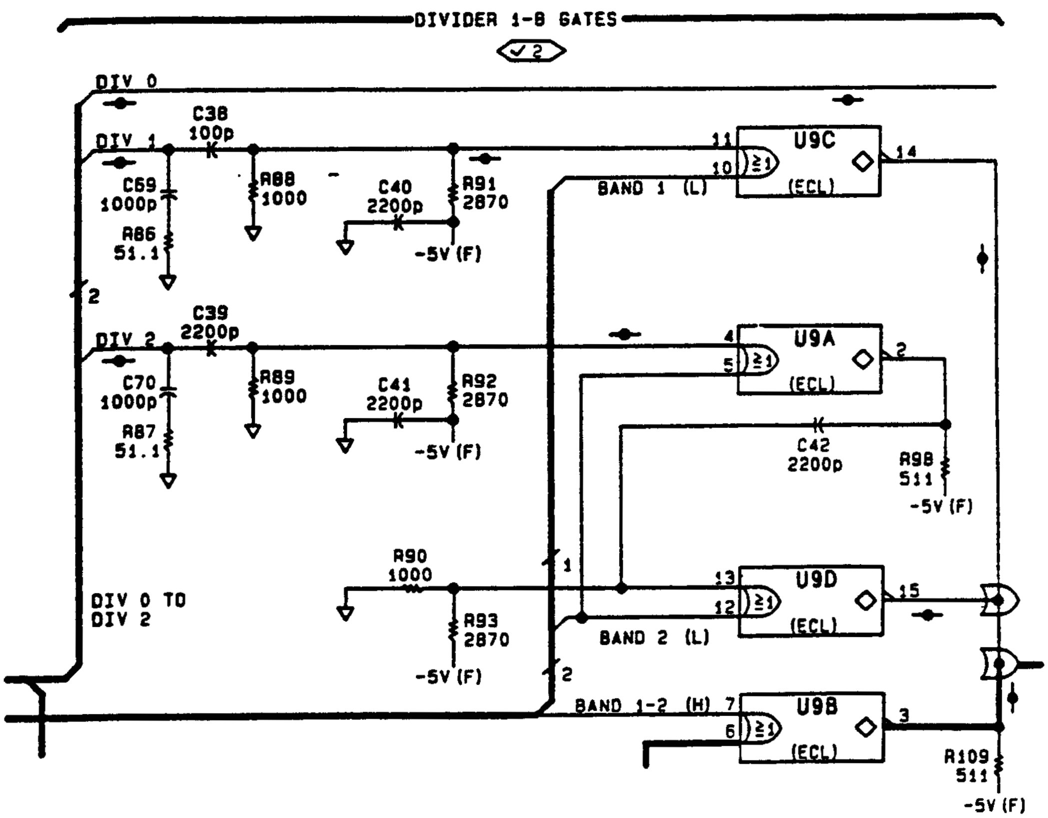
2911A and above	**On the A19 component locator:** • **08902-60126** - Use the new component locators and component coordinates for SS11A and SS11B, A19 LO Divider Assembly Component Locations (2911A and above), on page 8–114.6 through 8–114.9 **On the A19 schematic:** • **08902-60126** - Use the new schematic foldouts SS11A and SS11B with revision date *rev.01NOV89*. • **NOTES** - Use the schematic foldout NOTES from service sheet 11, and add note 9 as follows: OUT_DIS_H means OUTPUT DISABLE (H) DBLR/OUT_L means BAND DOUBLER OR OUTPUT DISABLE (L) DBLR/OUT_H means BAND DOUBLER OR OUTPUT DISABLE (H) 0/DBLR/OUT means BAND 0 OR DOUBLER OR OUTPUT DISABLE (H) 0_2_OR_DBL means BAND 0–2 OR BAND DOUBLER (H).



A19 LO Divider Assembly Component Locations (2618A to 2751A)



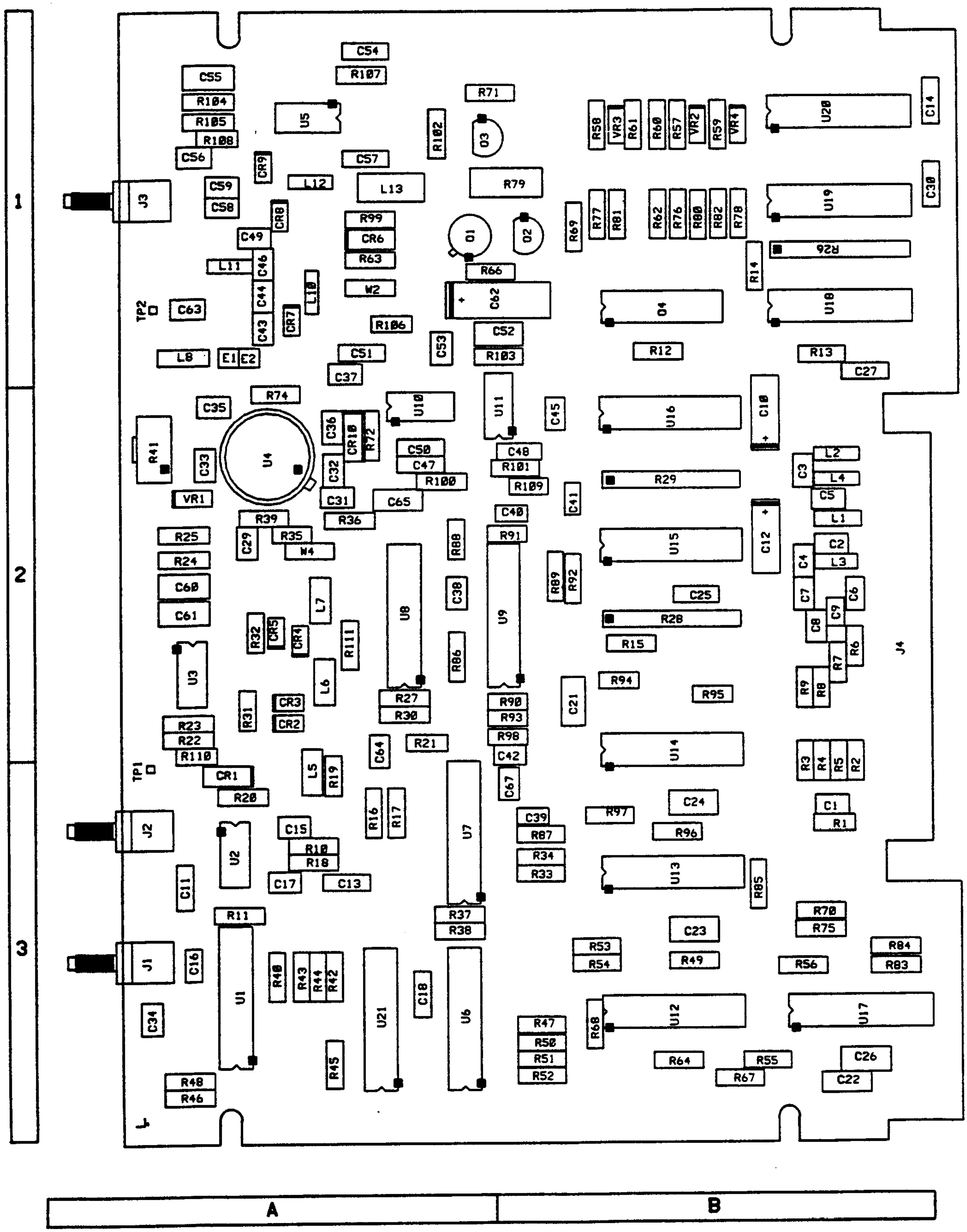
P/0 A19 LO Divider Assembly (2618A to 2751A)



P/0 A19 LO Divider Assembly (2618A to 2751A)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
C1	B,3	C58	A,1	R18	A,3	R83	B,3		
C2	B,2	C59	A,1	R19	A,3	R84	B,3		
C3	B,2	C60	A,2	R20	A,3	R85	B,3		
C4	B,2	C61	A,2	R21	A,2	R86	A,2		
C5	B,2	C62	A,1	R22	A,2	R87	B,3		
C10	B,2	C63	A,1	R23	A,2	R99	A,1		
C11	A,3	C64	A,2	R24	A,2	R100	A,2		
C12	B,2	C65	A,2	R25	A,2	R101	A,2		
C13	A,3	C67	A,3	R27	A,2	R102	A,1		
C14	B,1			R30	A,2	R103	A,1		
C15	A,3	CR1	A,3	R31	A,2	R104	A,1		
C16	A,3	CR2	A,2	R32	A,2	R105	A,1		
C17	A,3	CR3	A,2	R33	B,3	R106	A,1		
C18	A,3	CR4	A,2	R34	B,3	R107	A,1		
C21	B,2	CR5	A,2	R35	A,2	R108	A,1		
C22	B,3	CR7	A,1	R36	A,2	R110	A,2		
C23	B,3	CR8	A,1	R37	A,3	R111	A,2		
C24	B,3	CR9	A,1	R38	A,3				
C25	B,2	CR10	A,2	R39	A,2	TP1	A,3		
C26	B,3			R40	A,3				
C27	B,1	E1	A,1	R41	A,2	U1	A,3		
C29	A,2	E2	A,1	R42	A,3	U2	A,3		
C30	B,1			R43	A,3	U3	A,2		
C31	A,2	J1	A,3	R44	A,3	U4	A,2		
C32	A,2	J2	A,3	R45	A,3	U5	A,1		
C33	A,2	J3	A,1	R46	A,3	U6	A,3		
C34	A,3			R47	B,3	U7	A,3		
C35	A,2	L1	B,2	R48	A,3	U8	A,2		
C36	A,2	L2	B,2	R49	B,3	U10	A,2		
C37	A,1	L3	B,2	R49	B,3	U11	A,2		
C43	A,1	L4	B,2	R50	B,3	U12	B,3		
C44	A,1	L5	A,3	R51	B,3	U17	B,3		
C45	B,2	L6	A,2	R52	B,3	U21	A,3		
C46	A,1	L7	A,2	R53	B,3				
C47	A,2	L8	A,1	R54	B,3	VR1	A,2		
C48	A,2	L10	A,1	R55	B,3				
C49	A,1	L11	A,1	R56	B,3	W 2	A,1		
C50	A,2	L12	A,1	R63	A,1	W 4	A,2		
C51	A,1	L13	A,1	R64	B,3				
C52	A,1			R67	B,3				
C53	A,1	R1	B,3	R68	B,3				
C54	A,1	R10	A,3	R70	B,3				
C55	A,1	R11	A,3	R72	A,2				
C56	A,1	R16	A,3	R74	A,2				
C57	A,1	R17	A,3	R75	B,3				

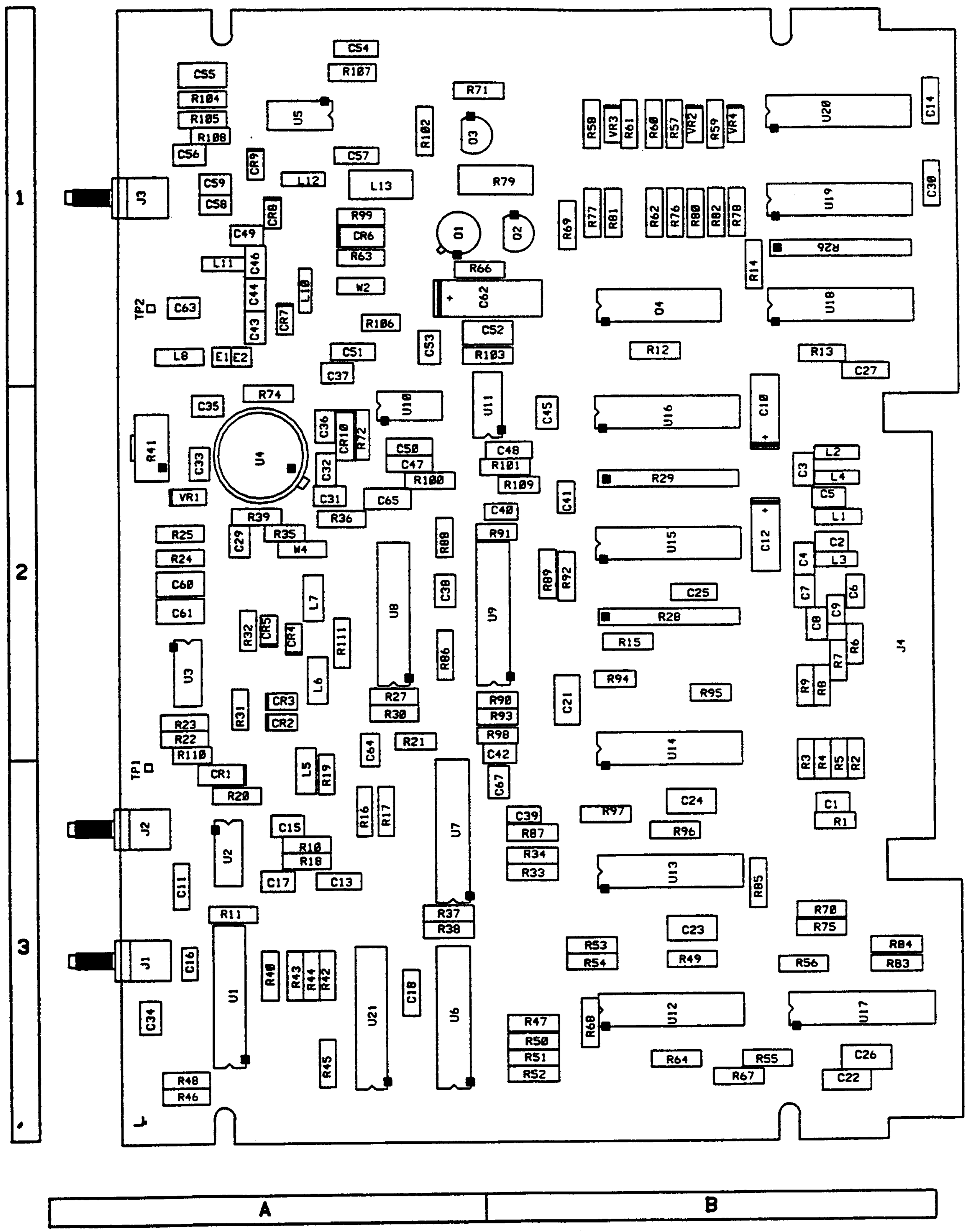
SS11A A19 LO Divider Assembly Component Coordinates (2911A and above)



SS11A A19 LO Divider Assembly Component Locations (2911A and above)

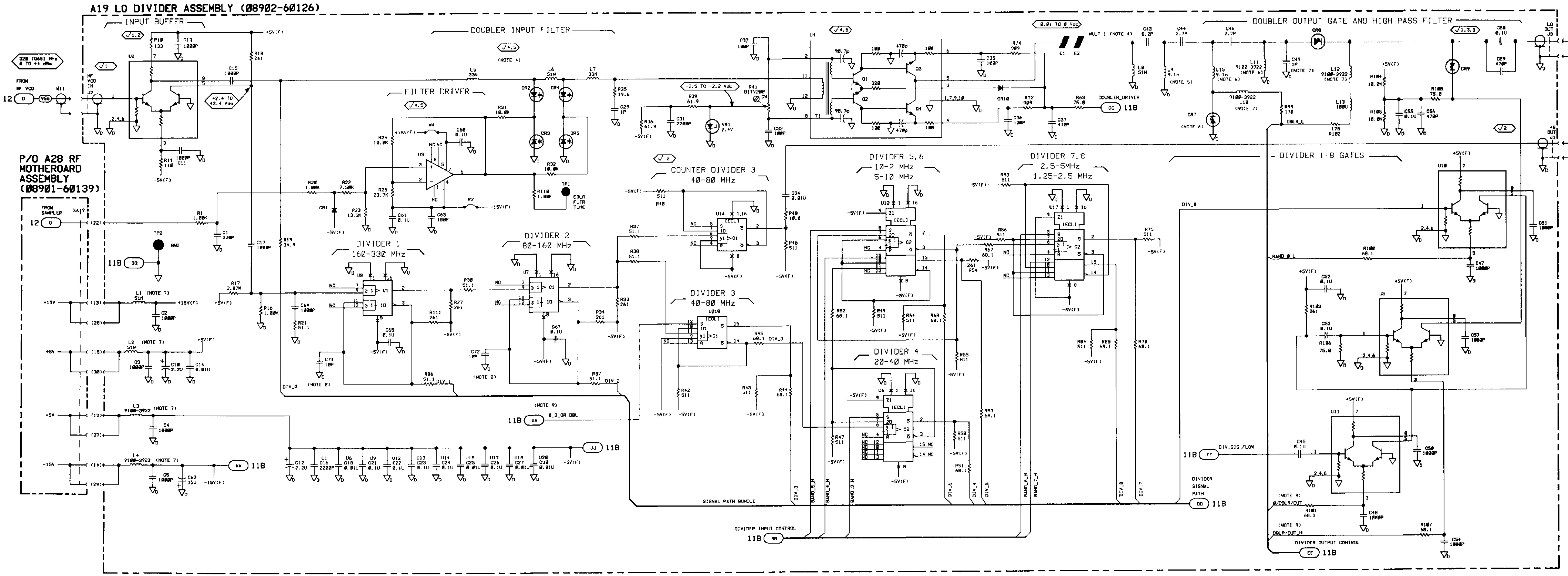
COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
C6	B,2	R78	B,1						
C7	B,2	R79	A,1						
C8	B,2	R80	B,1						
C9	B,2	R81	B,1						
C38	A,2	R82	B,1						
C39	B,3	R88	A,2						
C40	A,2	R89	B,2						
C41	B,2	R90	A,2						
C42	A,2	R91	A,2						
		R92	B,2						
CR6	A,1	R93	A,2						
		R94	B,2						
J4	B,2	R95	B,2						
		R96	B,3						
Q1	A,1	R97	B,3						
Q2	B,1	R98	A,2						
Q3	A,1	R109	B,2						
Q4	A,1								
Q12	B,1	TP2	A,1						
R2	B,3	U9	A,2						
R3	B,3	U13	B,3						
R4	B,3	U14	B,2						
R5	B,3	U15	B,2						
R6	B,2	U16	B,2						
R7	B,2	U18	B,1						
R8	B,2	U19	B,1						
R9	B,2	U20	B,1						
R13	B,1								
R14	B,1	VR2	B,1						
R15	B,2								
R26	B,1								
R28	B,2								
R29	B,2								
R57	B,1								
R58	B,1								
R59	B,1								
R60	B,1								
R61	B,1								
R62	B,1								
R66	A,1								
R69	B,1								
R71	A,1								
R76	B,1								
R77	B,1								

SS11B A19 LO Divider Assembly Component Coordinates (2911A and above)



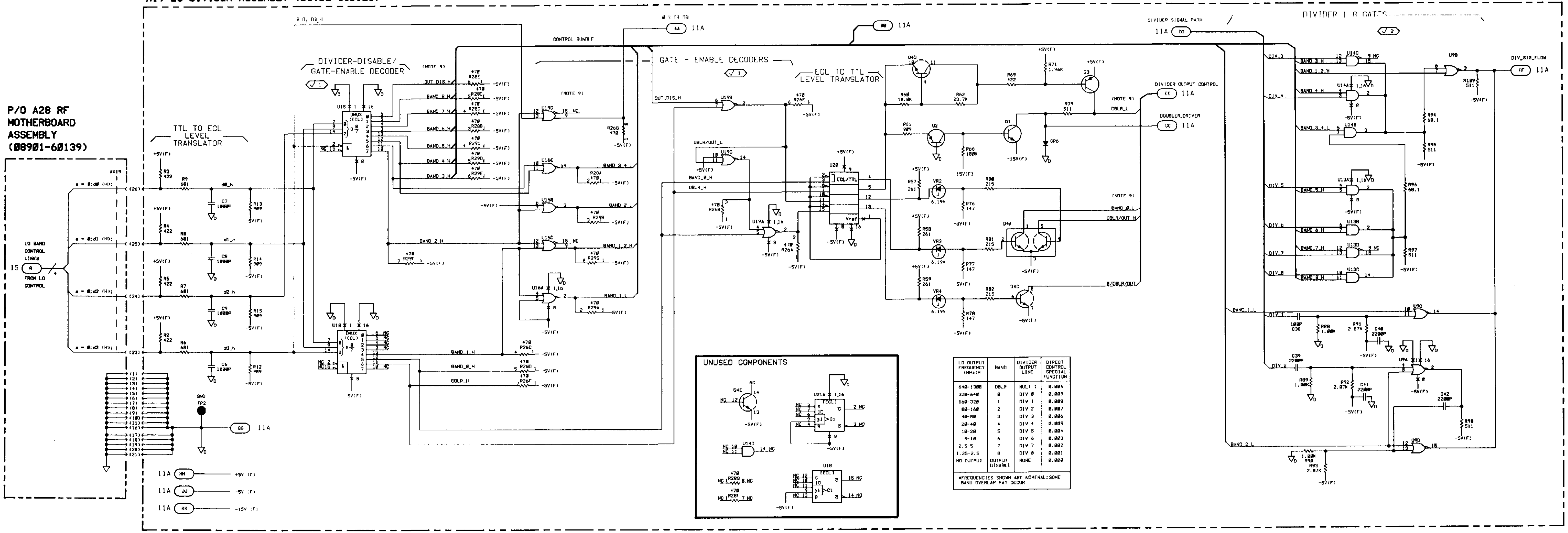
SS11B A19 LO Divider Assembly Component Locations (2911A and above)

SS11



SS11A
rev.1NOV89

A19 LO DIVIDER ASSEMBLY (Ø89Ø2-66Ø126)



LO OUTPUT FREQUENCY (MHz)*	BAND	DIVIDER OUTPUT LINE	DIRECT CONTROL SPECIAL FUNCTION
64Ø-13ØØ	DBLR	MULT 1	Ø.ØØA
32Ø-64Ø	Ø	DIV Ø	Ø.ØØ9
16Ø-32Ø	1	DIV 1	Ø.ØØ8
8Ø-16Ø	2	DIV 2	Ø.ØØ7
4Ø-8Ø	3	DIV 3	Ø.ØØ6
2Ø-4Ø	4	DIV 4	Ø.ØØ5
1Ø-2Ø	5	DIV 5	Ø.ØØ4
5-1Ø	6	DIV 6	Ø.ØØ3
2.5-5	7	DIV 7	Ø.ØØ2
1.25-2.5	8	DIV 8	Ø.ØØ1
NO OUTPUT	OUTPUT DISABLE	NONE	Ø.ØØØ

*FREQUENCIES SHOWN ARE NOMINAL: SOME BAND OVERLAP MAY OCCUR

SS11B

rev.1NOV89

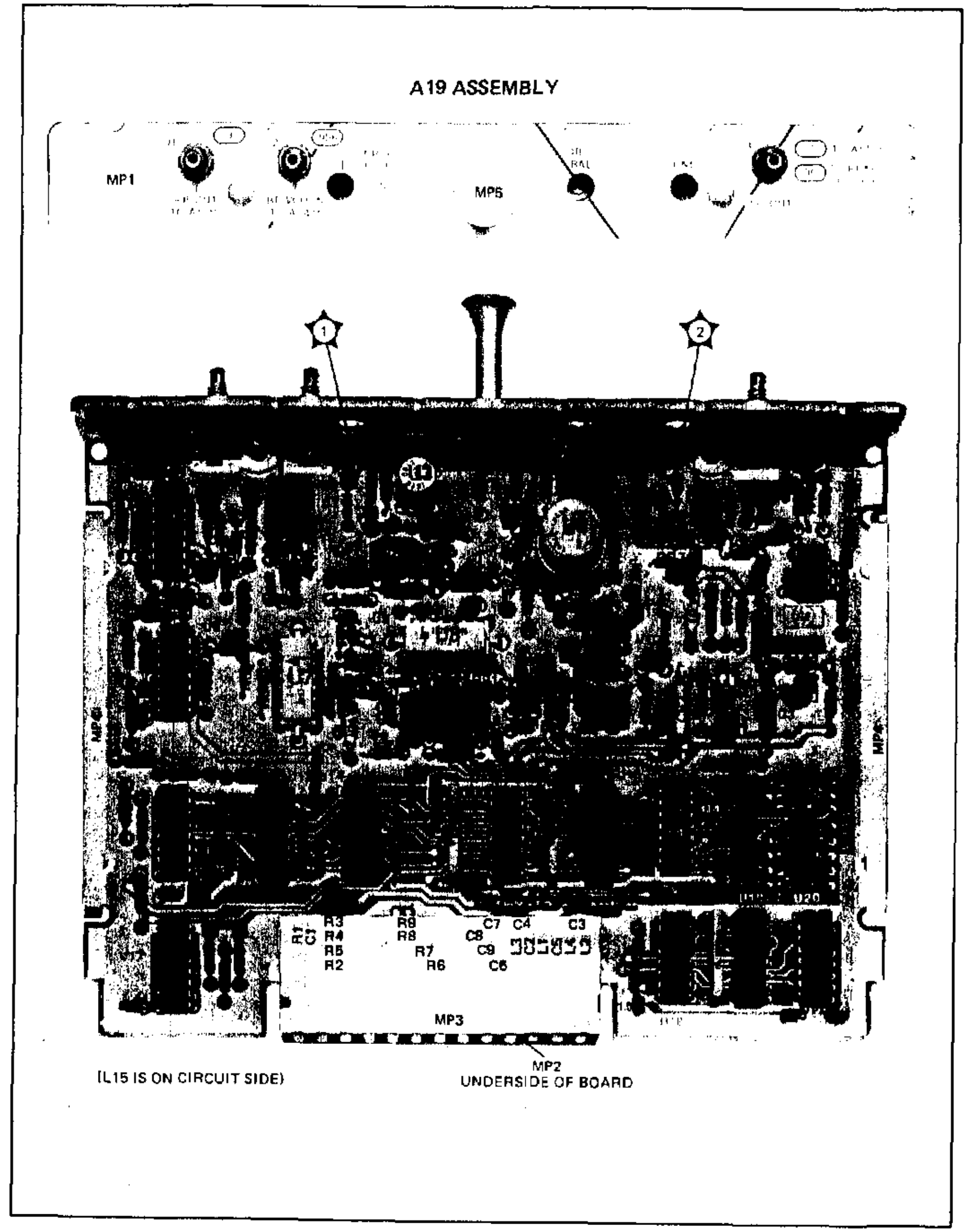


Figure 8-88. A19 LO Divider Assembly Component Locations

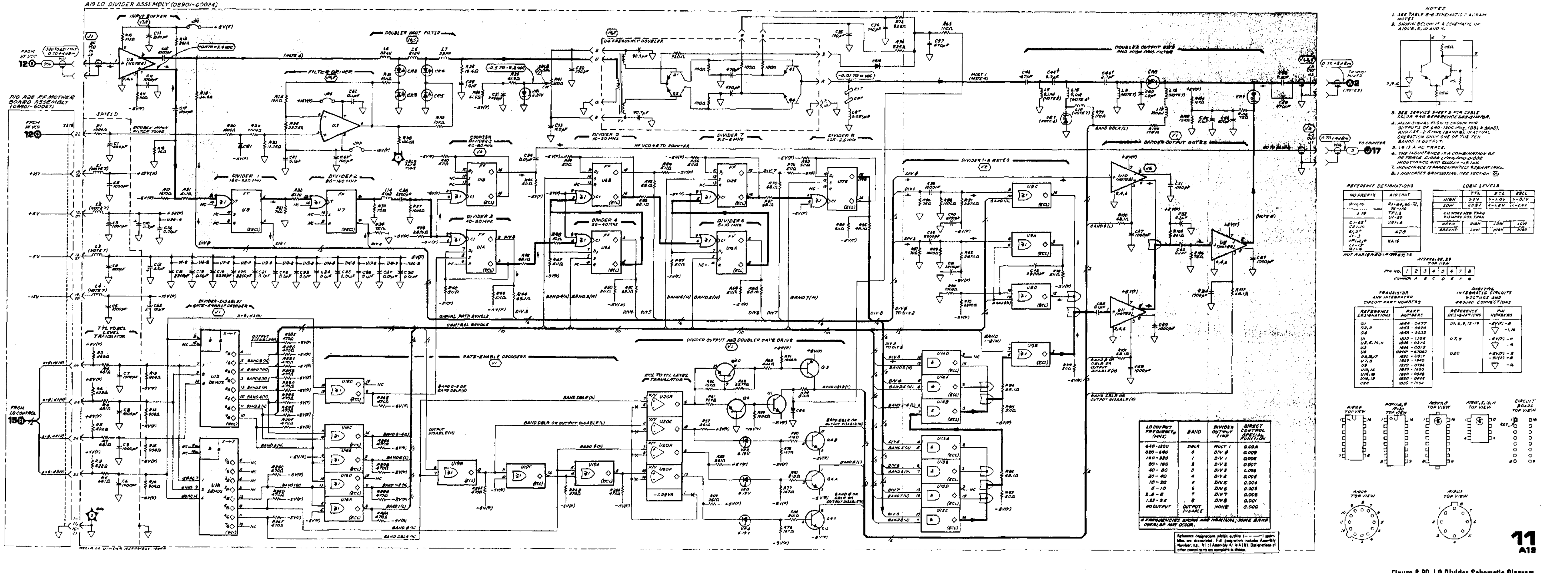


Figure 8-89. LO Divider Schematic Diagram

SERVICE SHEET 12 — SAMPLER AND HIGH FREQUENCY VCO (A23 & A24)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the Sampler and High Frequency VCO Assemblies are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTIONS

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

To avoid heat damage to the monoblock capacitors on the A24 High Frequency VCO Assembly, use low-temperature silver solder (HP 8090-0022). Apply silver solder to the printed circuit board at the appropriate pads, then place the capacitor on the soldered pads, and apply just enough heat to solder the capacitor to the board. To remove a monoblock capacitor, apply heat to the trace to melt the solder holding the capacitor in place, then lift the capacitor off the board.

Equipment

Audio Source .... HP 339A
Oscilloscope .... HP 1740A
Signal Generator .... HP 8640B Opt. 002
Spectrum Analyzer .... HP 8555A/8552B/141T
Voltmeter .... HP 3455A

⟨√1⟩ High Frequency VCO and Output Buffer Amplifiers Check

1. Connect a spectrum analyzer to A24J1 (HF VCO OUT).

2. Key in 55.0 SPCL to cause the HF VCO to sweep slowly back-and-forth across its range. The oscillator should sweep from below 310 to above 660 MHz at a power level between 0 and +4 dBm.

SERVICE SHEET 12 (Cont'd)

3. Connect the spectrum analyzer to A24J2 (HF VCO OUT). The signal should be the same as in step 2 except the level should be between −1 and +2 dBm.

Hint: If only one output of step 2 or 3 is low, the Output Buffer Amplifier is probably faulty. If there is no signal, or if the signal drops out at certain frequencies, the High Frequency VCO is probably faulty but may also be the result of improper varactor bias (see ⟨√2⟩ Varactor Bias Check).

⟨√2⟩ Varactor Bias Check

1. Key in 0.0FF SPCL to inhibit LO sweep. Key in 0.01E SPCL to connect the DAC to the HF VCO.

2. Key in the Direct Control Special Functions indicated below. For each setting, measure the points indicated with a dc voltmeter. When measuring the voltage between A24TP1 (TUNE) and A2TP2, connect the positive input to TP1 and the negative input to TP2. Neither side should be grounded.

Direct Control Special Functions	Voltage Limits (Vdc) at	
	A24TP1 to A24TP2	A28XA24 Pin 5
0.080, 0.090, 0.0A0, 0.0B0	+0.50 to +0.75	−11.2 to −10.1
0.08F, 0.09F, 0.0AF, 0.0BF	+15 or more	+10.1 to +11.2

Hint: The VCO Tune Clamp is active for Direct Control Special Functions 0.080, 0.090, etc. A24CR2 is then on, clamping the tune line to the negative voltage.

⟨√3⟩ Tune Voltage Filter and Switch Check

1. Key in 0.0F8 SPCL to switch the filter on. Key in 0.01E SPCL to connect the DAC to the HF VCO. Key in 0.088 SPCL and 0.098 SPCL to set the DAC to its midrange.

2. Key in the Direct Control Special Functions indicated below. For each setting, connect a dc voltmeter to the points indicated. (The voltmeter input impedance must be 10 MΩ or greater and neither side of the input should be grounded.)

Direct Control Special Functions	Voltage Limits (Vdc) at	
	A24Q4 Collector	A24U3B Pins 5 & 7
As in step 1	−15 to −11	−0.01 to +0.01
0.0FA	0.4 to 0.6 above A24TP1	−0.01 to +0.01

Hint: The voltage at pin 5 of A28XA24 should be between −4 and +5 Vdc. If the voltage across A24R2 is greater than 10 mV, A24CR1 may be leaky.

SERVICE SHEET 12 (cont'd)

3. Key in 0.0F8 SPCL.

4. Connect an ac voltmeter to A24TP1 (TUNE).

5. Set the audio source (in the distortion measurement set) to 10 kHz at 0.1 Vrms. If the output of the source is not 50Ω, put a 50Ω load in parallel with the output using a tee. Insert a 0.1 μF non-electrolytic capacitor in series with the (loaded) output. Connect the ac coupled output to the junction of A24R2 and R3 or to pin 5 of A28XA24.

6. Adjust the audio source level for a voltmeter reading of 10 mVrms.

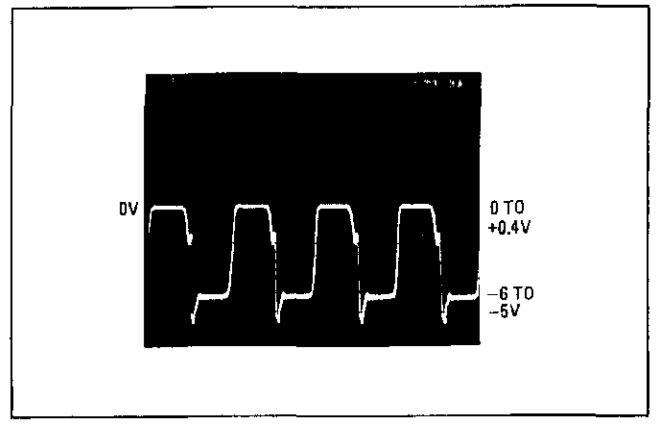
7. Key in 0.0FA SPCL to remove the filter. The voltmeter should read between 140 and 170 mVrms†.

⟨√4⟩ Sampler Check

1. Disconnect W17 from A23J2 (HF VCO IN).

2. Set the signal generator to 2 MHz CW at −2 dBm. Connect its RF output to A23J1 (LF VCXO IN).

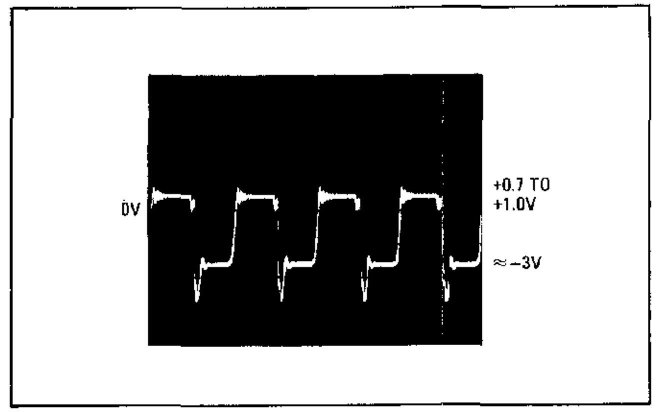
3. Check the collector (can) of A23Q2 with a dc coupled oscilloscope. The oscilloscope input should have a low-capacitance 10:1 divider probe. The signal should be at the signal generator's frequency with the following waveform:



4. Check the emitter of Q6 with the oscilloscope. The waveform should be as shown on the top of the next page.

5. Check the junction of A23CR6, CR8, and R27 with the oscilloscope. The waveform should be narrow, negative going pulses at the signal generator frequency. The pulse width will depend on the capacitive loading of the oscilloscope but should be approximately 15 ns.

SERVICE SHEET 12 (Cont'd)



6. Check the junction of A23CR7, CR9, and R28 with the oscilloscope. The waveform should be as in step 5 except that the pulses will be positive going.

7. Connect a dc coupled oscilloscope to A23TP1 (SAMP AMPL).

8. Slowly vary A23R34 (OFS) through its range. The voltage should vary smoothly over the minimum range of −1 to +1V.

Hint: If the voltage at A23TP1 jumps rapidly through 0V as adjustment is made, the Sampling Bridge is probably not being gated on by the Impulse Generator. If the voltage doesn't adjust at all, the Sampler Amplifier may be at fault.

9. After the repair has been completed, perform the Sampler Efficiency and Offset Adjustment. For this adjustment, the Sampler Assembly must be inserted in its extrusion.

⟨√5⟩ Bandwidth and Loop Switching HF VCO Tune Integrator and Amplifier Check

1. Disconnect any signal at the INPUT jack. Connect a high-impedance, dc coupled oscilloscope to pin 9 of A28XA23.

2. Key in 0.017 SPCL to open the loops. Key in 0.0F2 SPCL to turn on the Sweep Up Current Source. The voltage should be +10.1 to +11.2 Vdc.

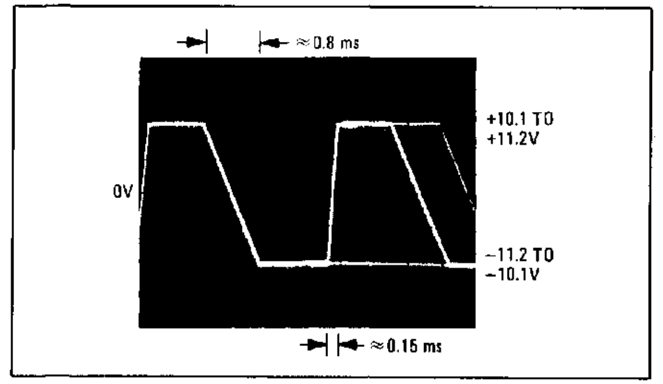
Hint: The voltage at pin 8 of A28XA23 should be between −12 and −11 Vdc.

3. Key in 0.0FF SPCL to turn off the Sweep Up Current Source and turn on the Sweep Down Current Source. The voltage should be −11.2 to −10.1 Vdc.

Hint: The voltage at pin 8 of A28XA23 should be between +1.8 and +2.2 Vdc.

SERVICE SHEET 12 (Cont'd)

4. Press AUTOMATIC OPERATION. The waveform should be as follows:



5. Key in the Direct Control Special Functions indicated below. For each setting, make the measurements indicated with a dc voltmeter.

Direct Control Special Function	Voltage Limits (Vdc) at	
	A23Q11 Gate	A23Q10 Base
0.013	0 to +0.2	+0.3 to +0.8
0.019	−15 to −12	−0.8 to −0.5

6. Key in the Direct Control Special Functions indicated below. For each setting, make the measurements indicated with a dc voltmeter.

Direct Control Special Function	Voltage Limits (Vdc) at A23Q12 Gate
0.0FA	0 to +0.2
0.0F8	−15 to −12

⟨√6⟩ No-HF-VCO Detector and Out-of-Lock Detector Check

1. Set the signal generator to 500 MHz CW at −2 dBm. Connect its RF output to A23J2 (HF VCO IN). A23DS1 (NO HF VCO) should be off.

2. Reduce the signal level to −10 dBm. A23DS1 should be on.

3. Key in 0.0FA SPCL. A23DS2 (OUT OF LOCK) should be on.

4. Key in 0.0F8 SPCL. A23DS2 should be off.

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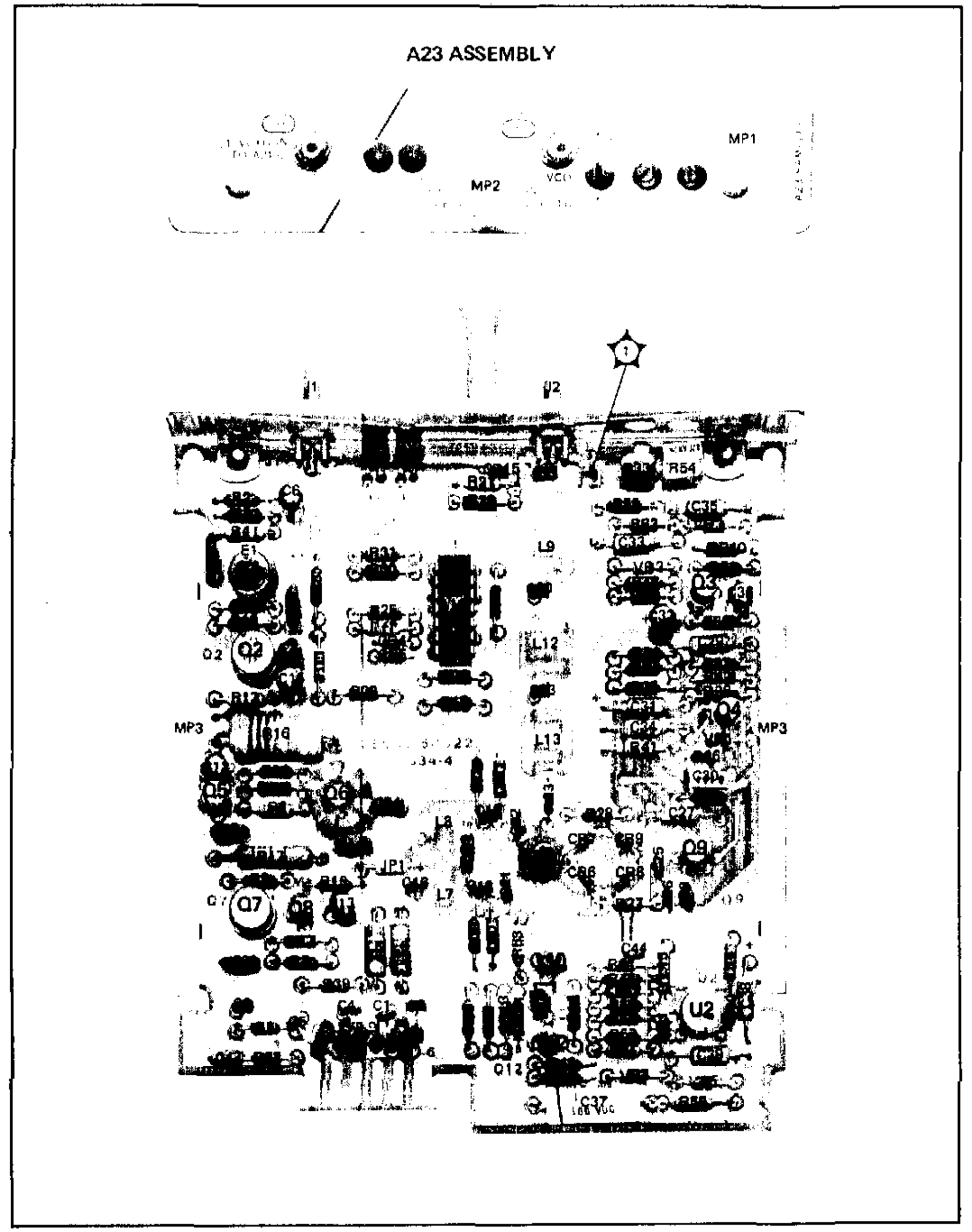


Figure 8-90. A23 Sampler Assembly Component Locations

CHANGES

All Serial Prefixes	**On the A24 schematic:** • R7 - Under VCO-TUNE VOLTAGE CLAMP, change the voltage connection for R7 to −15 V (F1). **On the A23 schematic:** • R55 - Add an asterisk (*) to R55 to indicate a factory selected component.
2031A and above	**On the A23 schematic:** • C45 - Add C45, 1.8 pF, between the CR8/CR9 junction and ground • Q6 - In the Table of Transistor and Integrated Circuit Part Numbers, change Q6 to 1853-0281.
2128A and above	**On the A28 schematic:** • 08901-60139 - Change the part number of A28 RF Motherboard Assembly to 08901-60139.
2312A and above	**On the A24 schematic:** • C17 - Under HIGH FREQUENCY VCO, change the value of C17 to 10 pF.
2324A and above	**On the A24 schematic:** • U3 - In the Table of Transistor and Integrated Circuit Part Numbers, change A24U3 to 1826-0785.
2545A and above	**On the A23 component locator:** • 08901-60144 - Use the new component locator, Figure 8–67. A23 Sampler Assembly Component Locations (2545A and above), on page 8-116.3. **On the A23 schematic:** • 08901-60144 - Change the part number of the A23 Sampler Assembly to 08901-60144. • Q11, Q12 - In the Table of Transistor and Integrated Circuit Part Numbers, change A23Q11 and Q12 to 1855-0420.

Reserved for future changes.

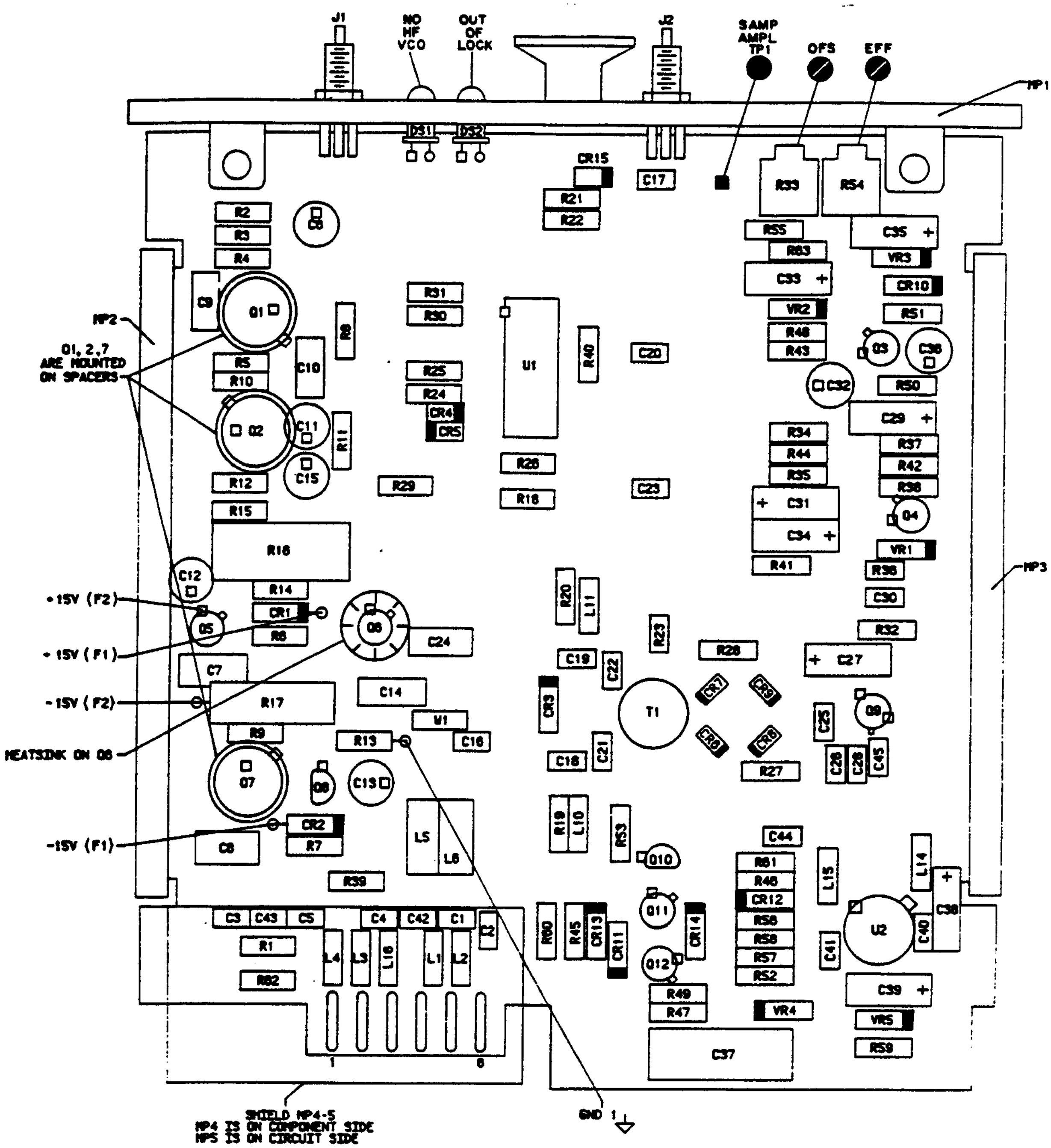


Figure 8-67. A23 Sampler Assembly Component Locations (2545A and above)

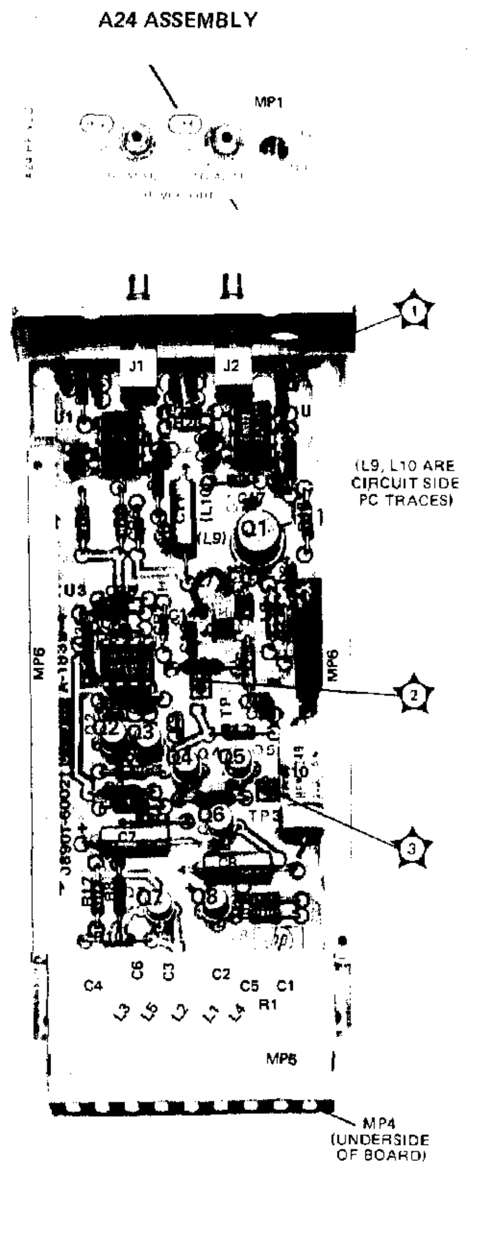


Figure 8-91. A24 High Frequency VCO Assembly Component Locations

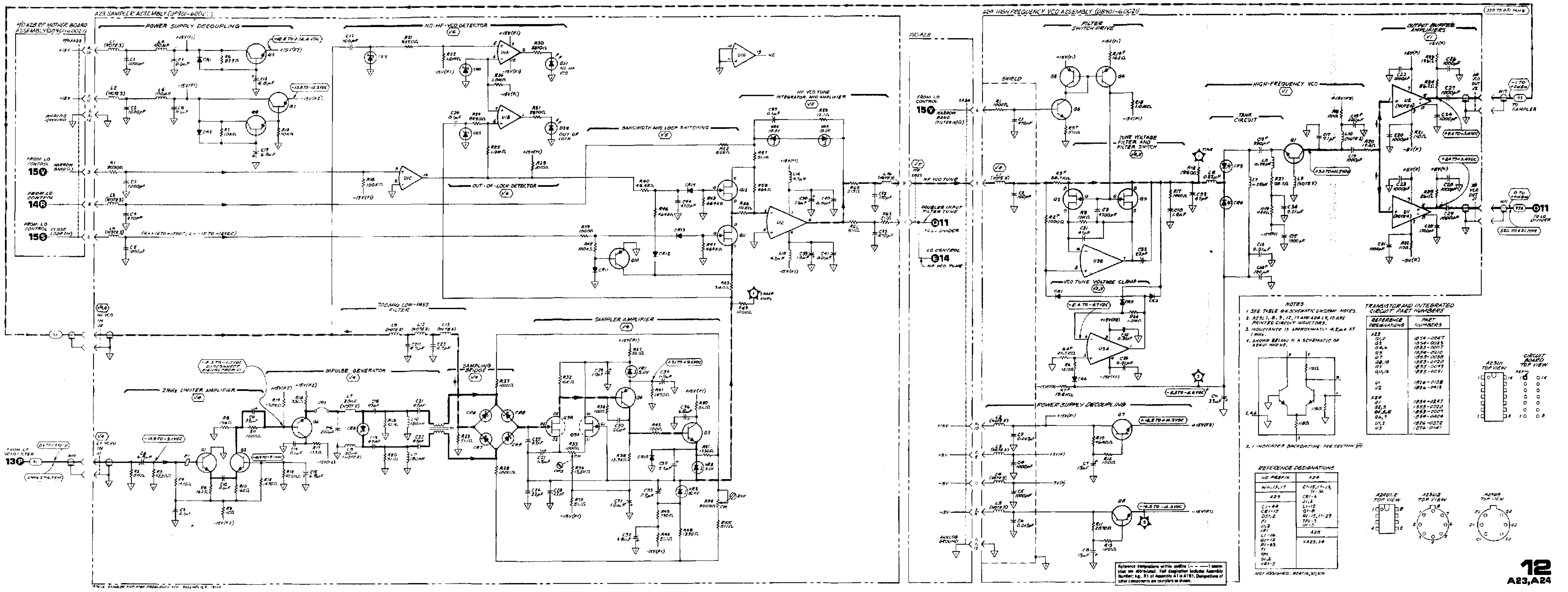


Figure 8-92. Sampler and High Frequency VCO Schematic Diagram

SERVICE SHEET 13 — LOW FREQUENCY VCXO AND FILTER (A21, A22)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD2
- Parts List .... Page 6-39 & 6-41
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-69

TROUBLESHOOTING

General

Procedures for checking the Low Frequency VCXO and Filter Assemblies are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., √3. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., +1.9 to +2.1 Vdc. Extend the board assembly where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Counter .... HP 8640B
Oscilloscope .... HP 1740A
Voltmeter .... HP 3455A

√1 Low Frequency VCXO General Check

1. Connect a dc voltmeter to A20TP3 (LF VCXO TUNE). (A20TP3 is shown on service Sheet 14.)

2. Connect a high-impedance, ac coupled oscilloscope to A22J1 (LF VCXO OUT).

3. Key in 0.01B SPCL to connect the DAC to the LF VCXO.

4. Key in the Direct Control Special Functions indicated below. For each setting, note the reading on the voltmeter and the waveform level on the oscilloscope. The waveform should be sinusoidal with a period of approximately 500 ns. The readings should be within the limits shown below.

SERVICE SHEET 13 (Cont'd)

Direct Control Special Functions	Limits	
	Voltmeter (Vdc)	Oscilloscope (Vpp)
0.080, 0.090, 0.0A0, and 0.0B0	0 to +2	0.36 to 0.52
0.08F, 0.09F, 0.0AF, and 0.0BF	+37 to +40	0.36 to 0.52

5. Connect a counter (in the signal generator) in place of the oscilloscope. Key in the Direct Control Special Functions indicated below. For each setting, observe the frequency which should be as shown below.

Direct Control Special Functions	Frequency Limits (MHz)
0.08F, 0.09F, 0.0AF, 0.0BF	2.0063 or higher
0.080, 0.090, 0.0A0, 0.0B0	1.9937 or lower

Hint: If the signal at A22J1 is not correct, but the tuning voltage is, perform the √2 9.26 and 11.26 MHz Xtal Oscillators and Double Balanced Mixer Check.

√2 9.26 and 11.25 MHz Xtal Oscillators and Double Balanced Mixer Check

NOTE

This check assumes that the VCXO tune line works properly. See step 4 of the √1 Low Frequency VCXO General Check.

1. Connect a counter (in the signal generator) to A22TP2.

2. Key in 0.01B SPCL to connect the DAC to the LF VCXO.

3. Key in the following Direct Control Special Functions. For each setting, note the counter reading.

Direct Control Special Functions	Frequency Limits (MHz)
0.080, 0.090, 0.0A0, 0.0B0	9.2628 or higher
0.08F, 0.09F, 0.0AF, 0.0BF	9.2572 or lower

4. Connect the counter to A22TP1.

SERVICE SHEET 13 (Cont'd)

5. Key in the following Direct Control Special Functions. For each setting, note the counter reading.

Direct Control Special Functions	Frequency Limits (MHz)
0.08F, 0.09F, 0.0AF, 0.0BF	11.2637 or higher
0.080, 0.090, 0.0A0, 0.0B0	11.2563 or lower

Hint: With A22Y1 unplugged the voltage at A22TP1 should be 0.6 to 0.8 Vpp (sinusoidal) as measured with a high-impedance ac coupled oscilloscope.

√3 Low Frequency VCXO Filter Check

NOTE

This check assumes that the √1 Low Frequency VCXO General Check gives positive results.

1. Connect a high-impedance, ac coupled oscilloscope either in parallel with A21J2 (LF VCXO OUT) with W13 connecting to A23J1 or directly to A21J2 with a 511Ω resistor in parallel with it. The signal should be sinusoidal with an amplitude of 0.5 to 1.0 Vpp and a period of approximately 500 ns.

Sampler and High Frequency VCO
A23, A24
SERVICE SHEET 12

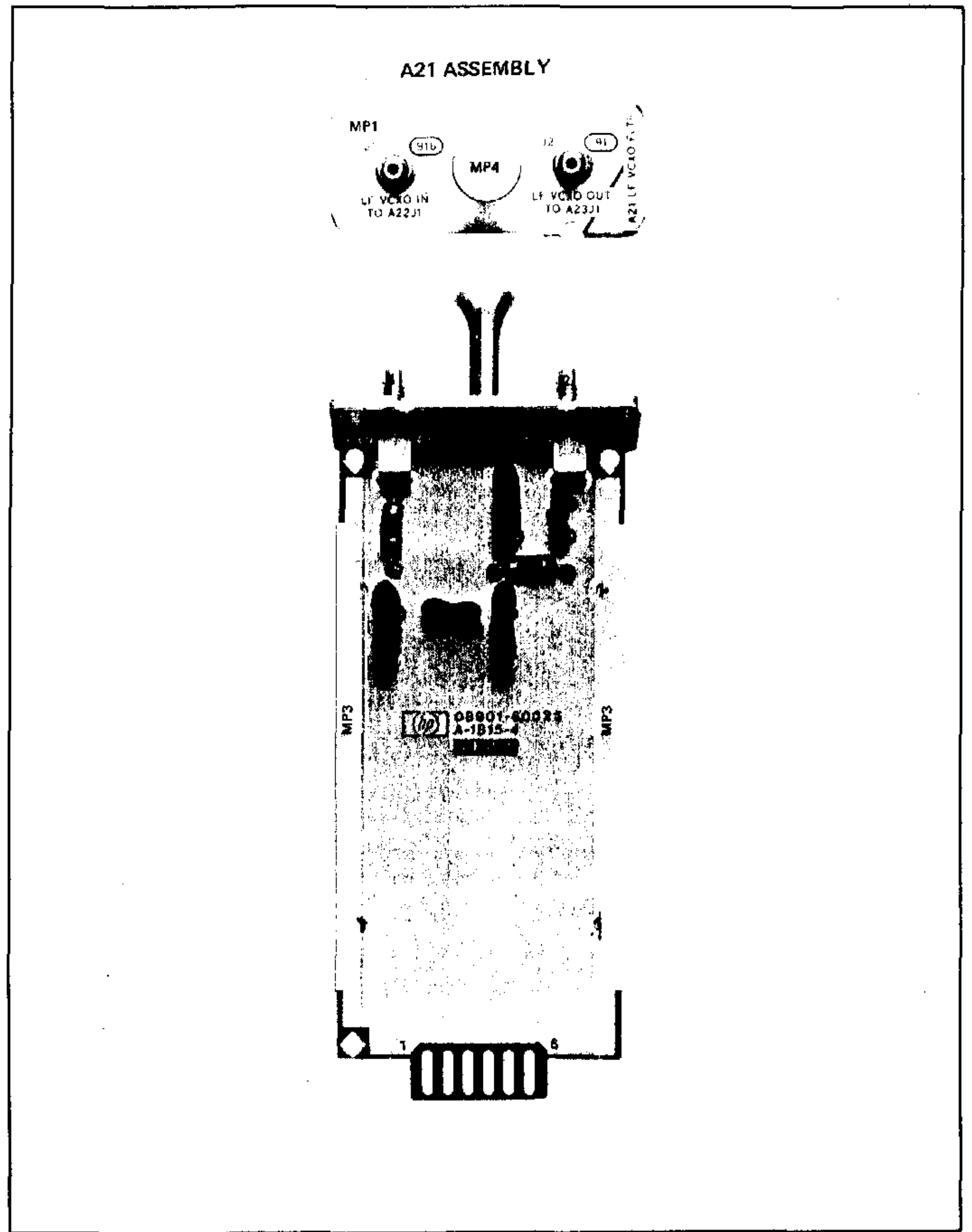


Figure 8-93. A21 Low Frequency VCXO Filter Assembly Component Locations

CHANGES

All serial prefixes	**On the A22 schematic:** • **CR2, CR4, CR6, CR8** - Change the symbols for CR2, CR4, CR6 and CR8 to standard diode symbols. These are not Schottkey diodes.
2128A and above	**On the A28 schematic:** • **08901-60139** - Change the part number of A28 RF Motherboard Assembly to 08901-60139.

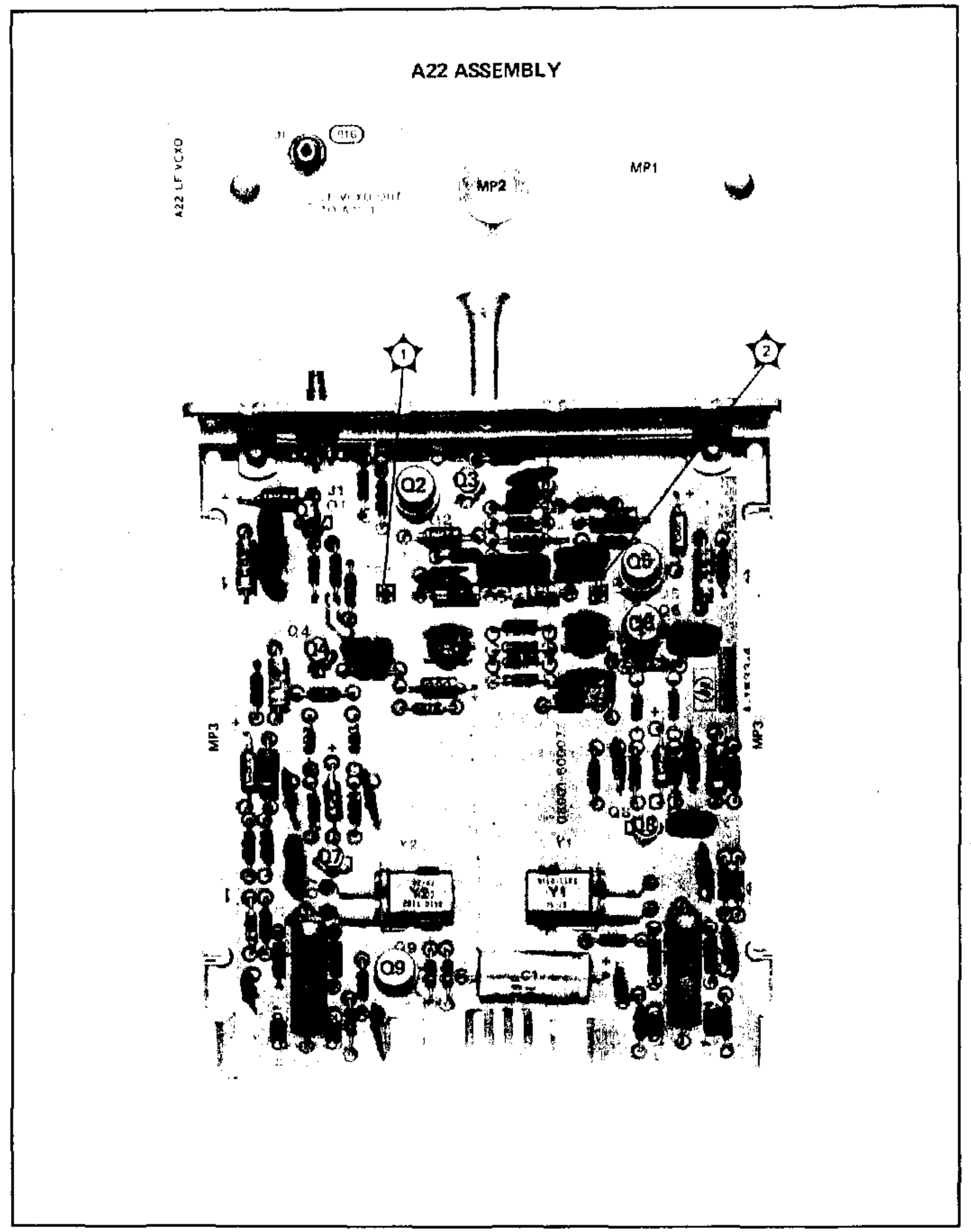


Figure 8-94. A22 Low Frequency VCXO Assembly Component Locations

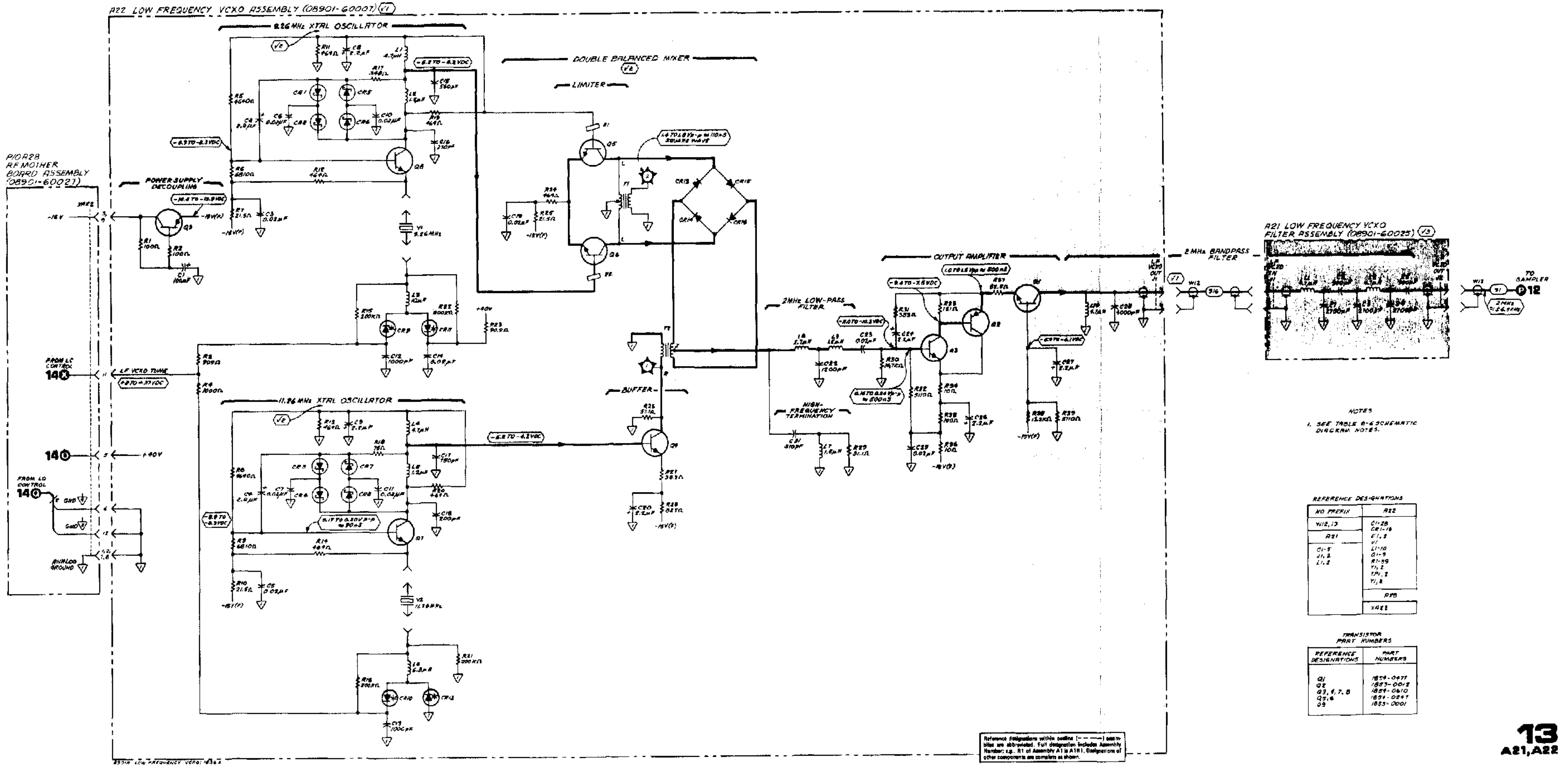


Figure 8-95. Low Frequency VCXO and Filter Schematic Diagram

SERVICE SHEET 14 — LO CONTROL — ANALOG CIRCUITS (P/O A20)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD2
- Parts List .... Page 6-36
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-70

TROUBLESHOOTING

General

Procedures for checking the LO Control Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTION

CMOS circuits can be damaged by static charges and circuit transients. Do not remove this assembly from the instrument while power is applied. Discharge the board, replacement device, and soldering iron to the same potential. (Use the conductive foam pad provided in the Service Accessory Kit HP 08901-60089.)

Equipment

Audio Source .... HP 339A
Multimeter .... HP 3455A
Oscilloscope .... HP 1740A

⟨√1⟩ Sweep Down and Sweep Up Current Sources Check

1. Key in 0.01F SPCL to open the LO loops.

2. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated with a dc voltmeter or a high-impedance, dc coupled oscilloscope.

Direct Control Special Function	Voltage Limits (Vdc) at		
	U3C-8	U3B-6	A28XA20-32
0.0FE	+4.5 to +5.4	0 to +0.8	+1.8 to +2.3
0.0F2	0 to +0.8	+1.2 to +1.6	−12 to −11

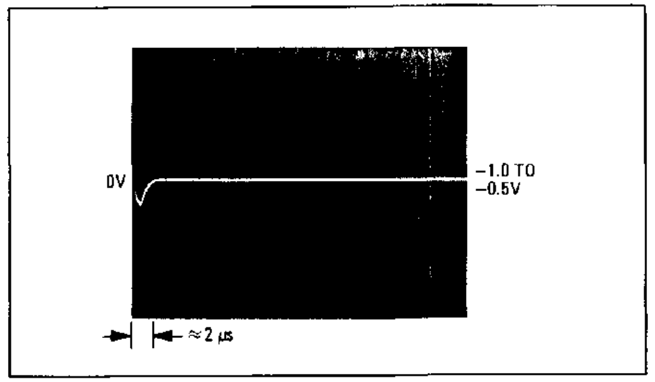
Direct Control Special Function	Condition of Base-Emitter Junction of				
	Q4	Q7	Q5	Q1	Q2
0.0FE	Off	On	Off	Off	Off
0.0F2	On	Off	Off	On	On

SERVICE SHEET 14 (Cont'd)

Hint: For this check Q10 and Q11 must be off. The voltage at the gates of Q10 and Q11 should be +11 to +15 Vdc.

3. Press AUTOMATIC OPERATION.

4. Check the voltage at the collector of Q5 with a high-impedance, dc coupled oscilloscope. The waveform should be a square wave with an amplitude of approximately 1.6 Vpp and a period of approximately 2.8 ms, but more importantly, observe the falling edge. Set the oscilloscope to trigger on a negative slope with a sweep time of 2 µs per division. The waveform will be intermittently stable and very faint but the falling edge should be as follows:



⟨√2⟩ Digital-to-Analog Converters and DAC Control Amplifier Check

1. Key in 0.0FF SPCL to inhibit LO sweep. Key in 0.01E SPCL to connect the DAC to the HF VCO.

2. Key in the Direct Control Special Functions indicated below. For each setting, measure U4B pin 6 and A20TP4 (HF VCO TUNE) with a dc voltmeter.

Direct Control Special Functions	Voltage Limits (Vdc)
0.080, 0.090, 0.0A0, 0.0B0	10 to −8
0.08F, 0.09F, 0.0AF, 0.0BF	+9 to +12

Hint: For this check Q18 must be off and Q13 on. The gate of Q18 should be between −15.4 and 11 Vdc. The gate of Q13 should be between −0.1 and +0.02 Vdc.

Hint: If pin 6 of U4B is correct but TP4 is not, check the components in the loop formed by A20U4B, A20Q11, A23Q11, and A23U2. (See Service Sheet 12.) A20Q11 must be on.

SERVICE SHEET 14 (Cont'd)

Hint: To test U4A independent of the DAC, key in 0.013 SPCL to open switch Q13, then connect a 10 kΩ resistor between the +15V supply and pin 2 of U4A. Pin 1 of U4A, pin 6 of U4B, and TP4 should be the same voltage (which should be between +4 and +7 Vdc.)

Hint: Since the output of the DAC is a current source, it is difficult to test the DAC independent of the DAC Control Amplifer (which is a transconductance amplifier).

3. Key in 55.0 SPCL to cause the LO to sweep slowly back and forth across its range. The voltage at TP4 should sweep slowly between the limits given in step 2.

⟨√3⟩ LF VCXO Tune Amplifier and LF VCXO Tune Filter Check

NOTE

This check assumes that the ⟨√2⟩ Digital-to-Analog Converter and DAC Control Amplifier Check gives positive results.

1. Key in the Direct Control Special Functions indicated below. For each setting, measure the dc resistance indicated.

Direct Control Special Function	Resistance (Ω) Between	
	U13 Pins 2 & 3	U14 Pins 2 & 3
0.0FA	<600	>10 000
0.0F8	>10 000	<600

Hint: When U13 is low resistance, the voltage across R69 should be between 3 and 7 Vdc; when high, the voltage should be between 0 and 50 mVdc. When U14 is low resistance, the voltage across R74 should be between 11 and 14 Vdc; when high, the voltage should be between 0 and 50 mVdc.

2. Connect a dc voltmeter to A20TP3 (LF VCXO TUNE).

3. Key in 0.01B SPCL to connect the DAC to the LF VCXO.

4. Key in the Direct Control Special Functions indicated below. For each setting, note the reading on the voltmeter.

Direct Control Special Functions	Voltage Limits (Vdc)
0.080, 0.090, 0.0A0, 0.0B0	0 to +2
0.08F, 0.09F, 0.0AF, 0.0BF	−37 to +40

Hint: For this check, Q18 must be on and Q13 off. The gate of Q18 should be between −0.02 and +0.1 Vdc. The gate of Q13 should be between −15.4 and −14.0 Vdc.

Low Frequency VCXO and Filter
A21, A22,
SERVICE SHEET 13

SERVICE SHEET 14 (Cont'd)

⟨√4⟩ Track Loop Amplifier Check

1. Key in 0.01D SPCL to switch on the track loop.

2. Check pin 14 of U5D with a dc voltmeter. The voltage should be between −15.4 and −11 Vdc.

3. Check Q10. The gate-to-source voltage should be between −0.02 and 0 Vdc.

4. Turn the instrument to STBY. Unplug A4 FM Demodulator Assembly. Turn the instrument back to ON.

5. Key in 0.0FF SPCL to inhibit LO sweep. Key in 0.01D SPCL.

6. Set the audio source (in the distortion measurement set) to 1 kHz at 0.5 Vrms. Connect its output to pin 3 of A28XA20.

7. Connect a high-impedance, ac coupled oscilloscope to pin 3 of A28XA20.

8. Fine adjust the audio source level for 2 Vpp as read on the oscilloscope.

9. Connect the oscilloscope to the source of FET Q10.

10. Key in the Direct Control Special Functions indicated below. For each setting, the oscilloscope should read as indicated.

Direct Control Special Function	Voltage Limits (mVpp)
0.004	600 to 880
0.005	300 to 440
0.006	150 to 220
0.007	75 to 110
0.008	38 to 58
0.009	19 to 28
0.00A	10 to 14

CHANGES

All Serial Prefixes	**On the A20 schematic:** • **U1, U4** - In the table of Transistor and Integrated Circuit Part Numbers, change the part number of U1 to 1826-0989, and U4 to 1826-0328.
1933A to 2616A	**On the A20 schematic:** • **U13, U14** - In the table of Transistor and Integrated Circuit Part Numbers, change the part number of U13 and U14 to 1990-0643.
2128A and above	**On the A28 schematic:** • **08901-60139** - Change the part number of A28 RF Motherboard Assembly to 08901-60139.
2324A and above	**On the A20 schematic:** • **E1, Q9** - In the VOLTAGE REFERENCE, add a ferrite bead, E1, to the base of Q9.
2542A to 2616A	**On the A20 component locator:** • **Q24, Q25** - Change Q24 to Q24A. Change Q25 to Q24B. (Q24 is a dual package PNP transistor.) **On the A20 schematic:** • **Q24, Q25** - Under the LF VCXO TUNE AMPLIFIER, change Q24 to Q24A, and Q25 to Q24B. Number the pins of Q24A as follows: collector is pin 1, base is pin 2, emitter is pin 3. Number the pins of Q24B as follows: collector is pin 7, base is pin 6, emitter is pin 5. Under NOTES draw a top-view pinout of A20Q24 as follows: starting to the left of the tab and proceeding counterclockwise, number the pins 1, 2, 3, 4, 5, 6, 7. In the table of Transistor and Integrated Circuit Part Numbers, delete Q25, and change Q24 to 1853-0594.

CHANGES

2617A and above	**On the A20 component locator:** • **08901-60285** - Use the new component locator, Figure 8–96. A20 LO Control Assembly Component Locations (2617A and above), on page 8-120.3. **On the A20 schematic:** • **08901-60285** - Use the new schematic foldout with revision date, rev.01NOV89.

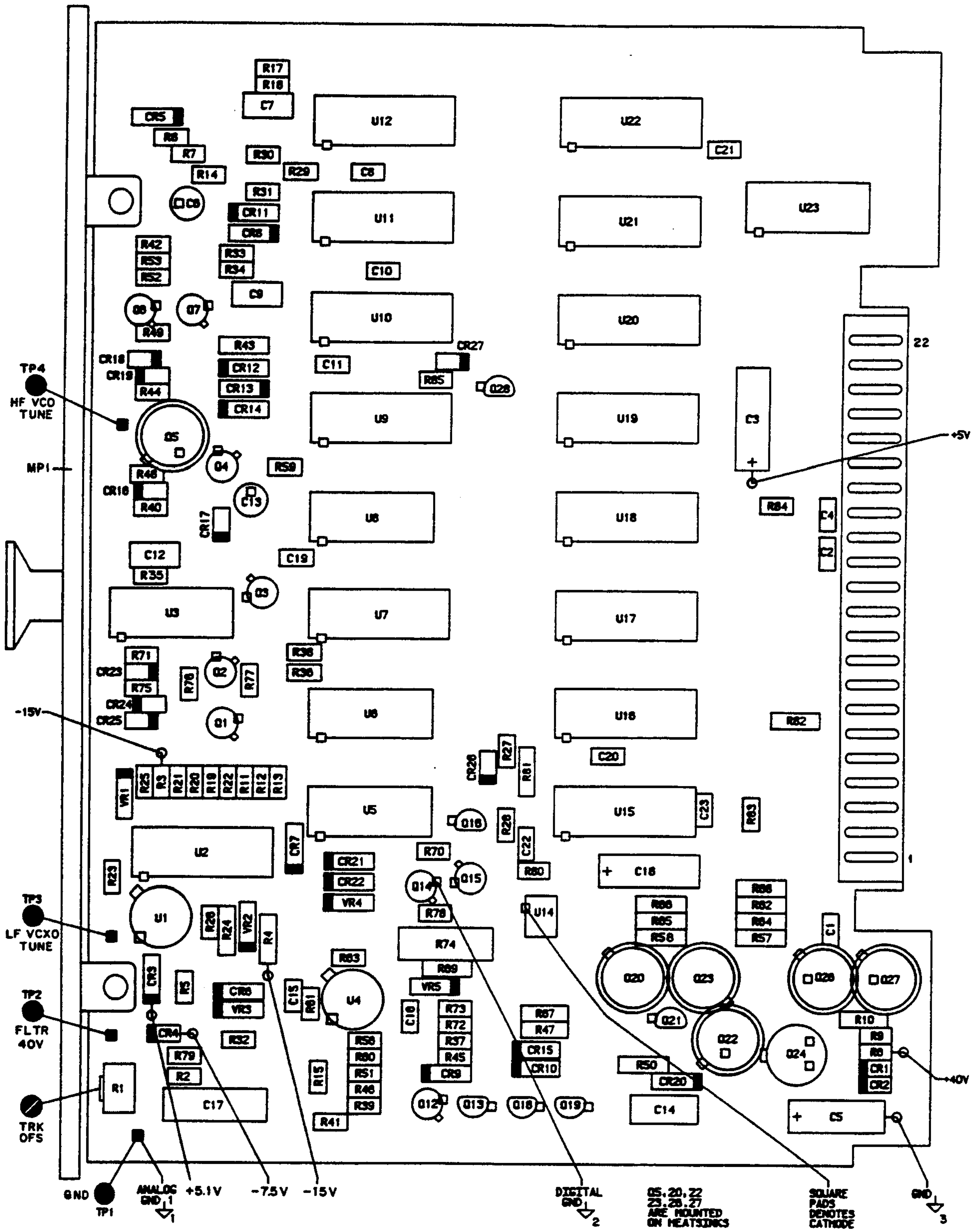


Figure 8–96. A20 LO Control Assembly Component Locations (2617A and above)

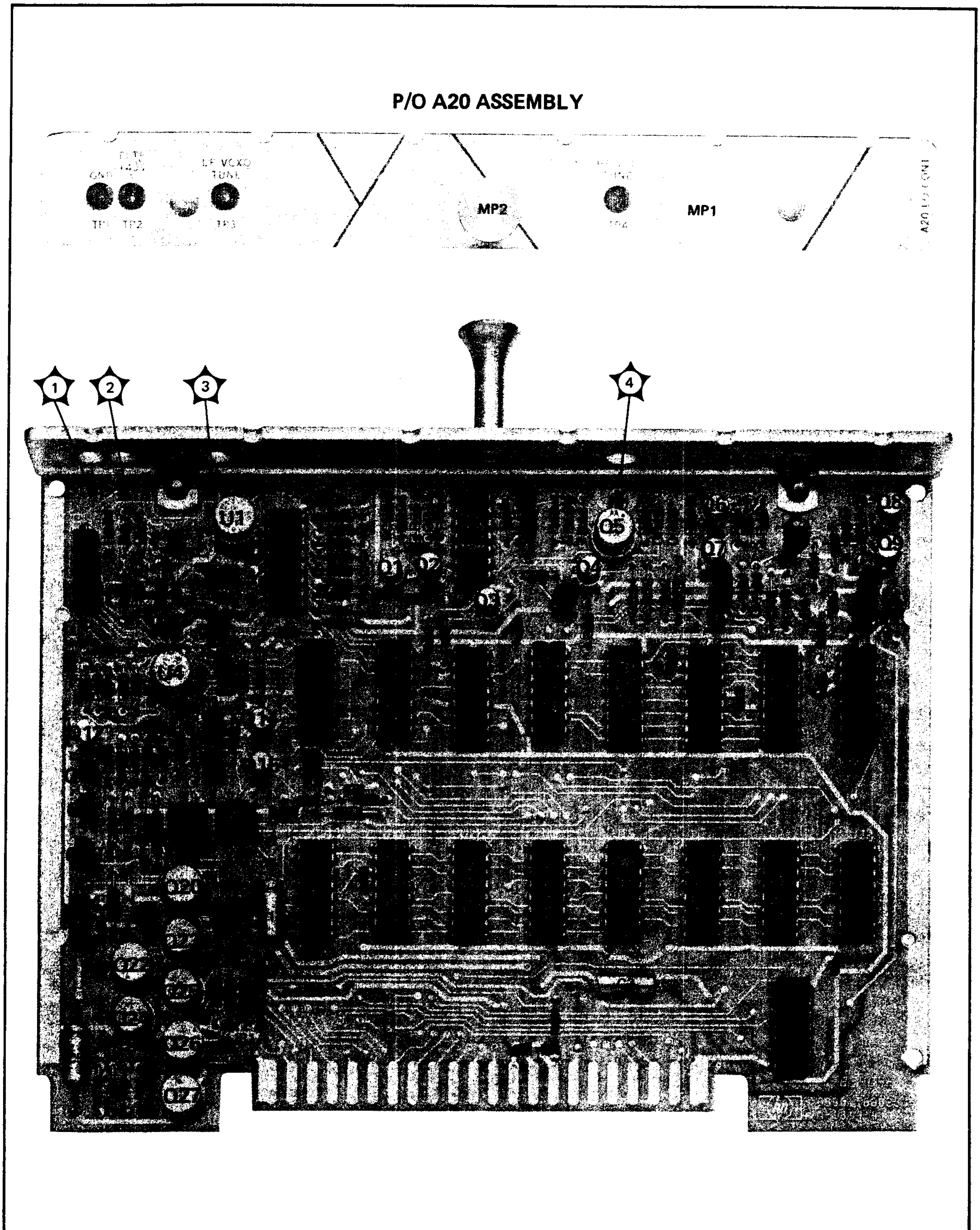
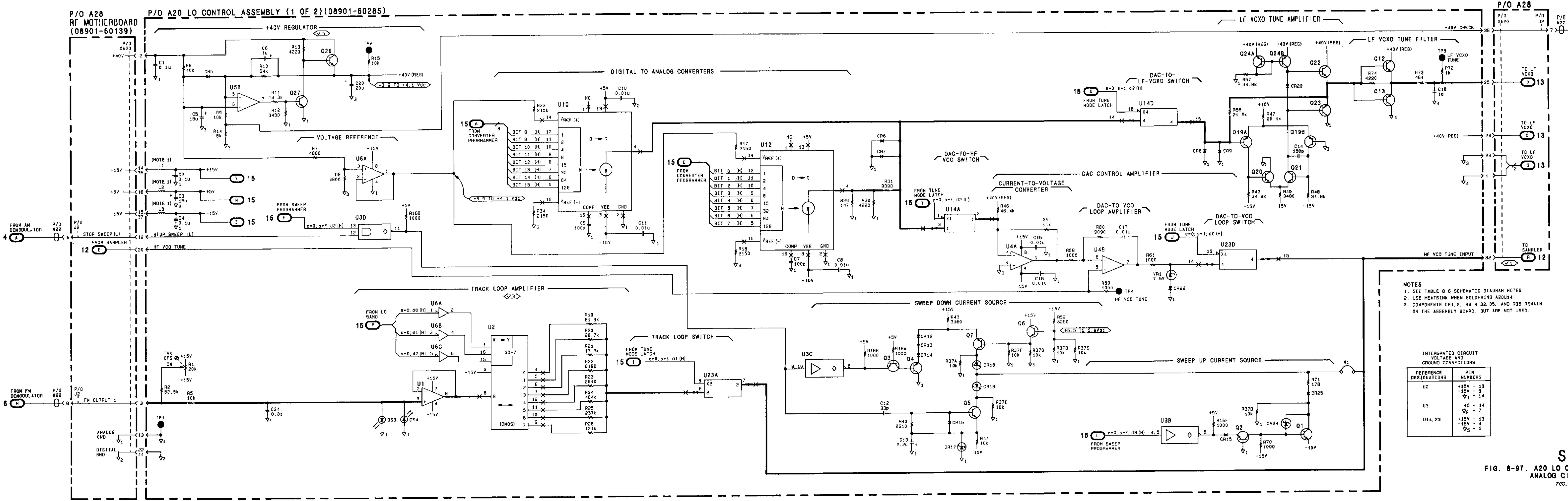


Figure 8-96. P/O A20 LO Control Assembly Component Locations (Analog Circuits)



NOTES
1. SEE TABLE 8-6 SCHEMATIC DIAGRAM NOTES.
2. USE HEATSINK WHEN SOLDERING A20U14.
3. COMPONENTS CR1,2, R3,4,32,35, AND R36 REMAIN ON THE ASSEMBLY BOARD, BUT ARE NOT USED.

INTERGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U2	+15V - 13 -15V - 3 ∇_1 - 14
U3	+5 - 14 ∇_2 - 7
U14, 23	+15V - 13 -15V - 4 ∇_5 - 5

SS14

FIG. 8-97. A20 LO CONTROL ANALOG CIRCUITS
rev.1NOV89

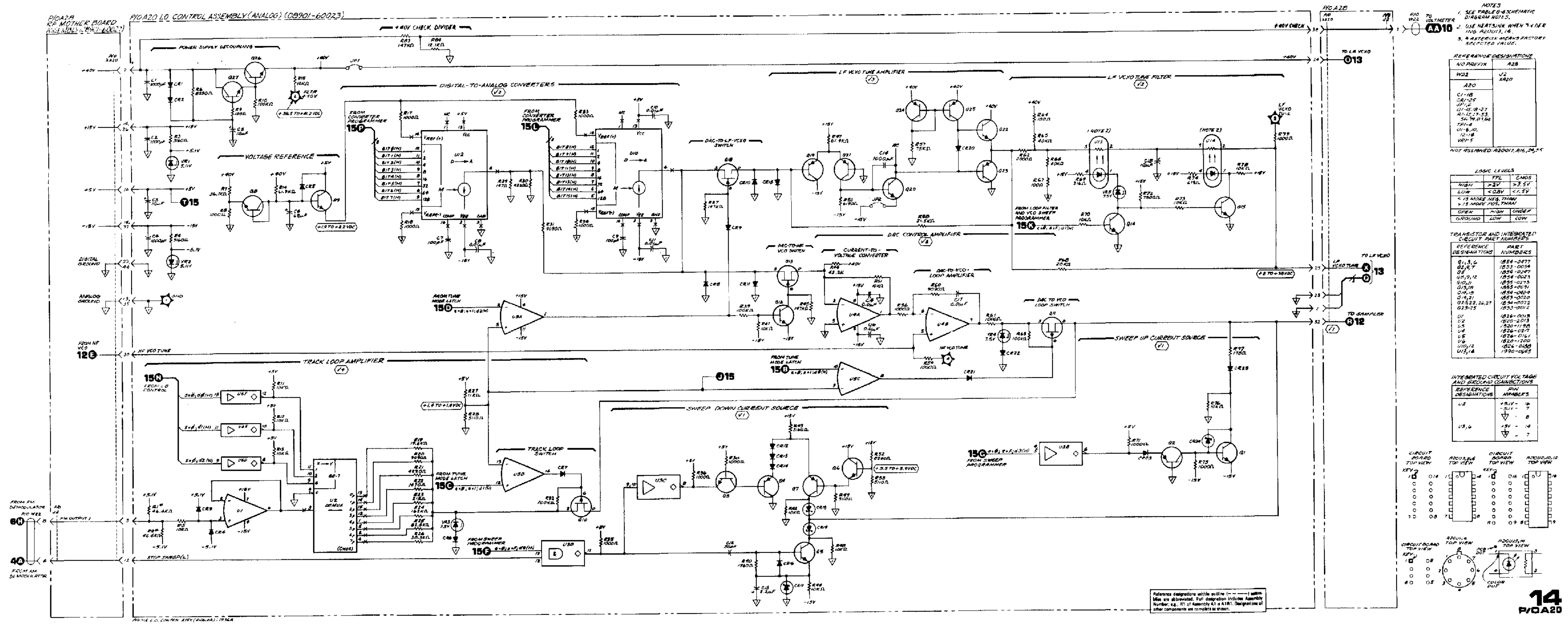


Figure 8-97. LO Control — Analog Circuits Schematic Diagram

SERVICE SHEET 15 — LO CONTROL — DIGITAL CIRCUITS (P/O A20)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the LO Control Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., √3. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals also are shown on the schematic inside a hexagon, e.g., +1.9 to +2.1 Vdc. Extend the board assembly where necessary to make measurements.

CAUTION

CMOS circuits can be damaged by static charges and circuit transients. Do not remove this assembly from the instrument while power is applied. Discharge the board, replacement device, and soldering iron to the same potential. (Use the conductive foam pad provided in the Service Accessory Kit HP 08901-60089.)

Equipment

Oscilloscope .... HP 1740A
Voltmeter .... HP 3455A

√1 Decoders and Latches General Check

1. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated with a dc voltmeter or a high-impedance, dc coupled oscilloscope. The Direct Control Special Functions are in the form 0.0sd. "s" is given in the table. Key in 0.0s0 SPCL first; a TTL low should be on the pins. Then key in 0.0sF; a TTL high should be on the pins. Furthermore, the pins should remain at their last state when any other IC is being addressed by the Direct Control Special Function.

Example: Key in 0.000 SPCL. Pins 16, 15, 10, and 9 of U19 should all read a TTL low. Key in 0.00F SPCL. The pins should all be high. Key in 0.010 SPCL. The same pins should remain high.

SERVICE SHEET 15 (Cont'd)

Direct Control Special Function	IC	Pins to Check
0.00d	U17	16, 15, 10, 9
0.01d	U18	16, 15, 10, 9
0.02d	U16	10, 9
0.03d	U16	16, 15
0.08d	U19	16, 15, 10, 9
0.09d	U20	16, 15, 10, 9
0.0Ad	U21	16, 15, 10, 9
0.0Bd	U22	16, 15, 10, 9
0.0Fd	U7	15, 10, 9

2. Key in 0.010 SPCL. Check pin 7 of U5B. It should be between +12 and +15 Vdc.

3. Key in 0.018 SPCL. Pin 7 of U5B should now be between −15 and −12 Vdc.

√2 Overpower and Attenuators Control Latch Check

1. Check that pin 1 of U15 is not a TTL low.

2. Key in 0.040 SPCL. Check pins 3 and 6 of U15 with a dc voltmeter or a high-impedance, dc coupled oscilloscope. The pins should be TTL high. Pin 14 of U15 should be a TTL low.

3. Key in 0.04F SPCL. Check pins 3, 6, and 14 of U15. The pins should all be TTL low.

4. Momentarily short pin 1 of U15 to ground. Check pins 3, 6, and 11 of U15. The pins should all go TTL high while pin 1 is grounded but return low when the short on pin 1 has been removed. (U15 does not remain reset because pin 9 is constantly being pulsed.)

5. Key in 0.050 SPCL to enable the Overpower Protect Status read-back transistor Q16. Check the collector of Q16 with a high-impedance, dc coupled oscilloscope. The collector of Q16 should be a steady high. The display should show 0000.0000.

6. Momentarily short pin 1 of U15. The waveform at the collector of Q16 should be a train of short, low-going TTL pulses with a period of approximately 7 ms. The pulses should remain unchanged when pin 1 is ungrounded. Also, the display should go from 0000.0000 to 0001.0000 when pin 1 is grounded and remain 0001.0000 when pin 1 is ungrounded.

CHANGES

2128A and above	**On the A28 schematic:** • **08901-60139** - Change the part number of A28 RF Motherboard Assembly to 08901-60139.
2617A and above	**On the A20 component locator:** • **08901-60285** - Use the new component locator, Figure 8–98. A20 LO Control Assembly Component Locations (2617A and above), on page 8-122.3. **On the A20 schematic:** • **08901-60285** - Use the new schematic foldout with revision date, rev.01NOV89.

Reserved for future changes.

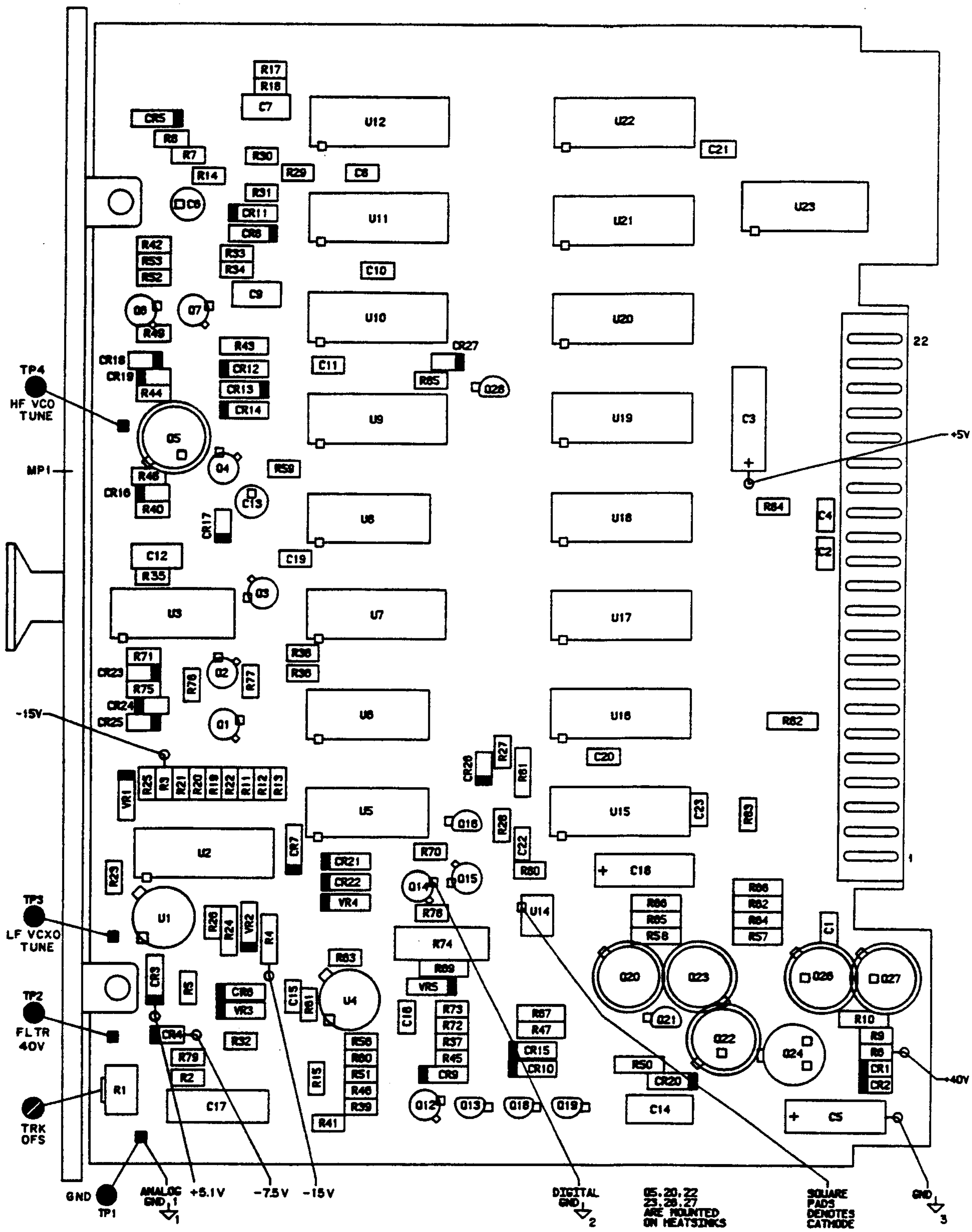


Figure 8–98. A20 LO Control Assembly Component Locations (2617A and above)

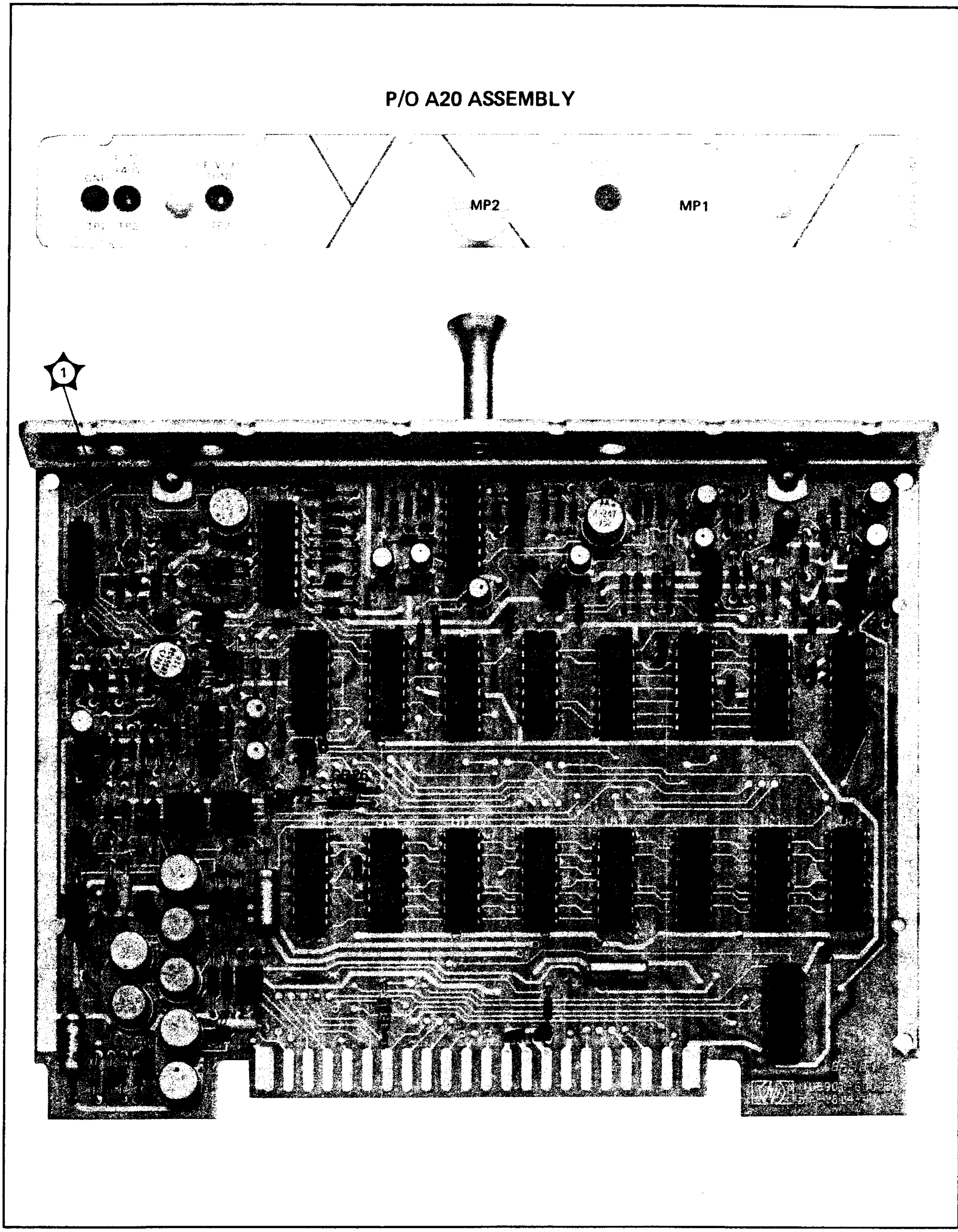
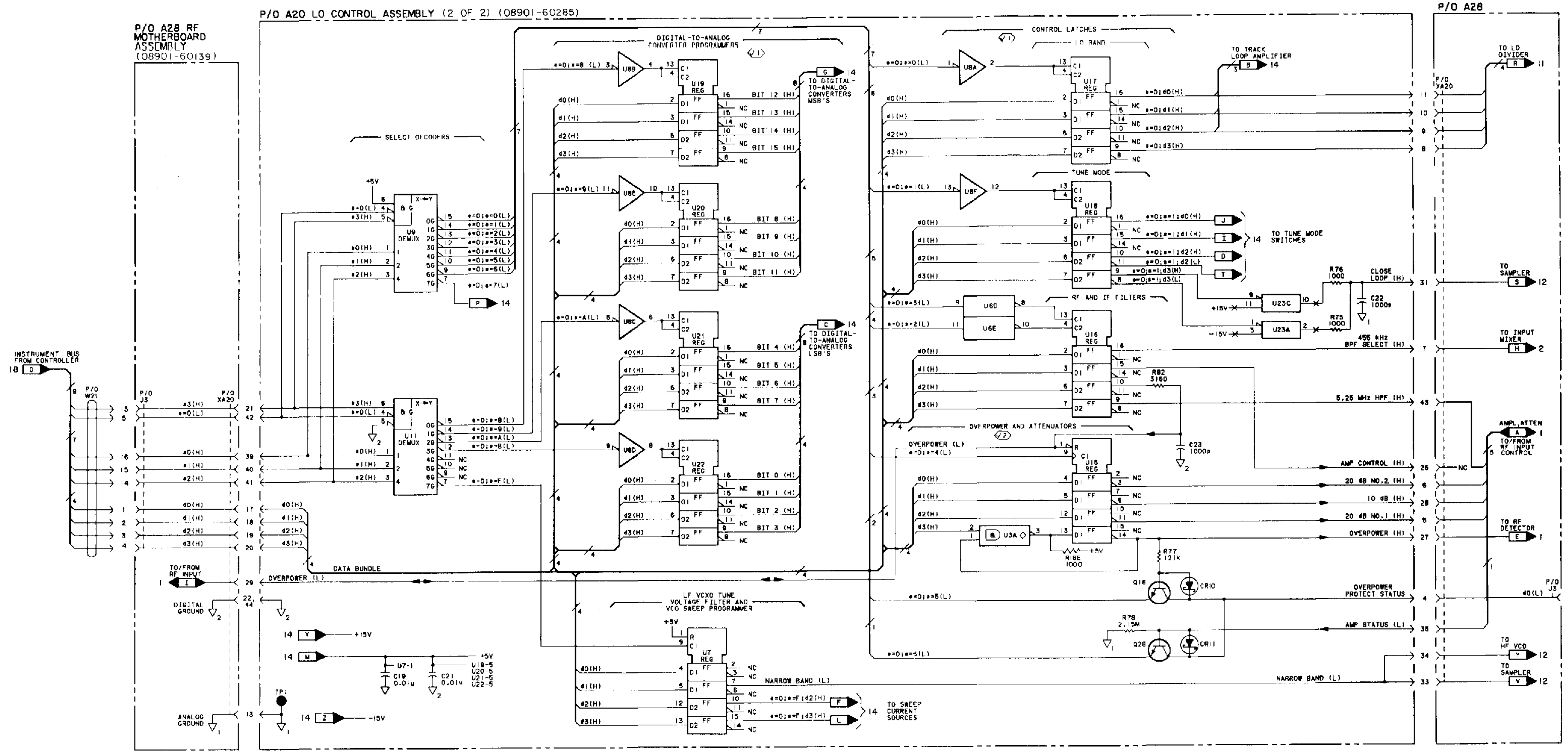


Figure 8-98. P/O A20 LO Control Assembly Component Locations (Digital Circuits)



NOTES

1. SEE TABLE 8-6 SCHEMATIC DIAGRAM NOTES.

DIGITAL INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U16-22	+5V - 5 ∇_2 - 12
U3,6,8,23	+5V 14 ∇_2 - 7
U7,9,11,15	+5V - 16 ∇_2 - 8
U23	+15 - 13 -15 - 4 ∇_1 - 5

SS15

FIG. 8-99. LO CONTROL DIGITAL CIRCUITS

rev.1NOV89

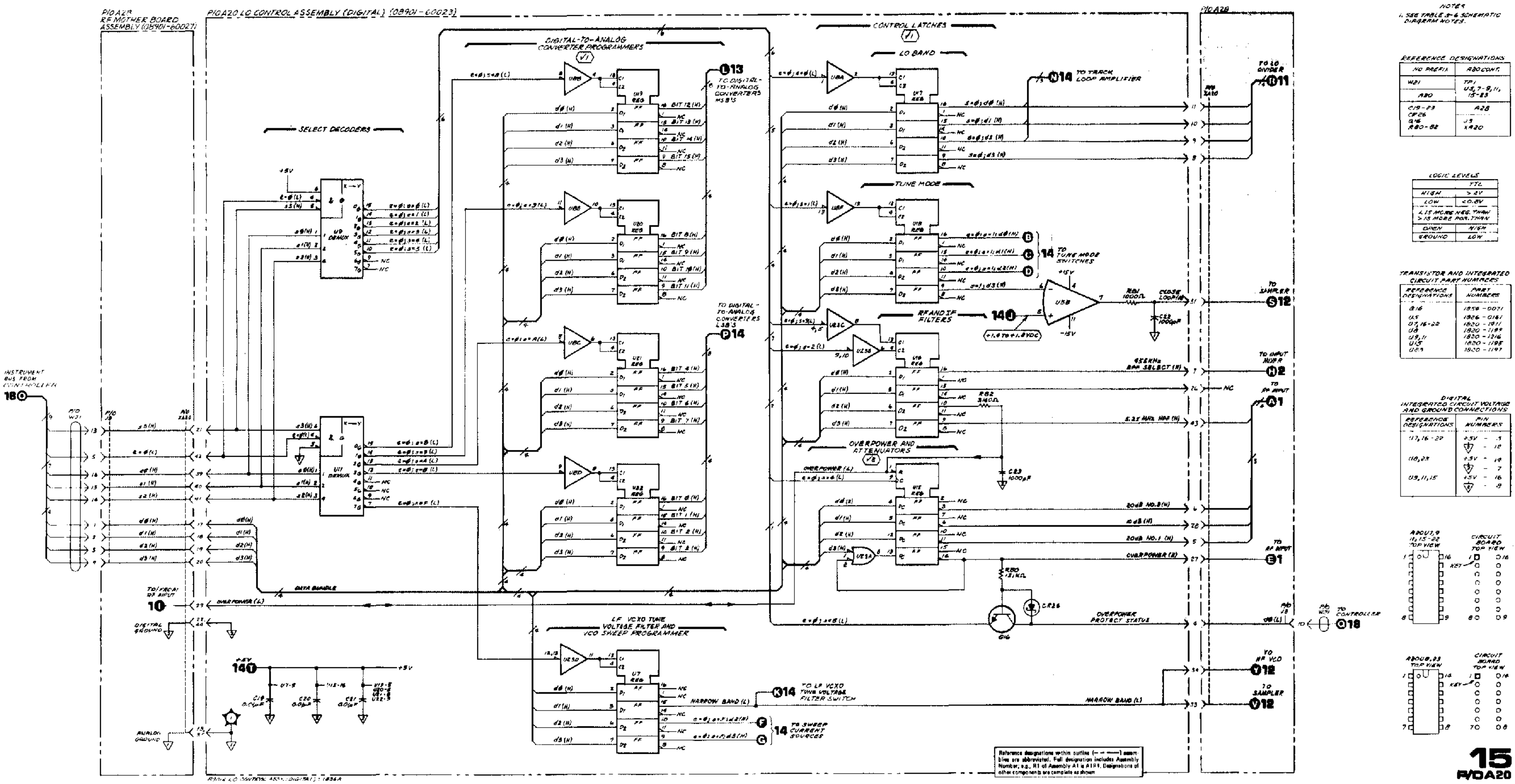


Figure 8-99. LO Control — Digital Circuits Schematic Diagram

SERVICE SHEET 16 — COUNTER — TIME BASE CIRCUITS (P/O A11)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD4
- Parts List .... Page 6-23
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-72

TROUBLESHOOTING

General

Procedures for checking the Counter Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., √3. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., +1.9 to -2.1 Vdc. Extend the board assembly where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope .... HP 1740A
Signal Generator .... HP 8640B

√1 10 MHz Time Base Reference Oscillator and ECL-to-TTL Translator Check

1. Connect a high-impedance, dc coupled oscilloscope to U2A pin 3. The waveform should be an ECL square wave with a period of 100 ns.

Hint: If the instrument has Option 002 (the high-stability internal reference oscillator), the input to A11J4 (10 MHz IN) should be a non-sinusoidal waveform of approximately 1 Vpp and 100 ns period. If the frequency of the time base reference is only slightly off, perform the Internal Reference Frequency Adjustment.

2. Connect the oscilloscope to the collector of Q4 and then Q3. The waveform in each case should be a TTL "square" wave with a period of 100 ns.

√2 External Time Base Buffer and Time Base Select Switch Check

NOTE

This check assumes that the √1 10 MHz Time Base Reference Oscillator and ECL-to-TTL Translator Check gives positive results.

LO Control — Digital Circuits P/O A20 SERVICE SHEET 15

SERVICE SHEET 16 (Cont'd)

1. Set the signal generator to 10 MHz CW at +13 dBm. Connect its RF output to A11J6 (EXT 10 MHz IN) or to the rear-panel J9 (TIME BASE 10 MHz INPUT).

2. Measure the following points with a high-impedance, dc coupled oscilloscope with the signal generator output both on and off:

Signal Generator Output	Signal Condition (TTL)						DS1
	U21-4	U4A-2	U4E-10	U3D-11	U3B-6	U3C-8	
On	(1)	(1)	L	(1)	H	(1)	On
Off	H	H	H	H	(2)	(2)	Off

(1) Square wave at signal generator's frequency.
(2) Square wave at internal time base reference frequency.

√3 Time Base Dividers Check

NOTE

This check assumes that the √2 External Time Base Buffer and Time Base Select Switch Check gives positive results.

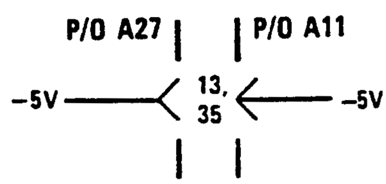
1. Check the following points with a high-impedance, dc coupled oscilloscope (all waveforms are TTL pulses):

IC	Pin	Nominal Period (μs)
U10A	2	0.5
U10A	12	0.5
U4B	4	0.5
U9A	12	4
U9B	5	8
U8A	12	40
U8B	5	80
U10B	5	160
U20B	6	160

CHANGES

All serial prefixes	**On the A11 schematic:** • **A11** - Use the partial schematic, P/O Figure 8-101. Counter – Timebase Ciruits Schematic Diagram, on page 8-124.3.
2623A and above	**On the A11 schematic:** • **08901-60292** - Change the part number of the the A11 Counter Assembly (standard) to 08901-60290. Change the part number of the A11 Counter Assembly (option 002) to 08901-60291.

Reserved for future changes.



P/O Figure 8-101. *Counter - Timebase Ciruits Schematic Diagram*

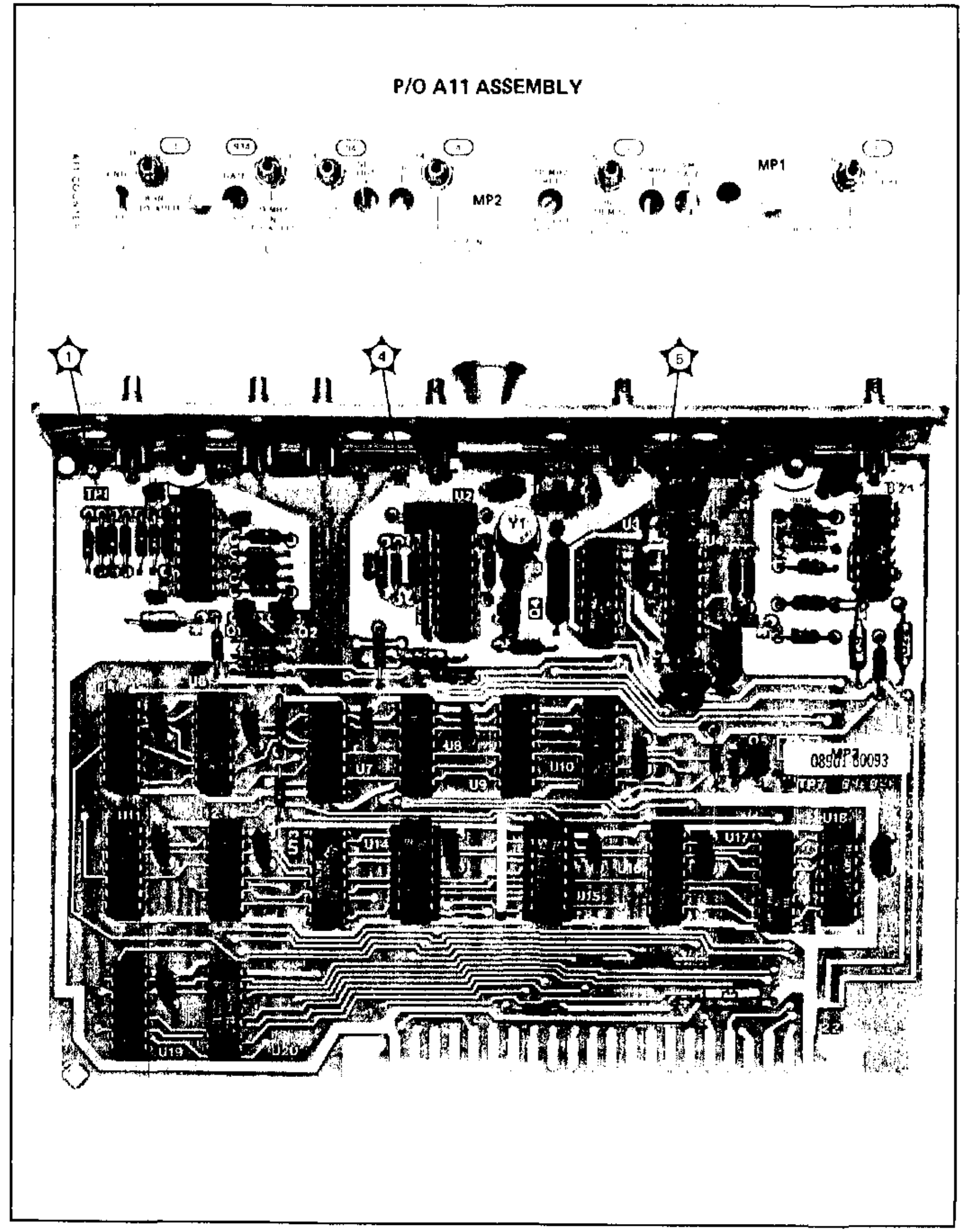


Figure 8-100. P/O A11 Counter Assembly Component Locations (Time Base Circuits)

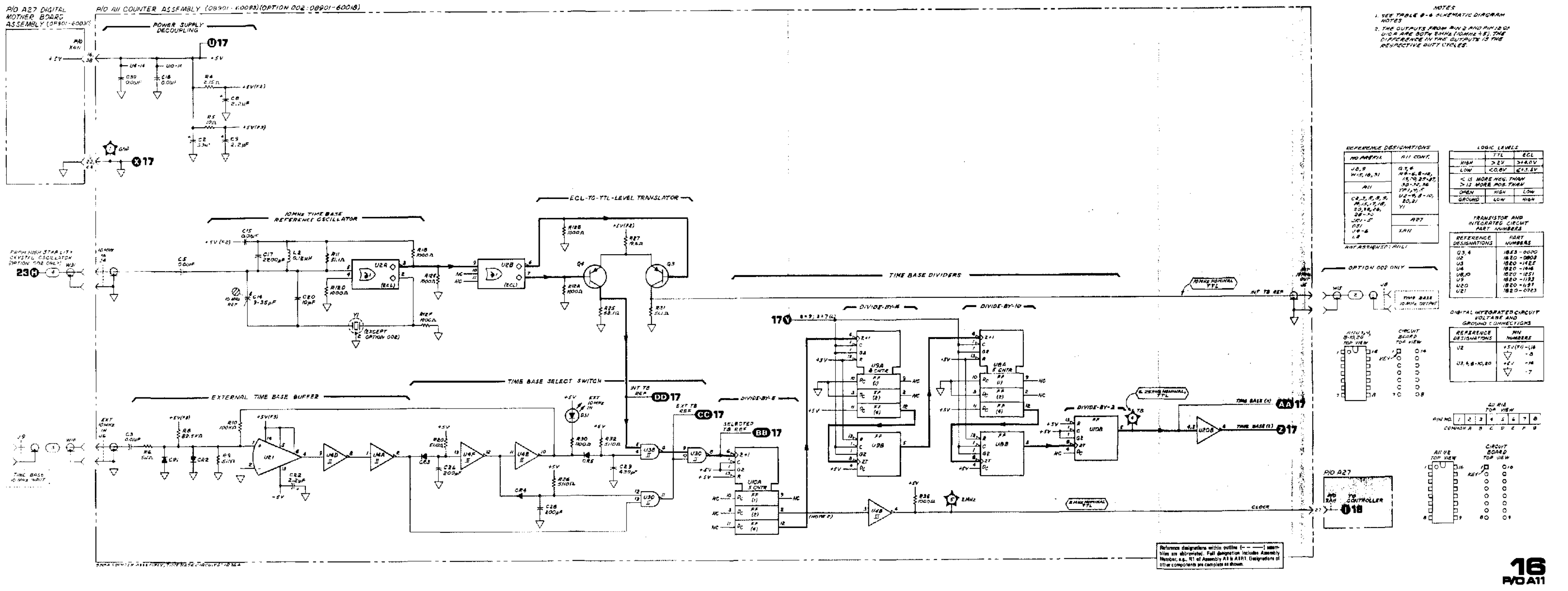


Figure 8-101. Counter — Time Base Circuits Schematic Diagram

SERVICE SHEET 17 — COUNTER — COUNTER CIRCUITS (P/O A11)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD4
- Parts List .... Page 6-23
- Direct Control Special Functions .... Page 8-8
- Signature Analysis .... Page 8-18
- Principles of Operation .... Page 8-72

TROUBLESHOOTING

General

Procedures for checking the Counter Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

- Oscilloscope .... HP 1740A
- Signal Generator .... HP 8640B
- Signature Analyzer .... HP 5004A

⟨√1⟩ Stage 1 Check

1. Disconnect all cables from the A11 Counter Assembly. For Option 002 only, disconnect W31 (yellow) back to A11J5 (INT 10 MHz IN) using an extender cable.

2. Set signal generator to 82 MHz CW at 0 dBm. Connect its RF output to A11J1 (÷8 IN).

3. Jumper pin 10 of U1B to A11TP1 (GND) to enable stage 1.

4. Key in 0.314 SPCL to assure SA Initialization is disabled.

5. Connect a high-impedance, dc coupled oscilloscope to the collector of Q2 then the collector of Q1. The oscilloscope should have a low-capacitance 10:1 divider probe. The waveform should be sinusoidal and TTL compatible with a period of approximately 24 ns.

Hint: Pins 4, 5, and 6 of U1A should be ECL low. Pin 11 of U1B should be an ECL square wave with a period of 160 μs. See logic level definitions on the service sheet schematic for the ECL levels used in the instrument.

SERVICE SHEET 17 (Cont'd)

6. Connect the oscilloscope to pin 9 of U6B. The waveform should be a TTL square wave with a period of approximately 100 ns. Ringing of the waveform is normal.

Hint: Pins 1 and 4 of U6A should be TTL high. The waveform at pin 5 of U6A should be a TTL square wave with a period of approximately 50 ns.

7. Set the signal generator frequency to 40 MHz. The waveform on pin 9 of U6B should now have a period of approximately 200 ns.

8. Remove the jumper from pin 10 of U1B.

9. Key in 0.363 SPCL to enable Stage 1. Connect the oscilloscope to pin 10 of U1B. The waveform should be low-going ECL pulses with a period of approximately 7 ms.

10. Key in 0.360 SPCL to disable Stage 1. Pin 6 of U1A should be an ECL high. The collectors of Q1 and Q2 should be steady TTL complements (either may be high).

11. Key in 0.370 SPCL to initialize Stage 1. The collector of Q2 and pins 5 and 9 of U6 should be TTL low.

⟨√2⟩ Stages 2, 3, and 4, Count Transfer Logic, and Counter Gate Control Check

NOTE

This check assumes that ⟨√1⟩ Stage 1 Check gives positive results and that the internal 10 MHz Time Base Reference and Time Base Dividers are operative (see Service Sheet 16).

1. Remove the three ribbon cables (W20, W21, and W23) that connect to the rear of the A27 Digital Mother Board Assembly. W23 is on the bottom of the mother board.

2. Set LINE to STBY. Remove the A14 Remote Interface Assembly from its socket. Set LINE back to ON.

3. Connect the signature analyzer start and stop to A13TP4 (TEST A), clock to A13TP10 (WRT), and ground to A13TP1 (GND) on the A13 Controller Assembly. Set start to trigger on a rising edge; set stop to trigger on a falling edge; set clock to trigger on a falling edge.

4. Disconnect all cables from the A11 Counter Assembly. Jumper A11J1 (÷8 IN) to A11J5 (INT 10 MHz OUT). For Option 002 only, connect W31 (yellow) back to A11J4 (10 MHz IN) using an extender cable.

5. Jumper A13TP6 (TEST C) to A13TP1 (GND) on the A13 Controller Assembly. Momentarily ground A13TP2 (RESET). This initiates the signature analysis routine.

SERVICE SHEET 17 (Cont'd)

6. Check the following points with the signature analyzer probe:

Description	Location	Signature
+5V	A13TP8 (+5V)	U637
d0(L)	A11U15 pin 6	139U
d1(L)	A11U15 pin 3	7864
d2(L)	A11U15 pin 11	0009
d3(L)	A11U15 pin 8	UU97

Hint: If d0(L) only is faulty, the Oven Warm Readback Circuit (Q5) may be faulty. If a data line itself is suspected (e.g., if the signature for d2(L) only is faulty), the line itself may be faulty; see ⟨√5⟩ CPU I/O Port Check on Service Sheet BD4. Otherwise, continue with step 7. If no signatures are faulty, perform the other checks on this service sheet.

7. Remove A13U14 and U15 from their sockets.

CAUTION

The IC sockets are a high-grip type. Their lifetime is limited to only a few insertions. Use caution when removing or inserting ICs to avoid damage to the socket or IC.

8. Check the following points with the signature analyzer probe (the pin numbers for A11U15 are the socket pin numbers):

Description	Location	Signature
+5V	A13TP8 (+5V)	U637
d0(L)	A11U15 pin 6	F4H6
d1(L)	A11U15 pin 3	F4H6
d2(L)	A11U15 pin 11	4058
d3(L)	A11U15 pin 8	U637

Hint: If faulty, the problem is with the data line itself; see ⟨√5⟩ CPU I/O Port Check on Service Sheet BD4.

9. Check the following points with the signature analyzer probe:

SERVICE SHEET 17 (Cont'd)

Pin	U12	U13	U16	U17	U18	U20	Pin
1	3U50	U637	4144	5A66	8U7U	747P	1
2	F967	32P1	4U22	0C54	32P1	5CC4	2
3	7948	32P1	3U50	6209	8714	2UFA	3
4	8U7U	C773	U637	29PC	—	—	4
5	2UFA	U637	CFP3	0000	—	—	5
6	H9UH	3910	4AH4	U637	—	—	6
7	0000	8U7U	0000	3U50	0000	0000	7
8	747P	U637	74P6 or 7UUH	0000	—	—	8
9	8249	0000	7A82 or 7199	7948	—	—	9
10	—	C915	3U50	U74A	—	—	10
11	—	4U22	AC99 or 5HAP	5CC4	CFP3	8249	11
12	C773	0000	8714	0FA6	4AH4	8PPU	12
13	4144	C773	4U22	8PPU	U637	0FA6	13
14	U637	U637	U637	4144	U637	U637	14
15	—	0000	—	U637	—	—	15
16	—	0000	—	U637	—	—	16

Note: The signature for a high or +5V is U637. The signature for a low or ground is 0000. Dual signatures for U16 result because Time Base cannot now be read through U14D.

Hint: If faulty, check the components associated with the first faulty node (relative to the signal flow).

10. Plug in A11U14. Check the following points with the signature analyzer probe:

Pin	U5	U7	U11	U14	U19	Pin
1	8PPU	—	747P	32P1	H9UH	1
2	H9FP	—	2P6C	8U7U	9053	2
3	—	—	H9FP	8714	2P6C	3
4	CFP3	—	—	8U7U	UC92	4
5	—	—	UC92	U382	HU31	5
6	—	—	UC92	3202	HU31	6
7	0000	7199	0000	0000	0000	7
8	—	0000	0AHU	2PC7	9AP3	8
5	—	0000	1P16	H9UH	8AHH	9
10	—	0000	—	U74A	1P16	10
11	—	0000	0AHU	FH9F	9AP3	11
12	0AHU	—	9AP3	8PH6	U382	12
13	3U50	—	3U50	8U7U	3U50	13
14	U637	—	U637	U637	U637	14
15	—	—	—	—	—	15
16	—	U637	—	—	—	16

Note: The signature for a high or +5V is U637. The signature for low or ground is 0000.

Hint: If a signature is faulty, check the components associated with the first faulty node (relative to the signal flow). Otherwise, the fault

SERVICE SHEET 17 (Cont'd)

is probably with A11U15. Note that some outputs of Stages 1 and 2 cannot be checked because the data occurs at a higher rate than the signature analysis clock.

11. For reference, the signatures with A11U14 and A11U15 plugged in are as follows:

Pin	U5	U7	U11	U12	U13	U14	U15	U16	Pin
1	8PPU	—	747P	3U50	U637	P5A8	8AHH	4144	1
2	H9FP	—	2P6C	F967	P5A8	8U7U	2PC7	4U22	2
3	—	—	H9FP	7948	8P53	8714	7864	3U50	3
4	CFP3	—	—	8U7U	C773	8U7U	HU31	U637	4
5	—	—	UC92	2UFA	U673	U382	2PC7	CFP3	5
6	—	—	UC92	H9UH	A815	0009	139U	4AH4	6
7	0000	7199	0000	0000	CH74	0000	0000	0000	7
8	—	0000	0AHU	747P	U637	2PC7	UU97	7UUH	8
9	—	0000	1P16	8249	0000	H9UH	U382	7199	9
10	—	0000	—	—	C915	U74A	2PC7	3U50	10
11	—	0000	0AHU	—	4U22	UU97	0009	8PH6	11
12	0AHU	—	9AP3	C773	0000	8PH6	9053	8714	12
13	3U50	—	3U50	4144	C773	8U7U	2PC7	4U22	13
14	U637	—	U637	U637	U637	U637	U637	U637	14
15	—	—	—	—	0000	—	—	—	15
16	—	U637	—	—	0000	—	—	—	16

Pin	U17	U18	U19	U20	Pin
1	5A66	8U7U	H9UH	747P	1
2	0C54	8P53	9053	5CC4	2
3	6209	8714	2P6C	2UFA	3
4	29PC	—	UC92	—	4
5	0000	—	HU31	—	5
6	U637	—	HU31	—	6
7	3U50	0000	0000	0000	7
8	0000	—	9AP3	—	8
9	7948	—	8AHH	—	9
10	U74A	—	1P16	—	10
11	5CC4	CFP3	9AP3	8249	11
12	0FA6	4AH4	U382	8PPU	12
13	8PPU	U637	3U50	0FA6	13
14	4144	U637	U637	U637	14
15	U673	—	—	—	15
16	U673	—	—	—	16

Note. The signature for a high or +5V is U637. The signature for a low or ground is 0000.

Hint: Note that some of the outputs of Stages 1 and 2 cannot be checked because the data occurs at a higher rate than the signature analysis clock.

SERVICE SHEET 17 (Cont'd)

⟨√3⟩ Input Selector and Voltmeter Gate Check

NOTE

This check assumes that ⟨√1⟩ Stage 1 check gives positive results.

1. Connect a high-impedance, dc coupled oscilloscope to A11TP3 (SEL OUT). The oscilloscope should have a low-capacitance 10:1 divider probe.

2. For Option 002 only, connect W3 (yellow) to A11J4 (10 MHz IN) using an extender cable.

3. Jumper pin 10 of U1B to A11TP1 (GND) to enable Stage 1. Jumper A11TP6 (VM GATE) to A11TP1 (GND) to force Stop Count low.

4. Set the signal generator to 10 MHz CW at +16 dBm (TTL compatible level). Connect its RF output to input indicated below with a 50Ω termination in parallel. For each input, key in the Direct Control Special Function indicated and note the period of the waveform at A11TP3. The waveform should be TTL compatible.

Input Jack	Direct Control Special Function	Nominal Period (ns) at A11TP3
A11J1 (÷8 IN)	0.314	800
A11J3 (IF IN)	0.315	100
None	0.316	100
A11J2 (10 MHz IN)	0.317	100
None	0.31C	100
A11J6 (EXT 10 MHz IN)	0.31D	100
None	0.31E	100

Hint: If the only failure is with 0.316 (a check of the voltmeter input), check pin 10 of U20C which should be a TTL high. Pin 8 of U20C should be a TTL square wave with a period of 100 ns.

5. Remove the short from A11TP6. Check pin 2 of U7 which should be a TTL low.

⟨√4⟩ Select Decoder, Data Latch, and Oven Warm Readback Circuit Check

1. For Option 002 only, connect W3 (yellow) to A11J4 (10 MHz IN) using an extender cable.

2. Key in the Direct Control Special Functions indicated below. For each setting, check the pins on U17 indicated with a high-impedance, dc coupled oscilloscope.

Direct Control Special Function	Level (TTL) at U17 Pin							
	15	14	13	12	11	10	9	7
0.300	*	H	H	H	H	H	H	H
0.310	H	*	H	H	H	H	H	H
0.320	H	H	*	H	H	H	H	H
0.330	H	H	H	*	H	H	H	H
0.340	H	H	H	H	*	H	H	H
0.350	H	H	H	H	H	*	H	H
0.360	H	H	H	H	H	H	*	H
0.370	H	H	H	H	H	H	H	*

*Low-going TTL pulses, ~7 ms period.

3. Key in the Direct Control Special Functions indicated below. For each setting, check the pins on U13 indicated.

Direct Control Special Function	Level (TTL) at U13 Pin			
	16	15	11	9
0.310	L	L	H	L
0.31F	H	H	L	H

4. For Option 002 only, temporarily unplug the A11 Counter Assembly; tape over pin 34 of the edge connector with a small piece of tape so it can no longer make contact, then plug the assembly back in.

5. Key in 0.300 SPCL to enable the Oven Warm Readback Circuit readback. The display should read 0001.0000 (oven cold).

6. Ground the end of R39 that connects to pin 34 of the edge connector. The display should read 0000.0000 (oven warm).

7. Key in 0.000 SPCL to disable oven readback. Check pin 6 of U15B (the d0(L) line) with the oscilloscope. The signal should be a steady TTL high.

8. Remove the tape from pin 34 of the edge connector.

CHANGES

All serial prefixes	**In the Troubleshooting Section:** • - In ⟨√1⟩ Stage 1 Check, step 1, change A11J5 to A11J4. • - In ⟨√2⟩ Stage 2, 3, and 4, Count Transfer Logic, and Counter Gate Control Check, step 7, change A13U14 to A11U14. **On the A11 schematic:** • R16 - Change the value of R16 to 1 k ohm.
2623A and above	**On the A11 schematic:** • **08901-60292** - Change the part number of the the A11 Counter Assembly (standard) to 08901-60290. Change the part number of the A11 Counter Assembly (option 002) to 08901-60291.

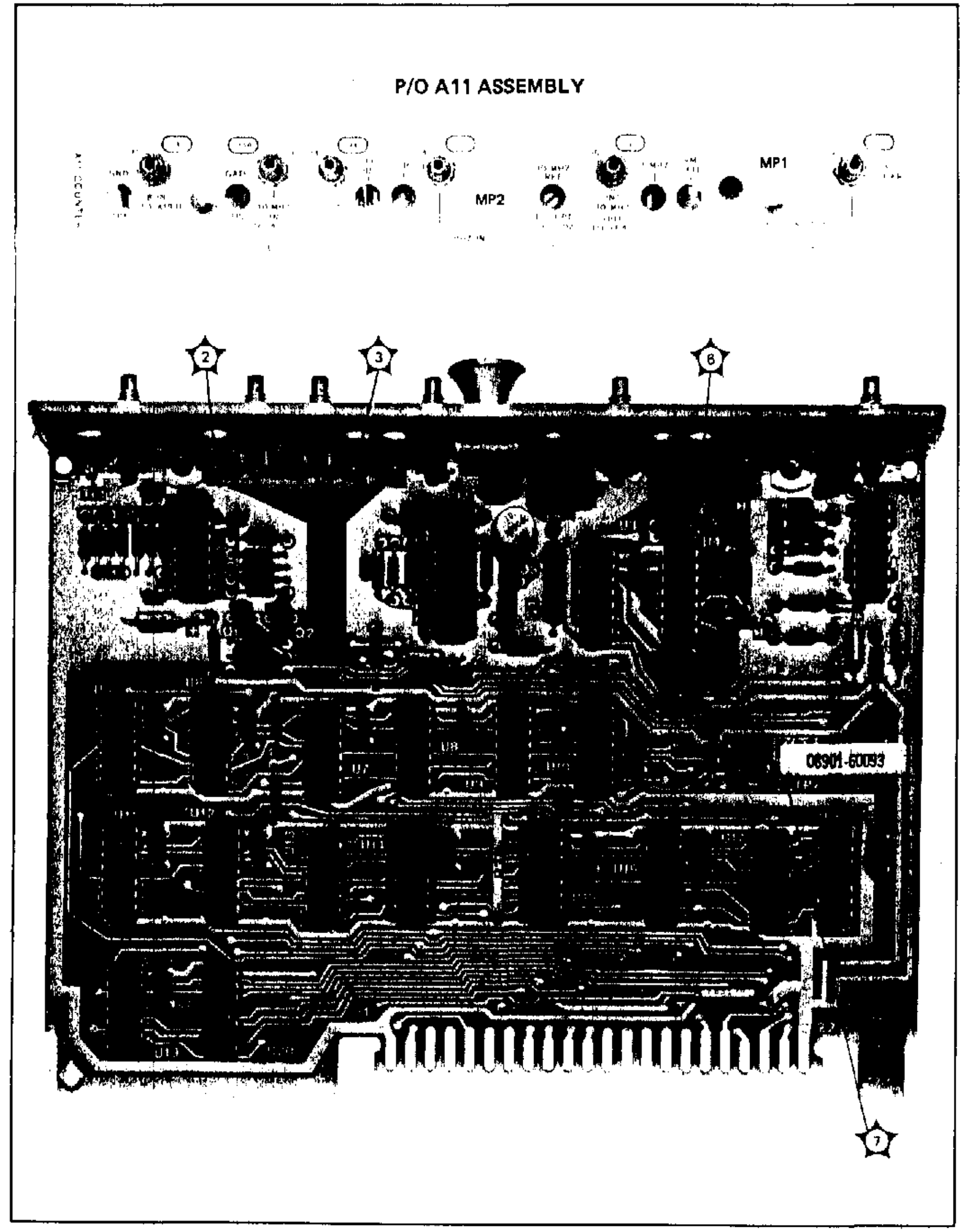
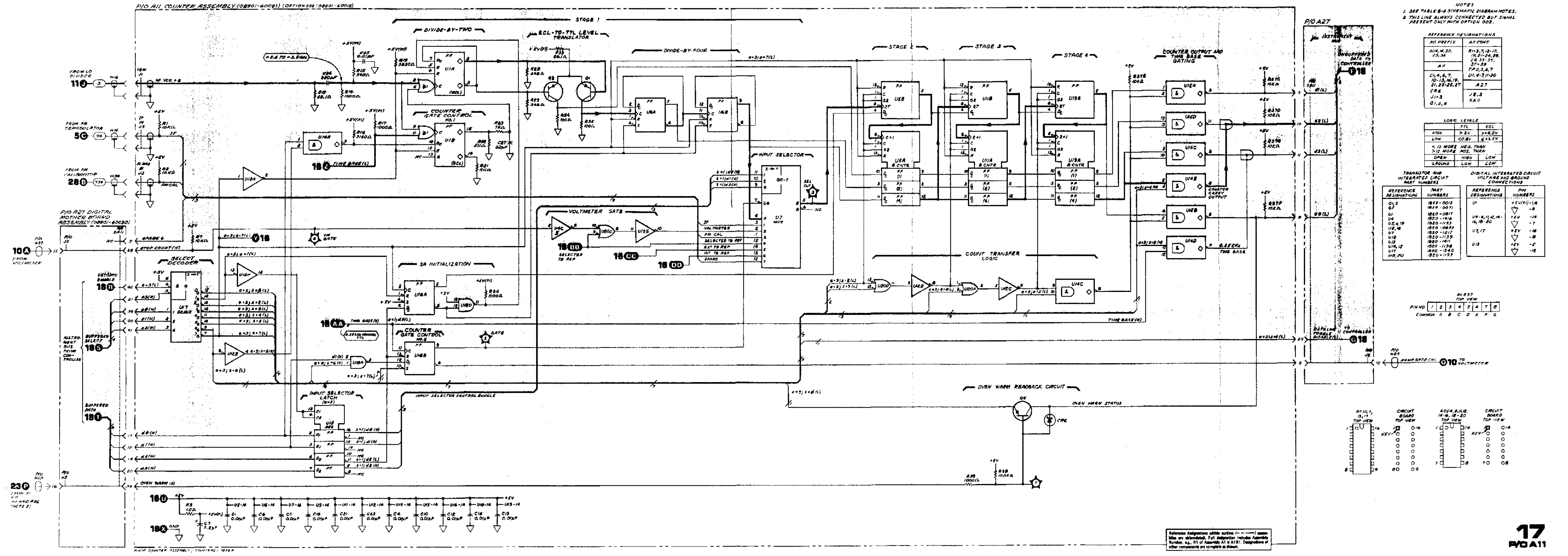


Figure 8-102. P/O A11 Counter Assembly Component Locations (Counter Circuits)



17
P/O A11

Figure 8-103. Counter — Counter Circuits Schematic Diagram

SERVICE SHEET 18 — CONTROLLER — MICROPROCESSOR (P/O A13)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD4
- Parts List .... Page 6-25
- Direct Control Special Functions .... Page 8-8
- Signature Analysis .... Page 8-18
- Principles of Operation .... Page 8-74

TROUBLESHOOTING

General

Procedures for checking the Controller Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTIONS

MOS and CMOS ICs can be damaged by static charges and circuit transients. Do not remove this assembly from the instrument while power is applied. Discharge the board and replacement IC to the same potential. (Use the conductive foam pad provided in the Service Accessory Kit HP 08901-60089.) When unplugging ICs, place the board on a conductive pad. When the IC is unplugged, insert it into the foam also.

Several ICs on this assembly are held in high-grip sockets. Both the socket and the device can be damaged if an attempt is made to remove the device with an IC extraction tool. The recommended procedure is to first ground the tip of a small blade-type screwdriver, then slide the tip between the IC and the socket and slowly pry up the IC one pin at a time.

If the Modulation Analyzer powers up correctly, it is a strong indication that the Controller circuits are operating properly. In most cases, the two most common indications of a Controller fault is that the instrument fails to complete even the first phase of the power-up routine or that it behaves very erractically. However, be very careful about assuming a Controller failure when the instrument behaves erratically. Because of the close interrelationship of the circuit components, the data feedback loops, and the software, a failure that is occurring in one section of the instrument can affect other areas. For example, almost any malfunction will prevent the Modulation Analyzer from tuning properly.

In addition, keep the following points in mind when troubleshooting the Controller:

SERVICE SHEET 18 (Cont'd)

1. *It is important to understand the structure of the Controller's* buses. Data on these buses is often unstable or meaningless because of multiplexing, switching transients, and open collector circuits. These conditions cause no problems for the Controller itself since it is synchronous and knows when the bus lines contain stable signals. (This is also true for the signature analyzer.) However, this is not true of other instruments testing the Controller such as a logic probe or oscilloscope. These test instruments, though, can still be used to examine qualitative factors such as general activity, logic levels, waveform timing, and bus conflicts.

2. Since bus structures also make it possible for many devices to be connected together on a single node, finding the one bad device on such a node can be difficult. A current tracer is useful for this purpose.

3. The Controller is a sequential processor. Program flow depends on a long sequence of instructions and events. If even a single bit of information is incorrect, the entire sequence can be changed. Bad *memory bits are the most common source of single-bit errors.*

4. The proper operation of the clock circuits is critical.

5. An improper reset can cause the Controller to appear to be running, but it may be incorrectly initialized or running the wrong sequence of software.

6. Interrupts are edge triggered. A stuck interrupt will interrupt once and then never again. An intermittent interrupt will keep interrupting. When the Controller is interrupted, the measurement is aborted, and the complete measurement cycle restarts at the beginning. Therefore, if the intermittent interrupt occurs frequently, it will completely prevent the instrument from operating.

Equipment

Digital Test/Extender Board .... HP 08901-60081
Signal Analyzer .... HP 5004A

⟨√1⟩ Power-Up and Reset Check

1. Switch LINE to STBY. Extend the A13 Controller Assembly with the Digital Test/Extender Board. Switch LINE to ON. Check the sequencing of the TEST LEDs. If the TEST LEDs are able to sequence through the power-up routine, even though errors are indicated, see the Power-Up Checks of Service Sheet BD1. If the TEST LEDs come on and remain in the random state as specified in the Power-Up Checks, perform step 2.

2. While monitoring pin 8 of U1C, momentarily ground A13TP2 (RESET) by shorting it to A13TP1 (GND). Pin 8 of U1C should go low momentarily to reset the CPU (U14).

SERVICE SHEET 18 (Cont'd)

Hint: If pin 8 of U1C does not go low, momentarily ground it. If the power-up/reset function then proceeds normally, check the Power On Reset circuit.

⟨√2⟩ Memory Select Decoders and ROM Check

NOTE

This check is a continuation of the Controller Kernel Check of Service Sheet BD4.

1. Switch LINE to STBY. Remove A13U15 (CPU External Register —RAM) from its socket. Extend A13 Controller Assembly with the Digital Test/Extender Board. Extend A14 Remote Interface Assembly in front of A13 on normal extender boards. Switch LINE to ON.

NOTES

The HP-IB cable W30 need not be connected to A14.

A13 and A14 may be inserted into any of the three open slots in the Digital Section.

2. Short A13TP2 (RESET) to A13TP1 (GND). Switch the ROMC switches on the extender board to ground. On the extender board, connect the signature analyzer clock to WRT, start and stop to ADDRESS 15, and ground to GND. Set the signature analyzer's start to trigger on a falling edge and stop and clock to trigger on a rising edge. Check the following pins on A13U12, A13U13, and A14U18 (see Service Sheet 22 for A14U18) with the signature analyzer probe:

Selected ROM	Pin on A13U12	Signature
1	15	4CP2
2	14	U1U2
3	13	P352
4	12	340A
5	11	8UH9
6	10	2F25
7	9	F615
8	7	6F7P
Selected RAM	**Pin on A13U13**	**Signature**
RAM	7	0U2U
Selected ROM	**Pin on A14U18**	**Signature**
11	9	0H59

Hint: If faulty, check A13U12, A13U13, or A14U17 and their output lines.

SERVICE SHEET 18 (Cont'd)

3. Connect the signature analyzer start and stop to the pin on the IC listed below. Then check the indicated CONTROL BUS test points on the extender board with the signature analyzer probe.

NOTE

The signatures below are valid only for the ROMs with the specified part number. Consult Section VII BACKDATING or the Manual Changes Supplement for signatures corresponding to ROMs with other part numbers.

ROM	Start/Stop		Signature on CONTROL BUS DATA Test Point *							
	IC	Pin	0	1	2	3	4	5	6	7
1	A13U12	15	0P97	H1A3	F272	C5H9	F361	5727	H97H	A31H
2	A13U12	14	1CU9	H04A	4FPF	11F5	7127	9436	3198	221C
3	A13U12	13	FUUH	4071	P1U9	86A5	89HC	HC04	UP6U	P675
4	A13U12	12	PF63	CH3C	H738	FFU3	5085	P57A	69FU	HF09
5	A13U12	11	H5C4	U937	86CP	A58F	A136	FC40	9834	A624
6	A13U12	10	0959	U952	FHUF	P0U9	65UU	29UP	CP7H	A0U8
7	A13U12	9	U80C	1A8H	C898	76AA	UC8A	588A	F71A	8627
8	A13U12	7	U451	U20U	P807	HC50	0967	CPU1	84C6	H63A
11	A14U18	9	0147	PFC8	2U9A	4019	9UF0	39H3	F064	6A59

* Valid ROM part numbers:

ROM Number	Part Number
1	08901-80032
2	08901-80030
3	1818-0920 or 08901-80011
4	1818-0921 or 08901-80012
5	1818-0922 or 08901-80013
6	1818-0926 or 08901-80014
7	1818-0923 or 08901-80015
8	1818-0925 or 08901-80025
11	1818-0924 or 08901-80023

Hint: A faulty signature indicates a faulty ROM.

⟨√3⟩ Enable Decoder Check

1. Key in the Direct Control Special Functions indicated below. For each setting, check the pins on U17 indicated.

◀ Counter — Counter Circuits P/O A11 SERVICE SHEET 17

SERVICE SHEET 18 (Cont'd)

Direct Control Special Function	Level (TTL) at U17 Pin											
	1	2	3	4	7	9	10	11	12	13	14	15
0.000	L	L	L	*	H	H	H	H	H	H	H	*
0.100	H	L	L	*	H	H	H	H	H	H	*	H
0.200	L	H	L	*	H	H	H	H	H	*	H	H
0.300	H	H	L	*	H	H	H	H	*	H	H	H
0.400	L	L	H	*	H	H	H	*	H	H	H	H
0.500	H	L	H	*	H	H	*	H	H	H	H	H
0.600	L	H	H	*	H	*	H	H	H	H	H	H
0.700	H	H	H	*	*	H	H	H	H	H	H	H

*Low-going TTL pulses, ≈7 ms period.

Hint. If "enable = 7" is bad, these special functions cannot be keyed into the instrument (perform the Front-Panel Keys and Scanners Check — using Signature Analysis on Service Sheet 20).

⟨√4⟩ Select and Data Buffers Check

1. Key in the Direct Control Special Functions indicated below. For each setting, check the pins indicated.

Direct Control Special Function	Level (TTL) at U16 Pin							
	9	8	5	6	3	4	1	2
0.000	H	L	H	L	H	L	H	L
0.0FF	L	H	L	H	L	H	L	H

Direct Control Special Function	Level (TTL) at U18 Pin							
	12	11	9	8	1	3	5	6
0.000	H	L	H	L	H	L	H	L
0.0FF	L	H	L	H	L	H	L	H

CHANGES

2212A and above	**In the SS18 troubleshooting:** • <u>**Check 2**</u> - In ⟨√2⟩ Memory Select Decoders and ROM Check, replace the signature analysis and part number tables with those found on page 8–128.3.
2623A and above	**On the A13 component locator:** • <u>**C10, C11, L1**</u> - Delete C10, C11, and L1. **On the A13 schematic:** • <u>**C10, C11, L1**</u> - Delete C10, C11, and L1.

Reserved for future changes.

Signatures for ⟨√2⟩ Memory Select Decoders and ROM Check, step 3

ROM	Start/Stop		Signature on CONTROL BUS DATA Test Point							
	IC	Pin	0	1	2	3	4	5	6	7
1	A13U12	15	IPU9	4HOC	U93P	76PU	3919	P64P	167F	4119
2	A13U12	14	4P82	4P18	9U27	22C5	18AH	A678	A075	025A
3	A13U12	13	FUUH	4071	P1U9	86A5	89HC	HC04	UP6U	P675
4	A13U12	12	PF63	CHC3	H738	FFU3	5085	P57A	69FU	HF09
5	A13U12	11	H5C4	U937	86CP	A58F	A136	FC40	9834	A624
6	A13U12	10	0959	U952	FHUF	POU9	65UU	29UP	CP7H	AOU8
7	A13U12	9	2CA4	1A8H	C898	76AA	UC8A	588A	F71A	8627
8	A13U12	7	U451	U20U	P807	HC50	0967	CPU1	84C6	H63A
11	A14U18	9	3378	673F	3250	AFC9	5A23	PC30	5475	9FU9

ROM Part Numbers

ROM Number	Part Number
1	08901-80040
2	08901-80041
3	08901-80011
4	08901-80012
5	08901-80013
6	1818-0926 or 08901-80014
7	08901-80039 or 08901-80015
8	08901-80025
11	1818-1364

P/O A13 ASSEMBLY

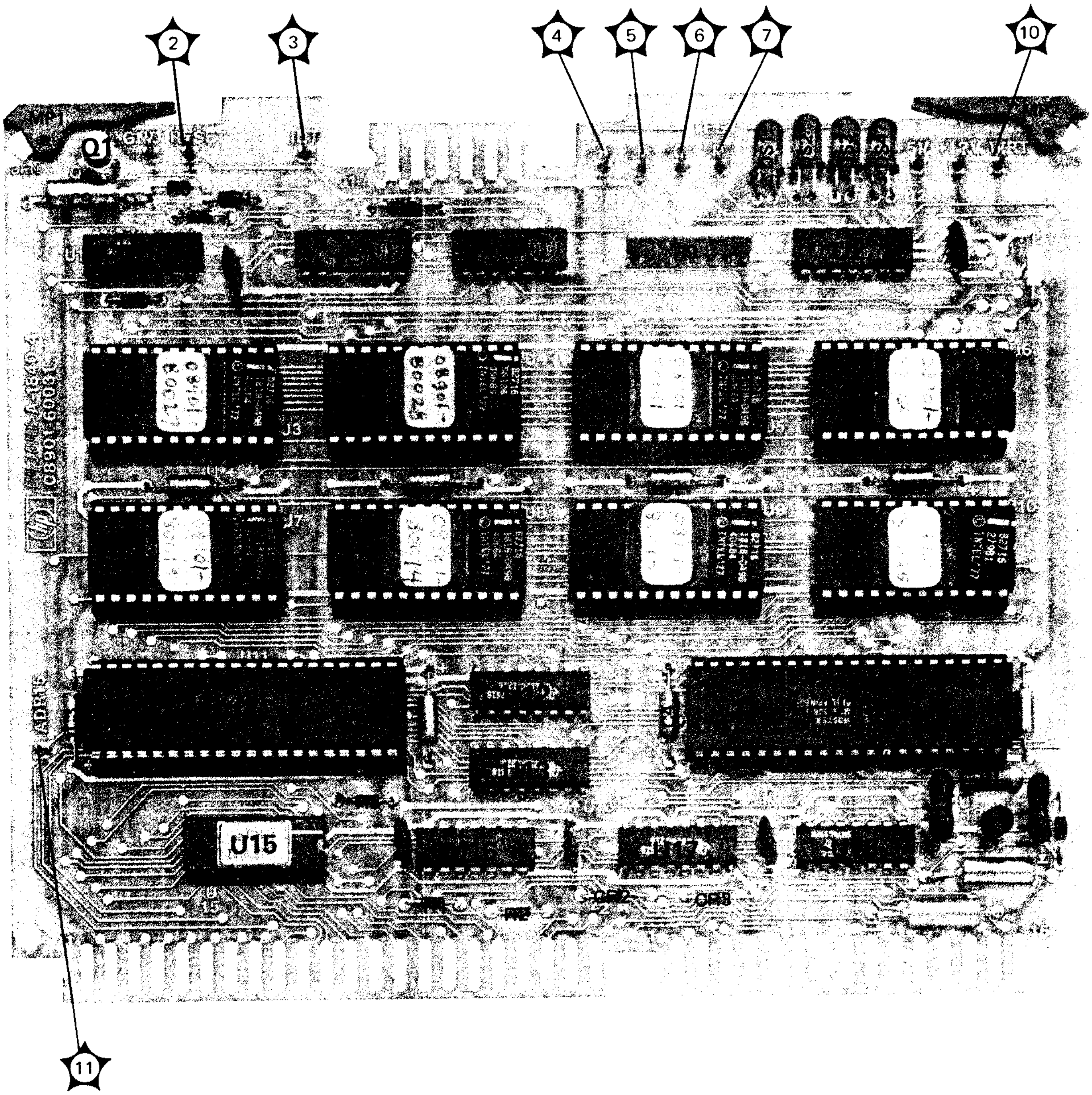


Figure 8-104. P/O A13 Controller Assembly Component Locations
(Microprocessor)

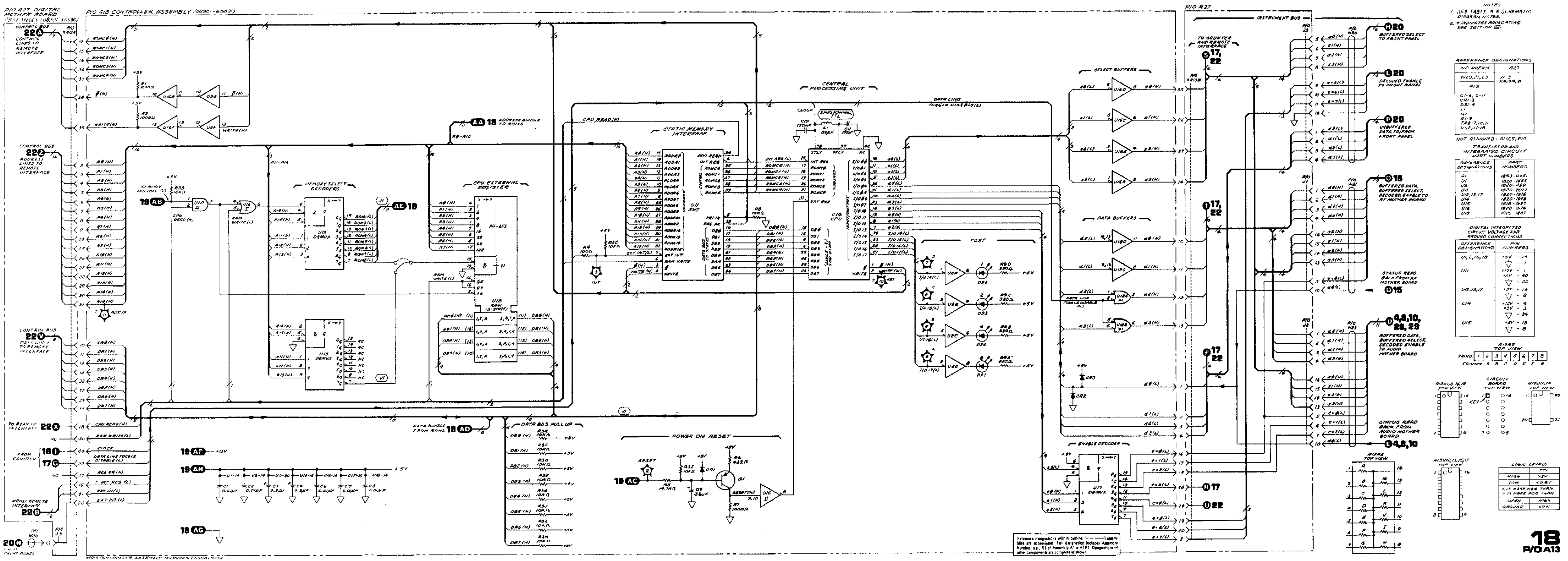


Figure 8-105. Controller — Microprocessor Schematic Diagram

SERVICE SHEET 19 — CONTROLLER — ROMS (P/O A13)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD4
- Parts List .... Page 6-25
- Direct Control Special Functions .... Page 8-8
- Signature Analysis .... Page 8-18
- Principles of Operation .... Page 8-74

TROUBLESHOOTING

Procedures for checking the ROMs are given in the Memory Select Decoders and ROM Check on Service Sheet 18.

CHANGES

All serial prefixes	**On the A13 schematic:** • <u>**U5, U6, U7**</u> - In the Table of Transistor and Integrated Circuit Part Numbers, change U5 to 08901-80011, U6 to 08901-80012, and U7 to 08901-80013.

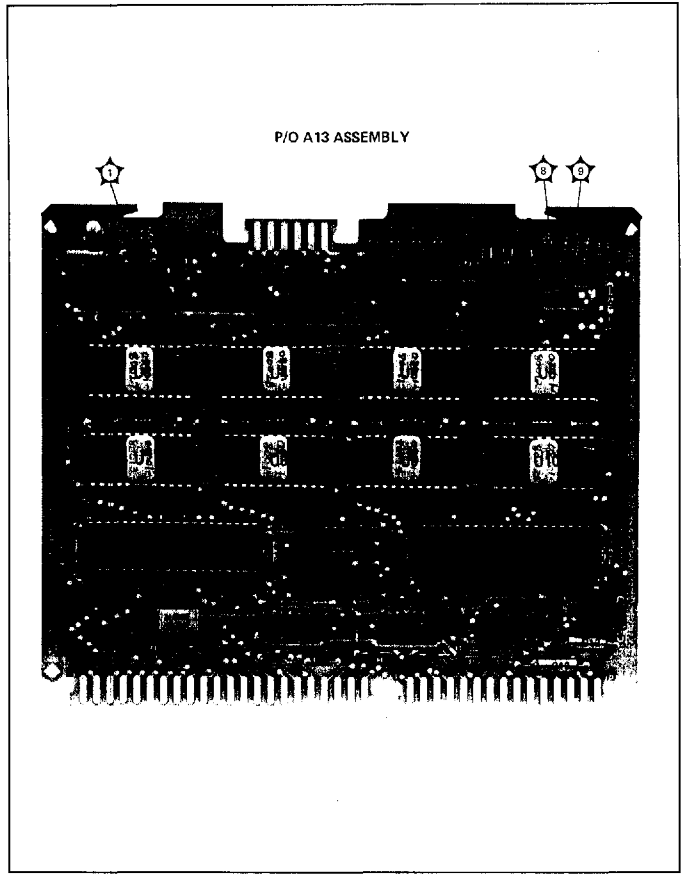


Figure 8-106. P/O A13 Controller Assembly Component Locations (ROM)

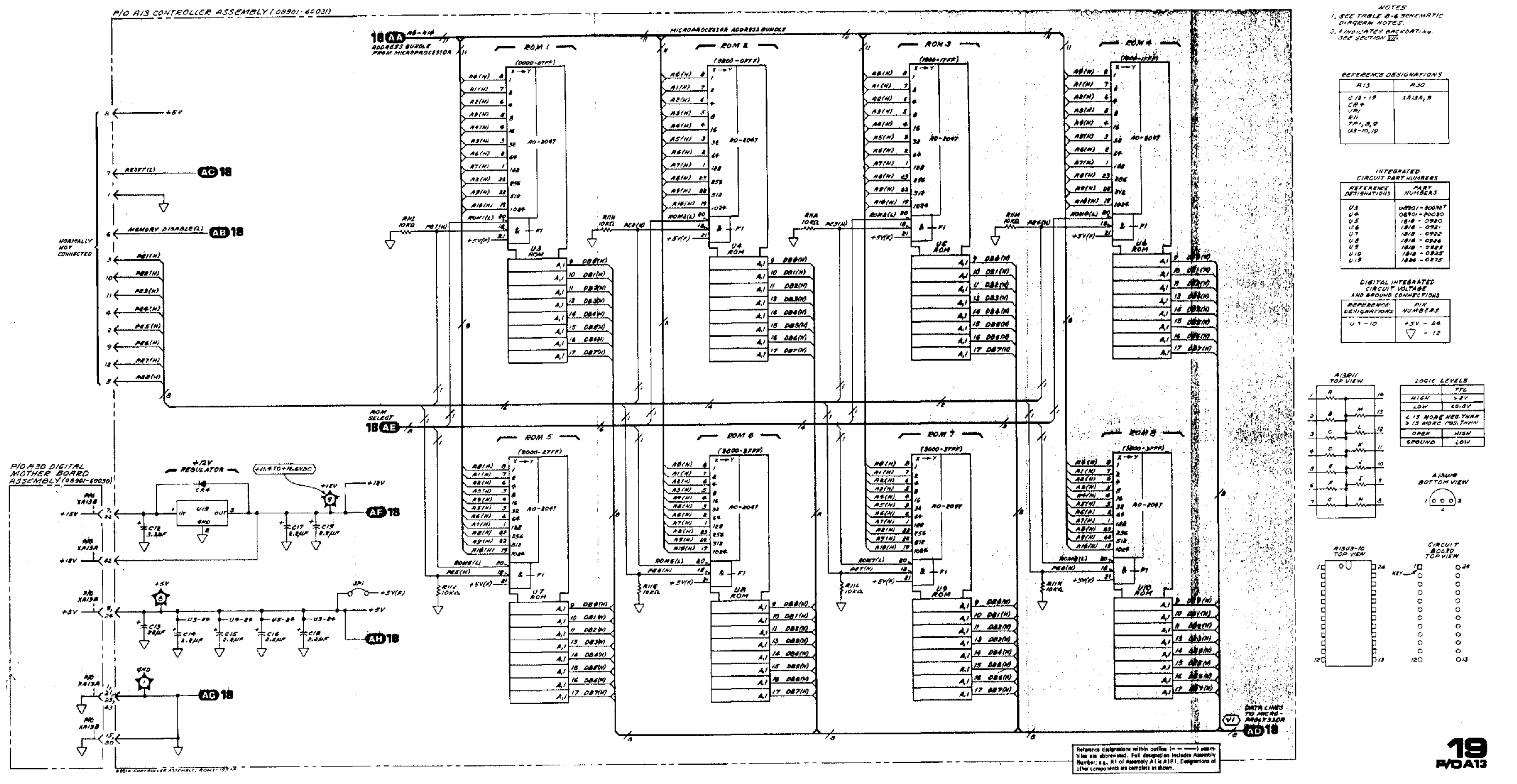


Figure 8-107. Controller — ROMs Schematic Diagram

SERVICE SHEET 20 — KEYBOARD AND DISPLAY — KEYBOARD CIRCUITS (P/O A1)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD4
- Parts List .... Page 6-4
- Direct Control Special Functions .... Page 8-8
- Signature Analysis .... Page 8-18
- Principles of Operation .... Page 8-75

TROUBLESHOOTING

General

Procedures for checking the Keyboard and Display Assembly are given below. The circuits or points to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Remove the front-panel assembly to gain access to the circuit side of the keyboard.

Equipment

- Oscilloscope .... HP 1740A
- Signature Analyzer .... HP 5004A
- Voltmeter .... HP 3455A

⟨√1⟩ Keystroke Detector Check

1. Press any key and observe TEST LED (2) on the A13 Controller Assembly. Each time the key is pressed the LED should toggle, i.e., change state. If it does, the Controller is being properly interrupted.

2. Remove the ribbon cable W20.
3. Check the following voltages:

Keys Down	Voltage Limits (Vdc) on A1U39 Pin				Level (TTL) at U21 Pin 1
	2	5	6	7	
None	-0.01 to +0.01	0.6 to 1.1	4.5 to 5.5	0 to 0.5	H
One	2.5 to 4.5	3.0 to 4.3	0 to 0.3	4.0 to 5.5	L

Hint: Any key should give the same voltage readings. The voltage at U39 pin 2 will be higher than the condition of one key down if more than one key is down.

4. Connect a high-impedance, dc coupled oscilloscope to U21 pin 1. Connect the oscilloscope's dc coupled external horizontal input to U39 pin 2. Press then release any key. The dot on the oscilloscope should move as follows:

```
          final position after release o (3)
                                       |
                                       |
position momentarily after release o — — — o position
                                  (2)        (1) when pressed
```

SERVICE SHEET 20 (Cont'd)

Hint: The dot should dwell at the intermediate position (2) momentarily after release of the key for 40 to 60 ms.

⟨√2⟩ Front-Panel Keys and Scanners Check — from Keyboard

NOTE

This check assumes proper operation of the following keys: Shift, SPCL, decimal, and all numeric. Otherwise, use ⟨√3⟩ below which requires a signature analyzer. It also assumes that the Keystroke Detector works properly (see ⟨√1⟩ above).

1. From the Troubleshooting Table for ⟨√2⟩ determine the row of the key to be checked and enter the Direct Control Special Function for that row. (The display should now show 1111.0000.)

2. Disable keyboard interrupts by shorting A13TP1 (GND) to A13TP3 (INT) on the A13 Controller Assembly.

3. Pressing any key in the appropriate row of the table should give the display shown. (No key down gives the display 1111.0000. Pressing a key not in the given row gives this display also.)

NOTE

To repeat step 1 above, it is first necessary to remove the jumper on the Controller.

⟨√3⟩ Front-Panel Keys and Scanners Check — Using Signature Analysis

1. Ground A13TP7 (TEST D) on the A13 Controller Assembly.

2. Connect signature analyzer start and stop to A13TP4 (TEST A). Set start and stop to trigger on a falling edge.

3. Connect signature analyzer clock to A13TP11 (WRT). Set clock to trigger on a rising edge.

4. Set Modulation Analyzer's LINE switch to STBY and back to ON. Disregard Front Panel Display readouts.

5. Connect the signature analyzer's probe to A13TP5 (TEST B).

6. Press the front-panel keys and note the signature. The signatures are documented in Figure 8-108.

Hint: Pressing keys simultaneously alters the signatures. If no meaningful results can be obtained, continue on with step 7.

SERVICE SHEET 20 (Cont'd)

7. Connect the signature analyzer's probe to the points indicated in the table below and check the signatures. (No keys should be *pressed.*)

Pin	U21	U22	U23	U38	Pin
1	—	U005	24P3	62AU	1
2	—	24P3	1381	F767	2
3	—	F767	F767	1999	3
4	U005	24P3	24P3	0000	4
5	8PAH	U005	1381	0000	5
6	F767	F767	F767	0000	6
7	0000	0000	0000	0000	7
8	AA4P	F767	F767	0000	8
9	F767	24P3	24P3	0000	9
10	1381	U005	1381	0000	10
11	AA4P	F767	F767	0000	11
12	AA4P	24P3	24P3	0000	12
13	8PAH	U005	1381	FCHA	13
14	24P3	24P3	24P3	F767	14
15	—	—	—	62AU	15
16	—	—	—	24P3	16

Note. The signature for a high or +5V is 24P3. The signature for a low or ground is 0000.

SHEET 20 (Cont'd)

Troubleshooting Table for ⟨√2⟩

Direct Control Special Function	Display vs. Key Pressed			
	0111.0000	1011.0000	1101.0000	1110.0000
0.750	(N/A)	LCL	>20 kHz	15 kHz
0.760	3 kHz	300 Hz	50 Hz	750 μs
0.770	75 μs	50 μs	25μs	PRE-DISP
0.780	RF LEVEL	ΦM	FM	AM
0.790	AUTO OPER	CALIBRATOR	S (Shift)	FREQ
0.7A0	CLEAR	. (decimal point)	kHz ↓	SPCL
0.7B0	(N/A)	kHz ↑	MHz	(N/A)
0.7C0	dB	%	AVG	PEAK HOLD
0.7D0	PEAK-	PEAK+	9	8
0.7E0	7	6	5	4
0.7F0	3	2	1	0

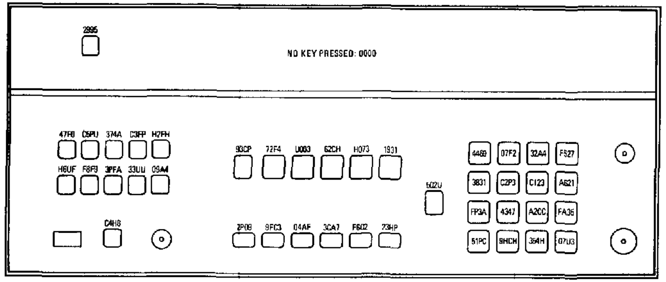


Figure 8-108. Signatures for the Front-Panel Keys and Scanners Check

Controller — ROM P/O A13 SERVICE SHEET 19

CHANGES

2447A and above	**On the A1 component locator:** • 08901-60261 - Use the new component locator, Figure 8–109. P/O A1 Keyboard and Display Assembly Component Locations (Keyboard Circuits) (2447A and above), on page 8–132.3.

Reserved for future changes.

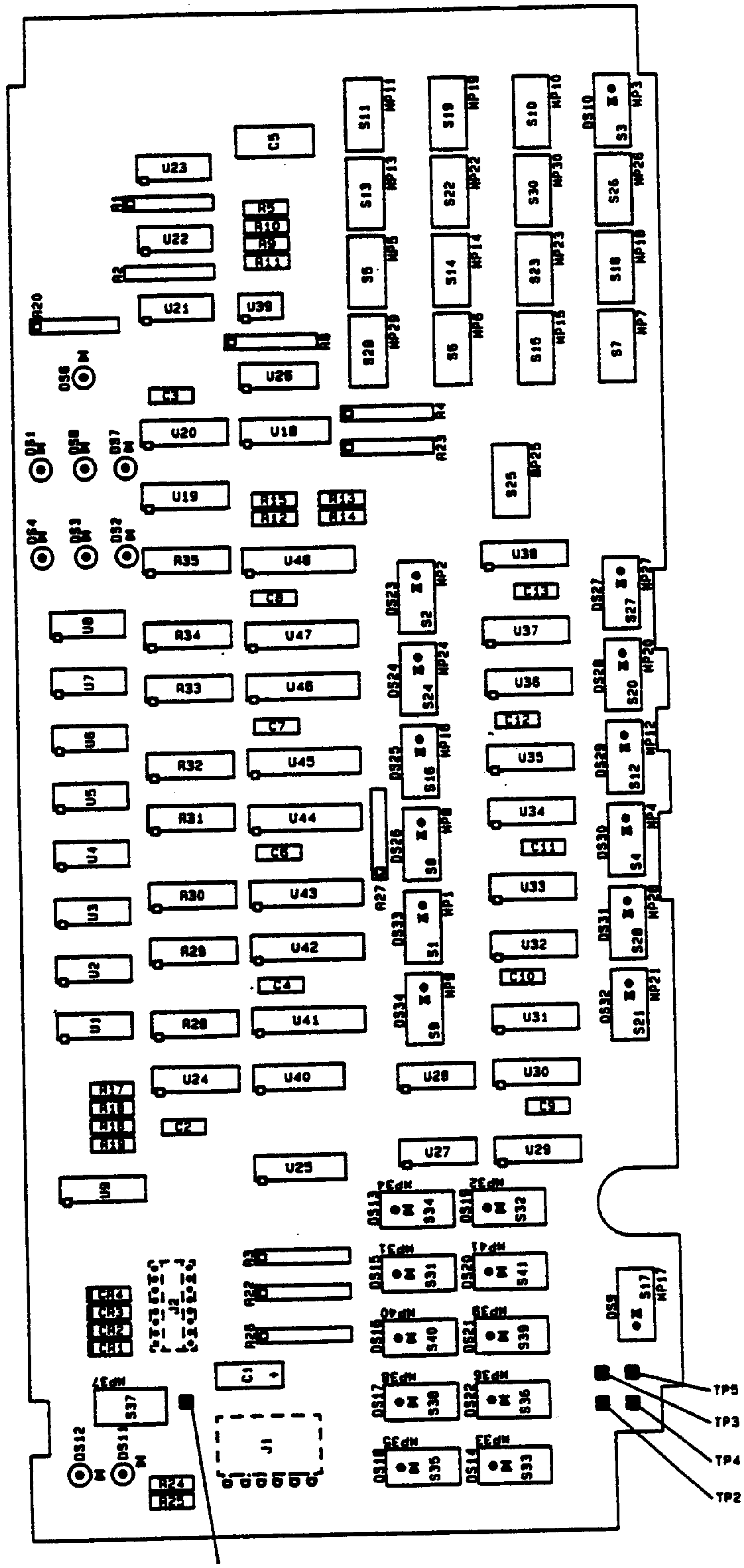


Figure 8–109. P/O A1 Keyboard and Display Assembly Component Locations (Keyboard Circuits) (2447A and above)

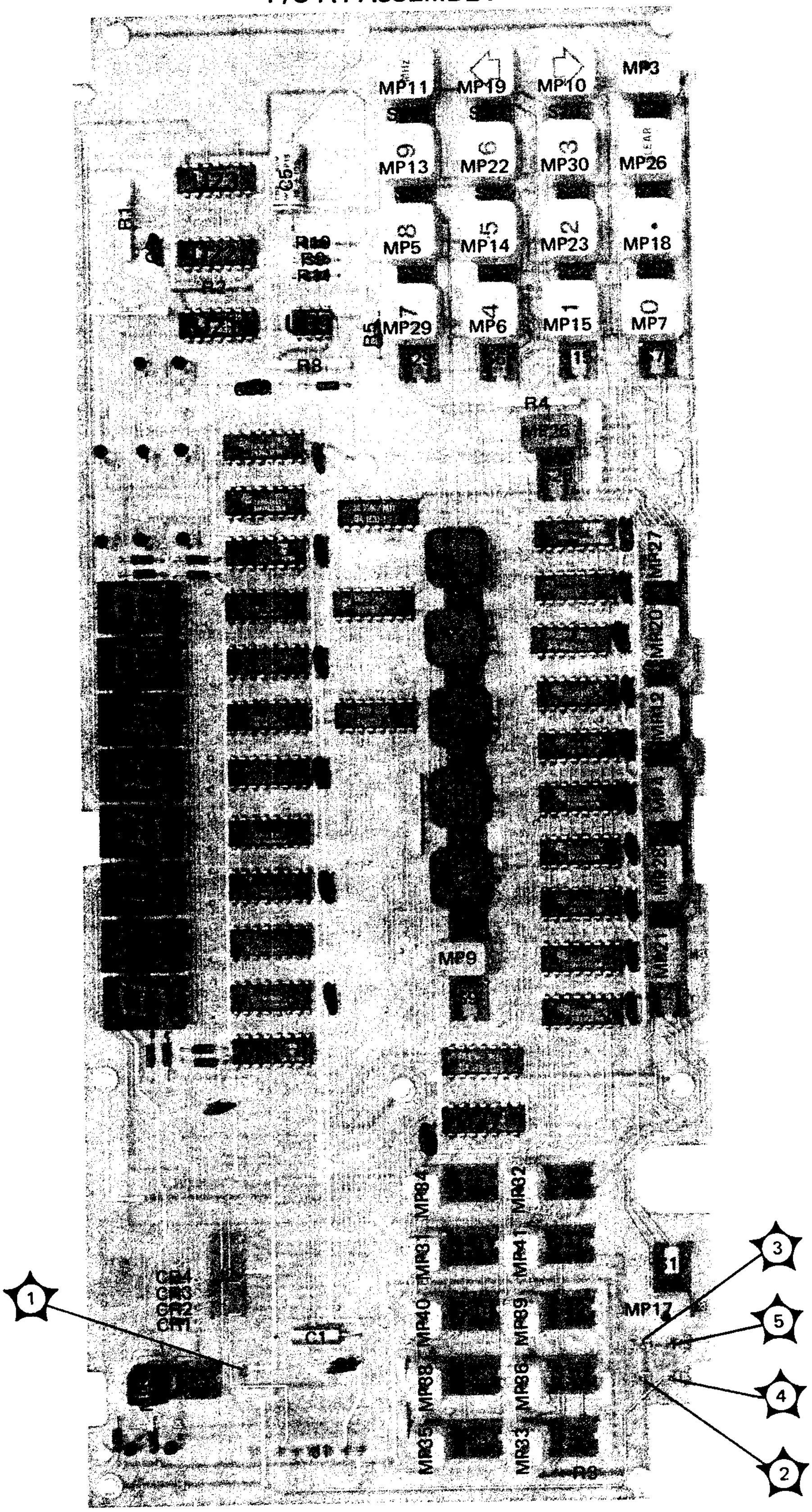


Figure 8-109. P/O A1 Keyboard and Display Assembly Component Locations (Keyboard Circuits)

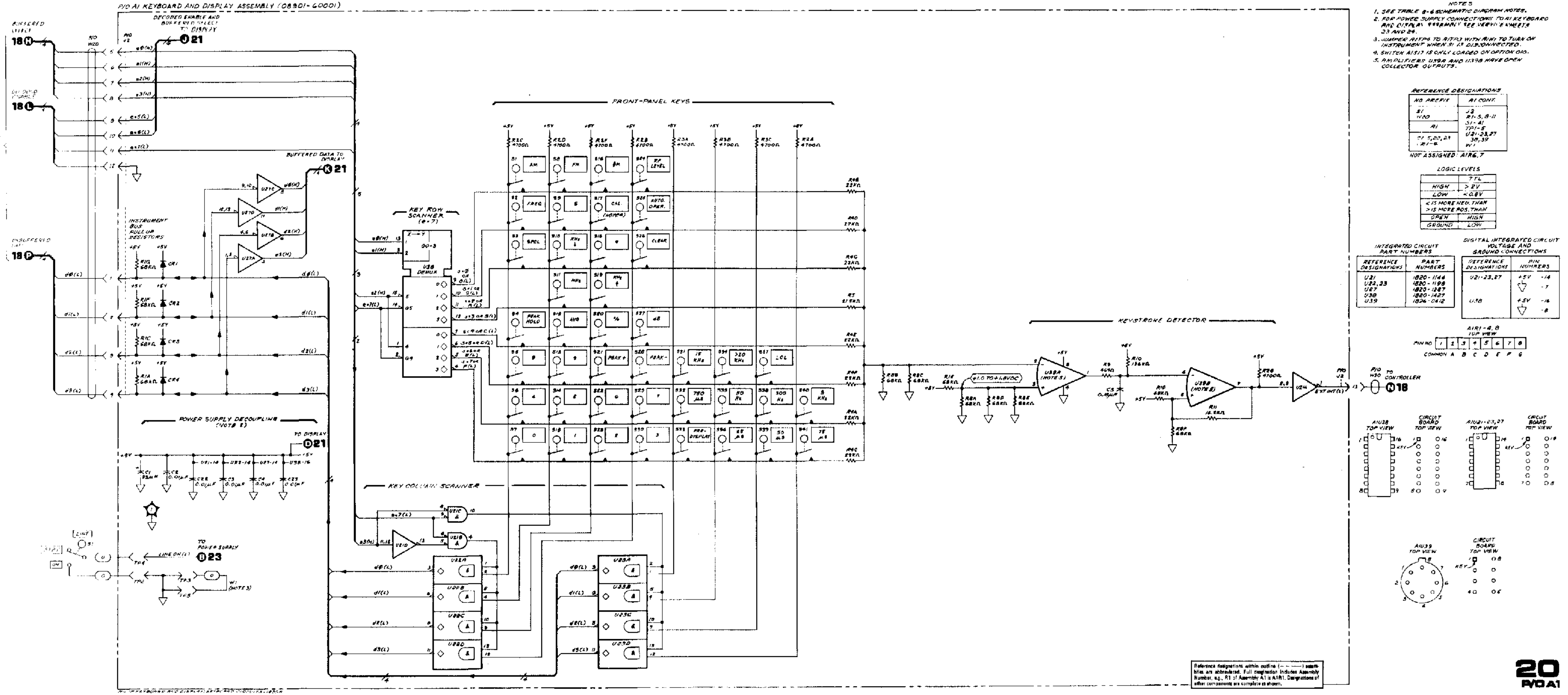


Figure 8-110. Keyboard and Display — Keyboard Circuits Schematic Diagram

SERVICE SHEET 21 — KEYBOARD AND DISPLAY — DECODER AND DISPLAY CIRCUITS (P/O A1)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD4
- Parts List .... Page 6-4
- Direct Control Special Functions .... Page 8-8
- Principles of Operation .... Page 8-76

TROUBLESHOOTING

General

The procedure for checking the Keyboard and Display Assembly is given below. The circuits are set to a desired (static) state using Direct Control special Functions. All levels except the outputs of the display drivers U10 to U17 are TTL. The outputs of U10 to U17 are about 5V when high or 3V when low unless the display diodes are open or shorted. (If the display diodes are open, the output will be 0V in both cases.)

Equipment

Voltmeter .... HP 3455A

√1 Annunciator and Key Light Check

1. Key in the Direct Control Special Functions listed below to turn on the desired annunciator or key light.

NOTE

The lights are grouped by select code. To turn all lights of a group on, set the data code to F.

Direct Control Special Function	Title	Light Type
0.528	%	Annunciator
0.524	kHz	Annunciator
0.522	radians	Annunciator
0.521	watts	Annunicator
0.538	MHz	Annunciator
0.534	REL	Annunciator
0.532	LIMIT	Annunciator
0.578	REMOTE	Annunciator
0.574	ADDRESSED	Annunciator
0.562	SPCL	Key Light
0.561	CALIBRATION	Key Light

SERVICE SHEET 21 (Cont'd)

Direct Control Special Function	Title	Light Type
0.681	>20 kHz	Key Light
0.698	50 Hz	Key Light
0.694	300 Hz	Key Light
0.692	3 kHz	Key Light
0.691	15 kHz	Key Light
0.6A1	PRE-DISPLAY	Key Light
0.6B8	25 μs	Key Light
0.6B4	50 μs	Key Light
0.6B2	75 μs	Key Light
0.6B1	750 μs	Key Light
0.6C2	PEAK+	Key Light
0.6C1	PEAK−	Key Light
0.6D8	PEAK HOLD	Key Light
0.6D4	AVG	Key Light
0.6D2	%	Key Light
0.6D1	dB	Key Light
0.6E2	S (Shift)	Key Light
0.6E1	AM	Key Light
0.6F8	FM	Key Light
0.6F4	ΦM	Key Light
0.6F2	RF LEVEL	Key Light
0.6F1	FREQ	Key Light

√2 Decimal Point Check

1. Key in the Direct Control Special Functions listed below to turn on the desired decimal point.

Direct Control Special Function	Number of Preceding Digit
0.504	1
0.502	2
0.501	3
0.518	4
0.514	5
0.512	6
0.511	7

SERVICE SHEET 21 (Cont'd)

√3 Display Check

1. Key in the Direct Control Special Functions listed below to turn on the desired digit in the desired position.

Digit Number	Direct Control Special Function
1	0.60d
2	0.61d
3	0.63d
4	0.64d
5	0.65d
6	0.66d
7	0.67d
8	0.68d

Character Displayed	d
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
—	A
E	B
H	C
L	D
P	E
(blank)	F

CHANGES

All serial prefixes	**On the A1 schematic:** • **R20, R22, R23, R26, R27** - Change the value of R20, R22, R23, R26, and R27 to 330 ohms. • **R21, R24, R25** - Change the value of R21, R24, and R25 to 348 ohms.
2212A and above	**On the A1 schematic:** • **DS5, R21** - Delete DS5 and R21 and their connection to +5 V.
2447A and above	**On the A1 component locator:** • **08901-60261** - Use the new component locator, Figure 8–111. P/O A1 Keyboard and Display Assembly Component Locations (Decoder and Display Circuits) (2447A and above), on page 8–134.3. **On the A1 schematic:** • **08901-60261** - Use the new schematic foldout with revision date *rev.01NOV89.*

Reserved for future changes.

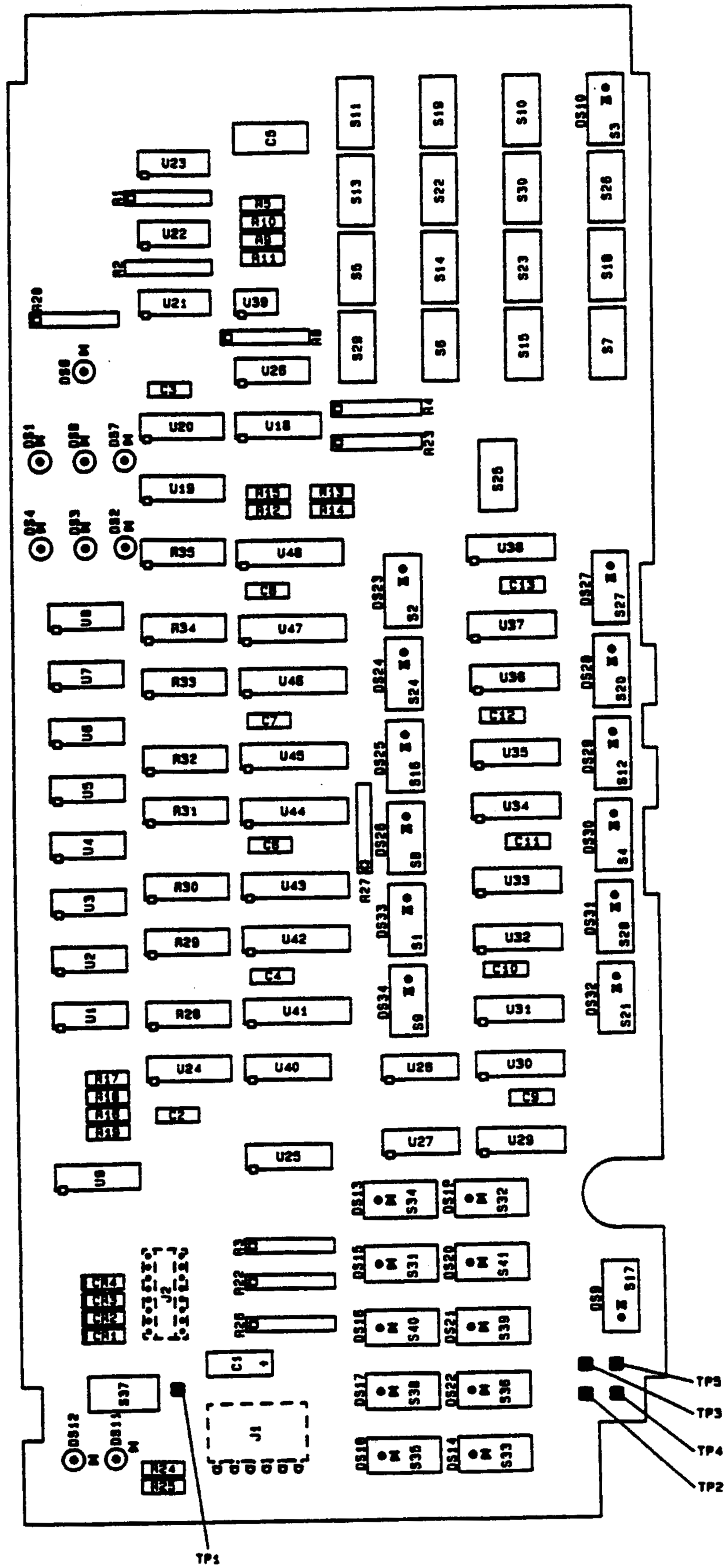
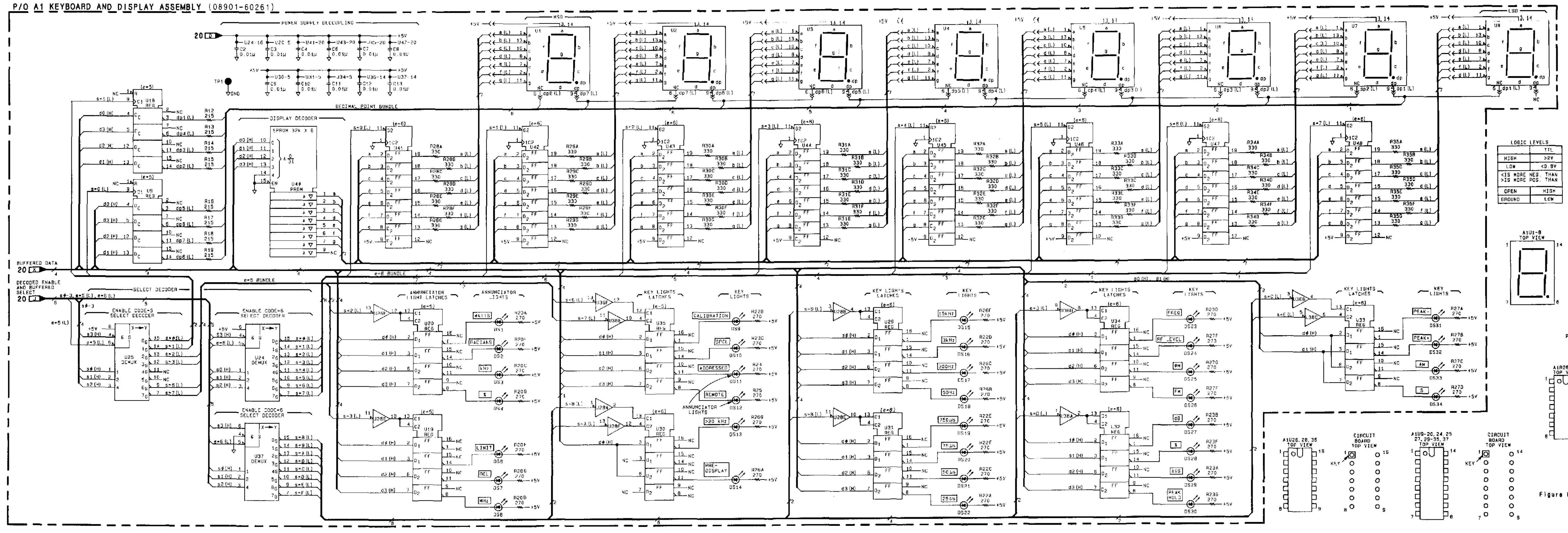


Figure 8-111. *P/O A1 Keyboard and Display Assembly Component Locations (Decoder and Display Circuits) (2447A and above)*

P/O A1 KEYBOARD AND DISPLAY ASSEMBLY (08901-60261)



NOTES

1. SEE TABLE 8-6 SCHEMATIC DIAGRAM NOTES.
2. SOCKETS FOR U1 TO U8 ARE UPSIDE DOWN. THUS THE PIN 1 MARK ON THE SOCKET INDICATES PIN 8 ON THE DISPLAY DEVICE.

REFERENCE DESIGNATION

A1
C5-21 DS1-34 R12-27 TP1 U1-9, 18, 24-26, 28-37, 40-48

LOGIC LEVELS

	TTL
HIGH	>2V
LOW	<0.8V
<IS MORE NEG. THAN >IS MORE POS. THAN	
OPEN	HIGH
GROUND	LOW

INTEGRATED CIRCUIT PART NUMBER

REFERENCE DESIGNATION	PART NUMBERS
U1-8	1990-0437
U9-18	1820-0839
U19, 20, 29-35	1820-1411
U24, 25, 37	1820-1216
U26, 28, 36	1820-1199
U40	1816-0916
U41-48	1820-2757

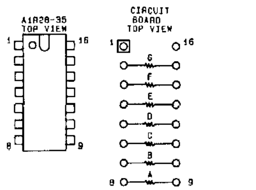
DIGITAL INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTION

REFERENCE DESIGNATION	PIN NUMBERS
U1-8	+5V - 3 ⏚ - 6
U9, 18, 40	+5V - 16 ⏚ - 8
U19, 20, 29-35	+5V - 6 ⏚ - 12
U21, 26-28, 36	+5V - 14 ⏚ - 7
U41-48	+5V - 20 ⏚ - 10

A1U1-8 TOP VIEW

A1R20, 22, 23, 26, 27 TOP VIEW

PIN NO.	1	2	3	4	5	6	7	8
	COMMON	A	B	C	D	E	F	G



21
P/O A1

Figure 8-112. Keyboard and Display-Decoder and Display Circuits Schematic Diagram.

rev.1NOV89

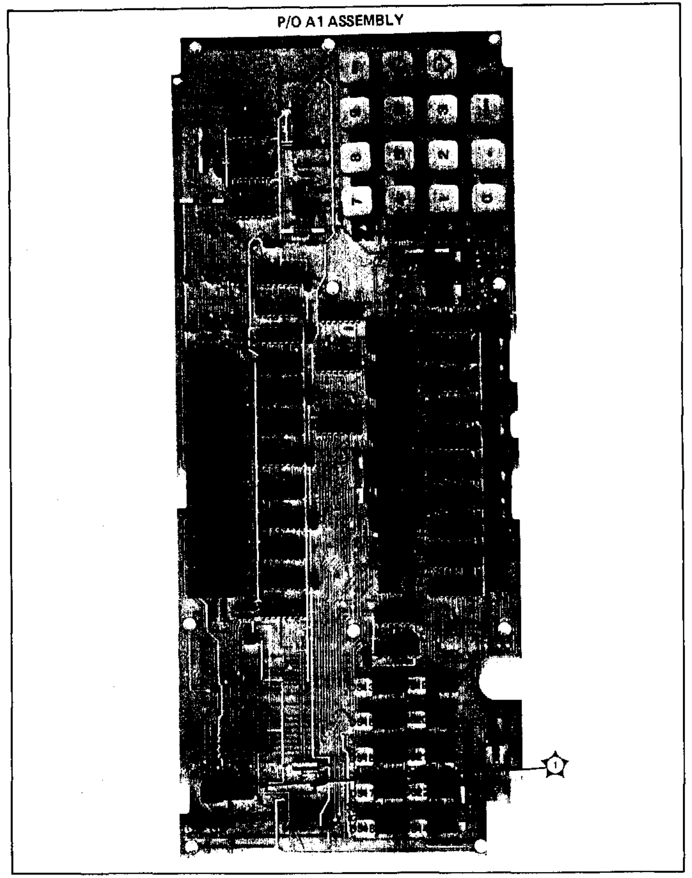


Figure 8-111. P/O A1 Keyboard and Display Assembly Component Locations (Decoder and Display Circuits)

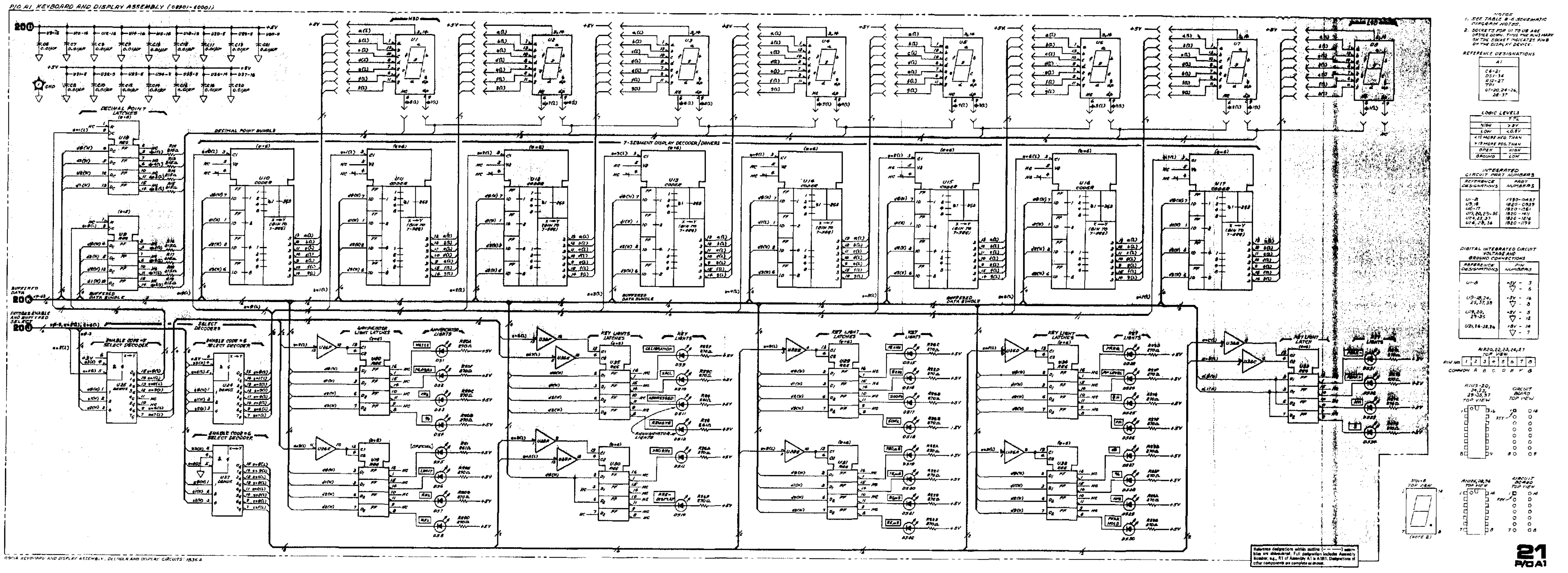


Figure 8-112. Keyboard and Display — Decoder and Display Circuits Schematic Diagram

SERVICE SHEET 22 — REMOTE INTERFACE HP-IB (A14)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the Remote Interface Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTIONS

MOS and CMOS ICs can be damaged by static charges and circuit transients. Do not remove this assembly from the instrument while power is applied. Discharge the board and replacement IC to the same potential. (Use the conductive foam pad provided in the Service Accessory Kit HP 08901-60089.) When unplugging ICs, place the board on a conductive pad. When the IC is unplugged, insert it into the foam also.

Several ICs on this assembly are held in high-grip sockets. Both the socket and the device can be damaged if an attempt is made to remove the device with an IC extraction tool. The recommended procedure is to first ground the tip of a small blade-type screwdriver, then slide the tip between the IC and the socket and slowly pry up the IC one pin at a time.

The following checks use the HP-IB Functional Checks in the Operating Manual as a basis for troubleshooting the Remote Interface Assembly. It is assumed in the following procedures that the failure was detected during the functional checks. Therefore, it is only necessary to perform the troubleshooting procedures starting with the equivalent functional check in which the failure occurred. During the procedures, the 61.N Service Special Functions (see page 8-14) are also used to help locate the failure.

When using the troubleshooting flowcharts, it is important that the associated notes be read. These notes help clarify the steps that are flagged. The troubleshooting procedures assume that the bus controller and the bus controller's HP-IB interface are operating properly. This means that it is assumed that the required inputs are present at the interface to the Modulation Analyzer. Always perform all of the HP-IB Functional Checks after any repair to the Remote Interface Assembly.

SERVICE SHEET 22 (Cont'd)

When using the flowcharts, refer to the Remote Interface Assembly principles of operation to clarify the sequence of troubleshooting. Refer to Figure 8-113 for an explanation of the HP-IB handshake. If replacement of a probable defective part does not correct the Remote Interface problem, check any related circuits that are connected to the faulty area. For example, some bus controllers simultaneously function as both talker and listener. As a result, they may mask a failure of the Remote Interface handshaking capabilities. This can happen when either the NRFD or NDAC output driver on the bus fails in a high state. This is a very subtle problem. The quickest way to determine if this is happening is to monitor the driver outputs while activating both output levels of the individual drivers.

Equipment

Digital Test/Extender Board .... HP 08901-60081
Oscilloscope .... HP 1740A
Logic Probe .... HP 5004A

⟨√1⟩ Address Recognition Check

1. Perform the steps shown in the Address Recognition Troubleshooting Flowchart (see Figure 8-114).

⟨√2⟩ Remote and Local Messages and the LCL Key Check

1. Perform the steps shown in the Remote and Local Messages and the LCL Key Troubleshooting Flowchart (see Figure 8-115).

⟨√3⟩ Sending the Data Message Check

1. Perform the steps shown in the Sending the Data Message Troubleshooting Flowchart (see Figure 8-116).

⟨√4⟩ Receiving the Data Message Check

1. Perform the Receiving the Data Message portion of the HP-IB Functional Checks (refer to the Operating Manual).

Hint: Most of the circuits that are used in this check were used in previous checks. Check the inputs and outputs of gates U2 and U6. If they are good, the problem could be U13, the Controller (see service Sheet 18), or the annunciators (see Service Sheet 21).

⟨√5⟩ Local Lockout and Clear Lockout/Set Local Messages Check

1. Perform the Local Lockout and Clear Lockout/Set Local Messages portion of the HP-IB Functional Checks (refer to the Operating Manual).

Hint: Most of the circuits that are used in this check were used in previous checks. If the instrument fails this check, the problem is probably in the Controller (see Service Sheet 18) or the front panel Keyboard circuits (see Service Sheet 20).

SERVICE SHEET 22 (Cont'd)

⟨√6⟩ Clear Message Check

1. Perform the Clear Message portion of the HP-IB Functional Checks (refer to the Operating Manual).

Hint: The circuits that are used in this check were used in previous checks. If a problem occurs during the Clear Message Check, repeat the previous checks starting at ⟨√1⟩ Address Recognition Check.

⟨√7⟩ Abort Message Check

1. Perform the steps shown in the Abort Message Troubleshooting Flowchart (see Figure 8-117).

Hint: Most of the circuits that are used in this check were used in previous checks. The flowchart is primarily used to check the IFC and serial-poll circuits.

⟨√8⟩ Status Byte Message Check

1. Perform the Status Byte Message portion of the HP-IB Functional Checks (refer to the Operating Manual).

Hint: Most of the circuits that are used in this check were used in previous checks. The most important difference is that the Controller must recognize that the Serial Poll Flip-Flop is set and send the status byte when addressed to talk.

⟨√9⟩ Require Service Message Check

1. Perform the Require Service Message portion of the HP-IB Functional Checks (refer to the Operating Manual).

Hint: Most of the circuits that are used in this check were used in previous checks. The most important difference is that the Controller must drive the SRQ(L) line low. It does this through gate U12D and the PIO (U13). Repeat the check and monitor the input and output of U12D.

⟨√10⟩ Trigger Message and Clear Key Triggering

1. Perform the Trigger Message and Clear Key Triggering portion of the HP-IB Functional Checks (refer to the Operating Manual).

⟨√11⟩ Memory Select Decoders and ROM 11 Check

1. Perform the Memory Select Decoders and ROM Check on Service Sheet 18.

⟨√12⟩ Select Decoder and Address Switches Check

1. Key in the Direct Control Special Functions indicated below. For each setting, check the pins on U11 indicated.

Keyboard and Display — Decoder and Display Circuits P/O A1 SERVICE SHEET 21

SERVICE SHEET 22 (Cont'd)

Direct Control Special Function	Level (TTL) at U11 Pin							
	15	14	13	12	11	10	9	7
0.400	*	H	H	H	H	H	H	H
0.410	H	*	H	H	H	H	H	H
0.420	H	H	*	H	H	H	H	H
0.430	H	H	H	*	H	H	H	H
0.440	H	H	H	H	*	H	H	H
0.450	H	H	H	H	H	*	H	H
0.460	H	H	H	H	H	H	*	H
0470	H	H	H	H	H	H	H	*

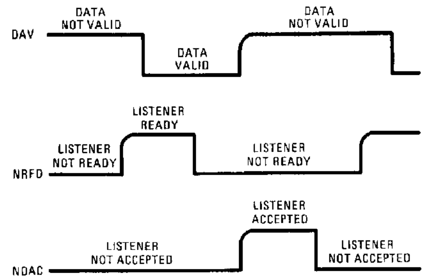
*Low-going TTL pulses ≈7 ms period.

2. Key in 0.450 SPCL to readback part of S1. The display should be of the form abcd.0000 where

   a=1 if S1D is open;
   b=1 if S1C is open;
   c=1 if S1B is open;
   d=1 if S1A is open.

3. Key in 0.460 SPCL to read back the rest of S1 and U3B. The display should be of the form abcd.0000 where

   a=1 if U3B is set;
   b=1 if S1G is open;
   c=1 if S1F is open;
   d=1 if S1E is open.



Start with the talker waiting for the listener to release NRFD (not ready for data) indicating it is ready.

When the listener is ready, NRFD goes high (false). The talker then places valid data on DIO1 through DIO8 and sets DAV (data valid) low (true).

NRFD then goes low (true) and the talker waits for the listener to indicate it has accepted the data (or ignored it) by releasing the NDAC (not data accepted) to a high (false, i.e., data is accepted).

The talker sets DAV high (false) and again waits for the listener to release NRFD.

(NOTE that if ATN is true, all instruments on the bus must handshake regardless of whether they are talkers, listeners, or bystanders. Being in remote or local has nothing to do with handshaking.) If ATN is false, they only handshake if addressed.

Figure 8-113. Simplified HP-IB Handshake Between a Talker and One Listener

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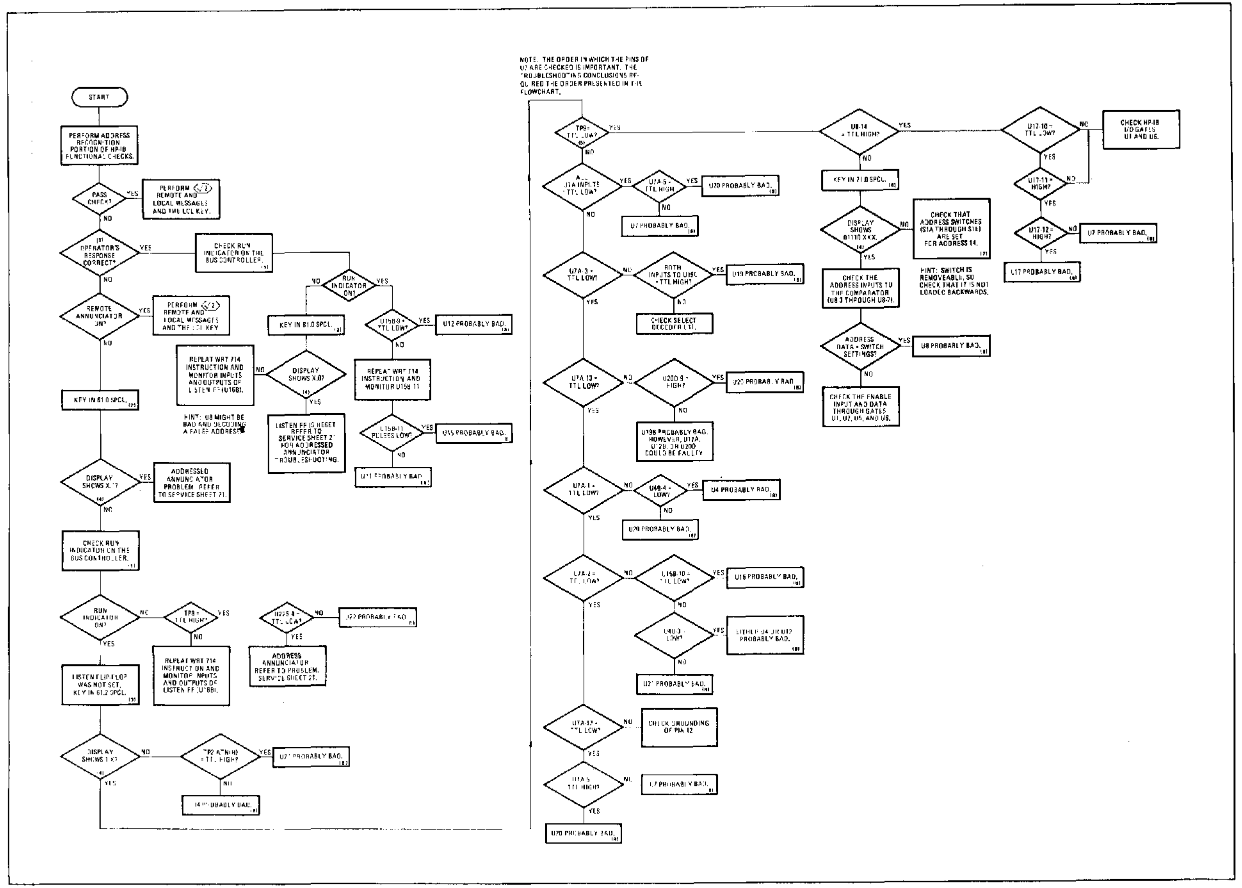


Figure 8-114. ⟨1⟩ Address Recognition Check Troubleshooting Flowchart

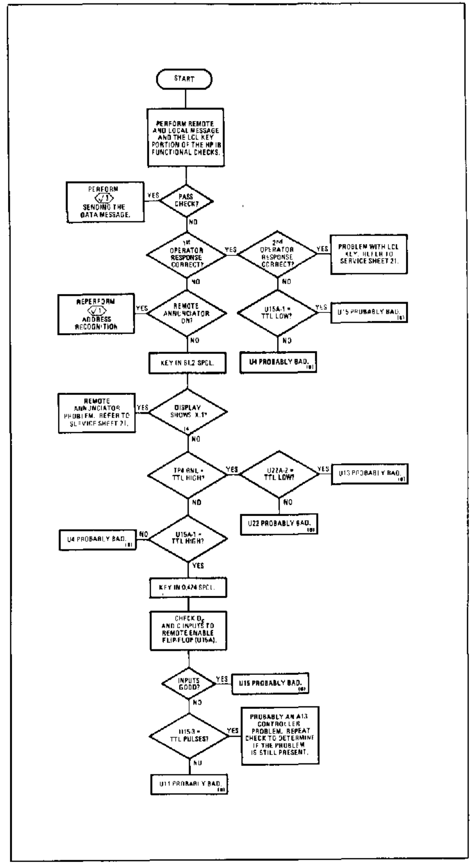


Figure 8-115. ⟨2⟩ Remote and Local Messages and the LCL Key Check Troubleshooting Flowchart

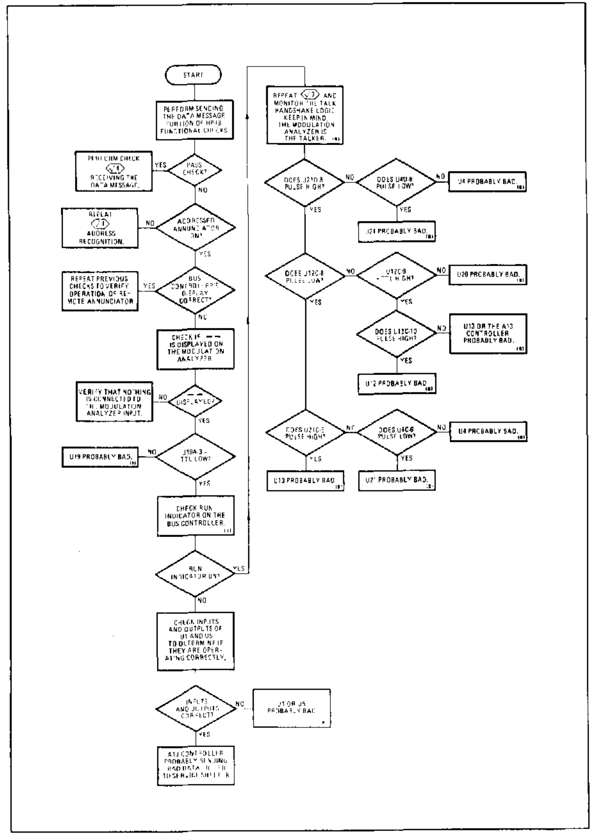


Figure 8-116. ⟨3⟩ Sending the Data Message Troubleshooting Flowchart

Remote Interface (HP-IB) Troubleshooting Flowcharts (P/O SERVICE SHEET 22)

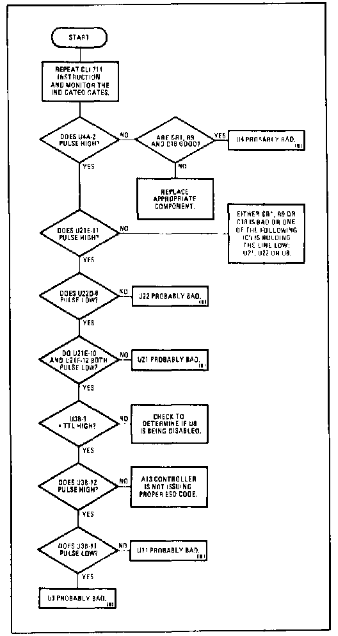


Figure 8-117. ⟨7⟩ Abort Message Check Troubleshooting Flowchart

NOTES

1. *The Run indicator shows the status of the handshake between the bus controller and the Modulation Analyzer. If it is still on, the handshake was not completed.*
2. *This special function reads back and displays the present state of the Talk and Listen flip-flops (see 61.N Display HP-IB status on page 8-14).*
3. *This special function reads back and displays the present state of the ATN bus control line and the state of the Remote Enable Flip-Flop.*
4. *X equals "don't care".*
5. *If TP9 is low, the handshake logic has satisfied the initial requirements to input address data to the Interface Control ROM. If TP9 is high, this requirement is not complete.*
6. *Displays HP-IB address set on the Address Switches.*
7. *Remember that the checkout procedure assumes that the Modulation Analyzer is set to address 14. If the instrument has been set for a different address, modify the HP-IB Functional Checks procedure and the troubleshooting information to match the new address.*
8. *Indicated IC is the most likely malfunction. However, if replacement does not fix the problem, check the circuits that drive or are driven by the specified IC and all wiring and components that are connected to the same signals.*
9. *See Figure 8-113 for a simplified explanation of the HP-IB Handshake.*

CHANGES

2424A and above	**On the A14 Schematic:** • **08901-60257** - In the upper left portion of the schematic, change the part number of the A14 schematic to 08901-60257. • **U8, U22F** - Use the schematic partial, P/O Figure 8–120. Remote Interface Assembly (2424A and above), on page 8–138.3. In the table of INTEGRATED CIRCUIT PART NUMBERS, change the part number of A14U8 to 1820-2740. Change the U8 entries in the table of DIGITAL INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS as follows: +5V, pin 20; ground, pin 10.
3022A and above	**On the A14 Schematic:** • **R5** - Under INTERFACE CONTROL, change the value of R5 to 2150 Ω.

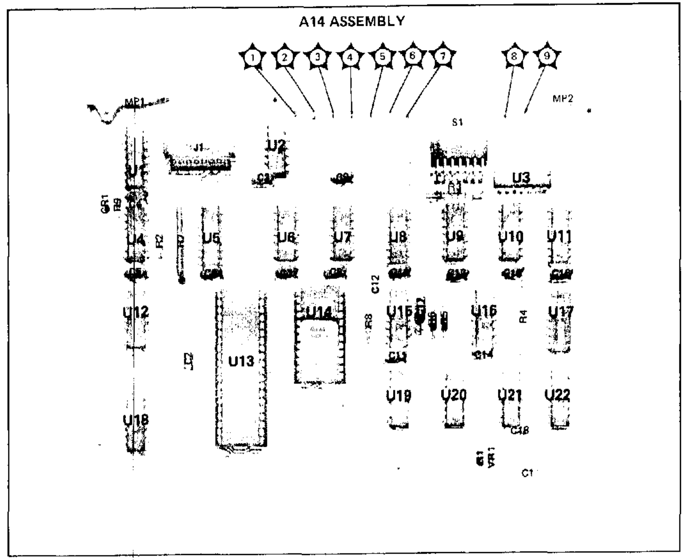


Figure 8-118. A14 Remote Interface Assembly Component Locations

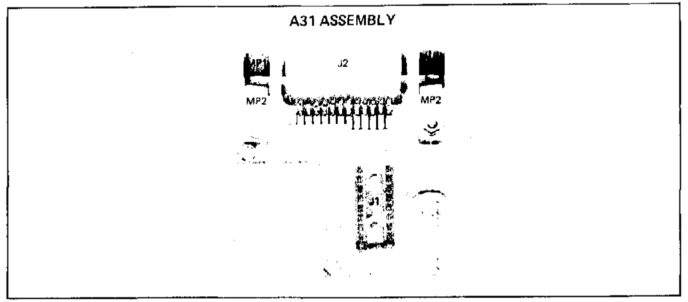


Figure 8-119. A31 Remote Interface Connector Assembly Component Locations

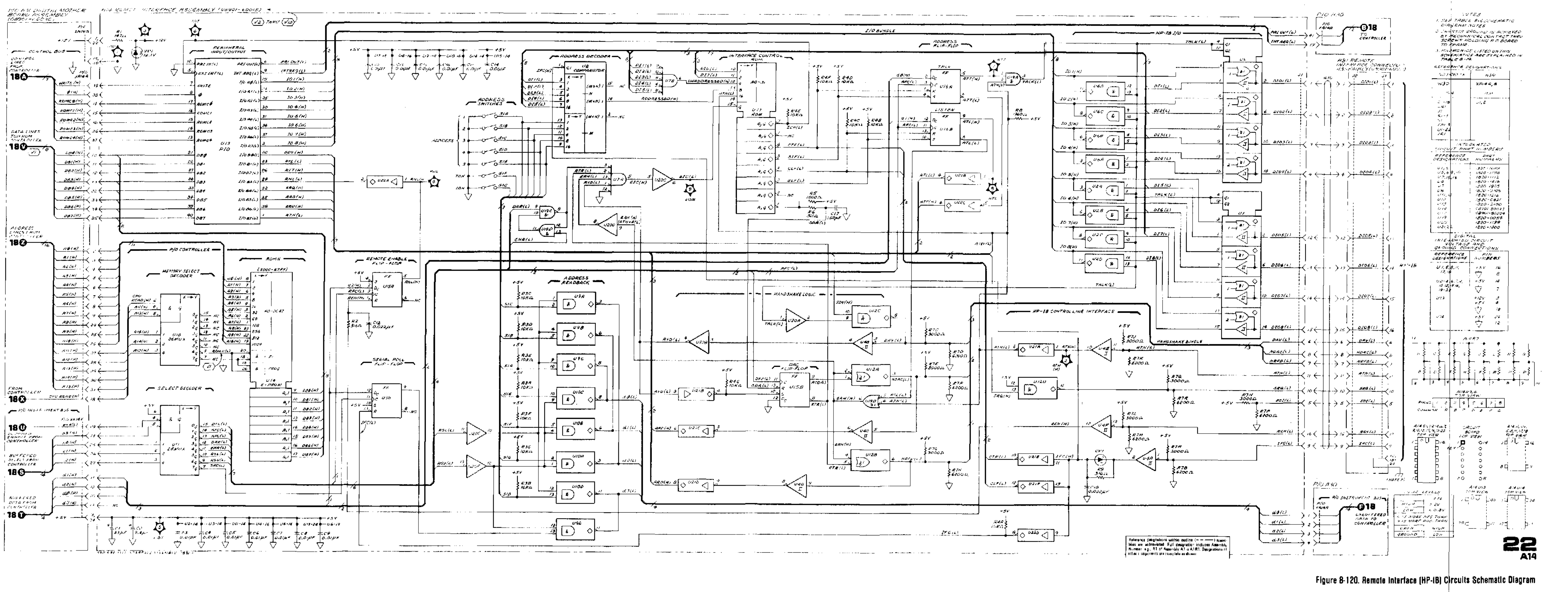


Figure 8-120. Remote Interface (HP-IB) Circuits Schematic Diagram

SERVICE SHEET 23 — +15V AND −15V POWER SUPPLIES (A10, A26, AND A29)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the +15V and −15V Power Supplies are given below. The circuits or points to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the A10 Power Supply Regulators Assembly where necessary to make measurements. This will require removal of the left side cover and two screws anchoring the assembly.

Most often a dead power supply is the result of a short on its output which originates on one of the other assemblies. Follow the ⟨√8⟩ Power Supply Check on Service Sheet BD2 to isolate a short to an assembly. Note that the +15V supply remains on in standby.

The supplies are interdependent. Often a short on one supply will shut down another. The interdependency is as follows.

If this supply goes dead:	These supplies will also go dead:
+15V	All Other Supplies
−15V	+5V and −5V Supplies
+5V	No Other Supply
−5V	No Other Supply
+40V	No Other Supply

Equipment

Audio Source .... HP 339A
Oscilloscope .... HP 1740A
Voltmeter .... HP 3455A

⟨√1⟩ Input Over-Voltage Protection Check

NOTE

This test checks only A26Q1. It does not check the conduction voltage of A26VR1 and VR2.

1. Unplug the instrument and set its line voltage selector to 120V.

CAUTION

For the remainder of this check, the instrument must not be connected to a power line.

SERVICE SHEET 23 (Cont'd)

2. Set the audio source to 50 or 60 Hz. Set its level to deliver 3 Vrms into 600Ω. Connect its 600Ω output to the high and low prongs of a power cord and plug the other end of the power cord into the rear-panel line module socket.

3. Connect a high-impedance, ac coupled oscilloscope to terminal T1 of triac A26Q1. The waveform should be a clipped 50 or 60 Hz sinusoid with an amplitude of 3 Vpp or greater.

Hint: If the voltage is near zero, check T1 and A26Q1. If the voltage is about 1.5 Vpp, a short may be across A26C3 or C4.

4. Short terminals T2 and G of triac A26Q1. The waveform should be more heavily clipped and have an amplitude of approximately 1 Vpp.

5. Set the instrument's line voltage selector to the proper setting.

⟨√2⟩ Full Wave Rectifiers Check

1. If there are any jumpers on the TEST test points on the A13 Controller Assembly, remove them.

2. Connect a high-impedance, dc coupled oscilloscope to the point indicated below. For each connection, key in 40.0 SPCL or switch LINE to STBY then back to ON to reset the instrument. While all front-panel LEDs are lighted, check the average dc voltage and ac ripple (100 or 120 Hz for common mains) which should be as indicated below.

Pin to Check on A26XA10	Average Voltage Limits (Vdc)	Maximum AC Ripple (Vpp)
19 or 41	17 to 27	1
21 or 43	−28 to −18	1
18 or 40	7 to 13	1
22 or 44	−13 to −7	1.5

Hint: An open rectifier diode will result in excessive ripple at the line frequency (50 or 60 Hz for common mains). An average voltage near or above maximum indicates no loading by the regulator or improper line selection. Lack of ripple indicates no loading by the regulator.

⟨√3⟩ +15V Regulator Check

1. Switch LINE to STBY. A10DS1 (+15V) should be on.

Hint: If A10DS1 (+15V) is off with LINE set to ON, but on with LINE set to STBY, the +15V supply is probably working properly but there may be a short on its load (the output side of relay A26K1), A26K1 may be defective, the Sense Line Switch may be defective, or the Over-Current Protection may be defective or too near tripping.

SERVICE SHEET 23 (Cont'd)

2. Measure the voltages indicated below with LINE switched to STDY and to ON. Use a dc voltmeter. The voltages given are for normally loaded, unloaded (all other assemblies dis-connected), and short-circuit conditions.

Point to Measure on A10 or or A26XA10	Typical Voltage (Vdc)				
	LINE ON			LINE STBY	
	Normal	Unloaded	Short	Normal	Short
TP2	+15.0	+15.0	0.0	0.0	0.0
TP3	+15.0	+15.0	0.0	+15.0	0.0
Pin 9,31	+15.6	+15.2	0.0	+15.2	0.0
Base Q12	+14.8	+14.5	+0.6	+14.5	+0.6

Hint: If the above voltages in a column are correct, the supply is working normally under the condition stated. If the supply is oscillating, check A10C1 and C21. If the supply voltage is only slightly incorrect, perform the Power Supply Adjustment.

⟨√4⟩ −15V Regulator Check

1. Measure the voltages indicated below with a dc voltmeter. The voltages given are for normally loaded, unloaded (all other assemblies disconnected), and short-circuit conditions.

Point to Measure or A10 or A26XA10	Typical Voltage (Vdc)		
	Normal	Unloaded	Short
TP7	15.0	−15.0	0.0
Pin 12, 34	15.0	15.1	−0.6
Base Q18	−15.0	−14.3	0.5

Hint: If the above voltages in a column are correct, the supply is working normally under the condition stated. If the supply is oscillating, check A10C2 and C22.

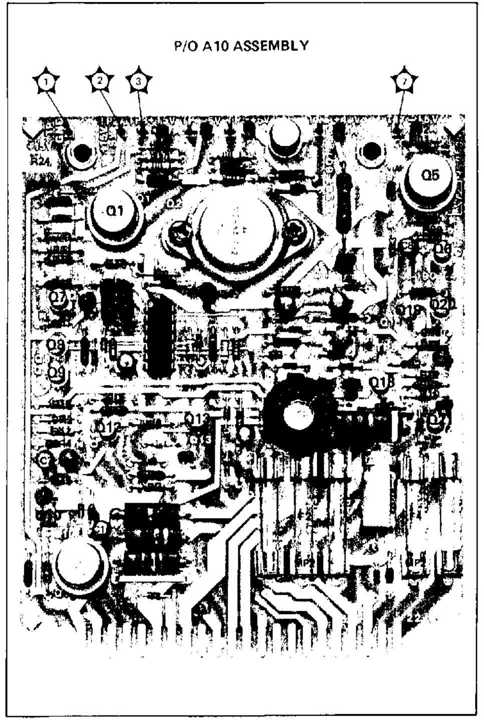


Figure 8-121. P/O A10 Power Supply Regulators Assembly Component Locations (+15V Regulators)

Remote Interface (HP-IB) Circuits A14, A31 SERVICE SHEET 22

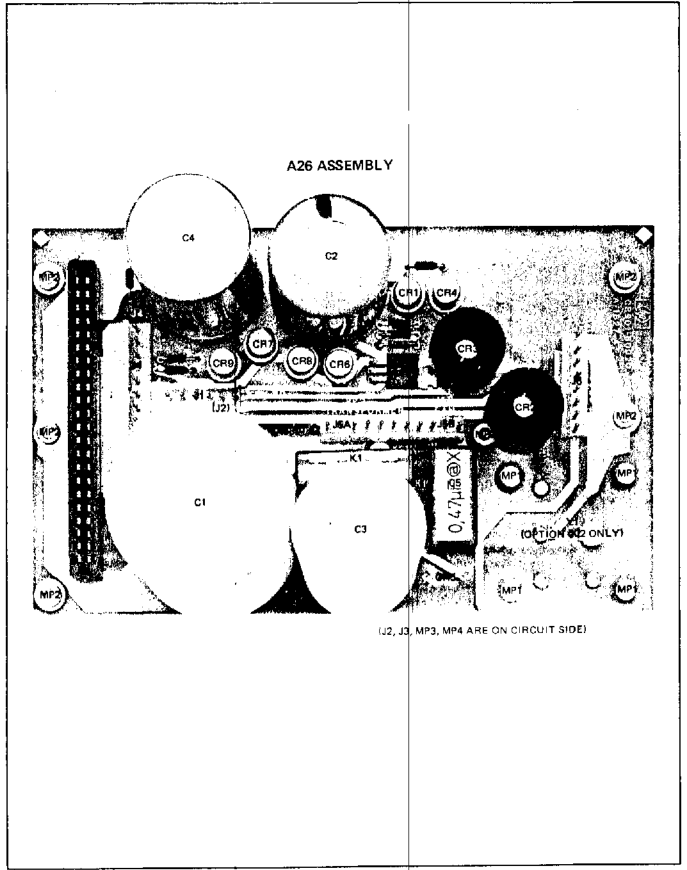


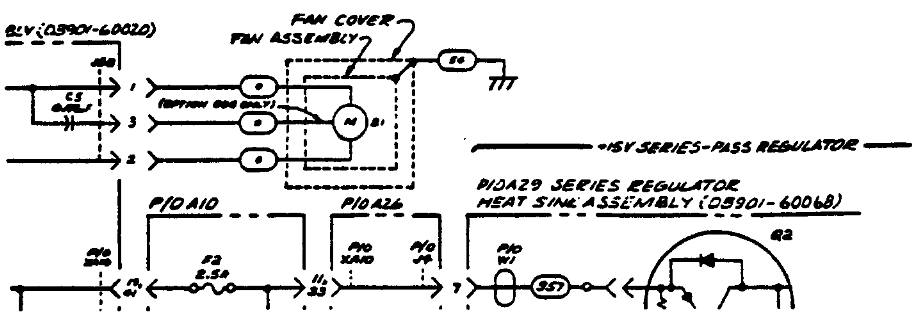
Figure 8-122. A26 Power Supply Motherboard Component Locations

CHANGES

All serial prefixes	**On the A10 component locator:** • <u>C22</u> - Find R6 and R2. Parallel with R6 and perpendicular to R2, there is a small unmarked capacitor. Label this capacitor C22. **On the A26 component locator:** • <u>CR6, CR7, CR9, VR1, VR2</u> - Change the following reference designators: CR6 to CR7 CR7 to CR9 CR9 to CR6 VR1 to VR2 VR2 to VR1 **On the A26 schematic:** • <u>J5A</u> - On the top left side of the schematic, change J5A pin 7 to pin 8; change the color code of this line from 0 to 04. Connect this same line to "E" on the A30 LINE POWER ASSEMBLY. Change J5A pin 8 to pin 7; change the color code of this line from 04 to 0. Connect this same line to "C" on the A30 LINE POWER ASSEMBLY. • <u>B1</u> - Use the schematic partial on page 8-140.3. This partial shows the correct wiring for safely grounding the fan (B1).
2012A and above	**On the A10 schematic:** • <u>R15, R17, R19</u> - Change the value of R15 to 1 k, R17 to 825 ohms, and R19 to 1.1 k. • <u>Q7, Q9</u> - In the table of Transistor and Integrated Circuit Part Numbers, change Q7 and Q9 to 1854-0811.
2133A and above	**On the A30 schematic:** • <u>C1</u> - Add C1, 0.1 μF, between lines "L" and "N."
2212A and above	**On the A26 schematic:** • <u>C5</u> - In the upper left portion of the schematic, add the following note to C5: C5 is inserted for Option 004 instruments only.
2308A to 2916A	**On the A10 schematic:** • <u>Q1, Q5</u> - In the Table of Transistor and Integrated Circuit Part Numbers, change Q1 and Q5 to 1884-0244.

CHANGES

2518A and above	**On the A10 schematic:** • **R3, R7** - Change the value of R3 to 422 ohms. Change the value of R7 to 0.47 ohms.
2607A and above	**On the A10 schematic:** • **C21, C22, C9, C10** - Change the value of C21 and C22 to 0.022 μF. Change the value of C9 and C10 to 10 μF.
2751A and above	**On the A26 schematic:** • **08901-60294** - Change the part number of the A26 schematic to 08901-60294. • **K1** - A26 is shown in two places on this service sheet, to the left of the A10 schematic, and to the right of the A10 schematic. On the left-hand schematic, locate P/O K1 (STANDBY RELAY). Number the switch pivot junction dot "2" and the dot to its left "13." Number the junction dot connected to the anode of CR5 "4" and the dot connected to the cathode of CR5 "5." On the right-hand schematic, locate P/O K1. Number the switch pivot junction dot "7," the ground junction dot "11," and the third junction dot "12."
2925A and above	**On the A10 schematic:** • **Q1, Q5** - In the Table of Transistor and Integrated Circuit Part Numbers, change Q1, Q5 to 1884-0345. • **R67, R68** - Add R67 (133 ohms) between the junction of VR2 anode and Q1 gate, and ground. Add R68 (133 ohms) between the junction of VR3 anode and Q5 gate, and the −15 V supply.



Fan Grounding Schematic Diagram (All serial prefixes)

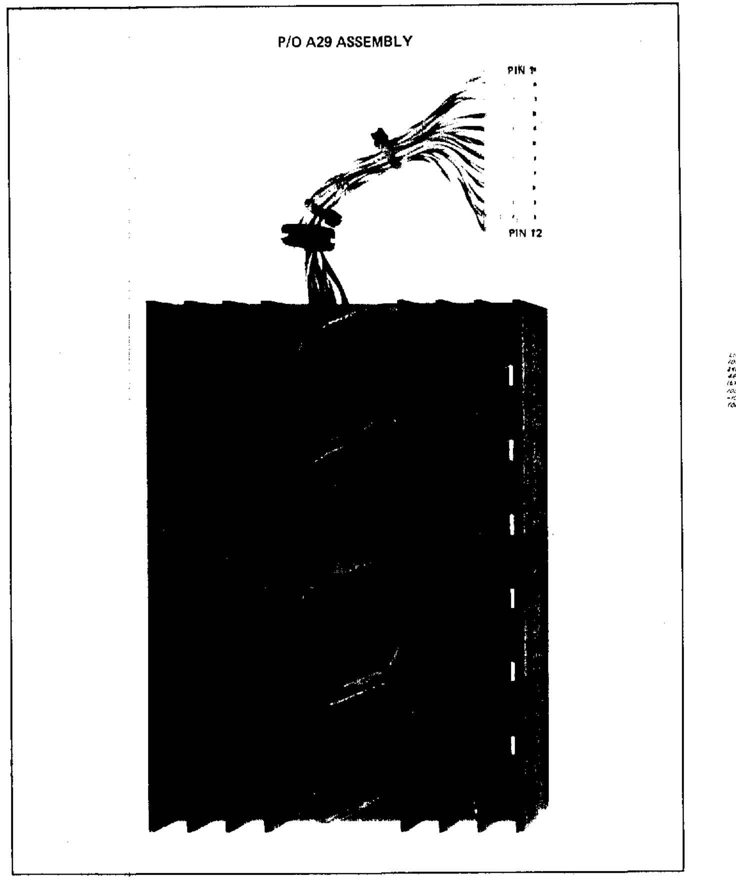
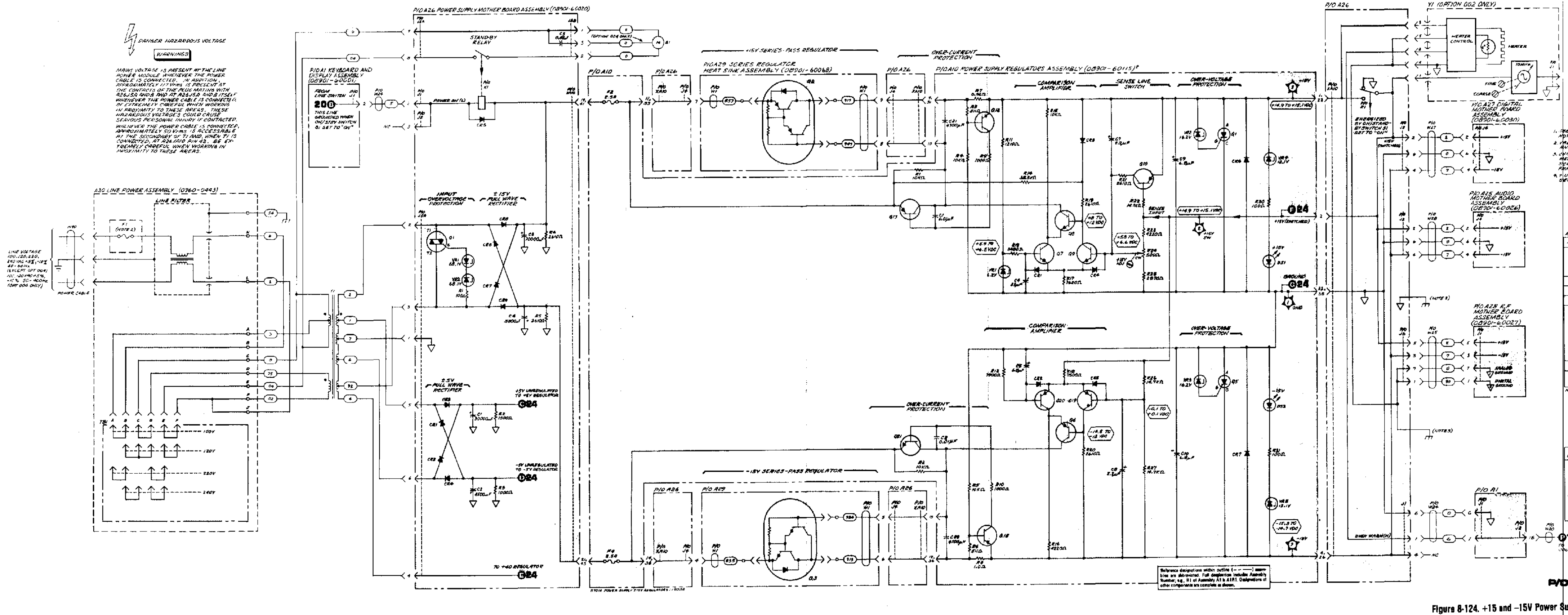


Figure 8-123. P/O A29 Series Regulator Heat Assembly Component Locations (-15V Regulators)



23

P/O A10,A26,A29,A30

Figure 8-124. +15 and -15V Power Supplies Schematic Diagram

SERVICE SHEET 24 — +5V, -5V, AND +40V POWER SUPPLIES (A10)

OTHER REFERENCES

- Block Diagram .... Service Sheet BD2
- Power Supply Adjustment .... Page 5-4
- Parts List .... Page 6-21
- Principles of Operation .... Page 8-81

TROUBLESHOOTING

General

Procedures for checking the +5V, -5V, and +40V Power Supplies are given below. The circuits or points to check are marked on the schematic diagram by a hexagon *with a check mark and a number* inside, e.g., √3. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., +1.9 to +2.1 Vdc. Extend the A10 Power Supply Regulators Assembly where necessary to make measurements. This will require removal of the left side cover and two screws anchoring the assembly.

Most often a dead power supply is the result of a short on its output which originates on one of the other assemblies. Follow the √8 Power Supply Check on Service Sheet BD2 to isolate a short to an assembly.

Equipment

Oscilloscope .... HP 1740A
Voltmeter .... HP 3455A

√1 +5V Regulator Check

1. Measure the voltages indicated below with a dc voltmeter. The voltages given are for normally loaded, unloaded (all other assemblies disconnected), and short-circuit conditions.

Point to Measure on A10 or A26XA10	Typical Voltage (Vdc)		
	Normal	Unloaded	Short
TP5	+5.3	+5.3	0.0
Pin 6, 28	+5.3	+5.3	+0.1
U1D Pin 14	+13.7	+13.7	-9.6

Hint: If the above voltages in a column are correct, the supply is working normally under the condition stated.

SERVICE SHEET 24 (Cont'd)

√2 -5V Regulator Check

1. Measure the voltages indicated below with a dc voltmeter. The voltages given are for normally loaded, unloaded (all other assemblies disconnected), and short-circuit conditions.

Point to Measure on A10 or A26XA10	Typical Voltage (Vdc)		
	Normal	Unloaded	Short
TP4	-5.2	-5.2	0.0
Pin 17, 39	-5.5	-5.2	-0.3
U1B Pin 7	-15.0	-15.0	+9.6

Hint: If the above voltages in a column are correct, the supply is working normally under the condition stated.

√3 +40V Regulator Check

1. Measure the voltages indicated below with a dc voltmeter. The voltages given are for normally loaded, unloaded (the RF Section disconnected), and short-circuit conditions.

Point to Measure on A10	Typical Voltage (Vdc)		
	Normal	Unloaded	Short
TP6	+41	+41	0
Cathode CR8	+68	+66	+68

Hint: If the above voltages in a column are correct, the supply is working normally under the condition stated. Line ripple at the cathode of CR8 should be between 3 and 4 Vpp under normal loading.

+15V and -15V Power Supplies
P/O A10, A26, A29, and A30
SERVICE SHEET 23

P/O A10 ASSEMBLY

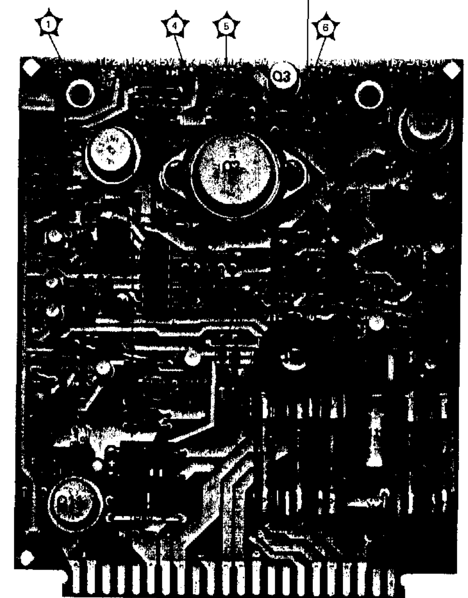


Figure 8-125. P/O A10 Power Supply Regulators Assembly Component Locations (+40V and ± 5V Regulators)

CHANGES

All serial prefixes	**On the A10 component locator:** • **R43, CR13** - Change R43 to CR13 and CR13 to R43. • **TP8** - Add a test point flag, TP8, to the test point located to the right of center of the the board. **On the A10 schematic:** • **TP8** - Add test point, TP8, to the base of Q17. lbreak Add TP8 to the Table of Reference Designations.
2308A and above	**On the A10 schematic:** • **Q11** - In the Table of Transistor and Integrated Circuit Part Numbers, change Q11 to 1884-0244.
2925A and above	**On the A10 schematic:** • **Q11** - In the Table of Transistor and Integrated Circuit Part Numbers, Q11 to 1884-0345. • **R69** - Add R69 (46.4 ohms) between the junction of VR9 anode and Q11 gate, and the −5 V supply.

P/O A29 ASSEMBLY

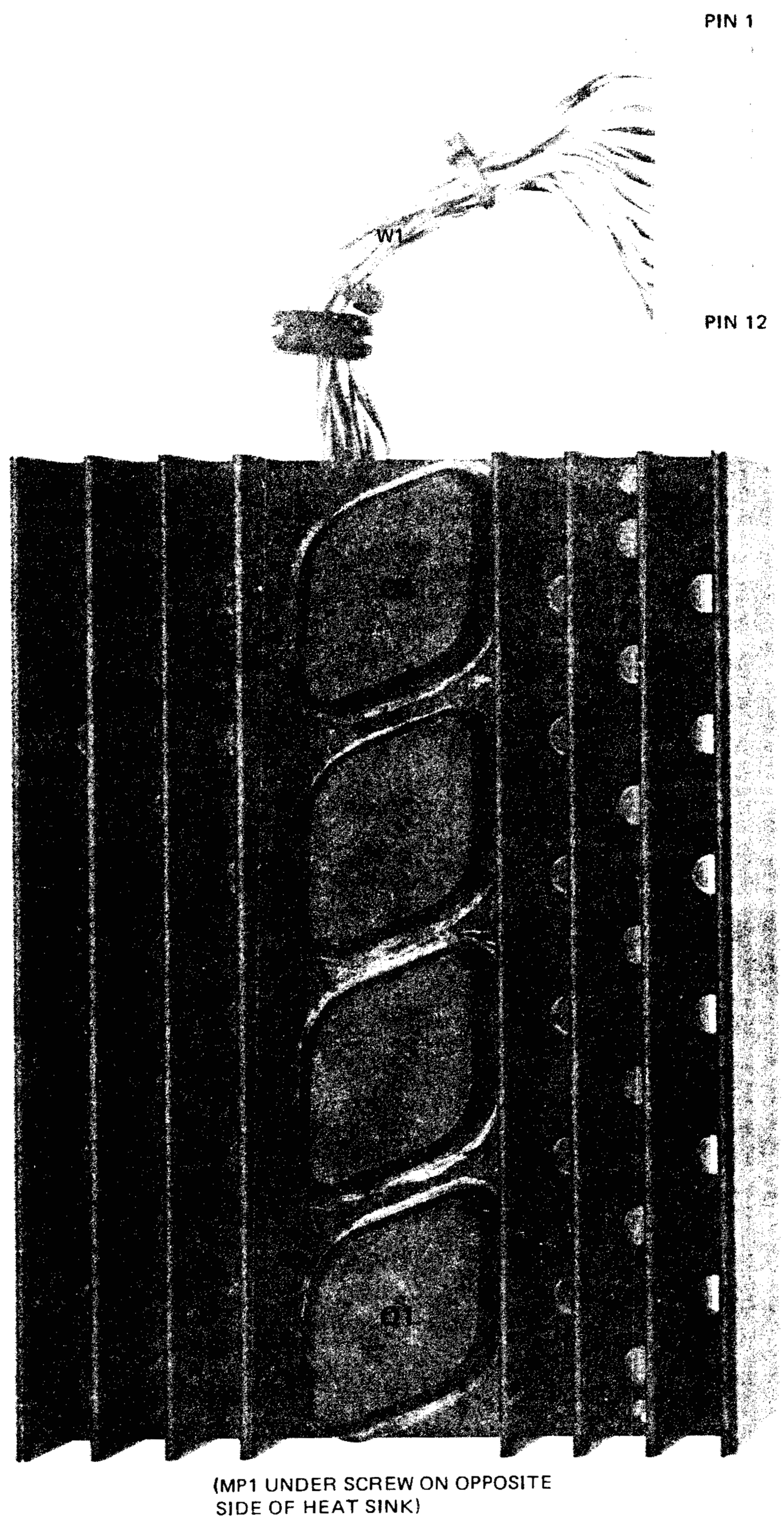
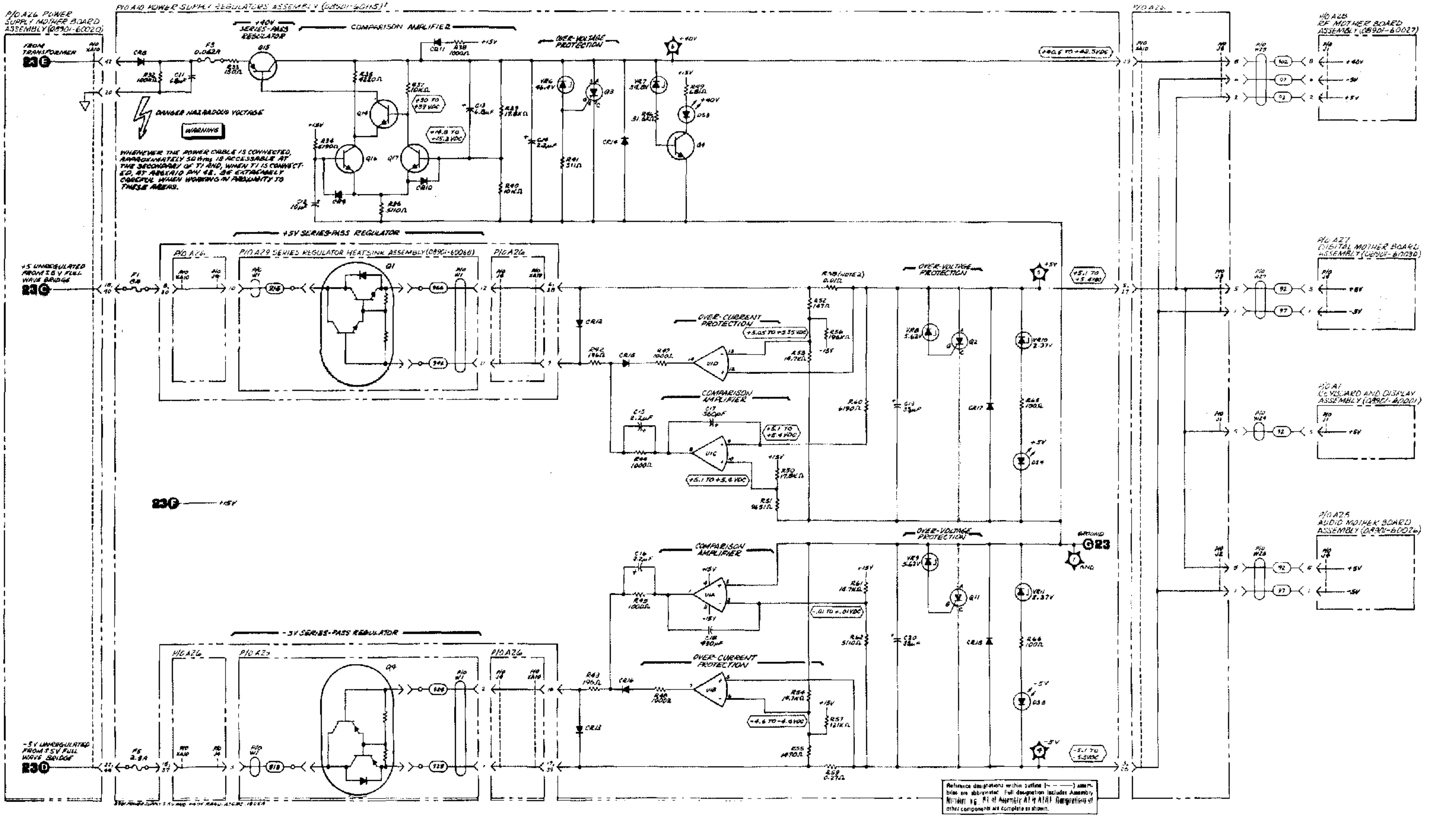


Figure 8-126. P/O A29 Series Regulator Heat Assembly Component Locations (+40V and ±5V Regulators)



NOTES

1. SEE TABLE 8-6 SCHEMATIC DIAGRAM NOTES.
2. A10R58 IS A 2.54 CM (1 INCH) STRIP OF NICKEL COPPER.
3. † INDICATES BACKDATING, SEE SECTION VII.

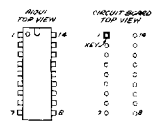
REFERENCE DESIGNATIONS

NO PREFIX	A25
W24,25,27,28	J4
A1	A26
J1	J1-4,6 XA10
A10	A27
C11-20 CR8-18 DS3-5 F1,3,5 Q2-4,11, 14-17 R32-42,45,46 TP1,4-6 U1 VR6-11	J4
	A28
	J1
	A29
	Q1,4 W1

NOT ASSIGNED: A10R63,64

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
A10	
Q2	1884-0005
Q3	1884-0073
Q4	1854-0071
Q11	1884-0012
Q14,16,17	1854-0474
Q15	1853-0038
U1	1826-0161
A29	
Q1	1854-0664
Q4	1853-0551



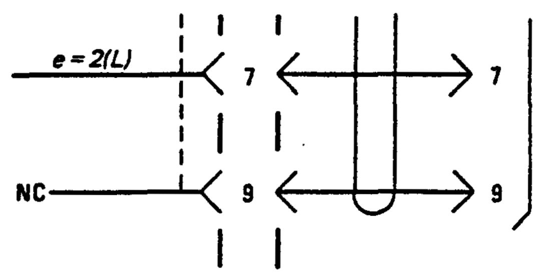
24
P/O A10, A29

Figure 8-127. +5V, -5V, and +40V Power Supplies Schematic Diagram

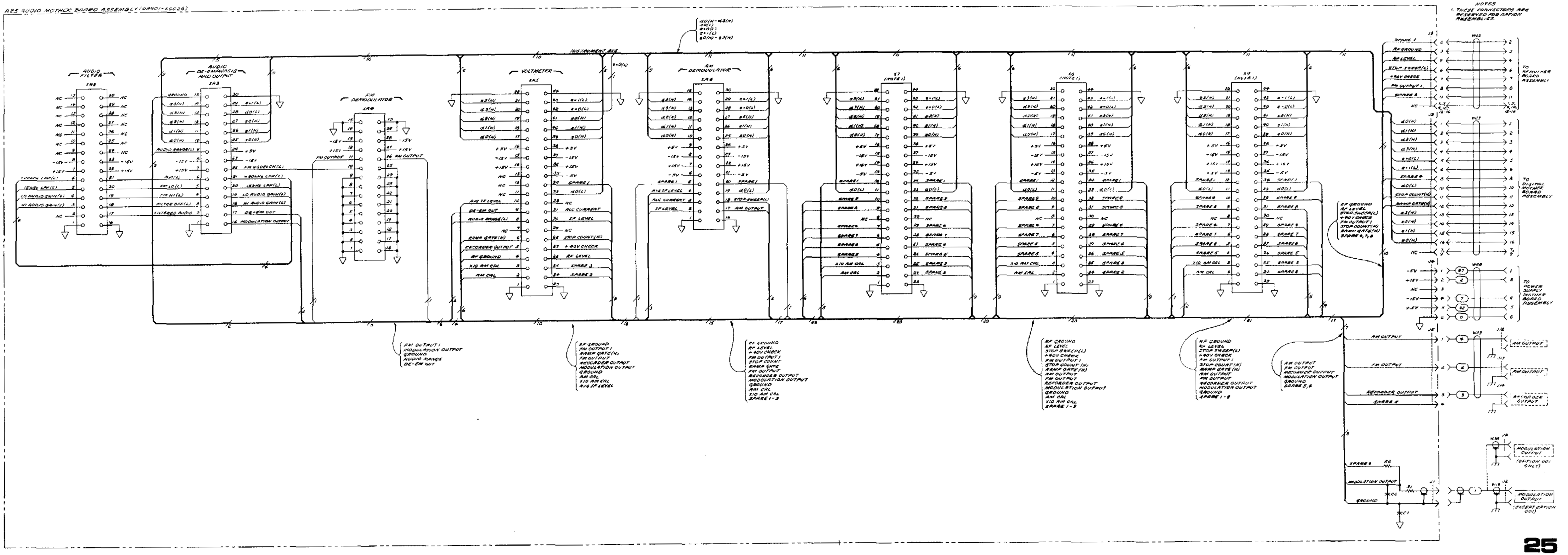
CHANGES

All serial prefixes	**On the A25 schematic:** • **C1, C2** - Change the value of C1 to 0.01 μF and C2 to 100 pF.
2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the part number of the A25 Audio Motherboard Assembly to 08901-60120.
2021A and above	**On the A25 schematic:** • **XA5, X7, X8, X9** - Add a line connecting XA5 pin 28, STOP COUNT (H), to X7 pin 8, X8 pin 8, and X9 pin 8. These pins are currently labeled NC. Label the pins, STOP COUNT (H). • **J2, X7, X8, X9** - Add a line connecting J2 pin 7, e=2(L), to X7 pin 30, X8 pin 30, and X9 pin 30. These pins are currently labeled NC. Label the pins, e=2(L). • **W23** - Use the schematic partial, P/O Figure 8–129. Audio Motherboard Schematic Diagram (2021A and above), on page 8–144.3.
2616A and above	**On the A25 schematic:** • **08901-60286** - Change the part number of the A25 Audio Motherboard Assembly to 08901-60286.

Reserved for future changes.



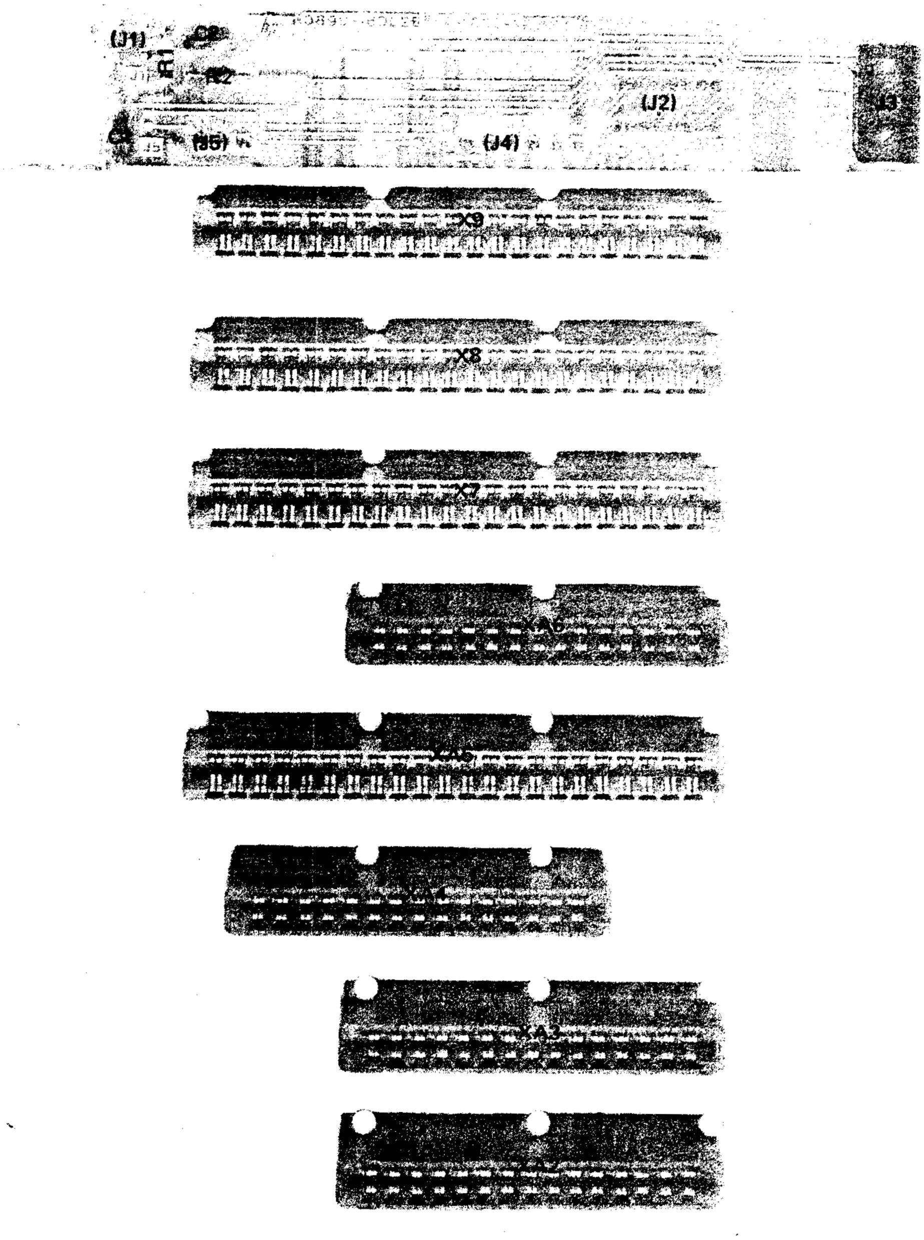
P/O Figure 8–129. *Audio Motherboard Schematic Diagram (2021A and above)*



25

Figure 8-129. Audio Motherboard Schematic Diagram

A25 ASSEMBLY



(J1, J2, J4, J5 ARE ON UNDERSIDE)

Figure 8-128. A25 Audio Motherboard Assembly Component Locations

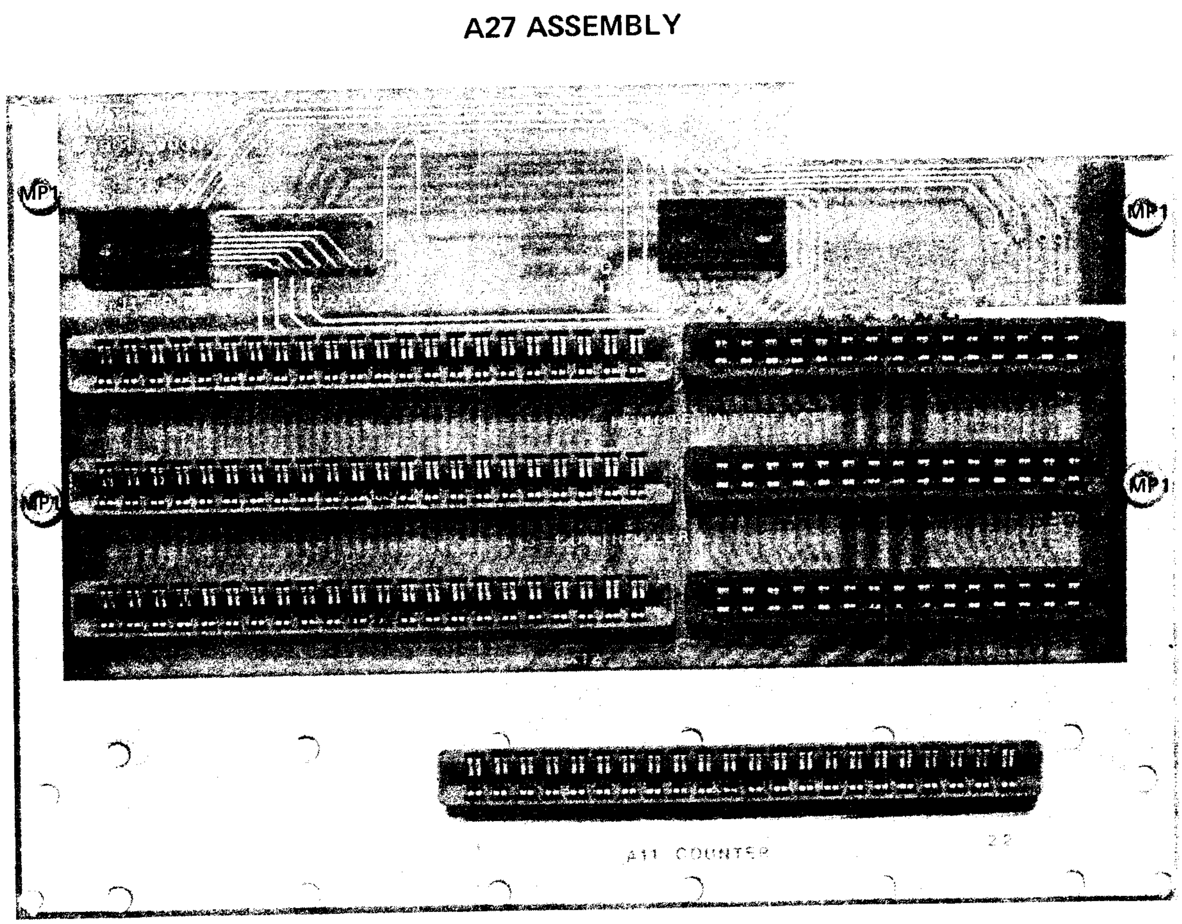


Figure 8-130. A27 Digital Motherboard Assembly Component Locations

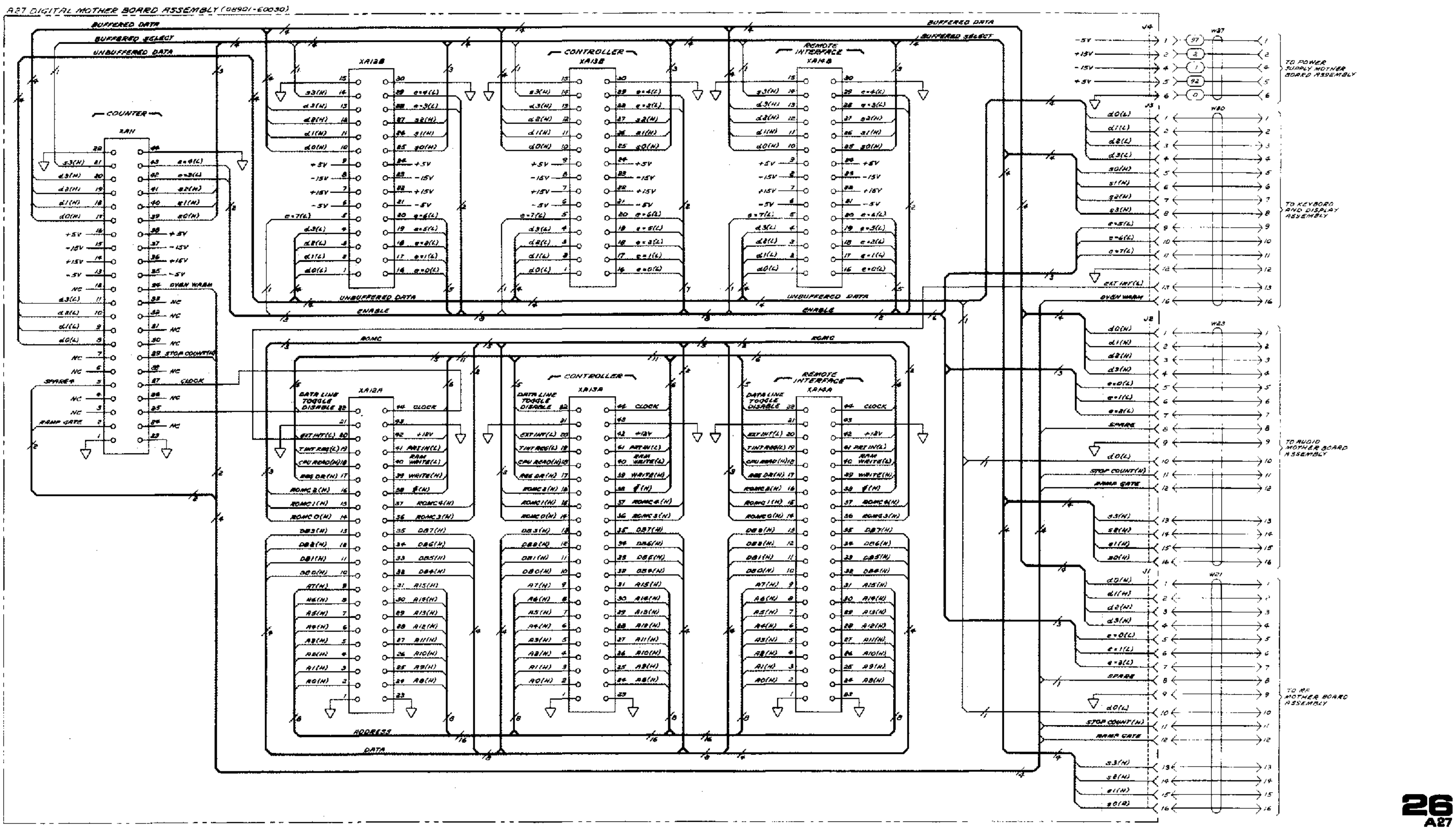


Figure 8-131. Digital Motherboard Schematic Diagram

CHANGES

2128A and above	**On the A28 schematic:** • **08901-60139** - Change the part number of A28 RF Motherboard Assembly to 08901-60139.

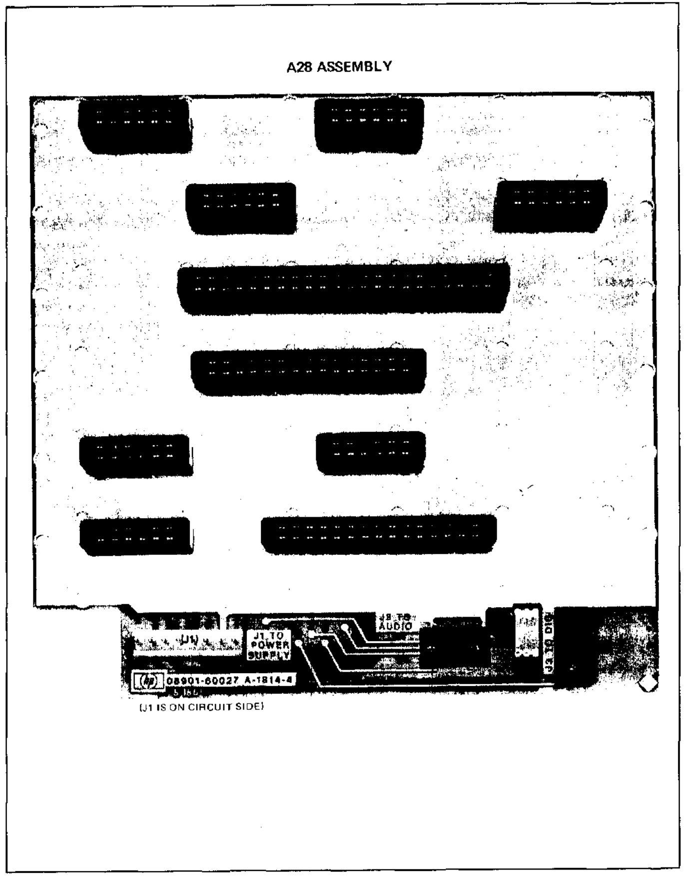
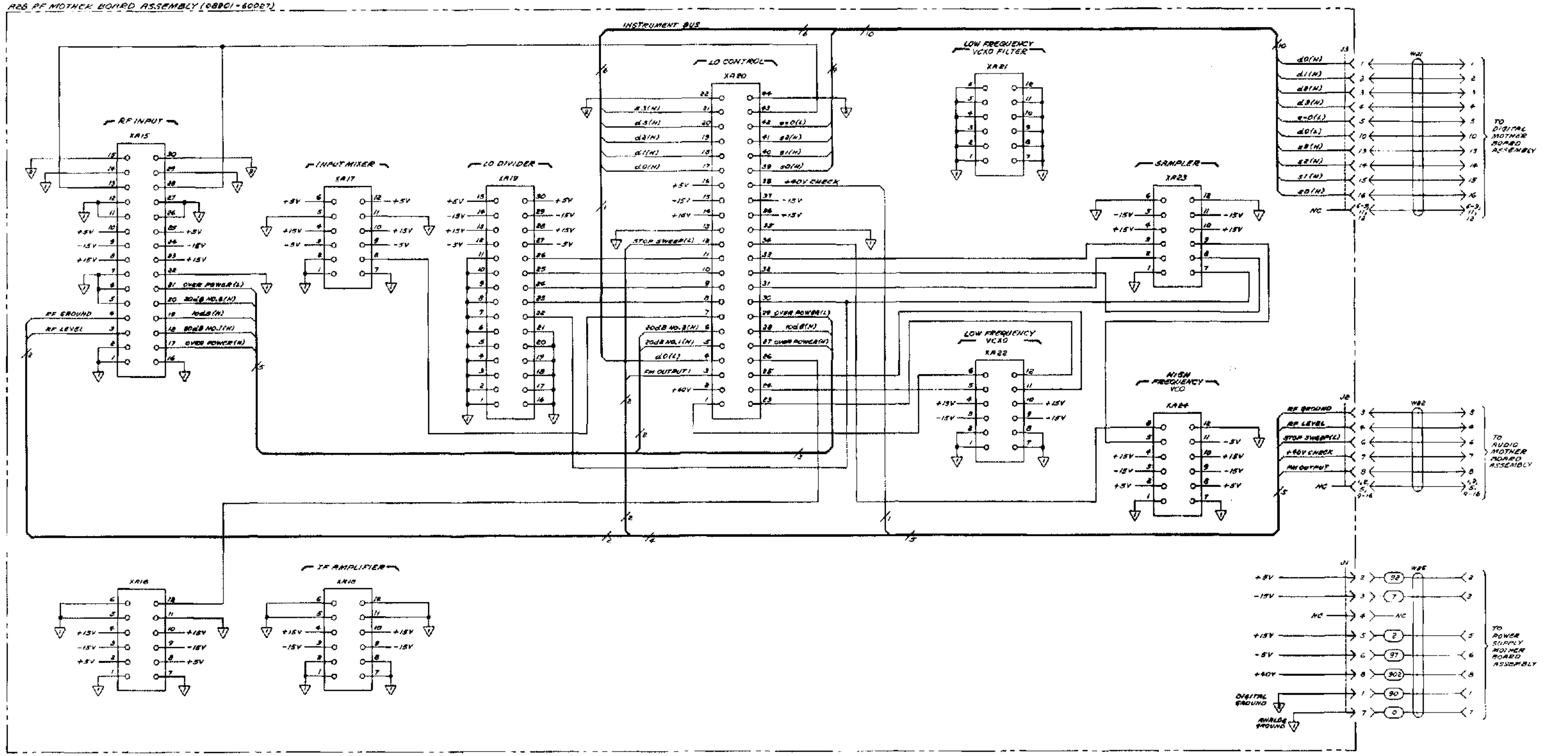


Figure 8-132. A28 RF Motherboard Assembly Component Locations



27
A28

Figure 8-133. RF Motherboard Schematic Diagram

SERVICE SHEET 28 — FM CALIBRATOR (OPTION 010, A51)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the FM Calibrator Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., √3. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., +1.9 to +2.1 Vdc. Extend the board assembly where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope .... HP 1740A
Voltmeter .... HP 3455A

√1 Trapezoid Generation Circuits and Mode Control Check

1. Measure pin 3 of U1 with a dc voltmeter. The voltage should be between -12.3 and -11.5 Vdc.

2. Measure the collector of Q10 with a dc voltmeter. The voltage should be between -10.6 and -9.6 Vdc.

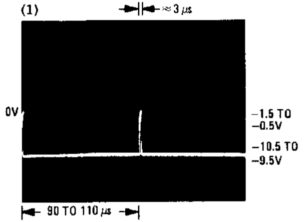
3. Measure pin 6 of U3 with a dc voltmeter. The voltage should be between -5.4 and -4.7 Vdc.

4. Key in the Direct Control Special Functions indicated below. For each setting, check the points indicated with a high-impedance, dc coupled oscilloscope.

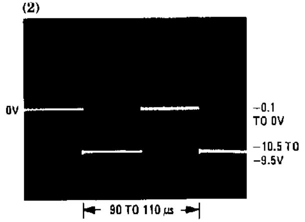
SERVICE SHEET 28 (Cont'd)

Direct Control Special Function	Voltage Level (Vdc) at			
	U5A Pins 4 & 6	U5A Pin 1	A51TP3	A51TP2
0.191	-10.5 to -9.5	-10.5 to -9.5	+0.6 to +1.0	-0.01 to 0
0.192	-10.5 to -9.5	-0.1 to 0	-10.9 to -10.3	-0.35 to -0.31
0.193	See (1).	See (2).	See (3).	See (4).

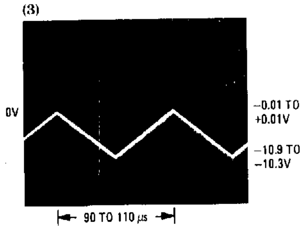
(1)



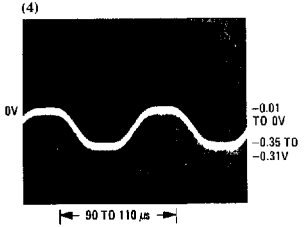
(2)



(3)



(4)



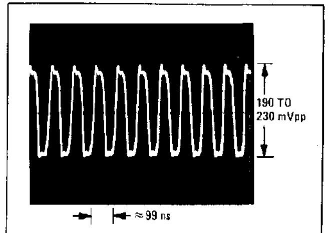
(RISE AND FALL RATES AT CENTER OF WAVEFORM BETWEEN 10 AND 20 mV/μs)

SERVICE SHEET 28 (Cont'd)

√2 10.1 MHz VCO, Output Amplifier, and Counter Buffer Checks

1. Connect an ac coupled oscilloscope to A51J1 (10 MHz OUT). Switch the input of the oscilloscope to 50Ω or terminate the input in 50Ω using a tee.

2. Key in 0.191 SPCL to set the VCO frequency to low. The oscilloscope waveform should be as follows:



3. Connect a high-impedance, dc coupled oscilloscope to A51J2 (10 MHz OUT). The oscilloscope input should have a low-capacitance 10:1 divider probe. The waveform should be a TTL-compatible square wave.

4. Connect W34 to A51J2. Use an extender cable if necessary to make the connection.

5. Key in 0.191 SPCL then 46.3 SPCL to set the 10.1 MHz VCO frequency to low and read it with the internal counter. The display should read between 1009000 and 1011000.

Hint: If the display is grossly in error but the period of step 2 is correct, check the counter. If the display is only slightly in error, perform the FM Calibrator Adjustments. The voltage at A51TP2 (TRAPEZOID OUT) should be between -10 and 0 mVdc.

6. Key in 0.192 SPCL then 46.3 SPCL to set the frequency to high and read it. The display should read 6000 to 7600 higher than in step 5.

Hint: The voltage at A51TP2 should be between -350 and -310 mVdc.

7. Reinstall A51 and secure it with its screws. Reconnect the cables to A51. Reconnect any other assemblies in their normal configuration. Connect CALIBRATION OUTPUT to INPUT.

8. Key in 12.1 SPCL to measure the residual FM of the FM Calibrator. The display should read 0.110 kHz or less.

Hint: If residual FM is excessive, change VR6 then VR5, Q7, Q2 as first tries.

√3 Select Decoder and Data Latch Check

1. Key in 0.190 SPCL.

2. Check pin 1 of U7 with a high-impedance, dc coupled oscilloscope. The waveform should be low-going TTL pulses with period of approximately 7 ms.

3. Check pins 11, 15, and 16 of U8. Pins 15 and 16 should be TTL low, pin 11 should be the complement of the waveform in step 2.

4. Key in 0.193 SPCL. Pins 15 and 16 of U8 should be TTL high.

CHANGES

All Serial Prefixes	**On the A51 schematic:** • **C18, C19** - In the OSCILLATOR COLLECTOR SUPPLY, change the reference designator C18 to C19, and change C19 to C18. • **R24** - Add an asterisk (*) to R24 to indicate a factory selected component.
2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the A25 assembly part number to 08901-60120.
2212A and above	**On the A51 schematic:** • **C10** - In the TRIANGLE GENERATOR, delete C10, and label pin 1 of U4 "NC".
2227A and above	**On the A51 schematic:** • **U4** - In the table of Transistor and Integrated Circuit Part Numbers, change U4 to 1826-0371.
2543A and above	**On the A51 schematic:** • **Q9** - In the table of Transistor and Integrated Circuit Part Numbers, change Q9 to 1854-0295.
2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.

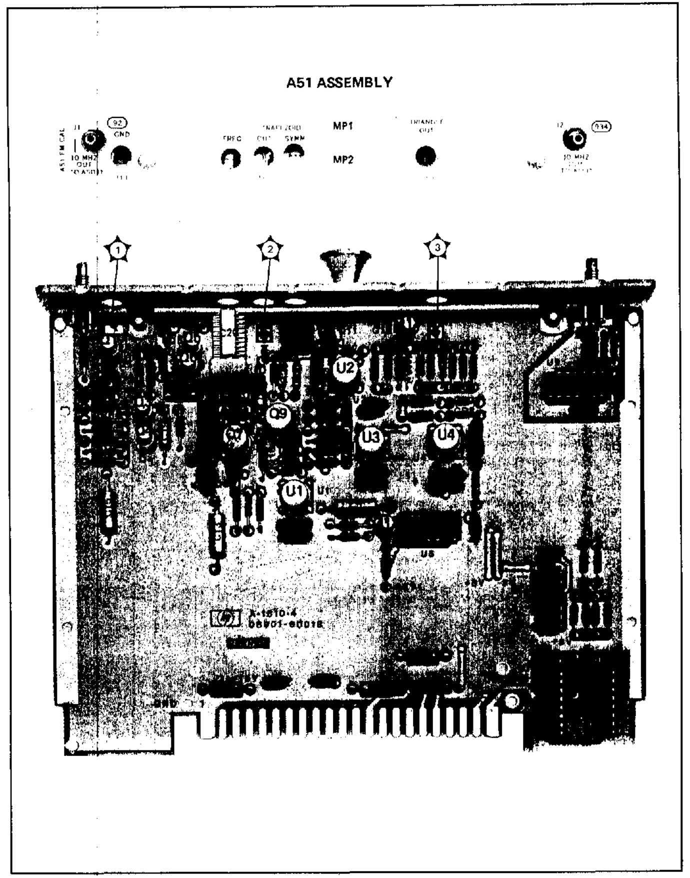


Figure 8-134. A51 FM Calibrator Assembly Component Locations (Option 010)

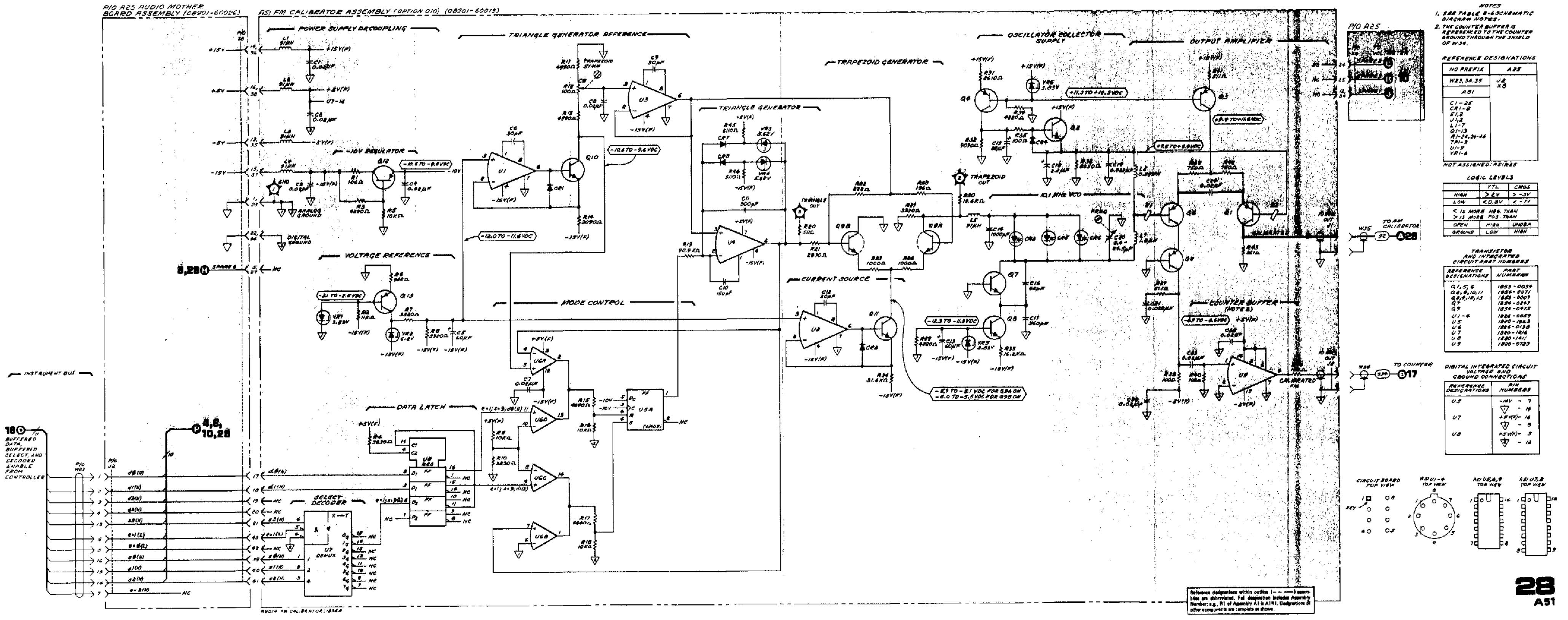


Figure 8-135. FM Calibrator Schematic Diagram (Option 010)

SERVICE SHEET 29 — AM CALIBRATOR (OPTION 010, A50)

OTHER REFERENCES

TROUBLESHOOTING

General

Procedures for checking the AM Calibrator Assembly are given below. The circuits to check are marked on the schematic diagram by a hexagon with a check mark and a number inside, e.g., ⟨√3⟩. In addition, any points outside the labeled circuit area that must be checked are also identified. Fixed signals are also shown on the schematic inside a hexagon, e.g., ⟨+1.9 to +2.1 Vdc⟩. Extend the board assembly where necessary to make measurements.

CAUTION

Tighten SMC connectors to 0.6 N·m (5 in. lb). Hand tightening of connectors is insufficient. Hand tightened connectors can work loose and cause reduced performance, malfunctions, or damage to the instrument.

Equipment

Oscilloscope .... HP 1740A
Signal Generator .... HP 8640B
Voltmeter .... HP 3455A

⟨√1⟩ Modulation Source Circuits Check

1. Measure the emitter of Q15 with a dc voltmeter. The voltage should be between -9.1 and -7.9 Vdc.

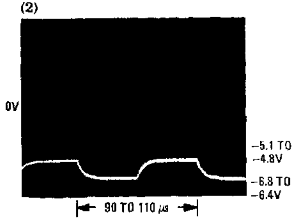
2. Disconnect W35 from A50J1 (10 MHz IN). Key in the Direct Control Special Functions indicated below. For each setting, check the points indicated with a high-impedance, dc coupled oscilloscope.

SERVICE SHEET 29 (Cont'd)

Direct Control Special Function	Voltage Level (Vdc) at				
	U7A Pin 4	U7A Pin 6	U7A Pin 1	Q6 Collector	CR6 Cathode
0.181	-5.2 to -4.7	-10.0 to -9.5	-10.0 to -9.5	6.8 to -6.4	-1.75 to -1.55
0.186	-10.0 to -9.5	-5.2 to -4.7	-5.2 to -4.7	-5.1 to -4.8	-0.1 to 0
0.184	-10.0 to -9.5	10.0 to 9.5	See (1).	See (2)	See (3).

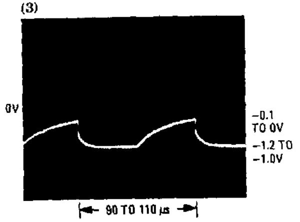
(1)

(2)



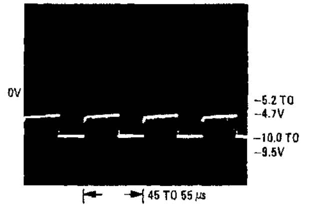
(INTITAL RISE AND FALL RATES BETWEEN 0.18 AND 0.20 V/µs)

(3)



SERVICE SHEET 29 (Cont'd)

Hint: For all settings above, pin 3 of U6 should be as follows:



3. Key in the Direct Control Special Functions indicated below. For each setting, check the points indicated.

Direct Control Special Function	Voltage Level (Vdc) at	
	U8A Pin 2	CR5 Cathode
0.186	-9.9 to -9.4	-0.1 to 0
0.183	-6.7 to -6.4	-2.0 to -1.6

⟨√2⟩ RF and Detector Circuits Check

1. Set the signal generator for 10.1 MHz CW at 4.5 dBm. Connect its RF output to A50J1 (10 MHz IN).

2. Connect a high-impedance, ac coupled oscilloscope to the base of Q1B (pin 6). The oscilloscope should have a low-capacitance 10:1 divider probe. Adjust the signal generator level for a waveform of 600 mVpp.

3. Connect the oscilloscope to the collector of Q1D (pin 11). The waveform of the 10.1 MHz signal should be a squarewave with some ringing and an amplitude between 550 and 650 mVpp excluding the ringing.

4. Key in 0.183 SPCL to turn both modulators off. The waveforms at the collectors of Q2 and Q3 should be between 800 and 1200 mVpp excluding the ringing and both waveforms should have the same amplitude within 50 mV.

Hint: Both modulators should be off; the cathodes of CR5 and CR6 should be between 0 and -100 mVdc.

SERVICE SHEET 29 (Cont'd)

5. Key in the Direct Control Special Functions indicated below. For each setting, check the points indicated.

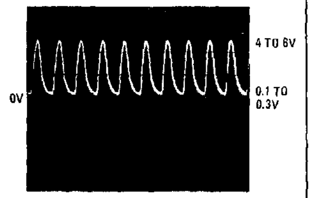
Direct Control Special Function	Level Excluding Ringing (mVpp) at		
	CR7 Anode	CR8 Anode	Q4 Collector
0.183	<10	<10	<10
0.186	200 to 300	<10	100 to 200
0.181	<10	200 to 300	100 to 200
0.185	200 to 300	200 to 300	200 to 400

6. Key in 0.186 SPCL to turn Modulator A on and B off.

Hint: None of the following steps will work properly with both modulators on.

7. Connect the oscilloscope to the collector of Q19. The waveform should be between 1.5 and 2.5 Vpp.

8. Set the oscilloscope to dc coupled and connect it to the collector of Q16. The 10.1 MHz waveform should be as follows:



9. Connect a dc voltmeter to pin 3 of U2 and note the reading which should be between +1.8 and +2.2 Vdc.

10. Connect a dc voltmeter to A50TP2 (X1 LVL). The voltmeter should read within ±10 mV of the voltage in step 9.

11. Connect a dc voltmeter to A50TP3 (X10 LVL). The voltmeter should read between -0.1 and +4 Vdc.

Hint: The X10 DC Amplifier has a gain of -10 and produces an offset of +22 Vdc.

⟨√3⟩ Select Decoder and Data Latch Check

1. Key in 0.180 SPCL. Check pin 1 of U8B with a high-impedance, dc coupled oscilloscope. The waveform should be narrow, high-going pulses with a maximum between +4 and +6V, a minimum between -9 and -10V, and a period of approximately 7 ms.

2. Key in the Direct Control Special Functions indicated below. For each setting, check the pins on U9 indicated.

Direct Control Special Function	Level (TTL) at U9 Pin		
	16	15	11
0.180	L	L	H
0.187	H	H	L

FM Calibrator (Option 010) A51 SERVICE SHEET 28

CHANGES

2021A to 2609A	**On the A25 schematic:** • **08901-60120** - Change the A25 assembly part number to 08901-60120.
2134A and above	**On the A50 schematic:** • **Q9** - In the Table of Transistor and Integrated Circuit Part Numbers, change Q9 to 1854-0811.
2229A and above	**On the A50 component locator:** • **08901-60209** - Use the new component locator, Figure 8–136. A50 AM Calibrator Assembly Component Locations (Option 010) (2229A and above), on page 8–152.3. **On the A50 schematic:** • **08901-60209** - Change the part number of the A50 AM Calibrator Assembly to 08901-60209. Use the schematic partial, P/O Service Sheet 29 – A50 AM Calibrator Assembly Schematic Diagram (Option 010) (2229A and above), on page 8–152.4 • **Q2, Q3, Q4, Q5** - Change Q2 to Q3, Q3 to Q4, Q4 to Q5A, Q5 to Q5B. • **Q5, Q9** - In the Table of Transistor and Integrated Circuit Part Numbers, change Q9 to 1854-0071; change Q5 to 1854-0475. • **R90** - Change the value of R90 to 215 ohms.
2616A and above	**On the A25 schematic:** • **08901-60286** - Change the A25 assembly part number to 08901-60286.

Reserved for future changes.

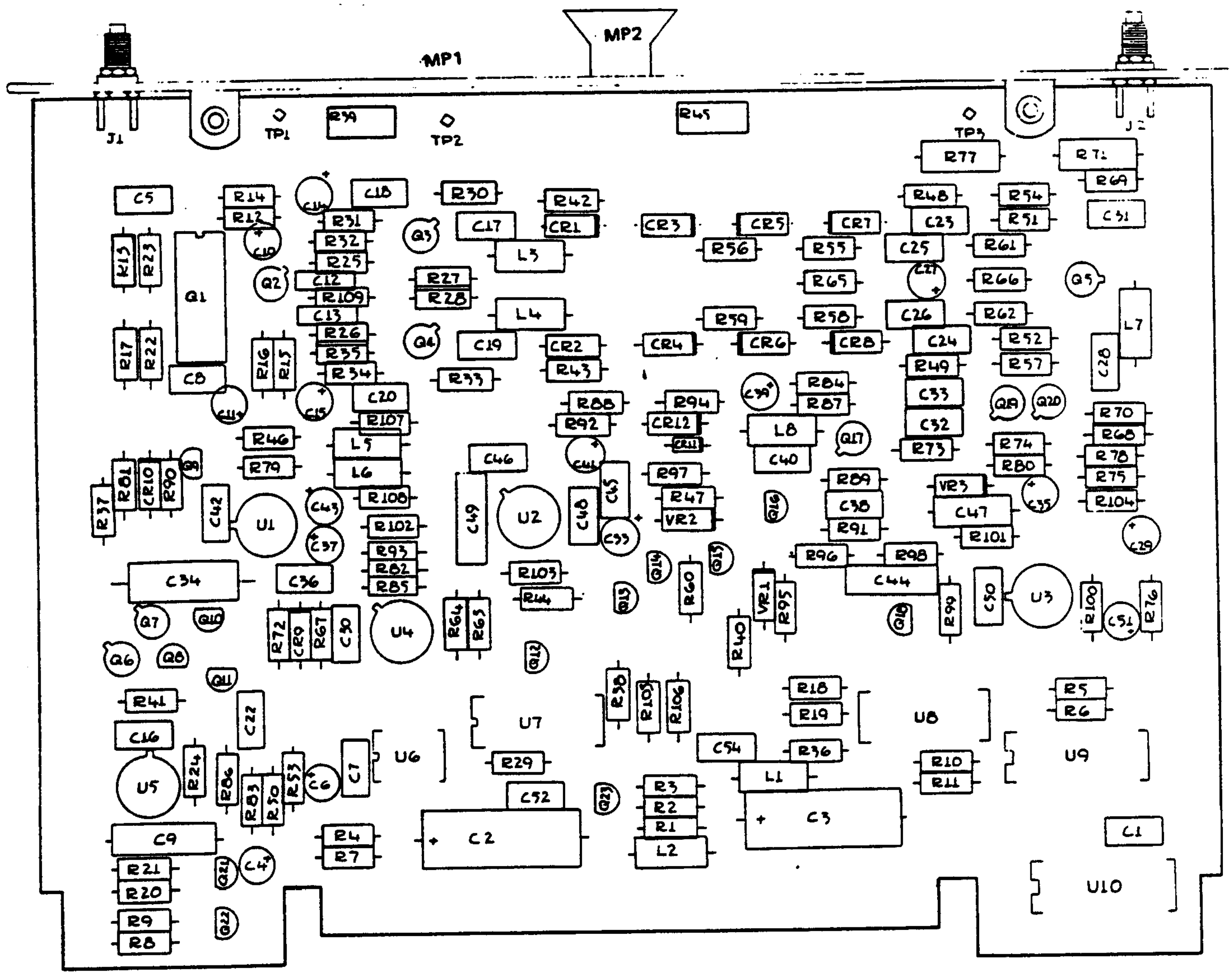
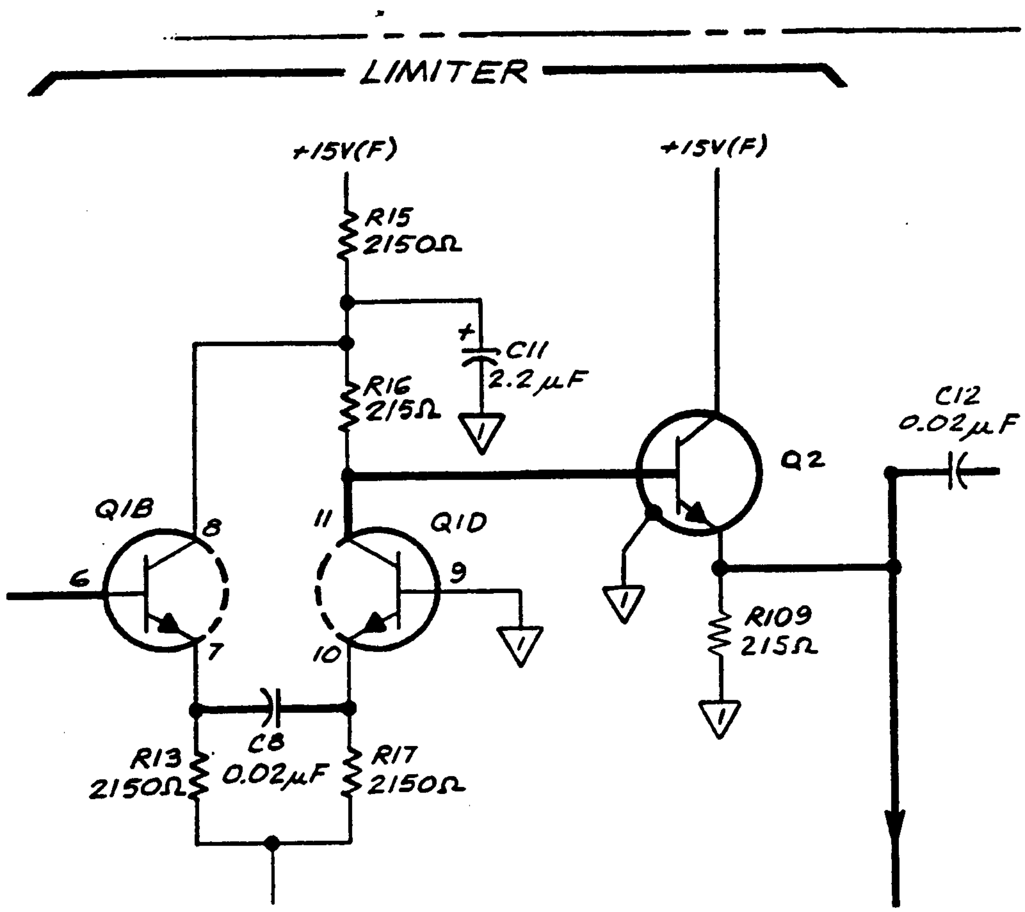


Figure 8–136. *A50 AM Calibrator Assembly Component Locations (Option 010) (2229A and above)*



P/O Figure 8–137. A50 AM Calibrator Schematic Diagram (Option 010) (2229A and above)

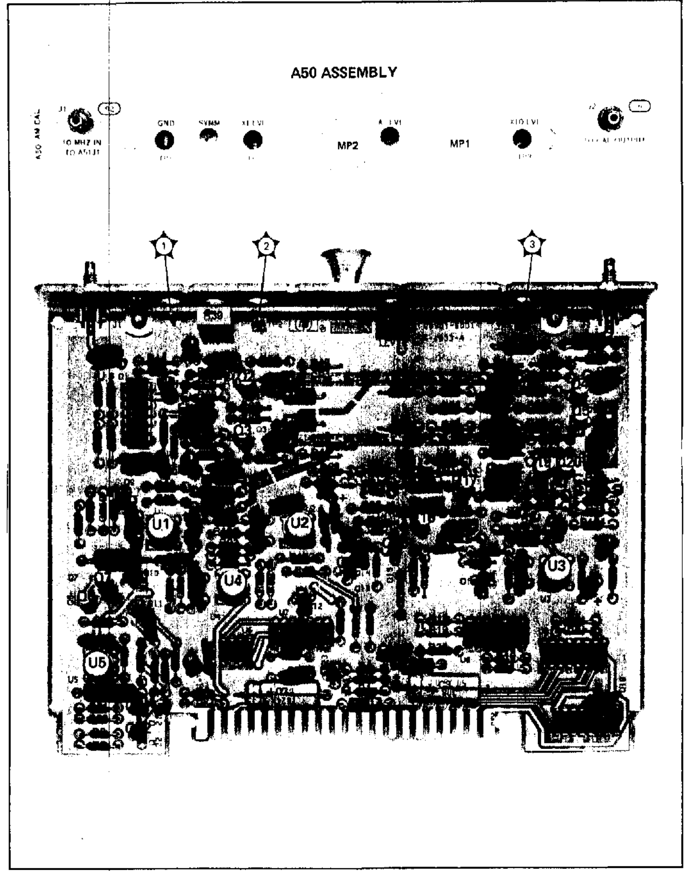
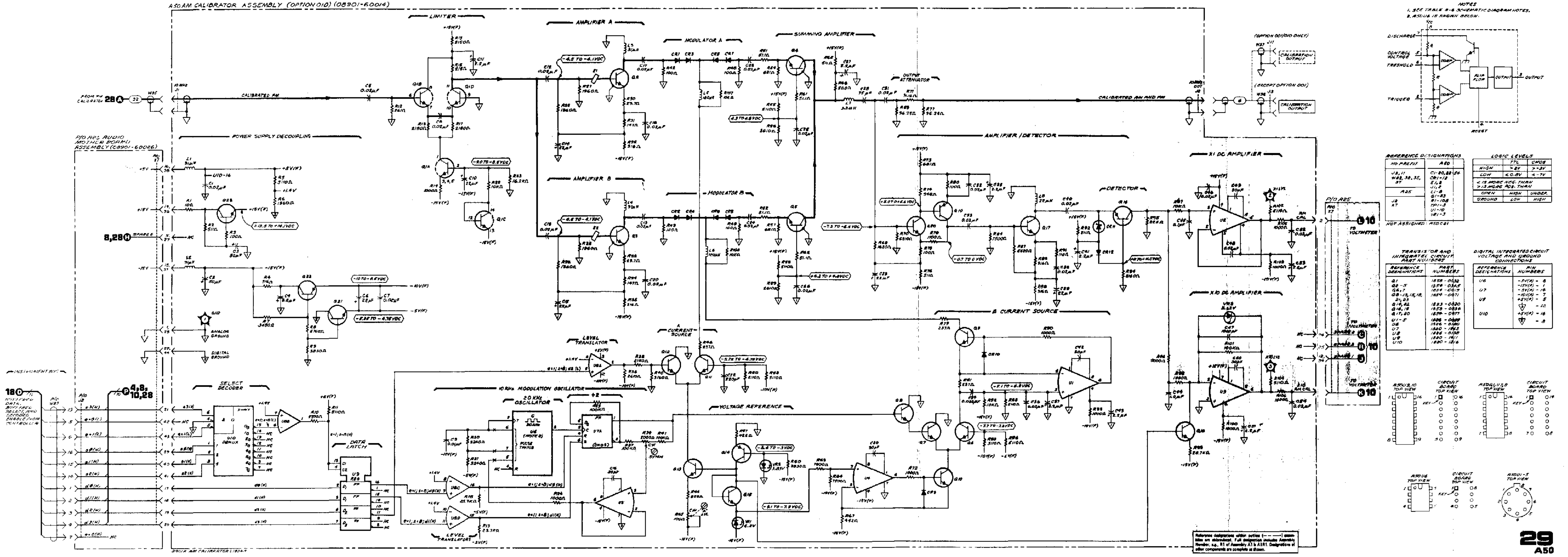


Figure 8-136. A50 AM Calibrator Assembly Component Locations (Option 010)



29
A50

Figure 8-137. AM Calibrator Schematic Diagram (Option 010)

SERVICE SHEET A

GENERAL REMOVAL PROCEDURES

Top Cover Removal

1. Remove the two top plastic standoffs on the rear panel by removing the Pozidriv screws from each standoff.

2. Unscrew the Pozidriv screw at the middle of the rear edge of the top cover. This is a captive screw and will cause the top cover to push away from the frame.

3. Lift the top cover off the instrument.

Bottom Cover Removal

1. Turn the instrument upside down.

2. Remove the two top plastic standoffs on the rear panel by removing the Pozidriv screws from each standoff.

3. Unscrew the Pozidriv screw at the middle of the rear edge of the bottom cover. This is a captive screw and will cause the bottom cover to push away from the frame.

4. Lift the bottom cover off the instrument.

Side Cover Removal

1. Remove the two screws holding each side panel strap handle in place (there is one screw at either end of each strap handle).

2. Remove the strap handle caps and the strap handles.

3. Slide the side panel towards the rear of the instrument and then pull it off.

Information Card Tray Removal

1. Turn the instrument upside down.

2. Remove two plastic standoffs from one side of the bottom cover.

3. Rotate the information card tray away from the remaining two plastic standoffs and remove.

FRONT-PANEL DISASSEMBLY PROCEDURE

Front-Panel Assembly Removal

1. Remove the information card tray.

2. Pry up the trim strip on the top of the instrument just above the front panel with a small screwdriver.

3. Remove the three screws in the channel covered by the trim strip.

4. Remove the two outside screws and the center screw from the bottom channel.

SERVICE SHEET A (Cont'd)

5. Pull the front-panel assembly outwards.

6. To completely separate the front panel from the instrument, disconnect the ribbon cable connectors and the RF cables.

Separation of the A1 Keyboard and Display Assembly from the Front-Dress Panel and Sub-Panel

1. Remove the front-panel assembly from the instrument (refer to Front-Panel Assembly Removal Procedure).

2. To separate the A1 Keyboard and Display Assembly from the front-dress panel (2) and sub-panel (7), first remove the Keyboard and Display insulator (21) by unscrewing the four pan-head screws (22), and removing the washers and spacers which hold it in place.

3. Remove the six remaining screws (26) and washers which fasten the A1 assembly to the sub-panel.

4. Disconnect the front panel LINE switch (9) jumpers at the A1 assembly.

5. Separate the A1 assembly from the front-dress panel and sub-panel.

Separation of the Front-Dress Panel and Display Window from the Sub-Panel

1. Remove the front-panel assembly from the instrument (refer to Front-Panel Assembly Removal Procedure).

2. To remove the front display window (4), remove the three retaining clips (8) and slide the screen straight up (towards the top edge of the front sub-panel).

3. To remove the front-dress panel (2), remove the front-panel jacks (if present) and slide the dress panel downward (towards the bottom edge of the front panel). The bottom edge of the front dress panel will have to be pulled out slightly to allow for clearance of the LINE switch (9).

REPLACEMENT OF PUSHBUTTON SWITCHES AND ANNUNCIATOR LEDS

Key Cap Replacement

To replace a front-panel pushbutton key cap, pull it off and snap on a new one. You will have to either remove the Keyboard from the Front Panel Assembly (refer to Front Panel Disassembly Procedure) or carefully use a pair of pliers to remove the key cap.

Watch the angular position of the key cap as you snap it in place, since eight different positions for installation are possible.

Key Cap LED Replacement

Many of the front-panel pushbutton key caps have molded-in clear lenses which are illuminated by miniature LEDs located in the center portion of the switch at the circuit board. During production

SERVICE SHEET A (Cont'd)

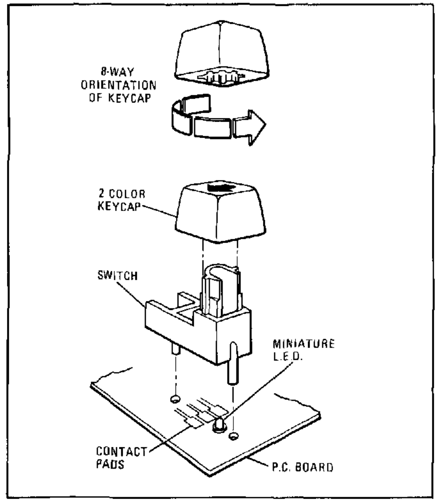


Figure 8-138. Front-Panel Pushbutton Switch Assembly

of the instrument, the LEDs are first soldered in place and then the switch is slid down around them and heat staked in place. If replacement of the LED becomes necessary (due to burnout), it can be replaced without having to tear out the switch. To replace a key cap LED, use the following procedure:

1. Remove the pushbutton key cap (refer to Key Cap Replacement Procedure).

2. Place the Modulation Analyzer on a table top. Lower the front panel so that it is facing downward (refer to the Front-Panel Disassembly Procedure). Unsolder the LED leads on the circuit side of the printed circuit board as you pull the LED down through the middle of the switch stem with a pair of small tweezers.

3. Insert a new LED (one with long leads). Make sure the polarity is right. Pull the leads through the circuit board and solder.

4. Clip off the excess LED lead length on the circuit side of the keyboard.

SERVICE SHEET A (Cont'd)

5. Put the front panel in place. Snap on the key cap. With the instrument power on, test the switch function to make sure that the LED works.

Switch Replacement

The front-panel switches have a very high cycle life. However, if one becomes faulty and needs replacement, follow the procedure outlined below:

1. Remove the pushbutton key cap. You will have to pull hard. Use your free hand to hold the board down as you pull.

2. Lower the front panel (refer to the Front-Panel Disassembly Procedure).

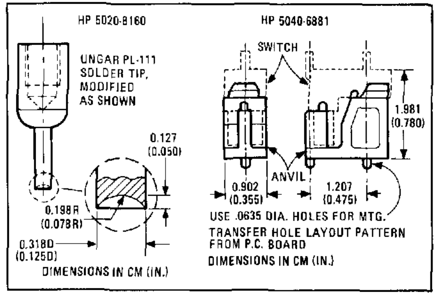
3. Remove the switch by chipping away the melted plastic tabs at the circuit of the keyboard which hold the switch in place.

4. To assure long life and reliable electrical performance, the circuit board contact traces (which are found underneath the switch) *should be clean and free of surface imperfections. Clean the switch* contact pads before installing a new switch. Make sure the LEDs are not tilted and that there is no excess solder around the leads.

5. For reliable operation, any method of assembly must assure that the switch is mounted tightly against the pc board. To facilitate the heat staking operation, specially molded support anvils (HP 5040-6881) can be ordered.

NOTE

The following operation should be done in a well ventilated area. If the heat staking tip is too hot, the plastic will vaporize and emit fumes. These fumes, however, are non-toxic.



8-139. Heat Staking Tip and Assembly Anvil

SERVICE SHEET A (Cont'd)

6. To assure proper switch assembly, verify that the switch is pushed firmly against the circuit board and, with the hot (440°C or 825°F) staking tip, push down on each of the posts (2) of the switch. Each post should take about one second to stake. With the proper cycle, the post should turn a darker color and, in about ten seconds, return to its original bright red color. The correctly staked post should have a smooth round "rivet" like top.

CAUTIONS

Do not disturb the assembly for at least 10 seconds after heat staking.

If not enough heat is applied, the plastic will tend to stick to the tip of the iron.

If too much heat is applied, the plastic will fume profusely, the "rivet" will be irregularly shaped, and the plastic will be permanently discolored.

If the staking tool is worn or flaked, it will cause a misshaped rivet and/or a contamination deposit on the surface.

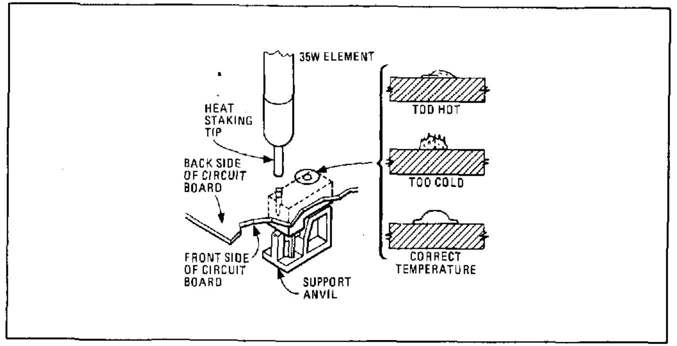


Figure 8-140. Typical Assembly for Heat Staking Operation

CHANGES

All serial prefixes	**In the parts table:** • **<u>Item 31</u>** - Change item 31 reference designator to "W1 and J1."

Item Number	Reference Designator	Description
1	MP60	Knurled Nut (Opt. 010 only)
2	MP13	Front Dress Panel
3	MP58	HP Logo
4	MP40	Front Display Window
5	P/O MP15	Divider Strip
6	MP39	Front Panel Display RFI Shield
7	M15	Front Sub-Panel
8	MP34	Retaining Clip
9	S1	Front Panel LINE Switch
10	See MP60	Star Washer
11	See S1	Lock Washer
12	See S1	Machine Screw
13	W32	Calibration Output Cable Assembly (Opt. 010 only except in combination with Option 001)
14	A1	Keyboard and Display Assembly
15	MP47	A1 Support Shield
16	See MP47	Washer
17	See MP47	Lock Washer
18	See MP47	Machine Screw
19	W20	Cable
20	W24	Cable
21	See MP15	Keyboard and Display Insulator
22	See MP15	Machine Screw
23	See MP15	Lock Washer
24	See MP15	Washer
25	See MP15	Spacer
26	See MP15	Machine Screw
27	See MP15	Lock Washer
28	See MP15	Washer
29	W19	Cable Assembly (BNC to SMC jacks)
30	See MP60	Star Washer
31	W1	Cable Assembly (Type N to SMC jacks)
32	See MP59	Star Washer
33	MP59	Knurled Nut (except Opt. 001)
34	MP60	Knurled Nut (except Opt. 001)

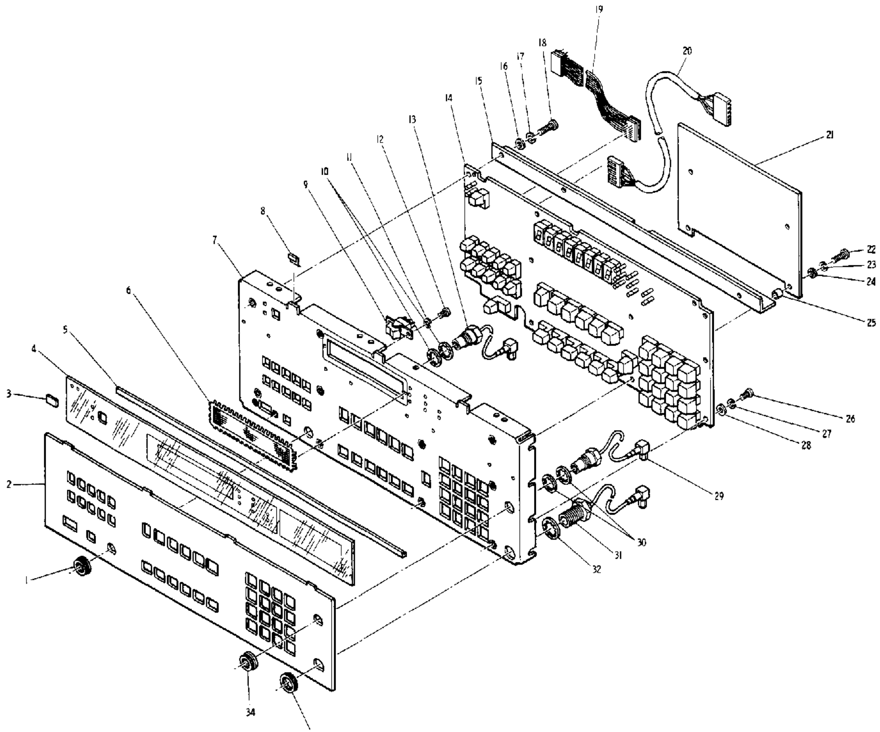


Figure 8-141. Front Panel Illustrated Parts Breakdown

SERVICE SHEET B

REAR-PANEL DISASSEMBLY PROCEDURE

In order to remove the Power Transformer (T1), the Line Power Module (A30), or the Remote Interface Connector Assembly (A31), the rear-panel assembly must be separated from the instrument.

Rear-Panel Removal

1. Remove the top and bottom covers and the side panels of the instrument (refer to General Removal Procedures, Service Sheet A).

2. Unplug the fan plug (6), heat sink wiring harness plug (30), and transformer plug (28) from the Power Supply Motherboard (A26).

3. Remove the four pan-head screws (21) which hold the support bracket (for the LO Section) in place.

4. Remove the top left and bottom left machine screws (50) and lock washers at the power transformer cover (51). These two screws secure the wire duct support (24).

5. Remove the two machine screws at each of the four corners of the rear panel (where it connects to the corner struts).

6. The rear panel can now be pulled a short distance away from the instrument.

7. The rear panel, in most cases, can be worked on without being completely disconnected from the instrument. However, if it becomes necessary to remove the rear panel, this can be accomplished by unplugging the DIP plug at A31 J1 (not shown) on the underneath side of the Remote Interface Connector Assembly (22) and by disconnecting the input/output jacks at either the jacks themselves or at the assemblies to which their cables lead.

Fan Assembly (B1) Removal

1. Remove the top and bottom covers of the instrument (refer to General Removal Procedures, Service Sheet A).

2. Unplug the fan power supply plug (6) at A26J5B on the Power Supply Motherboard.

3. To remove the fan ground wire (not shown) and its solder lug, remove hex nut (20) and lock washer from the fan-cover machine screw (54) and pull off the solder lug (17). Slide the fan cable insulating grommet (4) out of the holding groove in the rear panel.

4. Remove the four machine screws located at the four corners of the fan cover. Pull the fan assembly away from the instrument. Notice the rubber shock mounts (15) through which the machine screws are fit. These dampen fan vibrations. When re-installing the fan assembly, tighten the hex nuts (20) down so the end of each machine screw is visible.

General Removal and Front Panel Disassembly Procedures SERVICE SHEET A

SERVICE SHEET B (Cont'd)

Heat Sink Assembly (A29) Removal

1. Remove the top and bottom covers of the instrument (refer to General Removal Procedures, Service Sheet A).

2. Unplug the heat sink wiring harness connector (30) at A26J4 on the Power Supply Motherboard.

3. Remove the four machine screws (41) and lock washers which hold the heat sink in place (these are located at the four corners of the heat sink).

4. Pull the heat sink assembly (39) a short distance away from the back of the instrument.

5. Slide the grommet (32) out of the rectangular slot on the rear panel (located just behind the heat sink).

6. Feed the connector (30) through the rectangular slot and remove the heat sink assembly from the instrument.

Transformer (T1) Removal

1. Remove the rear panel of the instrument (refer to Rear-Panel Removal Procedure).

2. Unscrew the top right and bottom right screws at the transformer cover (51). The transformer is now mechanically disconnected from the rear panel, however, it is still electrically connected (hard wired) to the line power module (31).

3. To completely disconnect the transformer from the instrument, unsolder the wires connecting it to the line power module.

Line Power Module (A30) Removal

1. Remove the rear panel of the instrument (refer to Rear-Panel Removal Procedure).

2. Unsolder the line power module (31) from the power transformer (23).

3. To remove the line power module, push in the tabs on the sides of the module and push it out through the rear panel.

Remote Interface Connector Assembly (A31) Removal

1. Remove the instrument rear panel (refer to Rear-Panel Removal Procedure).

2. Unplug the connector cable at A31J1 (not shown) from the bottom side of the Remote Interface Connector Assembly (22).

3. Unscrew the standoffs (8) on either side of the remote interface connector and push the interface assembly through the rear panel.

CHANGES

All serial prefixes	**In the parts table:** • **Item 54, Item 56** - Change item 54 description to Machine Screw (6-32 X 2.50). Change item 56 description to Machine Screw (6-32 X 2.25). • **Item 58** - Add item 58, reference designator – MP28, description – star washer. **In the Illustrated parts breakdown:** • **Item 58** - Show a star washer between item 2 (Fan Cover) and item 3 (Fan Assembly) and in line with item 54 (Machine Screw). Designate this washer item 58.

Item Number	Reference Designator	Description
1	MP33	Wire Finger Guard
2	MP28	Fan Cover
3	B1	Fan Assembly
4	P/O B1	Grommet
5	P/O B1	Plastic Tubing
6	P/O B1	3-Pin Plug
7	MP53	Plug (except Opt. 001—J10, Input 50Ω)
8	P/O A31	Standoff
9	J12	BNC Connector
10	MP52	Plug (except Opt. 001/010, Calibration Output)
11	P/O A31	Lock Washer
12	See MP37	Machine Screw
13	See MP37	Lock Washer
14	See MP28	Shock Mount
15	See MP28	Shock Mount
16	See J12	Star Washer
17	See MP28	Solder Terminal Lug
18	See J12	Hex Nut
19	See MP28	Lock Washer
20	See MP28	Hex Nut
21	MP37	Bracket
22	A31	Remote Interface Connector Assy
23	T1	Power Transformer
24	MP31	Wire Duct Support
25	See T1	Washer
26	See T1	Lock Washer
27	See T1	Hex Nut
28	P/O T1	8-Pin Connector
29	MP16	Rear Panel
30	P/O A29W1	12-Pin Connector
31	A30	Line Power Module
32	P/O A29W1	Grommet
33	See A29Q3	Hex Nut
34	See A29Q3	Lock Washer
35	See A29Q3	Washer
36	A30TB1	Line Power Cord
37	A29MP1	Cable Clamp
38	F1	1 Amp Fuse (120 Vac) 2 Amp Fuse (220 Vac)
39	A29MP2	Heat Sink (Includes sockets for Q1—Q4)
40	See A29MP2	Lock Washer
41	See A29MP2	Machine Screw (6-32 x .625)
42	See A29Q3	Heat Conducting Insulator
43	A29Q3	2N6055 NPN Power Transistor
44	See A29Q3	Lock Washer
45	See A29Q3	Machine Screw (6-32 x .625)
46	See A29Q3	Lock Washer
47	See A29Q3	Machine Screw (6-32 x .625)
48	See A29Q3	Insulator Cover
49	See T1	Lock Washer
50	See T1	Machine Screw (10-32 x 2.25)
51	See T1	Transformer Cover
52	See T1	Machine Screw (10-32 x 2.25)
53	See T1	Lock Washer
54	MP28	Machine Screw (6-32 x 2.25)
55	MP28	Washer
56	See MP28	Machine Screw (6-32 x 2.50)
57	MP28	Washer

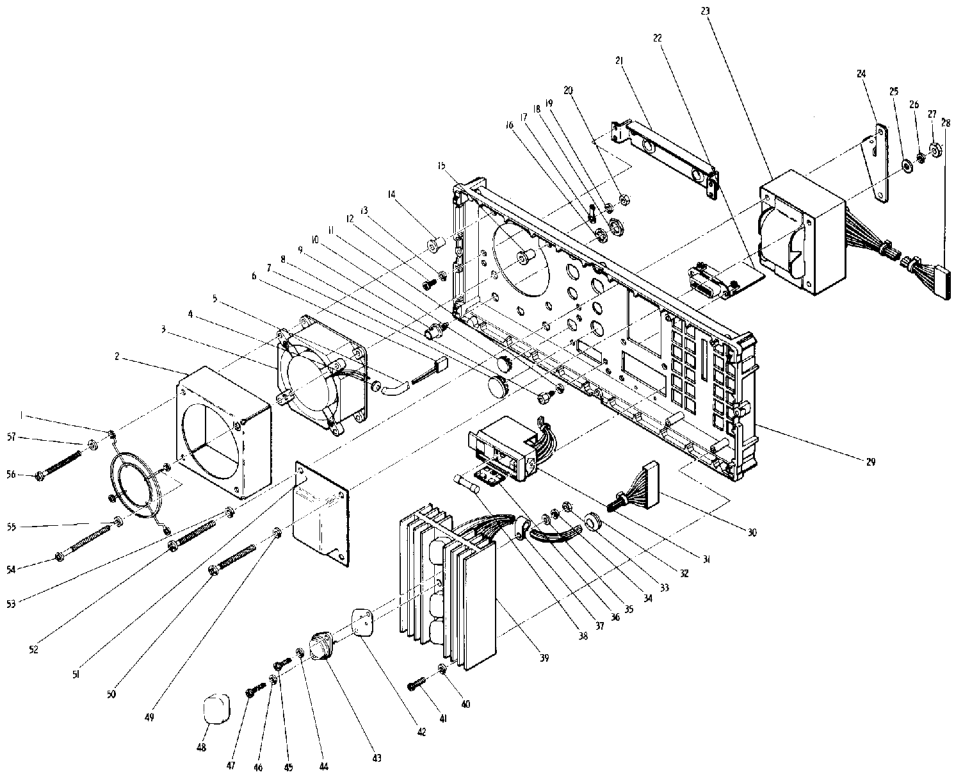


Figure 8-142. Rear Panel Illustrated Parts Breakdown

CHANGES

All serial prefixes	**Service Special Functions:** • **46.N** - Under 46.N Count Internal Signals, change "N=2 FM Calibrator" to "N=3 FM Calibrator."

SERVICE SHEET C
SERVICE SPECIAL FUNCTIONS

40.0 Controller Reset

41.0 Controller Clear

42.0 Display Software Date

43.N Service Error Display Control
N=0 Disable Display of Service Errors
N=1 Enable Display of Service Errors

46.N Count Internal Signals
N=1 Intermediate Frequency
N=2 Voltage-to-Time Converter
N=2 FM Calibrator
N=4 HF VCO ÷ 8
N=8 Selected Time Base Reference
N=9 External Time Base Reference
N=A Internal Time Base Reference
N=B (Spare)

49.N Display Internal Voltages (49.XY = 49.X-49.Y)
N=0 Ground
N=1 RF Level Ground
N=2 RF Level/2.96
N=3 RF Level
N=4 X10 AM Calibrator Level
N=5 X1 AM Calibrator Level
N=6 Audio Range
N=8 Ground
N=9 Average Detector
N=A Peak Detector
N=B Average IF Level
N=D IF Level
N=E ALC Current

50.N Display Internal Voltages (50.XY = 50.X-50.Y)
N=0 Ground
N=1 -15V Supply
N=2 -5V Supply
N=3 +5V Supply
N=4 +15V Supply
N=5 +40V Supply

52.N Read Only Memory Verification (N=ROM Number 1-8, 11) <Actual Checksum> . <Expected Checksum

SERVICE SHEET C (Cont'd)

54.N Local Oscillator Test
N=0 Performs all tests below — displays number of first test failed.

N	Test No.	Display Digits	Test
1	01	1 & 2	(Undefined)
1	02	3 & 4	Time Base
1	03	5 & 6	Counter
1	04	7 & 8	HF VCO and Divider Output
2	05	1 & 2	HF VCO Tuned to Top of Range
2	06	3 & 4	HF VCO Tuned to Bottom of Range
2	07	5 & 6	HF VCO Tuned to Mid-Range
2	08	7 & 8	(Undefined)
3	09	1 & 2	Gain of Most Significant DAC
3	10	3 & 4	Gain of Least Significant DAC
3	11	5 & 6	(Undefined)
3	12	7 & 8	(Undefined)
4	13	1 & 2	Phase Lock Loop Acquisition
4	14	3 & 4	Phase Lock Loop Stability
4	15	5 & 6	(Undefined)
4	16	7 & 8	(Undefined)
5	17	1 & 2	Tune LF VCXO with DAC
5	18	3 & 4	Gain of LF VCXO Drive
5	19	5 & 6	(Undefined)
5	20	7 & 8	(Undefined)

55.0 Sweep Doubler Band

56.0 Sweep Bands 4 through 8

57.0 Sweep Bands DBLR through 3

60.0 Key Scan (Jumper A13TP1 to A13TP3) (See Figure 8-143 for key scan codes.)

61.N Display HP-IB Status
N=0 <Addressed to Talk> . <Addressed to Listen> True=1
N=1 <DAV> . <RFD> <DAC> (True=1)
N=2 <ATN> . <REN> (True=1)
N=3 <SPM> . <SRQ> (True=1)
N=4 PIO Port A (True=1)

Display Digit	1	2	3	4	5	6	7	8
Mnemonic	IO8	IO7	IO6	IO5	IO4	IO3	IO2	IO1

N=5 PIO Port B (True=1)

Display Digit	1	2	3	4	5	6	7	8
Mnemonic	ATN	ARD	AAD	SRQ	RNL	ATT	ATL	SDV

ERROR MESSAGE SUMMARY

The error messages are grouped by error code as follows:

a. E01 through E19 and E90 through E99 are Operating Errors. Refer to the Operating Manual for additional information.

b. E20 through E29 are Entry Errors. Refer to the Operating Manual for additional information.

c. E30 through E89 are Service Errors. Refer to page 8-15 for additional information.

NOTE

Not all of the available error message numbers are used.

Operating Errors (E01 through E19 and E90 through E99).

E01 — Signal out of IF Range.
E02 — Input circuits underdriven.
E04 — Audio circuits overdriven.
E05 — FM squelched.
E06 — Input power protect relay open.
E07 — Display overrange.
E08 — Calibrator signal not at input (Option 010 only).
E09 — Option not installed.
E10 — Input frequency out of range.
E11 — Calculated value out of range.
E12 — Time base oven cold (Option 002 only).
E96 — No input signal sensed by instrument (HP-IB only).

Entry Errors (E20 through E29)

E20 — Entered value out of range.
E21 — Invalid key sequence.
E22 — Invalid Special Function prefix.
E23 — Invalid Special Function suffix.
E24 — Invalid HP-IB code.

Service Errors (E30 through E89)

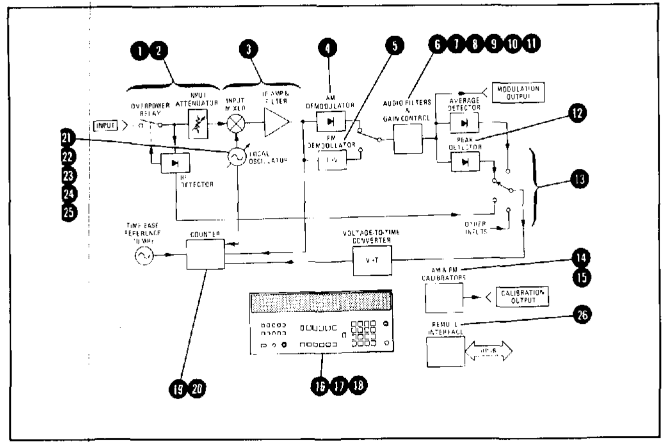
E70 — Phase lock loop step-down.
E71 — Phase lock loop step-up.
E72 — Audio overload.
E74 — FM Calibrator overdeviation.
E75 — FM Calibrator under deviation.
E76 — AM Calibrator modulators unequal.
E77 — AM Calibrator channel B out of range.
E78 — Key not found.
E79 — Audio autorange rangeback.
E80 — Audio settling timeout.
E81 — LO tuning adjusted to center signal in IF bandpass.
E89 — Software error.

Direct Control Special Function Readback Summary

Direct Control Special Function	Display vs. Key Pressed (No Key Pressed = 1111.0000)			
	0111.0000	1011.0000	1101.0000	1110.0000
0.750	(N/A)	LCL	>20 kHz	15 kHz
0.760	3 kHz	300 Hz	50 Hz	750 μs
0.770	75 μs	50 μs	25 μs	PRE-DISP
0.780	RF LEVEL	ΦM	FM	AM
0.790	AUTO OPER	CALIBRATOR	S (Shift)	FREQ
0.7A0	CLEAR	. (decimal point)	kHz ↓	SPCL
0.7B0	(N/A)	kHz ↑	MHz	(N/A)
0.7C0	dB	%	AVG	PEAK HOLD
0.7D0	PEAK–	PEAK–	9	8
0.7E0	7	6	5	4
0.7F0	3	2	1	0

Function Readback	Direct Control	Service Sheet	Meaning of Readback
Overpower Protect	0.050	15	d0=1 if relay tripped
IF Present	0.0E0	4	d0=1 if IF present
FM Squelch	0.170	8	d0=1 if squelched
Audio Overvoltage	0.150	8	d0=1 if overvoltage
Parity	0.1Fd then 0.1D0	10	d0=0 if d0 + d1 + d2 + d3 is even d0=1 if d0 + d1 + d2 + d3 is odd
Time Base Oven	0.300	17	d0=0 if cold
Time Base	0.360	17	d3=state of time base
Counter Carry	0.360	17	d2=1 if carry
Counter Stage 4	0.350	17	d=output
Counter Stage 3	0.340	17	d=output
Counter Stage 2	0.330	17	d=output
Counter Stage 1	0.320	17	d=output
HP-IB Address	0.450	22	d=complement of most significant bits
HP-IB Address	0.460	22	d0=complement of least significant bits d1=0 if talk only d2=0 is listen only d3=1 if serial poll FF set

DIRECT CONTROL SPECIAL FUNCTION READOUT SUMMARY



Hexadecimal Information for Direct Control Special Functions

Hexadecimal Character	Decimal Equivalent	Binary Equivalent	Keystroke Entry	HP-IB Code Entry	Display During Entry
0	0	0000	0	0	0
1	1	0001	1	1	1
2	2	0010	2	2	2
3	3	0011	3	3	3
4	4	0100	4	4	4
5	5	0101	5	5	5
6	6	0110	6	6	6
7	7	0111	7	7	7
8	8	1000	8	8	8
9	9	1001	9	9	9
A	10	1010	S (Shift) 0	X0	—
B	11	1011	S (Shift) 1	X1	E
C	12	1100	S (Shift) 2	X2	H
D	13	1101	S (Shift) 3	X3	L
E	14	1110	S (Shift) 4	X4	P
F	15	1111	S (Shift) 5	X5	(blank)

1 Attenuator Control and Overpower Reset (0.04d SPCL). See Service Sheet 1.

Attenuator	Direct Control Special Function	
	Without Overpower Reset	With Overpower Reset
Thru Path	0.04F	0.047
10 dB	0.04D	0.045
20 dB No. 2	0.04E	0.046
20 dB No. 1	0.04B	0.043

2 5.25 MHz High-Pass Filter Control and RF Level Detector (0.02d SPCL). See Service Sheet 1.

RF Level Detector	Direct Control Special Function	
	HPF In	HPF Out
On	0.02C	0.024
Off	0.028	0.020

3 IF Select (0.03d SPCL). See Service Sheet 2.

IF (Filter)	Direct Control Special Function
1.5 MHz (4 MHz Low-Pass)	0.030
455 kHz (455 kHz Bandpass)	0.031

4 AM ALC Control (0.0Dd SPCL). See Service Sheet 3.

ALC Mode	Direct Control Special Function
Off	0.0D0
Fast	0.0D3
Slow	0.0D1

5 FM Squelch (0.15d SPCL). See Service Sheet 6. Also see Readback Control.

Squelch	Direct Control Special Function
On	0.150
Off	0.152

6 Audio Input Select and Audio Overvoltage Detector Reset (0.11d SPCL). See Service Sheet 8.

Function	Direct Control Special Function
High Gain FM; Reset	0.118
Low Gain FM; Reset	0.112
AM; Reset	0.111
No Input; No Reset	0.110

7 Audio Gain Control (0.12d SPCL). See Service Sheet 7.

Audio Gain	Direct Control Special Function
High	0.121
Low	0.120

8 Audio Low-Pass Filter Select (0.13d SPCL). See Service Sheets 7 & 8.

Low-Pass Filter	Direct Control Special Function
3 kHz	0.134
15 kHz	0.13C
>20 kHz	0.13A
All Off	0.139

9 Audio High-Pass Filter and FM Pre-Display De-emphasis Control (0.14d SPCL). See Service Sheet 8.

High-Pass Filter	Direct Control Special Function	
	Pre-Display On	Pre-Display Off
300 Hz	0.144	0.14C
50 Hz	0.142	0.14A
All Off	0.141	0.149

10 FM De-emphasis, Phase Modulation, and + or −Peak Detector Control (0.10d SPCL). See Service Sheet 8.

Function	Direct Control Special Function	
	Peak+ Detector	Peak− Detector
De-emphasis: Off	0.100	0.108
De-emphasis: 25 μs	0.101	0.109
De-emphasis: 50 μs	0.104	0.10C
De-emphasis: 75 μs	0.102	0.10A
De-emphasis: 750 μs	0.103	0.10B
Phase Modulation	0.105	0.10D

11 Discharge Absolute Peak Detector. Key in 0.160 SPCL several times. See Service Sheet 8.

12 Voltmeter Peak Detector Control (0.1Ed SPCL). See Service Sheet 9.

Mode	Direct Control Special Function
Slow Charge	0.1E3
Fast Charge	0.1E1
Very Fast Charge; Hold	0.1E0
Discharge	0.1E0 then 0.1E1

13 Voltmeter Input Select (0.1Cd and 0.1Fd SPCL). See Service Sheet 10.

Selector	Input	Direct Control Special Function
A5U10	Ground	0.1C0 then 0.1F0
A5U10	RF Level Ground	0.1C0 then 0.1F1
A5U10	RF Level/2.96	0.1C0 then 0.1F2
A5U10	RF Level	0.1C0 then 0.1F3
A5U10	x10 AM Calibrator Level	0.1C0 then 0.1F4
A5U10	x1 AM Calibrator Level	0.1C0 then 0.1F5
A5U10	Audio Range Detector	0.1C0 then 0.1F6
A5U10	(Spare)	0.1C0 then 0.1F7
A5U11	Ground	0.1C0 then 0.1F8
A5U11	Average Detector	0.1C0 then 0.1F9
A5U11	Peak Detector	0.1C0 then 0.1FA
A5U11	Average IF Level	0.1C0 then 0.1FB
A5U11	(Spare)	0.1C0 then 0.1FC
A5U11	IF Level	0.1C0 then 0.1FD
A5U11	ALC Current	0.1C0 then 0.1FE
A5U11	(Spare)	0.1C0 then 0.1FF
A5U12	Ground	0.1C4 then 0.1F8
A5U12	−15V Supply	0.1C4 then 0.1F9
A5U12	−5V Supply	0.1C4 then 0.1FA
A5U12	+5V Supply	0.1C4 then 0.1FB
A5U12	+15V Supply	0.1C4 then 0.1FC
A5U12	+40V Supply	0.1C4 then 0.1FD
A5U12	(Spare)	0.1C4 then 0.1FE
A5U12	(Spare)	0.1C4 then 0.1FF

14 FM Calibrator Control (0.19d SPCL). See S[illegible] Sheet 28.

Frequency	Direct Control Special Function
Switching	0.193
High	0.192
Low	0.191

15 AM Calibrator Control (0.18d SPCL). See Service Sheet 29.

Mode		Direct Control Special Function
Channel A	Channel B	
On	Switching	0.184
On	Off	0.186
Off	On	0.181
On	On	0.185
Off	Off	0.183

16 Annunciator and Key Light Control (0.52d to 0.57d and 0.68d to 0.6Fd SPCL). See Service Sheet 21. To turn on all lights in a group, let d=F. To turn off all lights in a group, let d=0.

Type	Title	Direct Control Special Function
Annunciator	%	0.528
Annunciator	kHz	0.524
Annunciator	radians	0.522
Annunciator	watts	0.521
Annunciator	MHz	0.538
Annunciator	REL	0.534
Annunciator	LIMIT	0.532
Annunciator	REMOTE	0.578
Annunciator	ADDRESSED	0.574
Key Light	SPCL	0.562
Key Light	CALIBRATION	0.561
Key Light	>20 kHz	0.681
Key Light	50 Hz	0.698
Key Light	300 Hz	0.694
Key Light	3 kHz	0.692
Key Light	15 kHz	0.691
Key Light	PRE-DISPLAY	0.6A1
Key Light	25 μs	0.6B8
Key Light	50 μs	0.6B4
Key Light	75 μs	0.6B2
Key Light	750 μs	0.6B1
Key Light	PEAK +	0.6C2
Key Light	PEAK −	0.6C1
Key Light	PEAK HOLD	0.6D8
Key Light	AVG	0.6D4
Key Light	%	0.6D2
Key Light	dB	0.6D1
Key Light	S (Shift)	0.6E2
Key Light	AM	0.6E1
Key Light	FM	0.6F8
Key Light	ΦM	0.6F4
Key Light	RF LEVEL	0.6F2
Key Light	FREQ	0.6F1

17 Decimal Point Control (0.50d and 0.51d SPCL). See Service Sheet 21.

Number of Preceding Digit	Direct Control Special Function
1	0.504
2	0.502
3	0.501
4	0.518
5	0.514
6	0.512
7	0.511

18 Display Digit Control (0.60d to 0.67d SPCL). See Service Sheet 21.

Digit Number	Direct Control Special Function
1	0.60d
2	0.61d
3	0.62d
4	0.63d
5	0.64d
6	0.65d
7	0.66d
8	0.67d

Character Displayed	d	Character Displayed	d
0	0	8	8
1	1	9	9
2	2	—	A
3	3	E	B
4	4	H	C
5	5	L	D
6	6	P	E
7	7	(blank)	F

19 Counter Input Select (0.31d, SPCL). See Service Sheet 17.

Input	Direct Control Special Function
High Frequency VCO Divided by Eight	0.314
Intermediate Frequency	0.315
Voltage-to-Time Converter	0.316
FM Calibrator	0.317
Selected Time Base Reference	0.31C
External Time Base Reference	0.31D
Internal Time Base Reference	0.31E

20 Counter Control (0.36d and 0.37d SPCL). See Service Sheet 17. Also see Readback Control.

Function	Direct Control Special Function
Enable Low-Frequency Count Enable High-Frequency Count	0.363
Enable Low-Frequency Count Disable High-Frequency Count	0.362
Disable Low-Frequency Count Enable High-Frequency Count	0.361
Disable Counting	0.360
Initialize Counter Hardware	0.370

21 LO Band Control (0.00d SPCL). See Service Sheet 11.

Band Name	LO Output Frequency (MHz)	Direct Control Special Function
DBLR	640—1300	0.00A
0	320—640	0.009
1	160—320	0.008
2	80—160	0.007
3	40—80	0.006
4	20—40	0.005
5	10—20	0.004
6	5—10	0.003
7	2.5—5	0.002
8	1.25—2.5	0.001
Output Disable	No Output	0.000

22 LO Tune Mode Control (0.01d SPCL). See Service Sheet 14. Also key in 0.0FF SPCL to inhibit the sweep current sources.

Tune Mode	Direct Control Special Function
Close Sampler Loop; DAC to LF VCXO	0.013
Close Sampler Loop; DAC Off	0.017
Close Track Loop; DAC to LF VCXO	0.019
Close Track Loop; DAC Off	0.01D
Loops Open; DAC to LF VXCO	0.01B
Loops Open; DAC to HF VCO	0.01E
Loops Open; DAC Off	0.01F

23 LO Sweep and IF Detector Latch Control (0.0Fd SPCL). See Service Sheets 4 and 14.

Sweep Mode and IF Present Latch Status	Direct Control Special Function
Enable Latch to Stop Sweep Down	0.0FF
Sweep Down; Reset Latch	0.0FE
Sweep Up; Reset Latch	0.0F2

24 LF VCXO and HF VCO Tune Line Filter Control and IF Level Detector Reset (0.0Fd SPCL). See Service Sheets 4, 12, and 14.

Filter Bandwidth and IF Level Detector Reset	Direct Control Special Function
Narrow Filters; Detector Not Reset	0.0F8
Wide Filters; Detector Not Reset	0.0FA
Narrow Filters; Detector Reset	0.0F9 then 0.0F8
Wide Filters; Detector Reset	0.0FB then 0.0FA

25 DAC Setting (LO Frequency Control) (0.08d to 0.0Bd SPCL). See Service Sheet 14. The value of the data (d) determines the output of the selected DAC.

Weighting of DAC	Direct Control Special Function
Most Significant	0.08d
Second Most Significant	0.09d
Second Least Significant	0.0Ad
Least Significant	0.0Bd

26 Remote Interface Assembly (0.400 to 0.474 SPCL). See Service Sheet 22.

Function	Direct Control Special Function
Clear DAC Flip-Flop	0.400
Clear Talk and Listen Address FlipFlops	0.410
Set Talk, Clear Listen Address Flip-Flops	0.411
Clear Talk, Set Listen Address Flip-Flops	0.412
Set Talk, Set Listen Address Flip-Flops*	0.413
Clear Remote Enable (REN Flip-Flop	0.420
Set Remote Enable (REN) Flip-Flop	0.424
Allow Interface Control ROM to be Disabled	0.430
Allow Interface Control ROM to be Enabled	0.440
Clear Serial Poll Flip-Flop	0.470
Set Serial Poll Flip-Flop (Unless IFC is true)	0.474

*Disables Instrument. Re-establish control by turning instrument to STBY, then to ON or by issuing the Local message via the HP-IB.

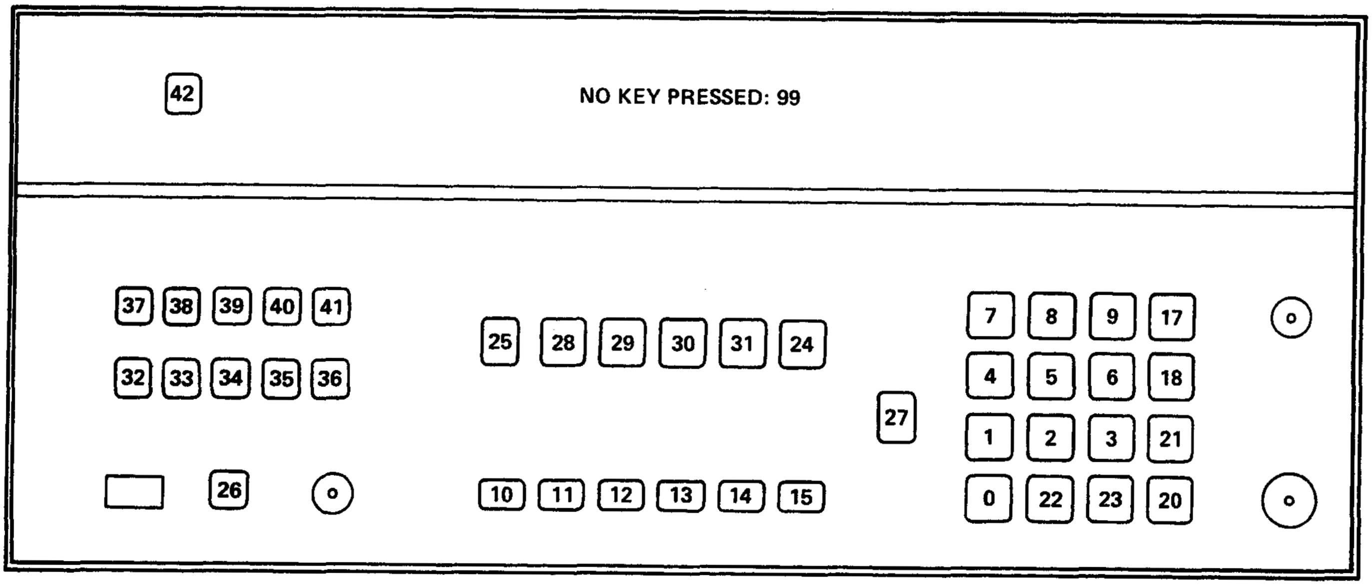


Figure 8-143. Key Scan Codes