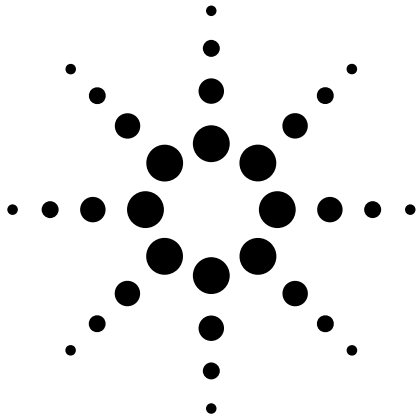


Agilent
8971C Noise Figure Test Set

Service Manual

Part Number 08971-90011
April 1, 1991

Agilent Technologies

Notice

Hewlett-Packard to Agilent Technologies Transition

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. To reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product name/number was HP XXXX the current name/ number is now Agilent XXXX. For example, model number HP8648 is now model number Agilent 8648.

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

To contact Agilent Technologies please use the information below;

Online assistance: http://www.agilent.com/find/assist

Americas

Canada 1 877 894 4414	Latin America (305) 269 7500	United States 1 800 829 4444

Asia Pacific

Australia 1 800 629 485	China 800 810 0189	Hong Kong 800 938 693
India 1 800 112 929	Japan 0 120 (421) 345	Korea 080 769 0800
Malaysia 1 800 888 848	Singapore 1 800 375 8100	Taiwan 0800 047 866
Thailand 1 800226 008		

Europe & Middle East

Austria 43 (0) 1 360 277 1571	Belgium 32 (0) 2 404 93 40	Denmark 45 70 13 15 15
Finland 358 (0) 10 855 2100	France 0825 010 700* *0.125 Euros/minute	Germany 49 (0) 7031 464 6333
Ireland 1890 924 204	Israel 972-3-9288-504/544	Italy 39 02 92 60 8484
Netherlands 31 (0) 20 547 2111	Spain 34 (91) 631 3300	Sweden 0200-88 22 55
Switzerland 0800 80 53 53	United Kingdom 44 (0) 118 9276201	

Other European Countries: http://www.agilent.com/find/contactus

Agilent Technologies

Service Manual

HP 8971C
Noise Figure Test Set

SERIAL NUMBERS

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument.

This manual applies to instruments with serial numbers prefixed 3007A and above.

HP Part No. 08971-90011

© HEWLETT-PACKARD COMPANY 1991
1501 Page Mill Road, Palo Alto, California

Contents

Figures

Tables

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 Institute of Standards and Technology, (NIST), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

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

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

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

LIMITATION OF WARRANTY

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

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

EXCLUSIVE REMEDIES

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

ASSISTANCE

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

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HP 8971C

Herstellerbescheinigung

Hiermit wird bescheinigt, dass dieses Gerät/System in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkenstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/System angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Mess- und Testgeräte:

Werden Mess- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Messaufbauten verwendet so ist vom betreiber sicherzustellen dass die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's Declaration

This is to certify that this product meets the radio frequency interference requirements of Directive FTZ 1046/1984. The German Bundespost has been notified that this equipment was put into circulation and has been granted the right to check the product type for compliance with these requirements.

Note: If test and measurement equipment is operated with unshielded cables and/or used for measurements on open setups, the user must ensure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

Safety Considerations

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.

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 result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

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

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

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

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

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

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

Safety Symbols

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

Indicates hazardous voltages.

Indicates earth (ground) terminal.

Warning 

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

Caution 

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

5

Adjustments

5-1. Introduction

This chapter defines adjustments that return the Test Set to peak performance. Adjustments are not required on any scheduled basis, and normally are performed only after a repair or when a performance test indicates that some parameters are out of specification. The only adjustment procedure for the Test Set is the Power Supply Adjustment. The power supply should be checked, and adjusted if needed, whenever a performance failure is noted, or whenever the power supply is replaced or repaired.

5-2. Safety Considerations

This paragraph contains important information that must be followed for your protection and to avoid damage to the equipment.

Warning

Adjustments described in this chapter are performed with power applied to the instrument and with protective covers removed. Maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). When the maintenance procedure can be performed without power, the power should be removed.

For additional safety information, refer to the Safety Considerations page found at the beginning of this manual.

5-3. Equipment Required

The adjustment procedure includes a list of recommended test equipment. A full listing of all recommended test equipment used in this manual can be found in table 1-3 of the Operating Manual. If substitutions must be made for the models recommended in the adjustment procedures, the test equipment must meet the critical specifications listed in table 1-3.

5-4. Adjustment Locations

The component location figure with service sheet A3d in chapter 8 shows the location of the power supply adjustments.

5-5. Power Supply Adjustment

Reference Service Sheet A3d

Description This procedure adjusts the +5 volt and +20 volt power supplies to their required tolerance. The +15 volt and −15 volt supplies are then checked.

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

Procedure

1. Remove the top cover and place the instrument in the service position as shown in figure 8-22. Connect the power cable to facility power and set the LINE switch to ON.
2. Connect the DVM low lead to A3TP6 GND on Power Supply/Driver Assembly A3. Connect the DVM high lead to A3TP1 5.1V on Power Supply/Driver Assembly A3.
3. Adjust A3R16 5.1V ADJ for DVM reading of +5.10 ±0.05 Vdc.
4. Connect the DVM high lead to A3TP2 20V on Power Supply Assembly A3.
5. Adjust A3R20 20V ADJ for a DVM reading of +20.00 ±0.1 Vdc.
6. Check the power supplies listed in the table below. The voltages should be within the tolerance listed.

Power Supply	Test Point	Minimum	Maximum
+15 Vdc	A3TP3 15V	+14.25	+15.75
−15 Vdc	A3TP4 15V	−15.75	−14.25
+5 Vdc	A3TP1 5V	+5.05	+5.15
+20 Vdc	A3TP2 20V	+19.9	+20.1

6

Replaceable Parts

6-1. Introduction

This chapter contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designation order. Table 6-3 lists the names and addresses that correspond to the manufacturer's code numbers.

6-2. Abbreviations

Table 6-1 lists abbreviations used in the parts list, schematics, and throughout the manual. Standard abbreviations may be in upper or lower-case letters. However, the replaceable parts list is a computer printout using only upper-case letters. Thus, abbreviations in the replaceable parts list are in upper-case letters only.

6-3. Replaceable Parts List

Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alphanumeric order by reference designation.

b. Chassis-mounted, or non-assembly, parts in alphanumeric order by reference designation.

The information given for each part consists of the following:

- Reference designation
- Hewlett-Packard part number
- Part number check digit (CD)
- Total quantity (Qty) used in the instrument
- Part description
- Five-digit code that represents a typical manufacturer
- Manufacturer's part number

Note

The total quantity for each part is given only once, at the first appearance of the part number in the list. Total quantities for optional assemblies are totaled by assembly and not integrated into the standard list.

6-4. Ordering Information

When ordering a part listed in the replaceable parts list, include the Hewlett-Packard part number, the check digit, and the quantity required. Address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

Note

Within the USA, it is better to order directly from the HP Parts Center. Ask your nearest HP office for information and forms for the "Direct Mail Order System".

6-5. Recommended Spares List

Spare parts are often stocked for an instrument to ensure quick return to service after a malfunction occurs. Hewlett-Packard prepares a "Recommended Spares" list for this instrument. The contents of the list are based on failure reports and repair data. Quantities given are for one year of parts support. A complimentary copy of the "Recommended Spares" list may be requested from your nearest Hewlett-Packard office.

When stocking parts to support more than one Test Set 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.

Table 6-1. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A ..... assembly
AT ..... attenuator; isolator; termination
B ..... fan; motor
BT ..... battery
C ..... capacitor
CP ..... coupler
CR .... diode; diode thyristor; varactor
DC ..... directional coupler
DL ..... delay line
DS .... annunciator; signaling device (audible or visual); lamp; LED
E miscellaneous electrical part
F ..... fuse
FL ..... filter
H ..... hardware
HY ..... circulator
J ..... electrical connector (stationary portion); jack
K ..... relay
L ..... coil; inductor
M ..... meter
MP . miscellaneous mechanical part
P electrical connector (movable portion); plug
Q ..... transistor; SCR; triode thyristor
R ..... resistor
RT ..... thermistor
S ..... switch
T ..... transformer
TB ..... terminal board
TC ..... thermocouple
TP ..... test point
U ..... integrated circuit; microcircuit
V ..... electron tube
VR ..... voltage regulator; breakdown diode
W ... cable; transmission path; wire
X ..... socket
Y crystal unit (piezoelectric or quartz)
Z .. tuned cavity; tuned circuit

ABBREVIATIONS

A ..... ampere
ac ..... alternating current
ACCESS ..... accessory
ADJ ..... adjustment
A/D ..... analog-to-digital
AF ..... audio frequency
AFC .... automatic frequency control
AGC .. automatic gain control
AL ..... aluminum
ALC .. automatic level control
AM .... amplitude modulation
AMPL ..... amplifier
APC . automatic phase control
ASSY ..... assembly
AUX ..... auxiliary
avg ..... average
AWG ... American wire gauge
BAL ..... balance
BCD ... binary coded decimal
BD ..... board
BE CU ..... beryllium copper
BFO . beat frequency oscillator
BH ..... binder head
BKDN ..... breakdown
BP ..... bandpass
BPF ..... bandpass filter
BRS ..... brass
BWO backward-wave oscillator
CAL ..... calibrate
ccw ..... counterclockwise
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 ..... centimetre
D/A ..... digital-to-analog
dB ..... decibel
dBm decibel referred to 1 mW
dc ..... direct current
deg ..... degree (temperature interval or difference)
... ° ... degree (plane angle)
°C degree Celsius (centigrade)
°F ..... degree Fahrenheit
°K ..... degree Kelvin
DEPC ..... deposited carbon
DET ..... detector
diam ..... diameter
DIA .. diameter (used in Parts List)
DIFF AMPL ..... differential amplifier
div ..... division
DPDT ..... double-pole, double-throw
DR ..... drive
DSB ..... double sideband
DTL .... diode transistor logic
DVM ..... digital voltmeter
ECL .... emitter coupled logic
EMF ..... electromotive force
EDP electronic data processing
ELECT ..... electrolytic
ENCAP ..... encapsulated
EXT ..... external
F ..... farad
FET .... field-effect transistor
F/F ..... flip-flop
FH ..... flat head
FIL H ..... fillister head
FM .... frequency modulation
FP ..... front panel
FREQ ..... frequency
FXD ..... fixed
g ..... gram
GE ..... germanium
GHz ..... gigahertz
GL ..... glass
GRD ..... ground(ed)
H ..... henry
h ..... hour
HET ..... heterodyne
HEX ..... hexagonal
HD ..... head
HDW ..... hardware
HF ..... high frequency
HG ..... mercury
HI ..... high
HP ..... Hewlett-Packard
HPF ..... high-pass filter
HR .. hour (used in Parts List)
HV ..... high voltage
Hz ..... Hertz
IC ..... integrated circuit
ID ..... inside diameter
IF .... intermediate frequency
IMPG ..... impregnated
in ..... inch
INCD ..... inncandescent
INCL ..... include(s)
INP ..... input
INS ..... insulation
INT ..... internal
kg ..... kilogram
kHz ..... kilohertz
kΩ ..... kilohm
kV ..... kilovolt
lb ..... pound
LC .... inductance-capacitance
LED ..... light-emitting diode
LF ..... low frequency
LG ..... long
LH ..... left hand
LIM ..... limit
LIN linear taper (used in Parts List)
lin ..... linear
LK WASH ..... lock washer
LO ..... low; local oscillator
LOG .. logarithmic taper (used in Parts List)
log ..... logrithm(ic)
LPF ..... low pass filter
LV ..... low voltage
m ..... metre (distance)
mA ..... millampere
MAX ..... maximum
MΩ ..... megohm
MEG meg (10^6) (used in Parts List)
MET FLM ..... metal film
MET OX ..... metallic oxide
MF ..... medium frequency; microfarad (used in Parts List)
MFR ..... manufacturer
mg ..... milligram
MHz ..... megahertz
mH ..... millihenry
mho ..... mho
MIN ..... minimum
min ..... minute (time)
... ' ... minute (plane angle)
MINAT ..... miniature
mm ..... millimetre
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

NOTE

All abbreviations in the Parts List appear in uppercase.

Table 6-1. Reference Designations and Abbreviations (2 of 2)

ABBREVIATIONS (cont'd)

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 ..... poiut
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
RAM .. random-access memory
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 .... super-high frequency
SI ..... silicou
SIL ..... silver
SL ..... slide
SNR ..... signal-to-noise ratio
SPDT ..... single-pole, double-throw
SPG ..... spring
SR ..... split ring
SPST single-pole, single-throw
SSB ..... single sideband
SST ..... stainless steel
STL ..... steel
SQ ..... square
SWR ..... standing-wave ratio
SYNC ..... synchronize
T ..... timed (slow-blow fuse)
TA ..... tantalum
TC temperature compensating
TD ..... time delay
TERM ..... terminal
TFT ..... thin-film transistor
TGL ..... toggle
THD ..... thread
THRU ..... through
TI ..... titaninm
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 .... ultra-high frequency
UNREG ..... unregulated
V ..... volt
VA ..... voltampere
Vac ..... volts, ac
VAR ..... variable
VCO ..... voltage-controlled oscillator
Vdc ..... volts, dc
VDCW ..... volts, dc, working (used in Parts List)
V(F) ..... volts, filtered
VFO ..... variable-frequency oscillator
VHF ..... very-high frequency
Vpk ..... volts, peak
Vp-p ..... volts, peak-to-peak
Vrms ..... volts, rms
VSWR . voltage standing-wave ratio
VTO . voltage-tuned oscillator
VTVM vacuum-tube voltmeter
V(X) ..... volts, switched
W ..... watt
W/ ..... with
WIV .. working inverse voltage
WW ..... wirewound
W/O ..... without
YIG ..... yttrium-iron-garnet
Z_o ... characteristic impedance

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}

NOTE

All abbreviations in the Parts List appear in uppercase.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A1A1	08971-60121	9	1	DISPLAY ASSEMBLY	28480	08971-60121
A1A1DS1	1990-0759	6	2	LED-LIGHT BAR LUM-INT=3MCD IF=30MA-MAX	28480	HLMP-2620
A1A1DS2	1990-0759	6		LED-LIGHT BAR LUM-INT=3MCD IF=30MA-MAX	28480	HLMP-2620
A1A1J1	1251-5647	5	1	CONN-POST TYPE .100-PIN-SPCG 10-CONT	28480	1251-5647
A1A1R1	1810-0272	8	2	NETWORK-RES 10-SIP 330.0 OHM X 9	C1433	750-101
A1A1R2	1810-0272	8		NETWORK-RES 10-SIP 330.0 OHM X 9	C1433	750-101
A1A1XDS1	1200-1202	3	2	SOCKET-IC 16-CONT DIP DIP-SLDR	17117	21316-47A-445
A1A1XDS2	1200-1202	3		SOCKET-IC 16-CONT DIP DIP-SLDR	17117	21316-47A-445
A1A2				YIG HEATER INTERFACE ASSEMBLY (NOT FIELD REPAIRABLE, FACTORY REPLACEMENT ONLY)		
A1A2C1	0160-3334	9	30	CAP-FXD 0.01UF - 10 +10X7R	D9969	RPA10X74103K50V2-
A1A2J1	1252-3490	7	3	CONN-POST TYPE .100 PIN-SPCG 12-CONT	28480	1252-3490
A1A2MP1				HEATSINK-YIG (NOT FIELD REPAIRABLE, FACTORY REPLACEMENT ONLY)		
A1A2MP2				INSULATOR-PC BD (NOT FIELD REPAIRABLE, FACTORY REPLACEMENT ONLY)		
A1A2Q1	1854-0669	9	3	TRANSISTOR NPN 2N6057 SI TO-3 PD=150W	04713	2N6057
	0515-1452	1	4	SCREW-MACHINE ASSEMBLY M3 X 0.5 14MM-LG	28480	0515-1452
	1200-0043	8	10	INSULATOR-XSTR ALUMINUM	76530	322047
	1251-2313	6	28	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	00779	3-332070-5
A1A2Q2	1854-0669	9		TRANSISTOR NPN 2N6057 SI TO-3 PD=150W	04713	2N6057
	0515-1452	1		SCREW-MACHINE ASSEMBLY M3 X 0.5 14MM-LG	28480	0515-1452
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	00779	3-332070-5
A1A2R1	0699-1830	7	2	RESISTOR 5 +-0.5% 3W MF TC-0+-5	05347	RTK-34-5.0 OHM +- 0.5%
	0515-1453	2	4	SCREW-MACHINE ASSEMBLY M3 X 0.5 12MM-LG	28480	0515-1453
	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	00779	3-332070-5
A1A2R2	0699-1830	7		RESISTOR 5 +-0.5% 3W MF TC=0+-5	05347	RTK-34-5.0 OHM +- 0.5%
	0515-1453	2		SCREW-MACHINE ASSEMBLY M3 X 0.5 12MM-LG	28480	0515-1453
	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	00779	3-332070-5
A1A2U1	1826-1473	6	2	IC TEMP XDCR PRCN 3-TO-46 PKG	27014	LM35CAH
	0905-0313	8	1	O-RING .07-IN-ID .07-IN-XSECT-DIA SIL	83259	2-004 S604-70
	1251-1998	1	3	CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ	00779	3-331272-5
A1A3-A1A4				NOT ASSIGNED		
A1A5	08971-60108	1	1	INTERCONNECT/DISTRIBUTION BD ASSEMBLY	28480	08971-60108
A1A5C1	0160-0576	5	1	CAP-FXD 0.1UF 20% 50V	04222	SR205C104MAAH
A1A5C2	0180-3771	0	1	CAP-FXD 1.0UF TANT	56289	299D105X9035AB1
A1A5CR1	1901-0328	8	2	DIODE-PWR RECT	71744	GIG-089
A1A5CR2	1901-0328	8		DIODE-PWR RECT	71744	GIG-089
A1A5CR3	1902-0956	0	1	DIODE-ZNR 8.2V 5%	04713	
A1A5J1	1252-3381	2	1	CONN-POST TYPE	18873	78208-107
A1A5J2	1252-2242	2	1	CONN-POST TP-HDR	18873	78208-108
A1A5J3	1200-1204	5	2	SOCKET-IC 14-PIN	00779	2-641609-2
A1A5J4	1200-1204	5		SOCKET-IC 14-PIN	00779	2-641609-2
A1A5J5	1252-2152	3	1	CONN-POST TP-HDR	18873	69167-103
A1A5MP1	08971-00040	0	1	REG BRACKET	28480	08971-00040
A1A5MP2	0340-0614	8	1	INSUL-XSTR	28480	0340-0614
A1A5MP3	0380-0043	0	2	SPACER-CAPTIVE	28480	0380-0043
A1A5MP4	0515-0169	2	1	SCREW-METRIC	28480	0515-0169
A1A5MP5	0515-1146	2	2	SCREW-METRIC	28480	0515-1146
A1A5MP6	0590-1076	3	3	THD INSERT NUT	28480	0590-1076
A1A5Q1	1884-0310	0	1	THYRISTOR-SCR	04713	MCR69-3
A1A5R1	0698-3442	9	1	RESISTOR 237 1% .125W	19701	SFR25H
A1A5R2	0757-0424	7	2	RESISTOR 1.1K 1% .125W	19701	SFR25H
A1A5R3	0698-3437	2	1	RESISTOR 133 1% .125W	19701	SFR25H
A1A5R4	0757-0413	4	1	RESISTOR 392 1% .125W	19701	SFR25H
A1A5R5	0757-0294	9	1	RESISTOR 17.8 1% .125W	19701	SFR25H
A1A5R6	0757-0424	7	1	RESISTOR 1.1K 1% .124W	19701	SFR25H

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A1A5U1	1826-0393	7	1	IC REGULATOR LM317T (PHYSICALLY LOCATED ON SIDE WALL FOR IMPROVED HEAT SINKING)	27014	LM317T
A1A5U2	1826-0527	9	1	IC REGULATOR LM337T	27014	LM337T
A1A5W1-A1A5W2	8159-0005		2	JUMPER WIRE 22W (NOT INSTALLED)		8159-0005
				MISCELLANEOUS PARTS		
A1AR1	0955-0302	0	1	U-WAVE AMPLIFIER 700 MHZ MAX	24539	SC84-2837
	0515-1079	8	61	SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
A1AR2	5181-5705	1	1	RF AMPLIFIER	28480	5181-5705
				(STANDARD & OPTION 001 ONLY)		
	08971-20105	0	1	RF AMPLIFIER PLATE	28480	08971-20105
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3	00000	ORDER BY DESCRIPTION
A1AR3	5181-5702	8	1	LO AMPLIFIER (OPTION 001 AND 001/002 ONLY)	28480	5181-5702
	08971-20104		1	LO AMPLIFIER PLATE	28480	08971-20104
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3	00000	ORDER BY DESCRIPTION
A1AT1	08971-60102	5	2	FIXED COAX ATTEN	28480	08971-60102
A1AT2	0955-0242	1	1	ATTENUATOR 7+-0.5dB	28480	0955-0242
A1AT3	0955-0243	5	1	ATTENUATOR 7+-0.3dB (Except Option 002)	28480	0955-0243
A1AT4	S-33340C		1	FIXED ATTENUATOR 3 dB (Option 002 Only	28480	S-33340C
A1FL1				FILTER, YIG (NOT FIELD REPAIRABLE. FACTORY REPLACEMENT ONLY)		
A1FL2	0955-0305		1	U-WAVE FILTER-BANDPASS 1.5-2.5 GHZ	28480	0955-0305
A1J1	08673-60040	9	2	CONN AY OUTPUT	28480	08673-60040
	08971-20030	4	2	ADAPTR CONN APC	28480	08971-20030
	2190-0016	3	2	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	2	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A1J2	08673-60040	9		CONN AY OUTPUT	28480	08673-60040
	08971-20030	4		ADAPTR CONN APC	28480	08971-20030
	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 OF DESCRIPTION
A1J3	11729-60030	1	1	OUTPUT CONN AY	28480	11729-60030
	2190-0104	0	1	WASHER-LK INTL 7/16 IN .439-IN-ID	78189	1922-04
	2950-0132	6	1	NUT-HEX-DBL-CHAM 7/16-28-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A1K1	08971-60015		1	SW-TPLE XFER ASSEMBLY	28480	08971-60015
A1MP1	08971-00037	8	1	DECK-MICROCIRCUIT	28480	08971-00037
	0515-1146	0	17	SCREW-MACHINE ASSEMBLY M3 0.5 6MM-LG	28480	0515-1146
	3050-0891	7	17	WASHER-FL MTLC 3.0 MM 3.3-MM-ID	28480	3050-0891
A1MP2	08971-00039	0	1	MIXER BRACKET	28480	08971-00039
	0515-1146	0		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1146
	3050-0891	7		WASHER-FL MTLC 3.0 MM 3.3-MM-ID	28480	3050-0891
A1MP3	08971-20103		1	8-PORT SW PLATE	28480	08971-20103
A1MP4	08971-00035	7	1	CLAMP-FILER	28480	08971-00035
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
	3050-0891	7		WASHER-FL MTLC 3.0 MM 3.3-MM-ID	28480	3050-0891
A1MP5				NOT ASSIGNED		
A1MP6	08971-00003	9	1	FRONT PANEL-SUB	28480	08971-00003
	0515-1076	5	3	SCREW-MACH M3 X 0.5 4MM-LG 90-DEG-FLH-HD	28480	0515-1076
A1MP7	1400-0611	0	2	CLAMP-FL-CA 1-WD	06394	FFC-A-C8
A1MP8	1400-0017		4	CLAMP-CABLE		
A1MP9	1400-0017			CLAMP-CABLE		
A1MP10	1400-0017			CLAMP-CABLE		
A1MP11	1400-0017			CLAMP-CABLE		
A1U1	0955-0496	2	1	U-WAVE MIXER 26.5 GHZ MAX		
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
	0515-1146	0		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1146
A1W1	08971-20118	9	1	CBL AY-LO IN (EXCEPT OPTION 001 & 001/002)	28480	08971-20118

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A1W2	08971-20114	1	1	CBLAY-MXR IF	28480	08971-20114
A1W3	08971-20116	2	1	CBL AY-IF OUTPUT	28480	08971-20116
A1W4	08971-20113	5	1	CBL AY-AMP OUT	28480	08971-20113
A1W5	08971-20112	1		CBL AY-SW MIXER	28480	08971-20112
A1W6	08971-20111	3	1	CBLAY-YIG SW	28480	08971-20111
A1W7	08971-20110	2	1	CBL AY-FILTER	28480	08971-20110
A1W8	08971-20109	0	1	CBLAY-RF AMP SW	28480	08971-20109
A1W9	08971-20119	7	1	CA AY-RF INPUT (EXCEPT OPTION 002)	28480	08971-20119
A1W10	08971-20117	8	1	CBL AY-LD INPUT (OPTION 001 & 001/002 ONLY)	28480	08971-20117
A1W11	08971-20115	6	1	CA AY-MXR LO (OPTION 001 & 001/002 ONLY)	28480	08971-20115
A1W12	08971-20120		1	CBL AY-RF INPUT (OPTION 002 ONLY)	28480	08971-20120
A2	08971-60123	4	1	PROCESSOR ASSEMBLY (DOES NOT INCLUDE A2U22 EPROM)	28480	08971-60123
A2C1	0160-4808	4	1	CAP-FXD 470PF -5 +5COG	09969	RPA10COG471J100V
A2C2	0160-3334	9	16	CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C3	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C4	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C5	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C6	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C7	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C8	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C9	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C10	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C11	0180-0374	3	2	CAP-FXD 10UF -10 +10TA0 OHM	56289	150D106X9020B2
A2C12	0180-0229	7	1	CAP-FXD 33UF -10 +10TA0 OHM	56289	150D336X9010B2
A2C13	0160-5913	4	1	CAP-FXD 36PF -5 +5COG	06383	MA12COG3D360J
A2C14	0160-3334	9		CAP-FXD 0.01UF -10 +107R	09969	RPA10X7R103K50V
A2C15	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C16	0160-4835	7	11	CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R104K50VPT
A2C17	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C18	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C19	0160-3334	9		CAP-FXD 0.01UF - 10 +10X7R	09969	RPA10X7R103K50V
A2C20	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2C21	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A2CR1	1901-0050	3	17	DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A2CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A2CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A2CR4	1901-0539			DIODE-HOT CARRY		
A2DS1	1900-0652	8	2	LED-LAMP ARRAY LUM-INT=200UCD IF=SMA-MAX	28480	HLMP-6620 SELECTED
A2DS1	1900-0652	8	2	LED-LAMP ARRAY LUM-INT=200UCD IF=SMA-MAX	28480	HLMP-6620 SELECTED
A2J1	1252-0242	8	2	CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1252-0242
	1251-5595	2	2	POLARIZING KEY-POST CONN	76381	3518
A2J2	1252-0242	8		CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1252-0242
	1251-5595	2		POLARIZING KEY-POST CONN	76381	3518
A2J3	1251-8393	4	1	CONN-POST TYPE .100-PIN-SPCG 7-CONT	28480	1251-8393
A2L1	9100-1611	4	1	INDUCTOR RF-CH-MLO 220NH +-20%	91637	IM-4 .22UH 20%
A2MP1	0403-0285	9	4	BUMPER FOOT-ADH MTG 12.7-MM-WD	76381	SJ-5018 GRAY
A2MP2	0403-0285	9		BUMPER FOOT-ADH MTG 12.7-MM-WD	76381	SJ-5018 GRAY
A2MP3	0403-0285	9		BUMPER FOOT-ADH MTG 12.7-MM-WD	76381	SJ-5018 GRAY
A2MP4	0403-0285	9		BUMPER FOOT-ADH MTG 12.7-MM-WD	76381	SJ-5018 GRAY
A2R1	0698-3447	4	2	RESISTOR 422 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-422R-F
A2R2	0698-3155	1	15	RESISTOR 4.64K +-1% .125W TF TC=0-100	12498	CT4-1/8-TO-4641-F
A2R3	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R4	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R5	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R6	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A2R7	0698-3447	4		RESISTOR 422 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-422R-F
A2R8	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R9	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R10	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R11	1810-0286	4	5	NETWORK-RES 16-DIP 10.0K OHM X 15	11236	761-1-R10K
A2R12	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R13	0757-0443	0	6	RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1102-F
A2R14				NOT ASSIGNED		
A2R15	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R16	0757-1094	9	1	RESISTOR 1.47K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1471-F
A2R17	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R18	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	11236	761-1/8-TO-4641-F
A2R19	1810-0286	4		NETWORK-RES 16-DIP 10.0K OHM X 15	11236	761-1-R10K
A2R20	1810-0286	4		NETWORK-RES 16-DIP 10.0K OHM X 15	11236	761-1-R10K
A2R21	1810-0286	4		NETWORK-RES 16-DIP 10.0K OHM X 15	11236	761-1-R10K
A2R22	1810-0286	4		NETWORK-RES 16-DIP 10.0K OHM X 15	11236	761-1-R10K
A2R23	0698-7207	2		RESISTOR 61.9 +-1% .05W TF TC=0+-100	12498	C3-1/8-TO-61R9-F
A2R24	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R25	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2R26	0698-3155	1		RESISTOR 4.64K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-4641-F
A2SW1	3101-2747	5	2	SWITCH-DIP SL 8-1A 0.1A 30VDC	11236	207-8
A2SW2	3101-2747	5		SWITCH-DIP SL 8-1A 0.1A 30VDC	11236	207-8
A2TP1	0360-0535	0	25	CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP2	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP3	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP4	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP5	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP6	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP7	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP8	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP9	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP10	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP11	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP12	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2TP13	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A2U1	1820-3297	4	5	IC DRVR CMOS/74HC BUS OCTL	04713	MC74HC244N
A2U2	1820-2488	3	2	IC FF TTL ALS D-TYPE POS-EDGE-TRIG	01295	SN74ALS74AN
A2U3	1820-2488	3		IC FF TTL ALS D-TYPE POS-EDGE-TRIG	01295	SN74ALS74AN
A2U4	1826-1338	2	1	IC MISC 8-DIP-P PKG	01295	TL7705A
A2U5	1820-2624	9	1	IC-MPU; CLK FREQ=2 MHZ, ENHANCED 6800	04713	MC68B09P
A2U6	08971-80003	7	1	PAL PROGRAMMED	28480	08971-80003
A2U7	1826-0759	9	1	IC COMPARATOR GP QUAD 14-DIP-C PKG	27014	LM339J
A2U8	1820-3707	1	1	IC DRVR TTL ALS LINE OCTL	01295	SN74ALS541N
A2U9	1820-3481	8	2	IC TRANSCEIVER TTL ALS BUS OCTL	01295	SN741LS645AN
A2U10	1820-3297	4		IC DRVR CMOS/74HC BUS OCTL	04713	MC74HC244N
A2U11	1820-2634	1	1	IC INV TTL ALS HEX	01295	SN74ALS04BN
A2U12	1820-3481	8		IC TRANSCEIVER TTL ALS BUS OCTL	01295	SN74ALS645AN
A2U13	1820-3297	4		IC DRVR CMOS/74HC BOS OCTL	04713	MC74HC244N
A2U14	1820-2757	9	2	IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74ALS574AN
A2U15	1820-2656	7	1	IC GATE TTL ALS NAND QUAD 2-INP	01295	SN7R1LS00AN
A2U16	1820-3513	7	1	IC-INTERFACE XCVR INSTRUMENT BUS IEEE	27014	DS7516AN
A2U17	1820-3431	8	1	IC-INTERFACE XCVR INSTRUMENT BUS IEEE	27014	DS7516AN
A2U18	1820-2469	0	1	IC-PROGRAMMABLE TIMER, 3 TIME INTERVALS	04713	MC6840P
A2U19	1818-3183	2	1	IC CMOS 65536 (64K) STAT RAM 150-NS 3-S	S4013	HM6264LP-15
A2U20	1820-2549	7	1	IC-GPIB TALKER/LISTENER	34649	P8291A SELECTED
A2U21	1820-3100	8	1	IC DCDR TTL ALS BIN 3-TO-8-LINE 3-INP	01295	SN74ALS138N
A2U22	08971-80015	6	1	EPROM, PROGRAMMED (EXCEPT OPTION 001) (MUST BE ORDERED SEPARATELY)	28480	08971-80015
	08971-80014	6	1	EPROM, PROGRAMMED (OPTION 001 ONLY) (MUST BE ORDERED SEPARATELY)	28480	08971-80014

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A2U23	1820-2739	7	1	IC GATE TTL ALS NOR QUAD 2-INP	01295	SN7RALS02N
A2U24	1820-2983	3	1	IC-PERIPHERAL INTERFACE ADAPTER;CLK=2MHZ	04713	MC68B21P
A2U25	1826-1139	1	1	A/D 8-3/4-BIT 28-PLASTIC CMOS	27014	ADC0808CCN
A2U26	1818-3366	3	1	IC NMOS 16384 (16K) ELEC-ER-PROM 350-NS	10582	X2816AD-35
A2U27	1820-3764	0	1	IC MUXR/DATA-SEL TTL ALS 8-TO-1-LINE	01295	SN74ALS251N
A2U28	1820-3763	9	1	IC CNTR TTL ALS DECD UP/DOWN SYNCHRO	01295	SN74ALS190N
A2VR1	1826-0774	8	1	IC V RGL-TR-V-REF-FXD 1.22/1.24V TO-92	27014	LM385BZ-1.2
A2XU5	1200-0654	7	1	SOCKET-IC-DIP 40-CONT DIP DIP-SLDR	01295	C8740-01
A2XU22	1200-0567	1	1	SOCKET-IC-DIP 28-CONT DIP DIP-SLDR	01295	C8728-01
A2XU26	1200-0541	1	1	SOCKET-IC-DIP 24-CONT DIP DIP-SLDR	01295	C8724-01
A2Y1	1813-0130	3	1	CLOCK-OSCILLATOR-XTAL 16.0-MHZ 0.05%	11427	KXO-01-2-16
	0340-0944	3	1	INSULATOR-IC NYLON BLACK	13103	7717-156N
A3	08971-60122	3	1	POWER SUPPLY ASSEMBLY	28480	08971-60122
A3C1	0180-4260	3	1	CAP-FXD 25V		
A3C2	0180-3764	1	1	CAP-FXD -75 +01AL-ELCTL.0265 OHM	56289	36DE103G050BA2P
A3C3	0180-3281	7	1	CAP-FXD 6500UF -75 +10AL-ELCTLTO.075 OHM	56289	36DE1110
A3C4	0180-3787	8	1	CAP-FXD 2200UF -100 +10AL-ELCTLTO.038	56289	6L74D22H040JL5A
A3C5	0160-5910	1	21	CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C6	0160-4005	3	1	CAP-FXD 1UF -20 +20Y5V	09969	RPE114-130Z5U105M100V
A3C7	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R104K50VPT
A3C8	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R104K50VPT
A3C9	0180-2141	6	5	CAP-FXD 3.3UF -10 +10TAO OHM	56289	150D335X9050B2
A3C10	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R104K50VPT
A3C11	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R104K50VPT
A3C12	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R104K50VPT
A3C13	0180-2141	6		CAP-FXD 3.3UF -10 +10TAO OHM	56289	150D335X9050B2
A3C14	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R104K50VPT
A3C15	0180-0374	3		CAP-FXD 10UF -10 +10TAO OHM	56289	150D106X9020B2
A3C16	0180-0116	1	1	CAP-FXD 6.8UF -10 +10TAO OHM	56289	150D685X9035B2
A3C17	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C18	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C19	0180-2141	6		CAP-FXD 3.3UF -10 +10TAO OHM	56289	150D335X9050B2
A3C20	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20XR104K50VPT
A3C21	0160-5098	6	2	CAP-FXD 0.22UF -10 +10X7R	09969	RPA40X7R224K50V
A3C22	0160-4835	7		CAP-FXD 0.1UF - 10 +10X7R	09969	RPA20X7R104K50VPT
A3C23	0180-0197	1	1	CAP-FXD 2.2UF 20V TA	56289	150D225X9020A2-DYS
A3C24	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C25	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C26	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C27	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C28	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C29	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C30	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R10RK50VPT
A3C31	0160-4835	7		CAP-FXD 0.1UF -10 +10X7R	09969	RPA20X7R10RK50VPT
A3C32	0160-4805	1	3	CAP-FXD 47PF -5 +5COG	09969	RPA10COG470J100V
A3C33	0160-5910	1		CAP-FXD 0.47UF -29 +80Y5V	06383	MA14Y5V1H474Z
A3C34	0180-2141	6		CAP-FXD 3.3UF -10 +10TAO OHM	56289	150D335X9050B2
A3C35	0160-4805	1		CAP-FXD 47PH -5 +5COG	09969	RPA10COG470J100V
A3C36	0160-4805	1		CAP-FXD 47PF -5 +5COG	09969	RPA10COG470J100V
A3C37	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C38	0160-5098	6		CAP-FXD 0.22UF -10 +10X7R	09969	RPA40X7R224K50V
A3C39	0160-2291	5	1	CAP-FXD 0.18UF -10 +10POLYE-FL	19701	708D1MV184PK800AX
A3C40				NOT ASSIGNED		
A3C41	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C42	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C43	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C44	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C45	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C46	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C47	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A3C48	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C49	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C50	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C51	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C52	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C53	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C54	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C55	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C56	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C57	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C58	0180-2141	6		CAP-FXD 3.3UF -10 +10TAO OHM	56289	150D335X9050B2
A3C59	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C60	0160-3334	9		CAP-FXD 0.01UF -10 +10X7R	09969	RPA10X7R103K50V
A3C61	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C62	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3C63	0160-5910	1		CAP-FXD 0.47UF -20 +80Y5V	06383	MA14Y5V1H474Z
A3CR1	1906-0236	7	2	DIODE-CT-RECT 200V 15A	1B546	R712A
	0515-0897	6	19	SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
A3CR2	1906-0231	2	3	DIODE-CT-RECT 200V 15A	1B546	R712
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
A3CR3	1906-0236	7		DIODE-CT-RECT 200V 15A	1B546	R712A
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
A3CR4	1906-0231	2		DIODE-CT-RECT 200V 15A	1B546	R712
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
A3CR5	1906-0231	2		DIODE-CT-RECT 200V 15A	1B546	R712
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
A3CR6	1901-0418	7	4	DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A3CR7	1901-0418	7		DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A3CR8	1901-0418	7		DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A3CR9	1901-0418	7		DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A3CR10	1901-0328	8	10	DIODE-PWR RECT 400V 1A 6US	71744	G1G-089
A3CR11	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	71744	G1G-089
A3CR12	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	71744	G1G-089
A3CR13	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	71744	G1G-089
A3CR14	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	71744	G1G-089
A3CR15	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	71744	G1G-089
A3CR16	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	71744	G1G-089
A3CR17	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	71744	G1G-089
A3CR18	1901-0328	8		DIODE-PWR RECT 400V 11 6US	71744	G1G-089
A3CR19	1901-0328	8		DIODE-PWR RECT 400V 11 6US	71744	G1G-089
A3CR20	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR21	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR22	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR23	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR24	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR25	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR26	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR27	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR28	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR29	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR30	1901-0275	4	1	DIODE-ARRAY	56289	TND908
A3CR31	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR32	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR33	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR34	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A3DS1	1990-0778	5	1	LED-VISIBLE 1X5	28480	1990-0778
A3F1	2110-0003	0	5	FUSE (INCH) 3A 250V NTD FE UL	75915	312 003
A3F2	2110-0003	0		FUSE (INCH) 3A 250V NTD FE UL	75915	312 003
A3F3	2110-0002	9	2	FUSE (INCH) 2A 250V NTD FE UL	75915	312 002
A3F4	2110-0003	0		FUSE (INCH) 3A 250V NTD FE UL	75915	312 003
A3F5	2110-0003	0		FUSE (INCH) 3A 250V NTD FE UL	75915	312 003
A3F6	2110-0001	1	2	FUSE (INCH) 1AMP 250V NTD FE UL	11870	04.005
A3F7	2110-0012	1		FUSE (INCH) .5A 250V NTD FE UL	11870	04.005
A3F8	2110-0003	0		FUSE (INCH) 3A 250V NTD FE UL	75915	312 003
A3J1	1251-8032	8	1	CONN-POST TYPE .156-PIN-SPCG 8-CONT	28480	1251-8032
A3J2	1252-0242	8		CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1252-0242
A3J3	1252-0243	9	1	CONN-POST TYPE .100-PIN-SPCG 10-CONT	28480	1252-0243
A3J4	1200-1204	5	1	SOCKET-IC-DIP 14-CONT DIP DIP-SLDR	00779	2-641609-2
A3J5	1252-3490		2	HEADER, 13 POSN	28480	1252-3490
A3J6	1251-8393	4		CONN-POST TYPE .100-PIN-SPCG 7-CONT	28480	1251-8393
A3J7	0360-0124		2	CONN SGL CONTACT		
A3J8	0360-0124			CONN SGL CONTACT		
A3J9	1252-3493		1	HEADER 7 POSN	28480	1252-3493
A3J10	1252-3490			HEADER 13 POSN	28480	1252-3490
A3MP1	0403-0179	0	8	BUMPER FOOT-ADH MTG	76381	SJ 5012 BLK
A3MP2	0403-0179	0		BUMPER FOOT-ADH MTG	76381	SJ 5012 BLK
A3MP3	0403-0179	0		BUMPER FOOT-ADH MTG	76381	SJ 5012 BLK
A3MP4	0403-0179	0		BUMPER FOOT-ADH MTG	76381	SJ 5012 BLK
A3MP5	0403-0179	0		BUMPER FOOT-ADH MTG	76381	SJ 5012 BLK
A3MP6	0403-0179	0		BUMPER FOOT-ADH MTG	76381	SJ 5012 BLK
A3MP7	0403-0179	0		BUMPER FOOT-ADH MTG	76381	SJ 5012 BLK
A3MP8	0403-0179	0		BUMPER FOOT-ADH MTG	76381	SJ 5012 BLK
A3MP9	08971-00022	2	1	HEATSINK REGLTR	28480	08971-00022
A3MP10	08971-00025	5	1	HEAT SINK YIG DR	28480	08971-00025
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
A3MP11	0900-0010	2	4	O-RING .101-IN-ID .07=IN-XSECT-DIA-NTRL	51633	AS568-005 A-700
A3MP12	0900-0010	2		O-RING .101-IN-ID .07=IN-XSECT-DIA-NTRL	51633	AS568-005 A-700
A3MP13	0900-0010	2		O-RING .101-IN-ID .07=IN-XSECT-DIA-NTRL	51633	AS568-005 A-700
A3MP14	0900-0010	2		O-RING .101-IN-ID .07=IN-XSECT-DIA-NTRL	51633	AS568-005 A-700
A3MP15	2110-0269	0	16	FUHLR-CLP-TYP	91506	6008-32CN
A3MP16	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP17	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP18	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP19	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP20	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP21	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP22	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP23	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP24	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP25	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP26	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP27	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP28	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP29	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP30	2110-0269	0		FUHLR-CLP-TYP	91506	6008-32CN
A3MP31	08971-00020	0	1	SUPPORT-REAR	28480	08971-00020
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
A3Q1	1884-0244	9	6	THYRISTOR-SCR VRRM-400	11983	S26002A
A3Q2	1884-0244	9		THYRISTOR-SCR VRRM-400	11983	S26002A
A3Q3	1884-0244	9		THYRISTOR-SCR VRRM-400	11983	S26002A
A3Q4	1884-0244	9		THYRISTOR-SCR VRRM-400	11983	S26002A
A3Q5	1884-0244	9		THYRISTOR-SCR VRRM-400	11983	S26002A
A3Q6	1853-0462	8	1	TRANSISTOR PNP 2N3635 SI TO-39 PD-1W	04713	SN3635
A3Q7	1884-0244	9		THYRISTOR-SCR VRRM-400	11983	S26002A
A3Q8	1854-0474	4	1	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A3Q9	1854-0669	9		TRANSISTOR NPN 2N6057 SI TO-3 PD=150W	04713	2N6057
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
A3R1	0698-0083	8	2	RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1961-F
A3R2	0757-0441	8	1	RESISTOR 8.25K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-8251-F
A3R3	0757-0290	5	3	RESISTOR 6.19K +-1% .125W TF TC=0+-100	19701	5033R-1/8-TO-6191-F
A3R4	0757-0290	5		RESISTOR 6.19K +-1% .125W TF TC=0+-100	19701	5033R-1/8-TO-6191-F
A3R5	0757-0401	0	9	RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A3R6	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A3R7	0757-0280	3	19	RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R8	0757-0442	9	9	RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1002-F
A3R9	0757-0159	5	1	RESISTOR 1K +-1% .5W TF TC=0+-100	K8479	H2
A3R10	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R11	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A3R12	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R13	0757-0407	6	1	RESISTOR 200 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-201-F
A3R14	0757-0417	8	1	RESISTOR 562 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-562-RF
A3R15	0757-3132	4	1	RESISTOR 261 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2610-F
A3R16	2100-3212	8	1	RESISTOR-TRMR 200 10% TKF TOP-ADJ 1-TRN	28480	2100-3212
A3R17	0757-0403	2	2	RESISTOR 121 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-121R-F
A3R18	0757-0873	0	1	RESISTOR 1.62K +-1% .5W TF TC=0+-100	K8479	H2
A3R19	0757-0274	5	3	RESISTOR 1.21K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1211-F
A3R20	2100-0554	5	1	RESISTOR-TRMR 500 10% TKF TOP-ADJ 1-TRN	28480	2100-0554
A3R21	0757-0416	7	2	RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-511R-F
A3R22	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A3R23	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R24	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A3R25	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R26	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R27	0698-3446	3	2	RESISTOR 383 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-383R-F
A3R28	0698-0084	9	1	RESISTOR 2.15K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2151-F
A3R29	0757-0428	1	4	RESISTOR 1.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1621-F
A3R30	0757-0274	5		RESISTOR 1.21K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1211-F
A3R31	0757-0428	1		RESISTOR 1.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1621-F
A3R32	0698-3446	3		RESISTOR 383 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-383R-F
A3R33	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1002-F
A3R34	0757-0428	1		RESISTOR 1.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1621-F
A3R35	0757-0428	1		RESISTOR 1.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1621-F
A3R36	0757-0274	5		RESISTOR 1.21K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1211-F
A3R37	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1002-F
A3R38	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1002-F
A3R39	0698-3158	4	1	RESISTOR 23.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-2372-F
A3R40	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1002-F
A3R41	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R42	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R43	0698-3243	8	2	RESISTOR 178K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1783-F
A3R44	0698-3243	8		RESISTOR 178K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1783-F
A3R45	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R46	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R47	0698-6362	8	2	RESISTOR 1K +-0.1% .125W TF TC=0+-25	12498	NE55
A3R48	0698-0533	5	2	RESISTOR 4.64K +-0.1% .125W TF TC=0+-25	12498	NE55
A3R49	0698-6362	8		RESISTOR 1K +-0.1% .125W TF TC=0+-25	12498	NE55
A3R50	0698-0533	5		RESISTOR 4.64K +-0.1% .125W TF TC=0+-25	12498	NE55
A3R51	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R52	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R53	0757-0454	3	2	RESISTOR 33.2K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-3322-F
A3R54	0757-0443	0		RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1102-F
A3R55	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F
A3R56	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-101-F
A3R57	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-TO-1001-F

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A3R58	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-101-F
A3R59	0757-0443	0		RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1102-F
A3R60	0757-0443	0		RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1102-F
A3R61	0757-0465	6	3	RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A3R62	0757-0443	0		RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R63	0757-0464	5	1	RESISTOR 90.9K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-9092-F
A3R64	0698-3160	8	1	RESISTOR 31.6K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3162-F
A3R65	0811-1671	4	3	RESISTOR 2.7 +-5% 2W PWI TC=0+-400	11502	SPH
A3R66	0811-1671	4		RESISTOR 2.7 +-5% 2W PWI TC=0+-400	11502	SPH
A3R67	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-101-F
A3R68	0757-0279	0	1	RESISTOR 3.16K +-1% .125W TF TC=0+-100	19701	CT4-1/8-T0-3161-F
A3R69	0757-0290	5		RESISTOR 6.19K +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-6191-F
A3R70	0757-0443	0		RESISTOR 11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1102-F
A3R71	0757-0454	3		RESISTOR 33.2K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-3322-F
A3R72	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3R73	0698-3136	8	1	RESISTOR 17.8K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1782-F
A3R74	0698-0458	7	1	RESISTOR 51.1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5112-F
A3R75	0698-3437	2	1	RESISTOR 133 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-133R-F
A3R76	0698-0083	8		RESISTOR 1.96K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1961-F
A3R77	0698-3156	2	1	RESISTOR 14.7K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1472-F
A3R78	0757-0416	7		RESISTOR 511 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-511R-F
A3R79	0757-0438	3	1	RESISTOR 5.11K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5111-F
A3R80	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R81	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R82	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R83	0757-0442	9		RESISTOR 10K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1002-F
A3R84	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3R85	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A3R86	1810-0560	7	1	NETWORK-RES 16-DIP 5.6K OHM X 8	32997	4116R-001-562F
A3R87	1810-0212	6	1	NETWORK-RES 16-DIP 22.0K OHM X 8	01121	3168223
A3R88	0757-0199	3	2	RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A3R89	0757-0199	3		RESISTOR 21.5K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-2152-F
A3R90	0757-0200	7	2	RESISTOR 5.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5621-F
A3R91	0757-0200	7		RESISTOR 5.62K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-5621-F
A3R92	0757-0401	0		RESISTOR 100 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-101-F
A3R93	0757-0382	6	1	RESISTOR 16.2 +-1% .125W TF TC=0+-100	19701	5033R-1/8-T0-61R2-F
A3R94	0698-8822	9	1	RESISTOR 6.81 +-1% .125W TF TC=0+-100	12498	LO4D
A3R95	0757-0403	2		RESISTOR 121 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-121R-F
A3R96	0757-0420	3	1	RESISTOR 750 +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-751-F
A3R97	0811-1671	4		RESISTOR 2.7 +-5% 2W PWI TC=0+-400	11502	SPH
A3R98	0757-0465	6		RESISTOR 100K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1003-F
A3R99	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3R100	0757-0280	3		RESISTOR 1K +-1% .125W TF TC=0+-100	12498	CT4-1/8-T0-1001-F
A3TP1	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP2	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP3	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP4	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP5	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP6	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP7	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP8	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP9	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP10	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP11	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3TP12	0360-0535	0		CONNECTOR-SGL CONT TML-TS-PT	28480	0360-0535
A3U1	1826-0677	0	2	IC V RGLTR-ADJ-POS 1.2/32V TO-3 PKG	27014	LM338K
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
A3U2	1826-0677	0		IC V RGLTR-ADJ-POS 1.2/32V TO-3 PKG	27014	LM338K
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
	1200-0043	8		INSULATOR-XSTR ALUMINUM	76530	322047
A3U3	1826-0393	7	1	IC V RGLTR-ADJ-POS 1.2/32V TO-3 PKG	27014	LM317T
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	0340-0614	4	3	INSULATOR-XSTR POLYI HD-ANDZ	13103	4778A
A3U4	1826-0106	0	1	IC V RGLTR-FXD-POS 14.4/15.6V TO-220 PKG	04713	MC7815CT
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	0340-0614	4		INSULATOR-XSTR POLYI HD-ANDZ	13103	4778A
A3U5	1826-0277	6	1	IC V RGLTR-FXD NEG 14.4/15.6 TO-220 PKG	27014	LM317T-15
	0515-0897	6		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	28480	0515-0897
	0340-0614	4	3	INSULATOR-XSTR POLYI HD-ANDZ	13103	4778A
A3U6	1826-1222	3	1	IC OP AMP H-SLEW-RATE QUAD 14-DIP-C PKG	04713	MC34074AL
A3U7	1826-0600	9	3	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074ACN
A3U8	1826-1486	1	2	D/A 8-DGT 18-CERDIP CMOS	24355	AD7224CQ
A3U9	1826-0847	6	1	IC V RGLTR-V-REF-FXD 4.97/5.02V 8-DIP-P	06665	REF-02HP
A3U10	1826-1486	1		D/A 8-DGT 18-CERDIP CMOS	24355	AD7224CQ
A3U11	1826-1239	2	1	IC V RGLTR-V-REF-FXD 6.8/7.1V	27014	LM299AH
A3U12	1826-0600	9		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074ACN
A3U13	1826-0600	9		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074ACN
A3U14	1826-1420	3	4	IC OP AMP PRCN 8-DIP-C PKG	06665	OP-77EZ
A3U15	1826-1190	4	1	D/A 12-BIT 18-CERDIP CMOS	24355	AD7240BQ
A3U16	1826-1420	3		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-77EZ
A3U17	1826-1416	7	1	D/A 16-DGT 40-DIP-C CMOS	24355	AD7546BD
A3U18	1820-3789	9	5	IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG COM	27014	MM74HC574N
A3U19	1820-3789	9		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG COM	27014	MM74HC574N
A3U20	1826-1420	3		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-77EZ
A3U21	1820-3789	9		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG COM	27014	MM74HC574N
A3U22	1820-3789	9		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG COM	27014	MM74HC574N
A3U23	1826-1420	3		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-77EZ
A3U24	1820-2973	1	5	IC-INTERFACE DRVR PERIPHERAL HIGH	27014	DS3686N
A3U25	1820-2973	1		IC-INTERFACE DRVR PERIPHERAL HIGH	27014	DS3686N
A3U26	1820-2973	1		IC-INTERFACE DRVR PERIPHERAL HIGH	27014	DS3686N
A3U27	1820-2973	1		IC-INTERFACE DRVR PERIPHERAL HIGH	27014	DS3686N
A3U28	1820-2921	9	1	IC INV CMOS/74HC HEX	27014	MM74HC04N
A3U29	1820-2973	1		IC-INTERFACE DRVR PERIPHERAL HIGH	27014	DS3686N
A3U30	1820-3079	0	2	IC DCDR CMOS/74HC 3-TO-8-LINE	04713	MC74HC138N
A3U31	1820-3789	9		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG COM	27014	MM74HC574N
A3U32	1820-3297	4		IC DRVR CMOS/74HC BUS OCTL	04713	MC74HC244N
A3U33	1820-3079	0		IC DCDR CMOS/74HC 3-TO-8-LINE	04713	MC74HC138N
A3U34	1820-2757	9		IC FF TTL ALS D-TYPE POS-EDGE-TRIG OCTL	01295	SN74ALS574AN
A3U35	1820-3297	4		IC DRVR CMOS/74HC BUS OCTL	04713	MC74HC244N
A3VR1	1902-3357	1	1	DIODE-ZNR 56.2V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3357
A3VR2	1902-0969	5	1	DIODE-ZNR 30V 5% DO-35 PD=.4W TC=+.095%	28480	1902-0969
A3VR3	1902-0951	5	1	DIODE-ZNR 5.1V 5% DO-35 PD=.4W TC=+.035%	28480	1902-0951
A3VR4	1902-0967	3	1	DIODE-ZNR 24V 5% DO-35 PD=.4W TC=+.094%	28480	1902-0967
A3VR5	1902-0964	0	2	DIODE-ZNR 18V 5% DO-35 PD=.4W TC=+.09%	28480	1902-0964
A3VR6	1902-0964	0		DIODE-ZNR 18V 5% DO-35 PD=.4W TC=+.09%	28480	1902-0964
A3VR7	1902-0955	9	1	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.062%	28480	1902-0955
A3VR8	1902-1412	5	1	DIODE-ZNR 39V 5% DO-35 PD=.4W TC=+.113%	28480	1902-1412
A3VR9	1902-0953	7	1	DIODE-ZNR 6.2V 5% DO-35 PD=.4W TC=+.053%	28480	1902-0953
A3W1	8159-0005			JUMPER, WIRE, 22W		
A3W2	8159-0005			JUMPER, WIRE, 22W		
A3W3	8159-0005			JUMPER, WIRE, 22W		
A3W4	8159-0005			JUMPER, WIRE, 22W		
A3W5	8159-0005			JUMPER, WIRE, 22W		
	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	00779	3-332070-5
	1251-5595	2		POLARIZING KEY-POST CONN	76381	3518
A4	11729-60012	9	1	HP-IB INTERCONNECT ASSEMBLY	28480	11729-60012
A4J1	1251-5615	7	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1251-5615
A4J2	1251-3283	1	1	CONN-POST MICRORBN 24-CKT 24-CONT	28480	1251-3283
A4MP1	1251-4459	5	1	CLIP-CABLE PLUG RING-DUAL INLINE 14 CONT	06776	RC-73

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
A4MP2	0380-0643	3	2	STANDOFF-HEX .255-IN-LG 6-32-THD	28480	0380-0643
A4MP3	0380-0643	3		STANDOFF-HEX .255-IN-LG 6-32-THD	28480	0380-0643
A4MP4	0515-0925	1	2	SCREW-MACH M3 X 0.5 10MM-LG PAN-HD	28480	0515-0925
A4MP5	0515-0925	1		SCREW-MACH M3 X 0.5 10MM-LG PAN-HD	28480	0515-0925
A4MP6	0535-0006	1		NUT-HEX DBL-CHAM M4 X 0.7 3.8MM-THK	00000	ORDER BY DESCRIPTION
A4MP7	0535-0006	1		NUT-HEX DBL-CHAM M4 X 0.7 3.8MM-THK	00000	ORDER BY DESCRIPTION
A4MP8	1530-1098	4	2	MACHINED PART-BRS CLEVIS	28480	1530-1098
A4MP9	1530-1098	4		MACHINED PART-BRS CLEVIS	28480	1530-1098
A4MP10	2190-0017	4	2	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
A4MP11	2190-0017	4		WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
A4MP12	2190-0019	6	2	WASHER-LK HLCL 40. 4 .115-IN-ID	28480	2190-0019
A4MP13	2190-0019	6	2	WASHER-LK HLCL 40. 4 .115-IN-ID	28480	2190-0019
A4MP14	1200-0508	0	1	SOCKET-IC-DIP 14-CONT		
B1	08971-60110	8	1	FAN AY-TEMP SENS	28480	08971-60110
	0624-0458	6	4	SCREW-TPG 8-16 .375-IN-LG PAN-HD-POZI	28480	0624-0485
	1251-3808	6	1	KEYING PLUG-POST CONN	18873	65307-001
	1251-4169	4	1	CONN-POST TYPE .100-PIN-SPCG 7-CONT	28480	1251-4169
	1251-4182	1	5	CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	18873	47565
	3160-0483	6	1	FAN GRILLE	10960	08147
C1	0160-4065	5	1	CAP-FXD 0.1UF -20 +20PPR-MET	11890	PME 271 M 610
F1	2110-0001	9	1	FUSE (INCH) 1A 250V NTD FE UL (FOR 220 TO 240V AC INPUT)	75915	312 001
F1	2110-0002	9	1	FUSE (INCH) 2A 250V NTD FE UL (FOR 100 TO 120V AC INPUT)	75915	312 002
MP1	5062-3734	7	1	COVER-TOP, 421-6D	28480	5062-3734
MP2	5062-3746	1	1	COVER-BTM, 421-6D	28480	5062-3746
MP3	5041-8821	2	4	FOOT R PNL	28480	5041-8821
MP4	5041-8821	2		FOOT R PNL	28480	5041-8821
MP5	5041-8821	2		FOOT R PNL	28480	5041-8821
MP6	5041-8821	2	4	FOOT R PNL	28480	5041-8821
MP7	0515-1232	5		SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
MP8	0515-1232	5		SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
MP9	0515-1232	5		SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
MP10	0515-1232	5		SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
MP11	5041-8801	8	4	FOOT BOTTOM	28480	5041-8801
MP12	5041-8801	8		FOOT BOTTOM	28480	5041-8801
MP13	5041-8801	8		FOOT BOTTOM	28480	5041-8801
MP14	5041-8801	8		FOOT BOTTOM	28480	5041-8801
MP15	1469-1345	5	2	TILT STAND SST	28480	1460-1345
MP16	1460-1345	5		TILT STAND SST	28480	1460-1345
MP17	5062-3775	8	2	COVER SIDE	28480	5062-3775
MP18	5062-3775	8		COVER SIDE	28480	5062-3775
MP19	5062-3703	2	2	STRAP HNDL AY 15	28480	5062-3703
MP20	5062-3703	2		STRAP HNDL AY 15	28480	5062-3703
MP21	5041-6819	4	2	HANDLE CAP FRONT	28480	5041-6819
MP22	5041-6819	4		HANDLE CAP FRONT	28480	5041-6819
MP23	5041-6820	7	2	HANDLE CAP REAR	28480	5041-6820
MP24	5041-6820	7		HANDLE CAP REAR	28480	5041-6820
MP25	0515-1132	4	4	SCREW-MACH M5 X 0.8 10MM-LG	28480	0515-1132
MP26	0515-1132	4		SCREW-MACH M5 X 0.8 10MM-LG	28480	0515-1132
MP27	0515-1132	4		SCREW-MACH M5 X 0.8 10MM-LG	28480	0515-1132
MP28	0515-1132	4		SCREW-MACH M5 X 0.8 10MM-LG	28480	0515-1132
MP29	5020-8895	6	2	TRIM FRT HDL	28480	5020-8895
MP30	5020-8895	6		TRIM FRT HDL	28480	5020-8895
MP31	5001-0538	8	2	TRIM SIDE FRT F	28480	5001-0538
MP32	5001-0538	8		TRIM SIDE FRT F	28480	5001-0538
MP33	5041-8802	9	1	STRIP TRIM TOP	28480	5041-8802
MP34	5021-5401	0	1	FRAM-FRNT, 88.1H	28480	5021-5401
MP35	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
MP36	08971-00004	0	1	FRNT PANEL-DRESS	28480	08971-00004

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
	0510-1148	2	6	RETAINER-PUSH ON KB-TO-SHFT EXT	78553	C4154-017-27
MP37	5021-5831	6	2	SIDE STRUT	28480	5021-5831
	0515-1331	5	8	SCREW-METRIC SPECIALITY M4 X 0.7 THD; 7MM	28480	5015-1331
MP38	5021-5831	6		SIDE STRUT	28480	5021-5831
	0515-1331	5		SCREW-METRIC SPECIALITY M4 X 0.7 THD; 7MM	28480	5015-1331
MP39	08971-00042	7	1	REAR PANL	28480	08971-00042
MP40	6960-0009	1	1	PLUG-HOLE TR-HD FOR .438-D-HOLE BRS	71785	BS-51043
MP41	08971-00019	7	1	SUPPORT-RIGHT	28480	08971-00019
MP42	5041-1682	9	1	KEY CAP LINE	28480	5041-1682
MP43	08971-00009	5	1	BRACKET-LINE SWITCH	28480	08971-00009
	0515-1234	7	14	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
MP44	08971-00002	8	1	DECK	28480	08971-00002
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
MP45	08971-00029	9	1	TUNNEL-SIDE	28480	08971-00029
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
MP46	5040-6987	5	2	LIGHT PIPE	28480	5040-6987
MP47	5040-6987	5		LIGHT PIPE	28480	5040-6987
MP48	08971-20027	9	2	SPACER PC SUPRT	28480	08971-20027
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
MP49	08971-20027	9		SPACER PC SUPRT	28480	08971-20027
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
MP50	1400-0611	0		CLAMP-FL-CA 1-WD	06394	FCC-A-CB
MP51	0515-1146	0		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1146
MP52	0515-1146	0		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1146
MP53	0515-1146	0		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1146
MP54	0515-1146	0		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1146
MP55	0515-1146	0		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1146
MP56	0515-1146	0		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1146
MP57	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	ORDER BY DESCRIPTION
MP58	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	ORDER BY DESCRIPTION
MP85-	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	ORDER BY DESCRIPTION
MP86-MP91	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
S1	3101-2216	3	1	SWITCH-PB BPDT ALTNG 4A 250 VAC	71468	600351-NE15
	0515-0402	9	2	SCREW-MACH M2.5 X 0.45 4MM-LG PAN-HD	28480	0515-0402
	2190-0583	9	2	WASHER-LKJ HLCL 2.5 MM 2.6-MM-ID	28480	2190-0583
S2	3101-1973	7	1	SWITCH-DIP SL 7-1A 0.1A 50VDC	11236	11P-1028
	1200-1103	3	2	SHIM-SOCKET POLYETHYLENE; WHITE; 1.115	59730	609-S14
	1200-1104	4	1	SHROUD-SOCKET GLASS REINFORCED	59730	609-141B
S3	3103-0094	5	1	SWITCH-THRM FXD +193 15A OPN-ON-RISE	14604	3455-RBV-117-204
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
T1	9100-4596	0	1	PWR TRANSFORMER	09535	5180-4998
	0515-0903	5	4	SCREW-MACH M4 X 0.7 60MM-LG PAN-HD	28480	0515-0903
	0535-0006	1	6	NUT-HEX DBL-CHAM M4 X 0.7 3.8MM-THK	00000	ORDER BY DESCRIPTION
	2190-0586	2	4	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
U1	0960-0443	1	1	LINE MODULE-FILTERED	05245	F2058D
U2	1826-1473	6		IC TEMP XDCR PRCN 3-TO-46 PKG	27014	LM35CAH
	1400-0510	8	4	CLAMP-CABLE .15-DIA .62-WD NYL	02768	8511-28-00-9909
W1	08971-60097	7	1	CBL AY LINE SW (INCLUDES U1, S1, S2, S3, C1, MP42, MP43	28480	08971-60097
	0360-0265	3	2	TERMINAL-CRIMP R-TNG #6 12-10-AWG YEL	00779	34852
	0515-1079	8		SCREW-MACHINE ASSEMBLY M3 X 0.5 8MM-LG	00000	ORDER BY DESCRIPTION
	0535-0004	9	3	NUT-HEX DBL-CHAM M3 X 0.5 2.9MM-THK	00000	ORDER BY DESCRIPTION
	1251-2410	4	1	CONTACT-CONN U/W-UTIL MALE CRP	00779	350629-1
	1251-3925	8	1	CONTACT-CONN U/W-UTIL FEM CRP	00779	350628-1
	1251-7015	5	1	CONNECTOR-SGL CONT FEM-SNAP RND	27264	03-06-1011
	1251-7016	6	1	CONNECTOR-SGL CONT M-SNAP RND	27264	03-06-2011
	1400-0017	0	3	CLMP-CA .312-DIA .375-WD NYL	06394	3310 RED
	1400-0482	3	4	CABLE TIE .062-3-DIA .14-WD NYL	06394	PLT 3I-M8
	3050-0891	7		WASHER-FL MTLC 3.0 MM 3.3-MM-ID	28480	3050-0891

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Manufacturer Part Number
W2	08971-60095	5	1	CBL AY UNPROC (A2 TO A3)	28480	08971-60095
W3	08971-60096	6	1	CBL AY UNPROC (A2 TO HP-IB BD)	28480	08971-60096
W4	11729-60051	6	1	CBL AYU ADRS-HPIB	28480	11729-60051
W5	08971-60089	7	1	CBL AY-DISPLAY (A3 TO A1A1)	28480	08971-60089
W6-W8				NOT ASSIGNED		
W9	08971-60104	7	1	CA-AY RF COMP	28480	08971-60104
W10	08971-60098	8	1	CBL-AY LED	28480	08971-60098
W11	08971-60109	6	1	CA-AY YIG CONN	28480	08971-60109

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
C1433	AB ELEKTRONIK GMBH	SALZBURG AU	A-501
K8479	HOLSWORTHY ELECTRONICS LTD	HOLSWORTHY EG	
S4013	HITACHI AMERICA LTD	SUNNYVALE CA US	94086
00000	ANY SATISFACTORY SUPPLIER		
00779	AMP INC	HARRISBURG PA US	17111
01121	ALLEN-BRADLEY CO INC	EL PASO TX US	79935
01295	TEXAS INSTRUMENTS INC	DALLAS TX US	75265
02768	ITW FASTEX	DES PLAINES IL US	60018
04713	MOTOROLA INC	ROSELLE IL US	60195
05245	CORCOM INC	LIBERTYVILLE IL US	60048
05347	ULTRONIX INC	GRAND JUNCTION CO	81501
05876	U S POLYMERIC INC	STAMFORD CT	06904
06383	PANDUIT CORP	TINLEY PARK IL US	60477
06394	HOOVER UNIVERSAL INC BALL & RLR DIV	SALINE MI	68310
06665	PRECISION MONOLITHICS INC	SANTA CLARA CA US	95054
06776	ROBINSON NUGENT INC	NEW ALBANY IN US	47150
09535	JOHNSON MATTHEY AND MALLORY LTD	TORONTO CN	
09969	DALE ELECTRONICS INC	YANKTON SD US	57078
1B546	VARO INC	GARLAND TX US	75046
10582	CTS CORP ASHEVILLE DIV	SKYLAND NC US	28776
10960	T D R ELECTRONICS INC	BRISTOL RI	02809
11236	CTS CORP	ELKHART IN US	46514
11427	PACIFIC SPRING ENGINEERING CORP	SANTA FE SPGS CA	90670
11502	IRC INC	BOONE NC US	28607
11591	STUART RADIATOR CO	SAN FRANCISCO CA	94107
11870	MELABS INC	PALO ALTO CA	94304
11890	TOMIC ELECTRIC DIV	DETROIT MI	48234
11983	NORTRONICS CO INC	MINNEAPOLIS MN	55427
12498	CRYSTALONICS, DIV TELEDYNE	CAMBRIDGE MA	02140
13103	THERMALLOY INC	DALLAS TX US	75234
14604	ELMWOOD SENSORS INC	PAWTUCKET RI US	02861
15286	RHG ELECTRONIC LABORATORY INC	DEER PARK NY	11729
17117	ELECTRONIC MOLDING CORP	WOONSOCKET RI US	02895
18873	DUPONT E I DE NEMOURS & CO	WILMINGTON DE US	19801
19701	MEPCO/CENTRALAB INC	RIVIERA FL US	33404
24355	ANALOG DEVICES INC	NORWOOD MA US	02062
24539	AVANTEK INC	SANTA CLARA CA US	95054
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA US	95052
27264	MOLEX INC	LISLE IL US	60532
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
28520	HEYCO MOLDED PRODUCTS	KENTWORTH NJ US	07033
32559	BIVAR INC	SANTA ANA CA	92705
32997	BOURNS INC	RIVERSIDE CA US	92507
34649	INTEL CORP	SANTA CLARA CA US	95054
51633	FLUOROCARBON CO THE	SUNNYVALE CA	94088
56289	SPRAGUE ELECTRIC CO	LEXINGTON MA US	02173
59730	THOMAS & BETTS CORP	RARITAN NJ US	08869
71468	ITT CORP	NEW YORK NY US	10022
71744	GENERAL INSTRUMENT CORP	CLIFTON NJ US	07012
71785	TRW INC	CLEVELAND OH US	44124
75915	LITTELFUSE INC	DES PLAINES IL US	60016
76381	3M CO	ST PAUL MN US	55144
76530	MONADNOCK CO, THE	CITY OF IND CA	91747
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN IL	60126
78553	TINNERMAN PRODUCTS INC	CLEVELAND OH	44101
83259	PARKER SEAL CO DIV PARKER-HANNIFIN	LEXINGTON KY	90231
9N171	UNITRODE CORP	LEXINGTON MA US	02173
91506	AUGAT INC	MANSFIELD MA US	02048
91637	DALE ELECTRONICS INC	COLUMBUS NE US	68601

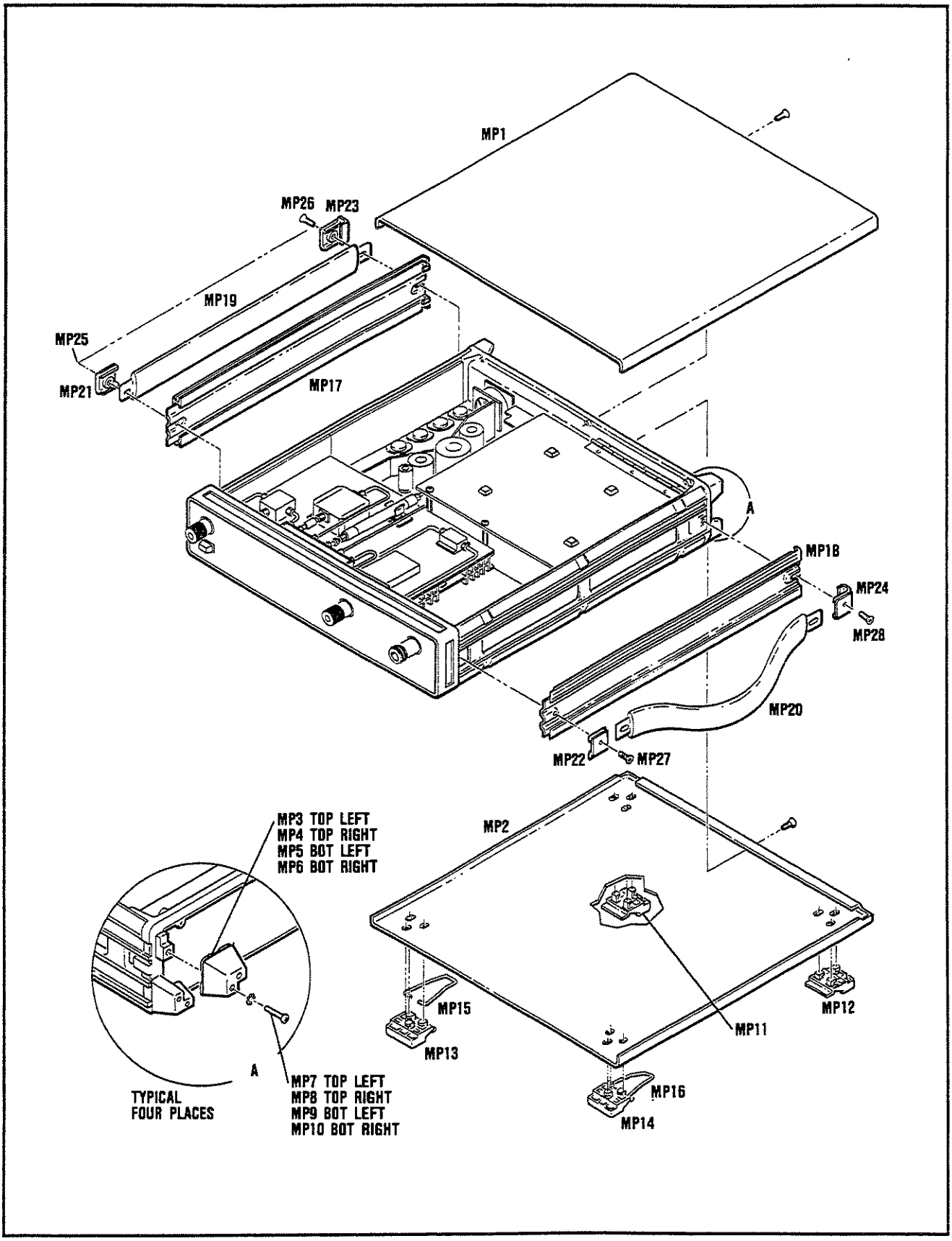


Figure 6-1. External Mechanical Parts

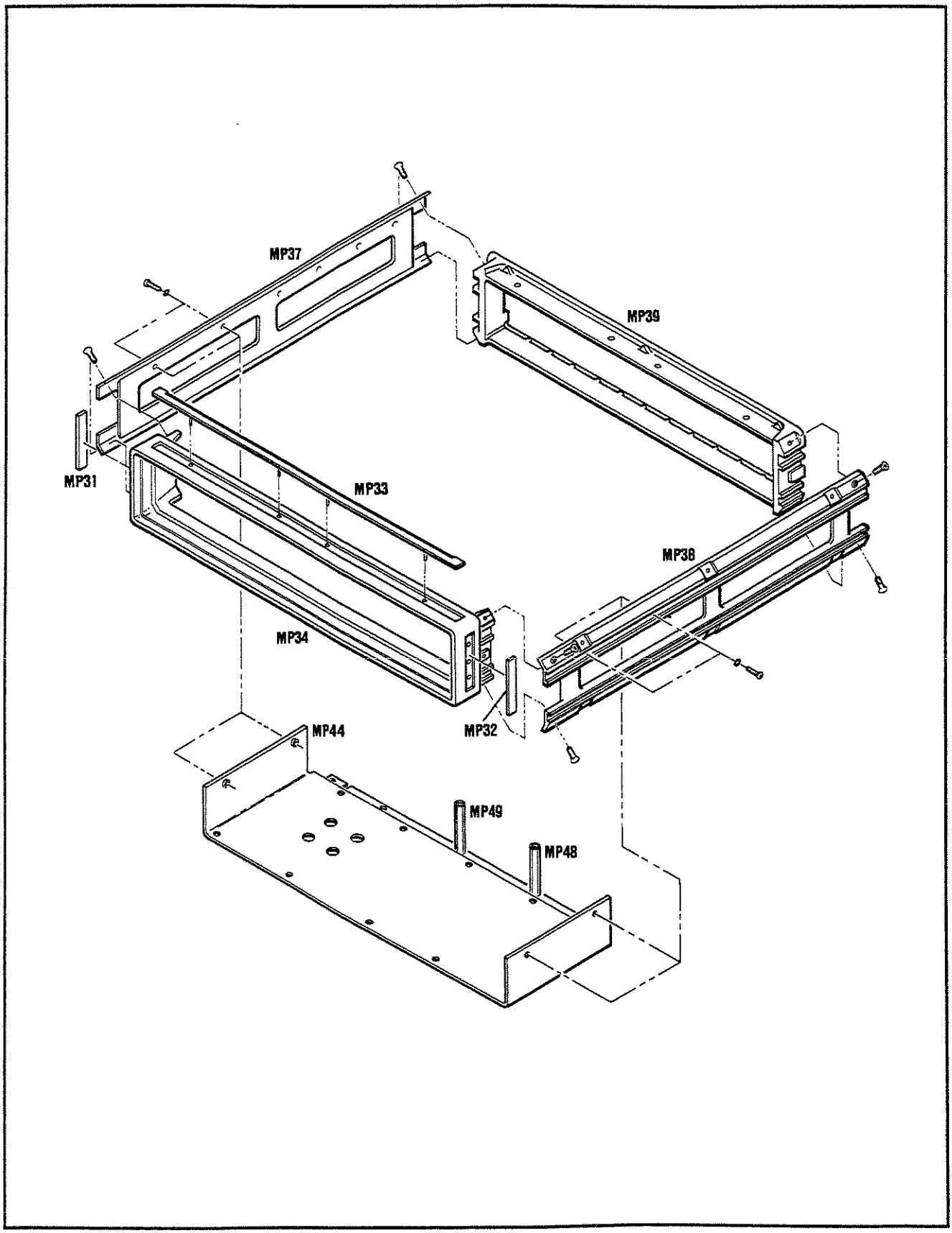


Figure 6-2. Chassis Parts

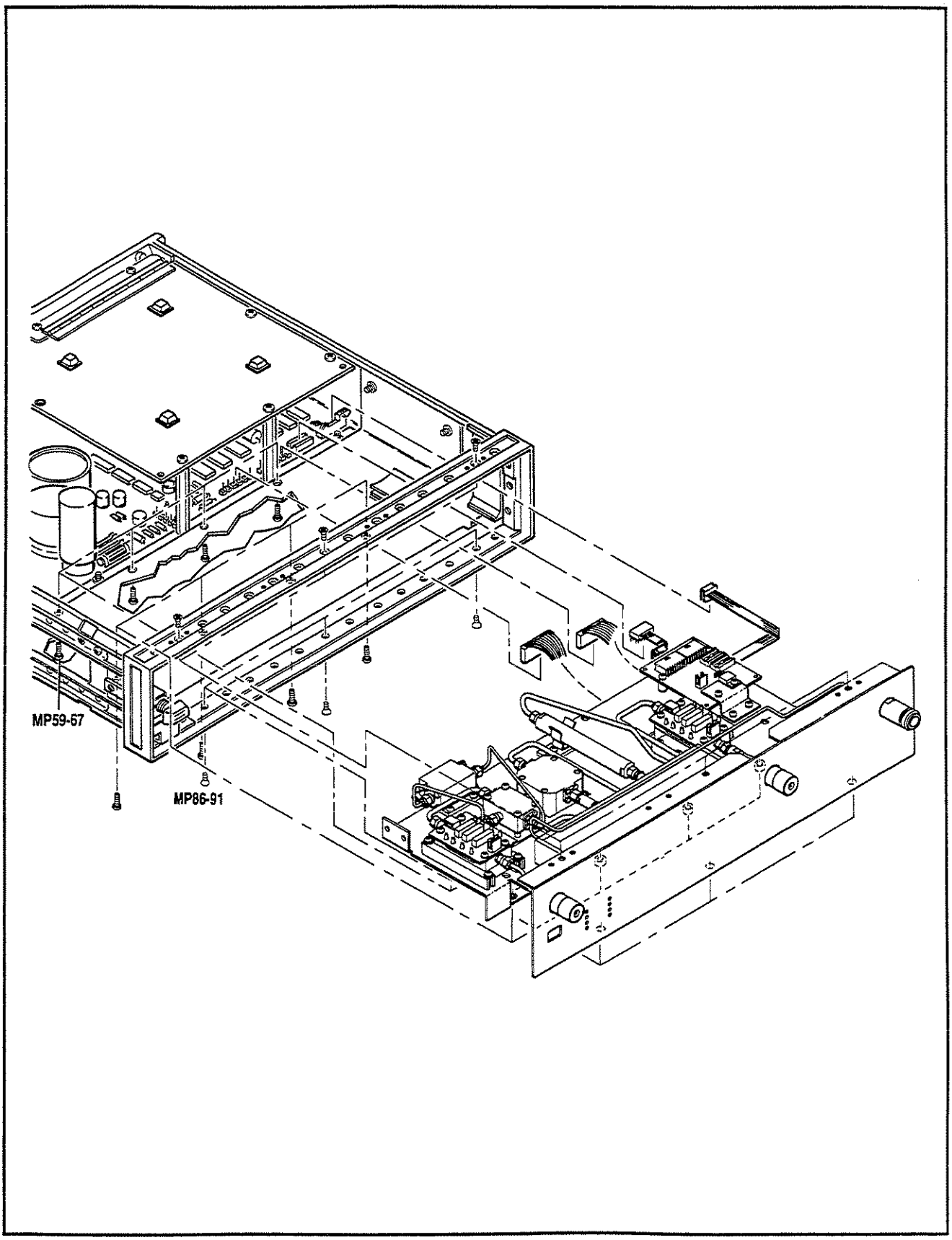


Figure 6-3. A1 Microwave Assembly Removal

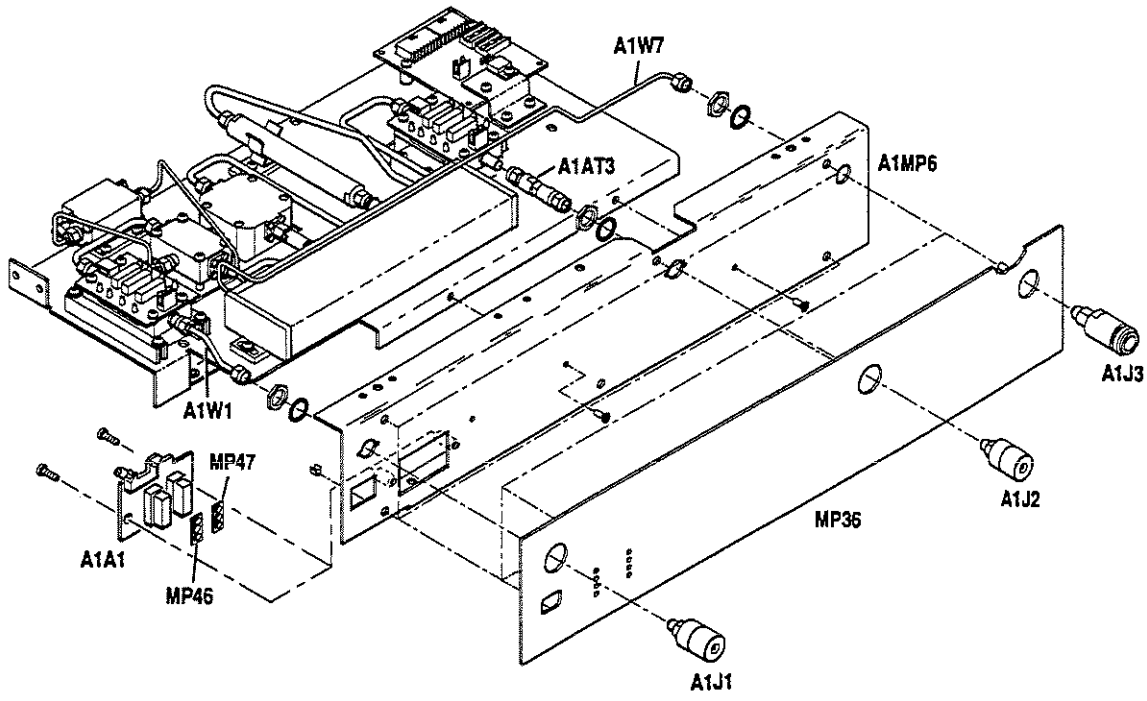


Figure 6-4. Front Panel Illustrated Parts Breakdown

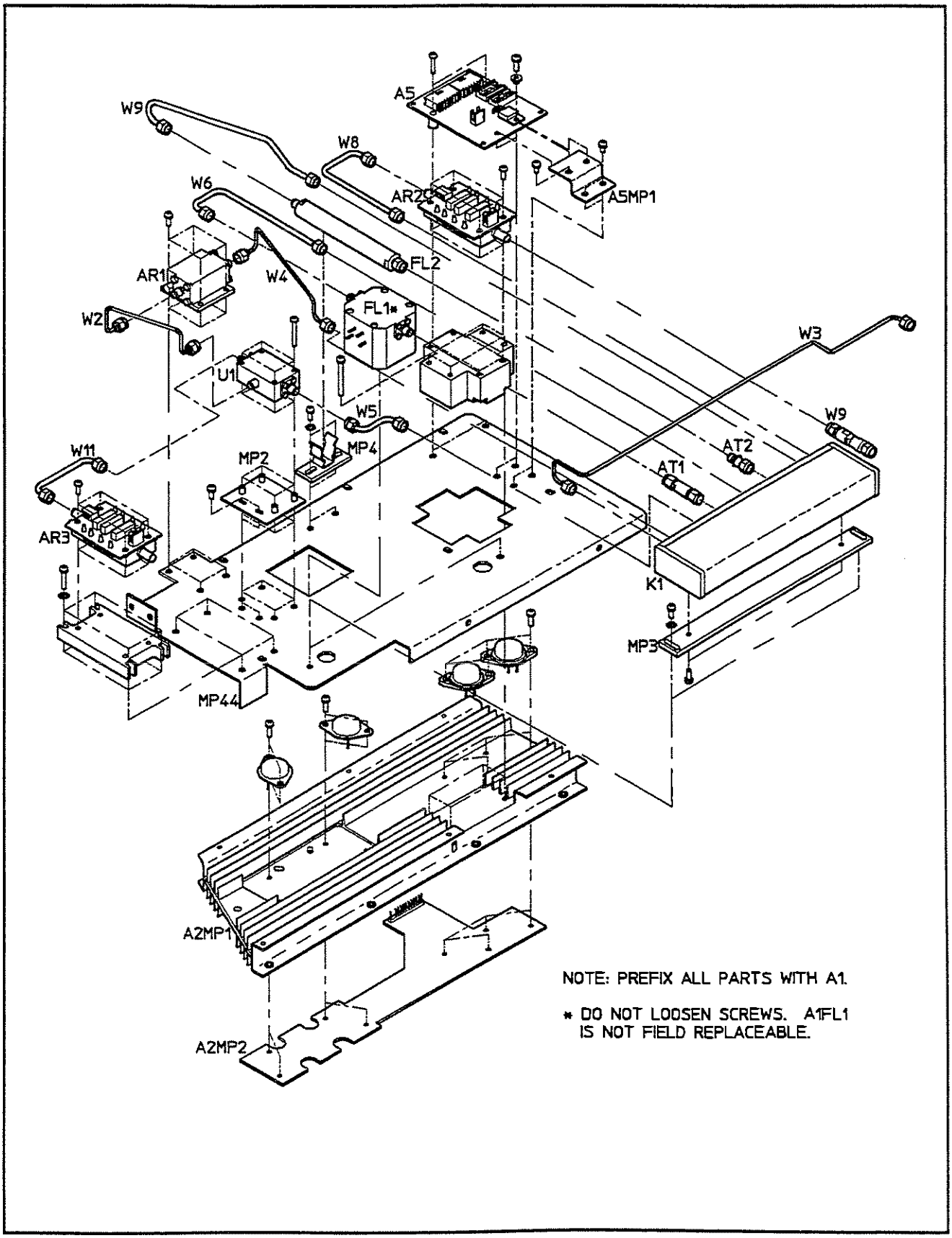


Figure 6-5. A1 Microwave Deck Illustrated Parts Breakdown

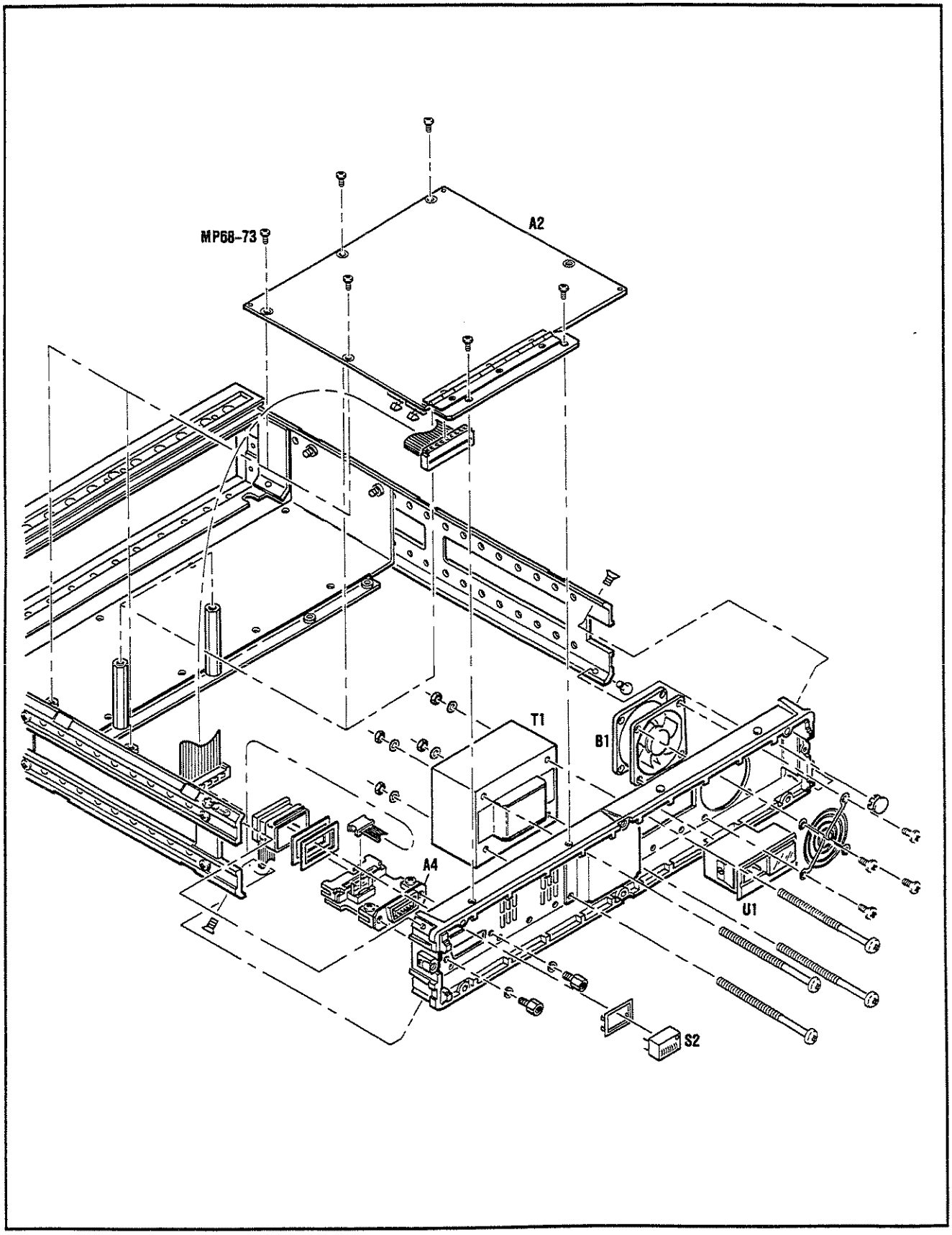


Figure 6-6. Rear Panel Illustrated Parts Breakdown

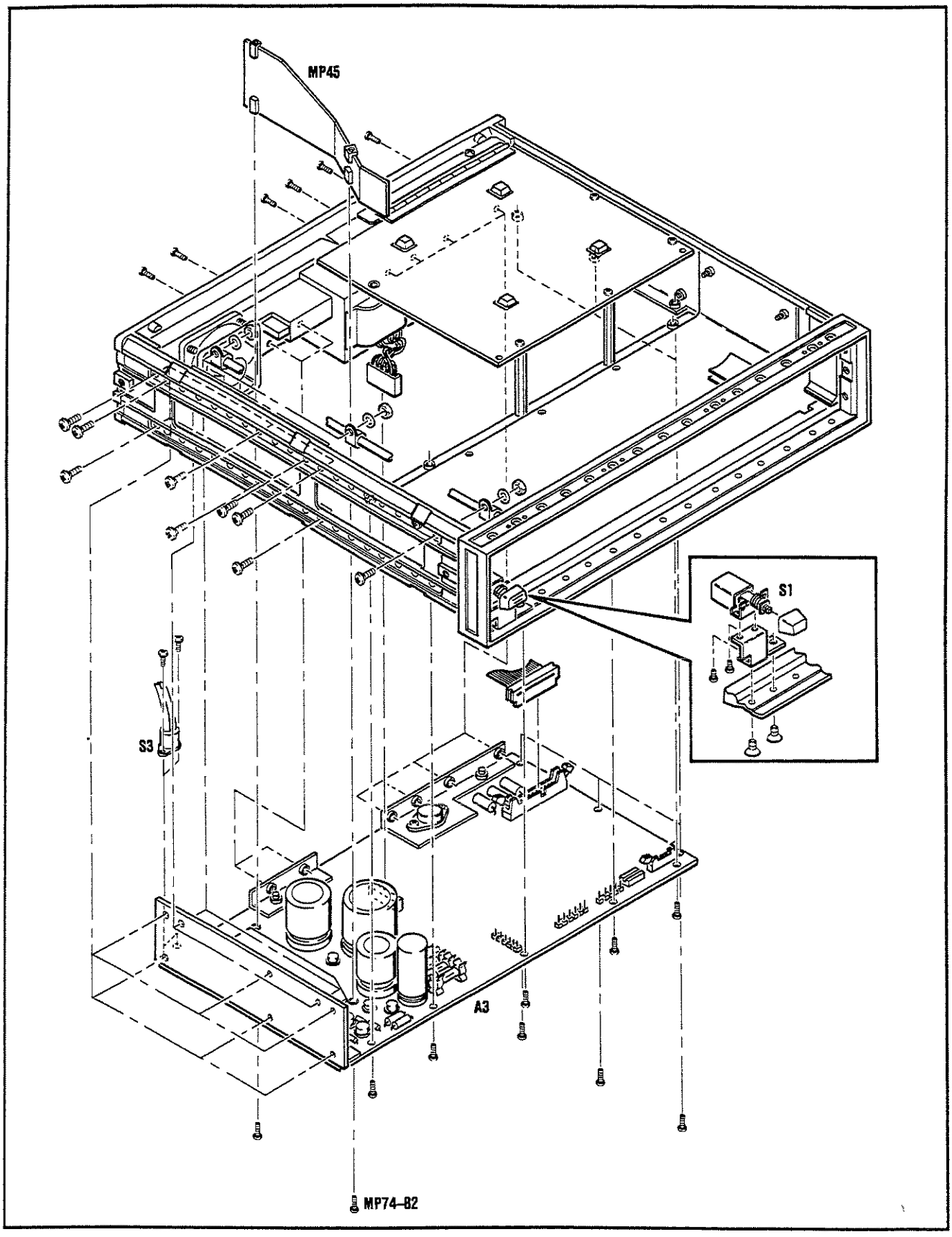


Figure 6-7. A3 Power Supply Removal

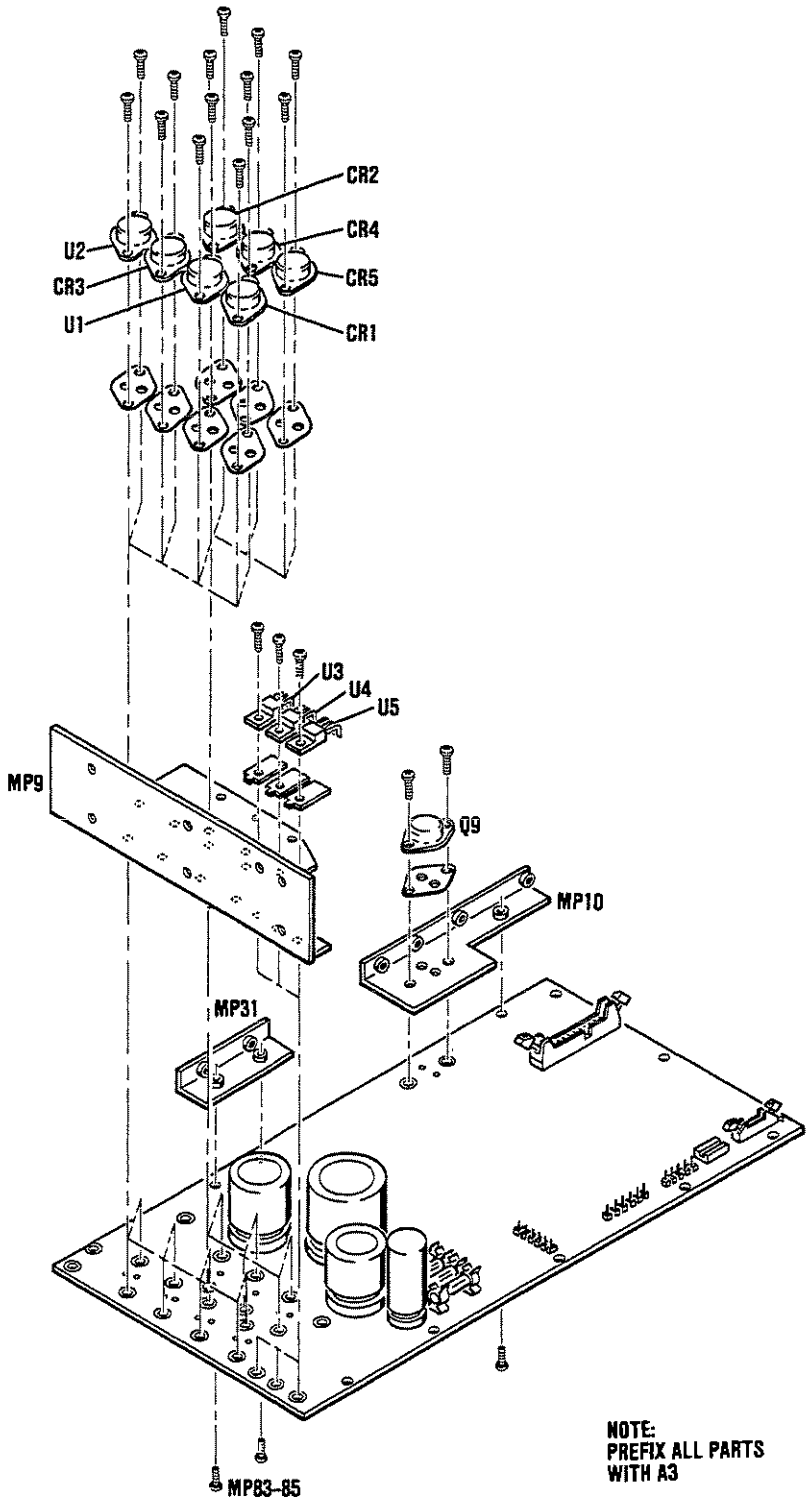


Figure 6-8. A3 Power Supply Illustrated Parts Breakdown

7

Manual Changes

General Information

Chapter 7 is not applicable to this manual.

7-2 This Page Intentionally Left Blank

8

Service

8-1. Introduction

This chapter contains information for troubleshooting and repairing the HP 8971C Noise Figure Test Set. The information is presented in modules called Service Sheets. Each service sheet includes block diagrams, schematics, principles of operation, and procedures for troubleshooting, repair, disassembly and reassembly of a particular assembly or function, as listed below:

BD1	Overall Functional Block Diagram
A1	Microwave Assembly A1
A2a	Microprocessor A2 Memory, Data, and Address Buses
A2b	Microprocessor A2 I/O and Diagnostics
A2c	Microprocessor A2 Switch Decoding and SA
A3a	Switch Driver/Interface Processor, Part of A3
A3b	YIG Filter Driver, Part of A3
A3c	Temperature Control, Part of A3
A3d	Power Supply, Part of A3
A4	HP-IB

8-2. Failure Modes and Service Strategy

8-3. General

Instrument problems usually fall into four general categories; Turn-on errors, Operator errors, Performance out of specification, or complete failure. The troubleshooting is different for each category.

The service strategy is to troubleshoot all assemblies except microprocessor A2 to the component level (i.e., IC, resistor, capacitor, etc.). Microprocessor A2 is replaced as an assembly if it fails a simple go/no-go test.

8-4. Turn-on Errors

Alternate flashing of the front panel SRQ and TALK annunciators when the Test Set is turned on indicates that the built-in diagnostic routine has detected a problem. Turn the Test Set off and then on. If the error repeats, begin troubleshooting in accordance with service sheet BD1.

8-5. Instrument Performance Out of Specification

The "Performance Tests" contained in chapter 4 of the 8970B, 8971B, and 8971C Operating Manual can be performed to verify that the instrument is operating normally and within specification.

If a parameter is out of limits, first check or adjust the power supply by following the procedure in chapter 5. If the adjustment fails to bring the parameter into specification, use the troubleshooting procedures starting on service sheet A1.

8-6. Board Assembly Failures

When a problem occurs that indicates a failure of one or more of the instrument functions, begin troubleshooting with service sheet BD1. These procedures are used to quickly isolate the problem to one of the major functional sections of the instrument. Troubleshooting is structured at two levels: overall and component.

a. The overall troubleshooting level, where problems are isolated to one of the functional board assemblies, is supported by service sheet BD1, which includes diagrams, theory of operation, and troubleshooting information.

b. Circuit-level troubleshooting isolates the problem to a stage within the circuits shown on the schematic. This level of troubleshooting is supported by service sheets BD1 through A3d, which include block diagrams, schematics, theory of operation, and troubleshooting information. Further troubleshooting, to the component level, is left to the skill and experience of the technician.

8-7. Service Sheets

The pages following the Service Introduction are the service sheets comprising block diagrams, schematics, supplemental diagrams, theory, and troubleshooting information.

8-8. Manual Updates

Production changes to the instrument made after the publication date of this manual are indicated by a change in the serial number prefix. Manual Updates provide information for these new instruments.

Keep this manual up to date by periodically requesting the latest Manual Update from your Hewlett-Packard Office.

8-9. Safety Considerations

8-10. Before Applying Power

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

8-11. Warnings and Cautions

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

Warning

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

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

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

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

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

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

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

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

Caution 

Do not disconnect or remove any carriers or boards in the instrument unless the instrument is unplugged. Some boards contain devices that can be damaged if the board is removed when the power is on. There are several components including MOS and CMOS devices that can be damaged by electrostatic discharge. Use conductive foam and grounding straps when servicing is required on sensitive components. Use care when unplugging ICs from high-grip sockets.

8-12. After Service Safety Checks

Visually inspect the interior of instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy the cause of any such condition.

Using a suitable ohmmeter, check resistance from instrument enclosure to ground pin on power cable plug. The reading must be less than one ohm. Flex the power cable while making this measurement to determine whether intermittent discontinuities exist.

Check any indicated front or rear panel ground terminals that are marked, using the above procedures.

Check resistance from instrument enclosure to line and neutral (tied together) with the power switch on and the power source disconnected. The minimum acceptable resistance is two megohms. Replace any component that results in a failure.

Check line fuse to verify that a correctly rated fuse is installed.

8-13. Recommended Test Equipment

Test Equipment and accessories required to maintain the 8971C Noise Figure Test Set are listed in Table 1-11 of the Operating Manual. Equivalents of the listed equipment may be used provided they meet the critical specifications listed in the manual.

8-14. Service Tools, Aids, and Information

8-15. Signature Analysis

Signature analysis is a simple means of verifying the operation of digital circuitry. When properly used, signature analysis can detect extremely subtle hardware faults. Signatures must match identically those given in the signature tables on the service sheets.

8-16. Required Service Tools

Posidriv Screwdrivers

Many screws in the Test Set appear to be Phillips type, but are actually Posidriv. To avoid damage to the screw head slots, use Pozidriv screwdrivers No. 1, HP 8710-0899, or No. 2, HP 8710-0900.

Tuning Tools

For power supply adjustments, an ordinary small screwdriver or suitable tool is satisfactory. Never force any adjustment.

8-17. Hardware Characteristics

Caution

The Test Set uses a mixture of Unified National (inch) and metric screws. The metric screws are defined in Industrial Fasteners publication (IFI 500) and are identified in the replaceable parts list as M (metric). Metric screws have a shiny silver appearance. The Unified National screws have a dull steel-gray appearance. Do not use a metric with a Unified National nut, or a metric nut with a Unified National screw, because thread damage will result.

Assembly Locations

Assemblies in the Test Set are numbered sequentially, left to right, top to bottom, and front to back.

Parts and Cable Locations

The locations of individual components mounted on printed circuit boards or other assemblies are shown on the service sheet near the related schematic diagram. The part reference designation is the assembly designation plus the part designation. For example, A3R9 is R9 on the A3 assembly. For specific component descriptions and ordering information, refer to Table 6-2, Replaceable Parts, in chapter 6. Chassis and frame parts, as well as mechanical parts (MP) and cables (W), are identified in Figures 6-1 through 6-8 in chapter 6.

Test Points and Adjustment Locations

Most test points and adjustments are indicated on the actual circuit board assemblies. Test points and adjustments are also indicated on the component locator figure near the assembly's schematic diagram.

Service Aids on Printed Circuit Boards

Service aids on printed circuit boards include test points, indicator lights, some reference designations, adjustment names, and assembly part numbers.

Other Service Documents

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

Etched Circuits (Printed Circuit Boards)

The etched circuit boards in the Test Set have plated-through holes that make a solderable path through to both sides of the insulating material. Soldering can be done from either side of the board. When soldering to any circuit board, take the following precautions:

a. Wear safety glasses while soldering and unsoldering.

b. Avoid unnecessary component unsoldering and soldering which can damage the circuit board and/or adjacent components.

c. Do not use a high-power soldering iron on printed circuit boards. Use the recommended 35-watt iron. Excessive heat may lift a conductor or damage the board.

d. Use a suction device or wooden toothpick to remove solder from component mounting holes. When using a suction device make sure that equipment is properly grounded to prevent electrostatic damage to MOS devices. Refer to table 8-1, "Etched Circuit Soldering Equipment", for information on tools for working on etched circuit boards.

Caution

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.

Electrostatic Discharge (ESD) Precautions

Electrostatic discharge (ESD) can damage certain devices in the Test Set, ranging from slight parameter degradation to complete failure. Being prone to damage from both static electricity and transient signals, these devices must be handled carefully. Take the following precautions to avoid damage:

a. Work on a pad of conductive rubber or similar material that is grounded uniformly across the surface. Be sure to use a wrist grounding strap.

b. 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. When a solder removal tool is used, make sure that the tip is conductive and that the barrel is metaled.

Table 8-1. Etched Circuit Soldering Equipment

Item	Application	Specification	Recommended Item	HP Part No.
Soldering tool	Soldering, unsoldering	35 W	Ungar 125 Ungar Div. Eldon Ind. Corp. Compton CA 902220	8690-0167
Soldering tip	Soldering, unsoldering	Chisel shape	Ungar PL113	8690-0007
Soldering tip	Soldering, unsoldering	Cupped shape	Modified Unger PL111	5020-8160
De-solder aid	To remove molten solder from connections	Suction device	Soldapult by Edsyn Co., Van Nuys CA. 91406	8690-0060
Solder	Soldering, wiring repair	Rosin (flux core) 63/37 tin/lead 18 gauge (AWG) 0.040 in diameter		8090-0607

8-18. Cleaning Intervals

Hewlett-Packard recommends a 12-month interval between cleaning for some parts of the Test Set. Front panel connectors should be cleaned every 6 months. Cleaning intervals, however, are mostly dependent upon where the Test Set is used. The Test Set should be cleaned more frequently if used in a dusty or very humid area.

Cleaning Solution

Hewlett-Packard recommends either of two solutions for cleaning printed circuit (PC) board edge connectors. For best results, use an ammonium hydroxide solution (NH4OH, 29.5% NH3 by weight). However, concentrated ammonia is toxic, requiring gloves, goggles, and proper ventilation. An acceptable alternative is an 80:20 solution of isopropyl alcohol and water (IPA/H_2O). This should be a satisfactory cleaner where ammonium hydroxide is not feasible.

6-Month Cleaning

Careful cleaning of front panel connectors is essential to assure long, reliable connector life, to prevent accidental damage to connectors, and to obtain maximum measurement accuracy and repeatability.

Loose particles on the connector mating plane surfaces can usually be removed with a quick blast of compressed air.

Dirt and stubborn contaminants that cannot be removed with compressed air can often be removed with a cotton swab or lint-free cleaning cloth moistened with a solvent.

Note

Use the least amount of solvent possible, and avoid wetting any plastic parts in the connectors with the solvent.

Use liquid solvents rather than spray. If a spray must be used, always spray the solvent onto a cloth or swab, never directly into a connector.

Very dirty connectors can be cleaned with 91% isopropyl alchohol, HP Part No. 8500-0559. Do not use aromatic or chlorinated hydrocarbons, esters, ethers, terpenes, higher alcohols, ketones or ether-alcohols such as benzene toluene, turpentine, dioxane, gasoline, cellosolve acetate, or carbon tetrachloride.

Whichever solvent is used, carefully avoid wetting the plastic support bead inside the connector and blow the connector dry immediately with a gentle stream of compressed air. Support beads are easily damaged by solvents.

Interior surfaces, especially on precision 3.5mm connectors, are very difficult to reach, and it is easy to damage connectors in trying to clean them. One suitable method is to cut off the sharp tip of a round wooden toothpick and then to wrap it with a single layer of lint-free cleaning cloth. (A round wooden toothpick or a very small diameter wooden rod is required: metal must never be used because it will scratch the plated surfaces; diameter must not exceed 0.070 in. or 1.7 mm. Moisten the cloth with a small amount of cleaning solvent and carefully insert it into the connector to clean the interior surfaces.

Use an illuminated magnifying glass or microscope to see clearly the areas you wish to clean.

When you have cleaned a connector, always be sure that it is completely dry before using it. Blow the connector dry with a gentle stream of clean compressed air and inspect it again under a magnifying glass to be sure that no particles or solvent residues remain.

12-Month Cleaning

Warning

Before cleaning, make sure the Test Set is disconnected from the power source. This is to eliminate the possibility of electrical shock.

Caution 

This instrument contains static-sensitive devices such as CMOS integrated circuits. Because static-sensitive devices can be damaged by a vacuum cleaner, use only a soft-bristle brush or clean, dry, deionized compressed air (maximum 20 pounds pressure) for cleaning.

1. Remove the top and bottom covers to gain access to the interior of the instrument.
2. Remove the 4 Pozidriv screws that secure the A2 Microprocessor Assembly.
3. Turn the instrument on its side. Open the A2 Assembly out so that the A3 Power Supply/Driver Assembly can be accessed.
4. Using a brush, remove dirt from the fan guard and fan blades.
5. Using compressed air, remove dust and dirt from the area behind the fan. Blow air out through the fan and remove loose dirt.
6. Blow compressed air into the opening behind the power supply regulators (under the label "A1 Microwave Assembly") to remove loose dirt.
7. Using air and/or a soft-bristle brush, clean all other accessible areas of the instrument, starting from the top, including the A2 and A3 circuit boards.
8. Using air and/or a soft-bristle brush, clean the bottom side of the instrument, including the printed circuit board.
9. Return the Microprocessor Assembly to its normal position and place the instrument in the normal position. Replace the 4 screws that secure the Microprocessor Assembly, and replace the instrument covers.

8-19. Schematic Symbology

Table 8-2, Schematic Diagram Notes, contains definitions of the general symbology used in this manual.

Qualifying symbology and dependency notation (See Tables 8-3 and 8-4) are the key means of defining relationships between various leads on the IC. For an exellent explanation of all of the symbology, we recommend the Texas Instruments, Inc., "High-Speed CMOS Logic Data Book, 1984".

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

Logic Symbols

Logic symbols used in this manual conform to the American National Standard ANSI/IEEE Std. 91-1984. This standard supersedes MIL-STD-806B. Table 8-3 through 8-4 give a brief summary of the symbols used for logic devices, and the associated qualifiers

and indicators. Not all of the symbols listed have been used in this manual, but they are included in the tables for the sake of completeness.

General Qualifying Symbols. The following table shows the characters generally used to define the basic function of a device represented by a logic symbol or element. The characters are placed near the top center or geometric center of the symbol or symbol element.

Table 8-2. Schematic Diagram Notes (1 of 2)

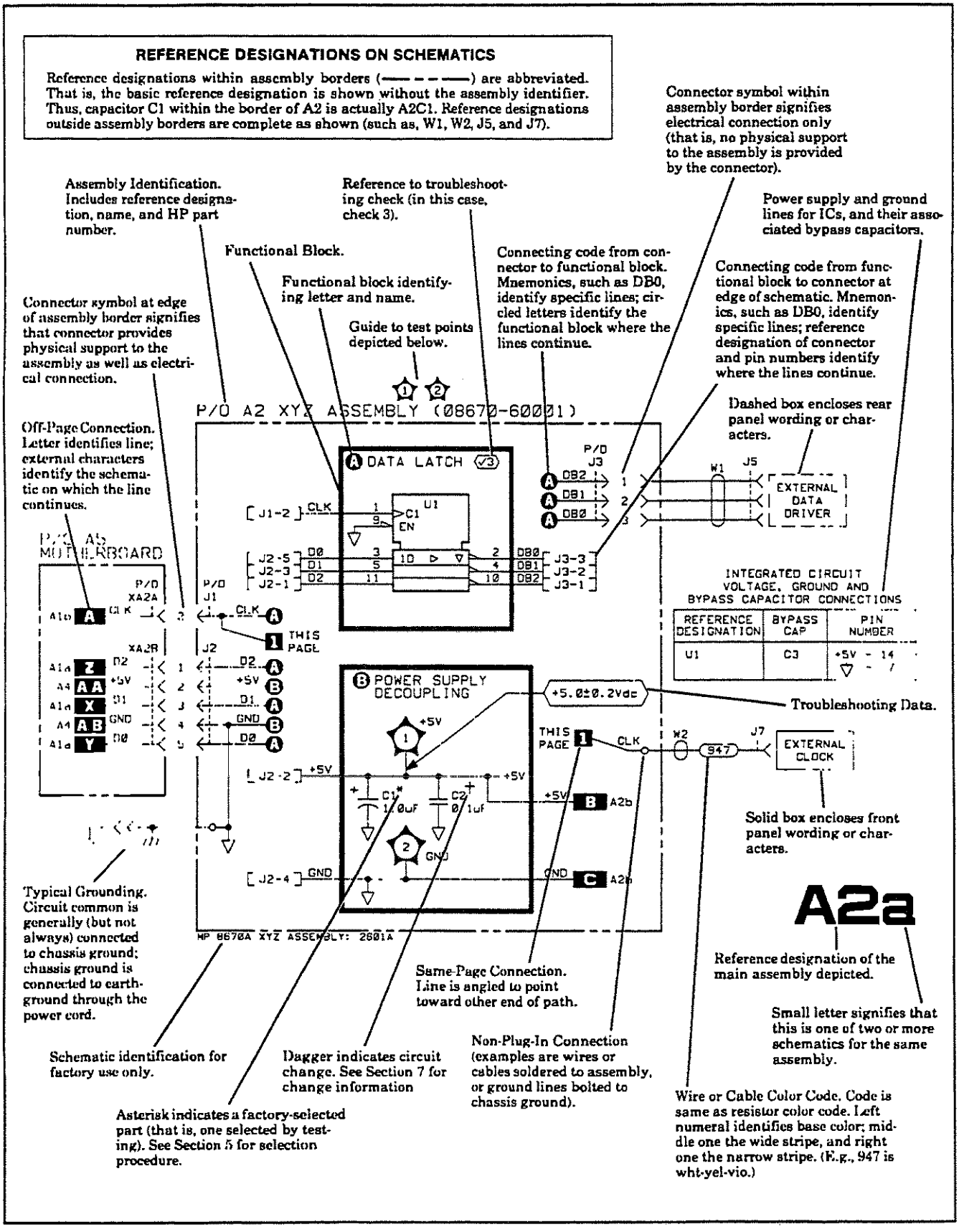
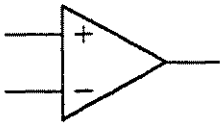


Table 8-2. Schematic Diagram Notes (2 of 2)

SCHEMATIC DIAGRAM NOTES



Operational Amplifier

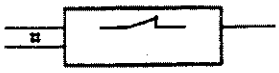
Highpass Filter

Bandpass Filter

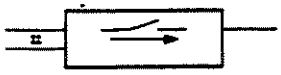
Lowpass Filter

Notch Filter

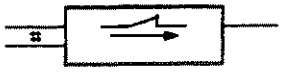
Bidirectional Analog Switch (Make). An analog signal can pass in either direction as long as the digital signal (#) is active. (The switch is shown in its inactive state.)



Bidirectional Analog Switch (Break). An analog signal will be blocked (that is, the switch is opened) when the digital signal (#) is active. (The switch is shown in its inactive state.)



Unidirectional Analog Switch (Make). An analog signal can pass only when the digital signal (#) is active. (The switch is shown in its inactive state.) The analog signal can pass only in the direction of the arrow.



Unidirectional Analog Switch (Break). An analog signal will be blocked (that is, the switch is opened) when the digital signal (#) is active. (The switch is shown in its inactive state.) When the signal flows, it flows only in the direction of the arrow.

Table 8-3. General Qualifying Symbols

Symbol	Description	Example
&	AND gate or function.	SN7400
≥1	OR gate or function. The symbol was chosen to indicate that at least one active input is needed to activate the output.	SN7402
=1	Exclusive OR. One and only one input must be active to activate the output.	SN7486
=	Logic identity. All inputs must stand at same state.	SN74180
2k	An even number of inputs must be active.	SN74180
2k + 1	An odd number of inputs must be active.	SN74ALS86
1	The output stands at its 1-state if and only if the input stands at its 1-state.	SN7404
> or <	Greater than or less than input of a magnitude comparator.	SN7485
▷ or ◁	A buffer or element with more than usual output capability (symbol is oriented in the direction of signal flow).	SN7406
	Schmitt trigger; element with hysteresis.	SN74LS18
X/Y	Coder, code converter (DEC/BCD, BIN/OUT, BIN/7-SEG, etc).	SN74LS347
MUX	Multiplexer/data selector.	SN74150
DMUX or DX	Demultiplexer.	SN74138
Σ	Adder.	SN74LS385
P–Q	Subtracter.	SN74LS385
CPG	Look-ahead carry generator.	SN74182
π	Multiplier.	SN74LS384
COMP	Magnitude comparator.	SN74LS682
ALU	Arithmetic logic unit.	SN74LS381
	Retriggerable monostable.	SN74LS422
1 	Nonretriggerable monostable (one-shot).	SN74121
G 	Astable element. Showing waveform is optional.	SN74LS320
!G 	Synchronously starting astable.	SN74LS624
G! 	Astable element that stops with a completed pulse.	•

[1]Portions of this logic symbology summary are from "1981 Supplement to the TTL Data Book for Design Engineers". copyright © 1981 Texas Instruments Incorporated. Reproduced by permission.

Table 8-4. Summary of Dependency Notation

Type of Dependency	Letter Symbol*	Affecting Input At Its 1-State	Affecting Input At Its 0-State
Address	A	Permits action (address selected).	Prevents action (address not selected).
Control	C	Permits action.	Prevents action.
Enable	EN	Permits action.	1. Prevents action of affected inputs. 2. Imposes external high-impedance state on open-circuit and 3-state outputs (internal state of 3-state output is unaffected). 3. Imposes high-impedance L-level on passive-pulldown outputs and high-impedance H-level on passive pullup outputs. 4. Imposes 0-state on other outputs.
AND	G	Permits action.	Imposes 0 state.
Mode	M	Permits action (mode selected).	Prevents action (mode not selected).
Negate	N	Complements state.	No effect.
RESET	R	Affected output reacts as it would to S = 0, R = 1.	No effect.
SET	S	Affected output reacts as it would to S = 1, R = 0.	No effect.
OR	V	Imposes 1 state.	Permits action.
Transmission	X	Transmission path established.	Transmission path not established.
Interconnection	Z	Imposes 1 state.	Imposes 0 state.

*These letter symbols appear at the AFFECTING input or output and are followed by a number. Each input or output AFFECTED by that input is labeled with that same number. When the labels EN, R, and S appear at inputs without the following numbers, the descriptions above do not apply. The action of these inputs is described under "Symbols Inside the Outline".

Service Sheet BD1 Overall Troubleshooting

Principles of Operation

The HP 8971C Noise Figure Test Set is an integral part of the HP 8970S/U Noise Figure Test System (see figure 8-1). The HP 8971C extends the frequency range of the HP 8970B Noise Figure Meter to 26.5 GHz. If the signal under test is above the Noise Figure Meter's high frequency limit of 1600 MHz, the Test Set down-converts the signal to an intermediate frequency (IF). The IF signal has noise characteristics virtually identical to the test signal, and is routed to the HP 8970B for noise figure measurement. The particular IF chosen by the Test Set is dependent upon the measurement mode.

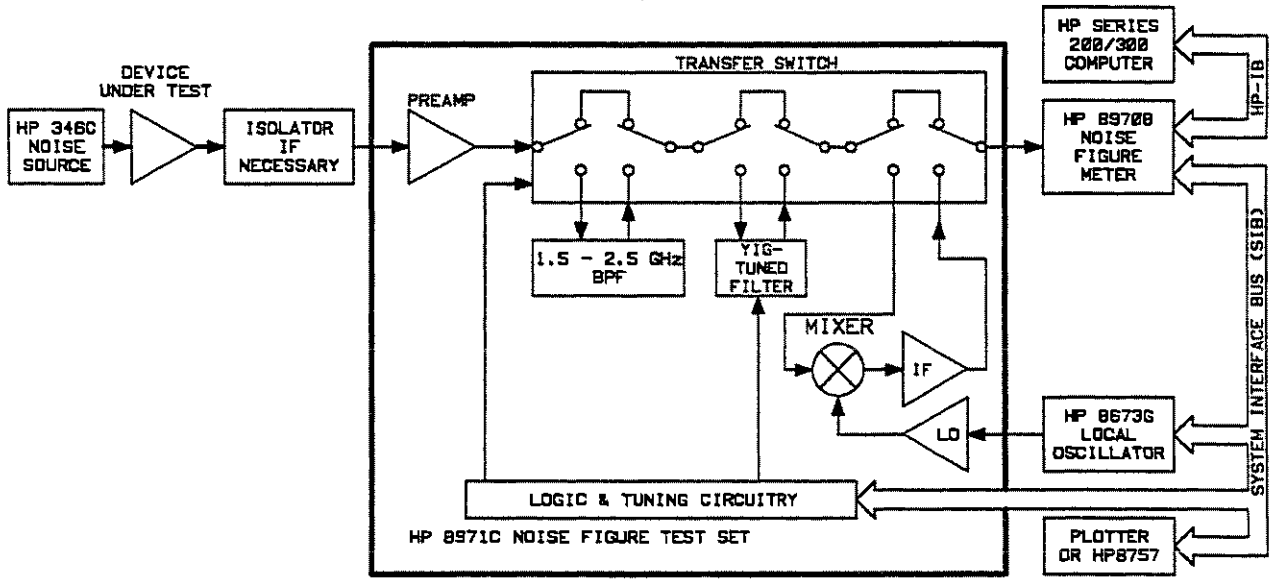


Figure 8-1. HP 8970S/U Noise Figure Test System

The HP 8971C has four modes of operation:

Band 1	SSB1	10–1600 MHz	
Band 2	SSB2	1601–2400 MHz	700 MHz IF
Band 3	SSB3	2401–26500 MHz	450 MHz IF
Band 4	DSB	2401–26500 MHz	25 MHz IF

The mnemonics SSB1, SSB2, SSB3, and DSB are the markings on the front panel annunciators, and indicate single-sideband or double-sideband measurement. The intermediate frequencies listed

above are the default conditions chosen by the HP 8970B Noise Figure Meter.

In band 1 the RF input signal is within the frequency range of the HP 8970B, and the signal is routed directly to the IF output connector, then to the HP 8970B for noise figure measurement.

For bands 2, 3, and 4 an external local oscillator (LO) is required. In these bands the RF input signal is mixed with the LO, and the resulting IF signal is routed to the IF output connector, then to the HP 8970B for noise figure measurement.

Front panel annunciators indicate the band selected (SSB1, SSB2, SSB3, and DSB), and the HP-IB status (Remote, Talk, Listen, and SRQ). Front panel annunciators also indicate instrument error conditions that occur during power-up. More discussion of error codes can be found later in this section.

A YIG tuned filter (YTF) is used for the Band 3 measurements (single sideband, RF range 2401–26500 MHz, 450 MHz IF). A temperature regulating circuit maintains YIG accuracy, keeping the YIG filter at a stable temperature approximately 16°C above ambient by heating or cooling the heatsink upon which the YIG is mounted.

Troubleshooting

General

If the instrument is not operating properly, the following BD1 Overall Level Procedures can be used to isolate the malfunction to one of the major functional assemblies. Once you have isolated the faulty board, refer to the appropriate Service Sheet (A1-microwave deck, A2-microprocessor, or A3-microprocessor interface/switch driver/power supply) to isolate the problem to the defective component within the board assembly.

Once the defective component has been replaced, run the Overall Level Procedures again to check for other possible defects.

When the Overall Level Procedures can be run with no failures, run the 8971C Performance Tests contained in Chapter 4 of the Operating Manual.

Overall Level Procedures

The Overall Level Procedures consist of the following:

1. Power Supply Check
2. Turn-On Check
3. Self-Test Checks
4. HP-IB Control Check
5. Microwave Operation Check

These checks should be run in sequence as each step assumes that previous steps have been run with no errors. Also, because of the interrelationship of the various elements of the instrument, it is

difficult to determine which element is at fault without running the checks in order.

Test Equipment

Digital Voltmeter..... HP 3456A
Oscilloscope..... HP 54111D
Noise Figure Meter..... HP 8970B

Check 1. Power Supply Check

1. Remove rear feet and top cover.
2. Remove four screws on microprocessor assembly A2 and swing A2 away from the chassis to gain access to the chassis components.

Warning **Dangerous voltages are present in line module U1 and at the inputs of transformer T1. For more information on safety, refer to Safety Considerations at the beginning of this chapter.**

3. Verify that the fan is running and that the power supply LEDs are lit. If they are not, proceed to Service Sheet A3d.
4. Connect DVM ground to A3TP6 GND. Connect DVM probe to the following points and verify that the power supply voltages and ripple are within specified limits as tabulated below.
5. If the +5.1 Vdc or +20 Vdc voltages are not within limits, adjust applicable supply in accordance with chapter 5 of this manual. If the problem persists, turn to service sheet A3d and continue troubleshooting.

   If the +15 Vdc, -15 Vdc, or +9 Vdc supply voltages are incorrect, continue troubleshooting with service sheet A3d.

   If the +7 Vdc or -5Vdc supply voltages are incorrect, proceed to Service Sheet A1 to troubleshoot assembly A1A5.

Power Supply	Test Point	Voltage (Vdc)	Ripple (Vp-p)
+5.1 Vdc	A3TP1	+ 5.10 ± 0.05	<0.050
+20 Vdc	A3TP2	+20.00 ± 0.10	<0.050
+15 Vdc	A3TP3	+15.00 ± 0.75	<0.050
−15 Vdc	A3TP4	−15.00 ± 0.75	<0.050
+ 9 Vdc	A3TP5	+ 9.00 ± 0.75	<0.050
+ 7 Vdc	A1A5J2 pin 8	+7.00 ±0.75	<0.050
- 5 Vdc	A1A5J2 pin 7	-5.00 ±0.50	<0.050

Check 2. Turn-On Check

1. Set TEST1 and TEST2 switches to 0. These switches are located on the rear panel, above the HP-IB connector.
2. Set the LINE switch to OFF for 5 seconds, then back to ON. The instrument will perform power-up self tests lasting about two seconds.
3. Observe the front panel LEDs. They should all light briefly, then go out, leaving only the SSB1 LED lit. This indicates that the power-up self tests have passed. Proceed as follows:

   If suspected problem is a turn-on error, go to Check 3, "Continuous Self Test Mode" to check for possible intermittent failure.

   If suspected problem is instrument performance out of specification, go to Check 4, "HP-IB Check".
4. If the LEDs fail to light, go to the next step. If the TALK and SRQ LEDs are alternately blinking, it indicates a self test error, proceed to check 3, "Self Test Checks".
5. If none of the front panel LEDs light, but microprocessor board status LEDs A2DS1 and A2DS2 do light, troubleshoot display board A1A1 (service sheet A1) or go to service sheet A3a and troubleshoot display driver A3U34 and address decoder A3U33. A possible problem is display ribbon cable W5.
6. If none of the LEDs light, proceed to Service Sheet A2a.

Check 3. Self Test Checks

The firmware of the HP 8971C includes a series of self tests capable of indicating hardware faults in a large portion of the circuitry that is under microprocessor control. If a fault is found, a self test error code (See Table 8-5) is reported by both the Status LEDs located on the component side of the A2 Board and the front panel annunicators. The reported six digit code is the same for both sets of LEDs, with a "1" representing the ON condition and "0" the OFF condition. The functional relationship for error code reporting is as follows:

Front Panel Annunciator	Status LED (A2 Board)
SSB1	1
SSB2	2
SSB3	3
DSB	4
REMOTE	5
LISTEN	6

The TEST 1 and TEST 2 switches are used to determine when self tests will run and how a self test failure will affect instrument operation. This leads to three modes of operation; Operational Mode, Self Test Mode, and Continuous Self Test Mode.

Operational Mode

This is the normal mode of operation for the HP 8971C. The self tests are run once at turn-on. If an error occurs, the instrument hangs up. In order to get a list of all self test errors, the instrument should be run in Self Test Mode.

1. On the rear panel, set both the TEST1 and TEST2 switches to zero.
2. Cycle the instrument line power off and then on.
3. If any self test errors occur, proceed to the Self Test Mode.

Self Test Mode

In the Self Test Mode, self tests are run once at turn-on. Errors do not cause the instrument to hang up, so this mode is useful for viewing multiple self test errors.

1. Place the HP 8971C in the service position (see figure 8-22).
2. On the rear panel, set TEST2 switch to 1. Set the LINE switch to OFF, wait 5 seconds, then set LINE switch to ON.
3. Observe microprocessor status LEDs DS1 and DS2; these LEDS are located on microprocessor board A2. The LEDs should light briefly, then display the setting of the SA-TEST switch (normally 00000000) for one second.
4. The microprocessor then begins the self tests, pausing after each failed test to display the error code on DS1 and DS2 for 5 seconds. See table 8-5 for continued troubleshooting directions.

Continuous Self Test Mode

The HP 8971C continuously runs self tests in this mode of operation. This is most effective for troubleshooting intermittent failures. Use this mode together with environmental chambers or when using cold spray and/or heat to pinpoint malfunctions.

1. On rear panel, set TEST1 switch to 1 and TEST2 switch to 0.
2. Set HP-IB address to 31 and cycle power off then on.
3. The continuous tests check for fatal errors. As the instrument runs through the self tests it will flash all of the status LEDs on and off every eight seconds. If an error occurs, the HP 8971C will hang up in the error state and display the error code on the microprocessor status LEDs. See Table 8-5 for troubleshooting instructions.

Note Be sure to set the HP 8971C address back to 10, and the TEST1 and TEST2 switches to zero, when testing is complete.

Table 8-5. Error Codes

Status LED 1 2 3 4 5 6	Condition	Troubleshooting Action
0 1 0 0 0 1	Stack RAM failed (A2U19 OR A2U6)	Go to service sheet A2a.
1 1 0 0 0 1	ROM checksum failure (A2U22)	Go to service sheet A2a.
0 0 1 0 0 1	Rest of RAM failed (A2U19)	Go to service sheet A2a.
1 0 1 0 0 1	PIA self test failed (A2U24, A2U6)	Go to service sheet A2b.
0 0 0 1 0 1	A/D failed (A2U25 or ref voltage)	Check for +5.0 ±0.05 Vdc at A3TP7. If okay go to service sheet A2b, otherwise go to service sheet A3c and troubleshoot temperature control reference circuit. Also make sure 2.5 Vdc is present on pin 5 of A2U25.
1 0 0 1 0 1	HP-IB chip failed (A2U20)	Go to service sheet A2b.
0 1 0 1 0 1	Timer chip failed (A2U18, A2U6, A2U5)	Go to service sheet A2b.
0 1 0 0 1 1	YIG coil sensitivity failure	Go to service sheet A3b.
1 1 0 0 1 1	Heater DAC readback failure	Go to service sheet A3a.
0 0 1 0 1 1	Heater DAC sense readback failure	Go to service sheet A3a.
1 0 1 0 1 1	Temp. Ref. DAC readback failure	Go to service sheet A3a.
0 1 1 0 1 1	YIG temperature regulation readback bad	Go to Service Sheet A3c.
1 1 1 0 1 1	The measured input air temperature is too high or too low (unrealistic measurement)	Go to service sheet A3c.
0 0 0 1 1 1	Coarse tuning table checksum bad	HP 8971C requires course peaking. See Special Function 64 in HP 8970B Operating Manual. Note: if 64 does not correct error, replace EEPROM A2U26.

Check 4. HP-IB Control Check

The HP 8971C is intended to be a slave in a system environment and as such receives commands only over the HP-IB. Thus, proper HP-IB operation is essential to instrument operation. This check verifies that the HP 8971C can be operated under external control. If the instrument is suspected of problems involving HP-IB control but passes this test, it is possible that the user's system is not providing the proper HP-IB control commands. If the proper commands are not provided, the HP 8971C may also appear to have poor microwave performance. Therefore, if both the HP-IB and microwave functionality of the HP 8971C have been verified, but the user's

problem persists, his system may be at fault. To test HP-IB control, proceed as follows:

1. Connect an HP-IB cable from the SIB connector of the HP 8970B to the HP-IB connector on the HP 8971C.
2. Cycle the power on both the HP 8970B and the HP 8971C.
3. Preset the HP 8970B:

   Press 0.9 SPECIAL FUNCTION.
4. Disable HP 8970B control of the system LO:

   Press 46.1 SPECIAL FUNCTION.

Note

When testing is completed, 46.0 SPECIAL FUNCTION must be entered to enable the system LO.

5. Disable Fine Tuning Calibration Error:

   Press 36.2 SPECIAL FUNCTION.
6. Activate control of the HP 8971C:

   Press 1.5 SPECIAL FUNCTION.

   If no error code appears in the right display of the HP 8970B, proceed to step 16.

   If E44 appears on the HP 8970B, proceed to step 7.

   If any other error code appears on the HP 8970B, troubleshoot accordingly before continuing.
7. Examine S2 on the HP 8971C rear panel to determine the HP-IB address.

   If it is 10, proceed to step 9.
8. Change the Noise Figure Test Set address in the HP 8970B:

   Press 40.2 SPECIAL FUNCTION. Enter the HP-IB address on the rear panel of the HP 8971C.

   If the error no longer appears on the HP 8970B, proceed to step 16.
9. Set A2SW2 SA-TEST switch to 01000001. This should display on LEDs A2DS1 and A2DS2 the bits that the microprocessor reads from the rear panel.

   If the value on the LEDs is inconsistent with the switch setting on the rear panel, proceed to step 11.
10. Check continuity of the HP-IB lines on the ribbon cable between A2 and A4, and the HP-IB lines on the A4 board (See Service Sheet A4 for a schematic).

    If a bad cable or board is found, replace it and proceed to step 16.

If the continuity checks out ok, replace microprocessor board A2.

Note

When replacing the A2 board, be sure to transfer the settings of the YIG CODE SWITCH (A2SW1) to the replacement board. as this determines the YIG post tuning drift compensation.

11. Inspect the cabling between S2 and A4 and between A4 and A2.

    If no problems are found, proceed to step 13.

12. Correct the problem, then turn on the line power.

    If the reading on LEDs A2DS1 and A2DS2 is now correct, set SA-TEST switch (A2SW2) to 00000000 and return to step 2.

13. Change each of the rear panel switches in succession while watching LEDs A2DS1 and A2DS2 to determine which bits are stuck. Then reset SA-TEST switch A2SW2 to 00000000.

14. Turn off line power and remove the ribbon cable connecting A2 to A4 at the A2 end.

15. Using the DVM check the continuity between the appropriate pins of the cable and ground (See SS A4 for schematic) as the rear panel switches are changed.

    If the continuity is correct for the suspect switches, replace the microprocessor board A2.

Note

When replacing the A2 board, be sure to tranfer the settings of the YIG CODE SWITCH (A2SW1) to the replacement board, as this determines YIG post tuning drift compensation.

16. Press FREQUENCY 2000 ENTER

    The front panel lights on the HP 8971C should indicate SSB2. If they do not, there could be a problem on the microprocessor board. Proceed to Service Sheet A2.

17. Press FREQUENCY 26500 ENTER

    The HP 8971C front panel lights should switch to SSB3. If they do not, proceed to Service Sheet A2.

18. Press 17.1 SPECIAL FUNCTION

    The front panel lights of the HP 8971C should switch to DSB. If they do not, proceed to Service Sheet A2.

19. Press FREQUENCY 10 ENTER

    The front panel lights of the HP 8971C should switch to SSB1. If they do not, proceed to Service Sheet A2.

Check 5. Microwave Operation Check

If instrument performance out of specification is suspected, proceed to Service Sheet A1 to test the microwave signal path.

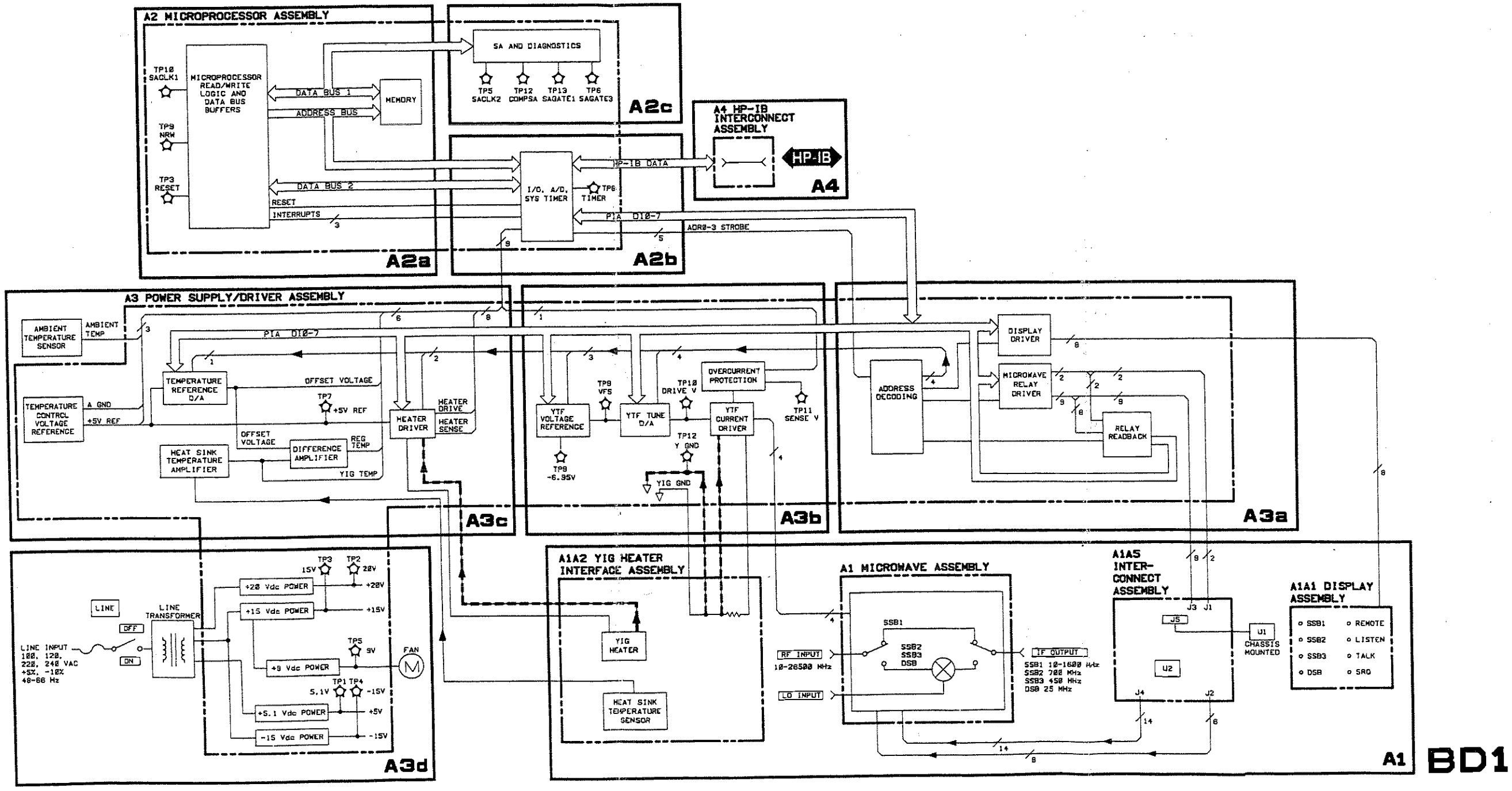


Figure 8-2. Overall Block Diagram

Service Sheet A1

Microwave and Deck Assembly

References

Overall Block Diagram	Service Sheet BD1
Power Supply/Driver	Service Sheet A3D
Disassembly and Reassembly	Service Sheet A
Replaceable Parts List	Chapter 6
Illustrated Parts Breakdowns	Chapter 6

Principles of Operation

General

The input frequency range of the HP 8970B Noise Figure Meter is 10 to 1600 MHz. For frequencies greater than 1600 MHz, the HP 8971C Noise Figure Test Set down-converts the input frequency to an intermediate frequency which the HP 8970B can accommodate. Service Sheet A1 shows the circuitry for down-converting the input signal.

The HP 8971C has four modes of operation as follows:

Band 1	SSB1	10–1600 MHz	
Band 2	SSB2	1601–2400 MHz	700 MHz IF
Band 3	SSB3	2401–26500 MHz	450 MHz IF
Band 4	DSB	2401–26500 MHz	25 MHz IF

SSB1, SSB2, SSB3, and DSB are mnemonics on the front panel annunciators indicating single sideband or double sideband measurement. Band 1 input signals from 10 MHz to 1600 MHz are not down-converted. These frequencies pass through amplifier A1AR2 (except on option 002 instruments) and are routed directly to the IF OUTPUT port by transfer switch A1K1. Band 2 and band 3 input signals from 1601 MHz to 26.5 GHz pass through amplifier A1AR2 (except on option 002 instruments) and are routed by switch A1K1 through one of two bandpass filters, A1FL1 for band 3, or A1FL2 for band 2. The signal then enters the RF port of mixer A1U1 where it is mixed with an external LO (controlled by the HP 8970B) to produce an IF of 700 MHz for band 2 or 450 MHz for band 3. The IF frequency is chosen by the HP 8970B and depends on the measurement frequency and measurement mode selected, as listed above. Band 3 is the default mode for signals from 2401 MHz to 26.5 GHz.

An additional mode, double sideband (Band 4, DSB), bypasses preselector filters A1FL1 or A1FL2. Input signals from 2401 MHz to 26.5 GHz are then switched directly to the RF port of mixer A1U1. The HP 8970B selects an IF of 25 MHz for this measurement mode.

Microwave Deck A1 Configurations

The following table shows the configuration for different 8971C Options:

Model	RF Preamp (A1AR2)	LO Amp (A1AR3)
Standard	Yes	No
Opt 001	Yes	Yes
Opt 002	No	No
Opt 001/002	No	Yes

RF Preamp A1AR2 (Not on Option 002)

Preamp A1AR2 is a broadband amplifier used to improve the noise figure of the preselector-downconverter combination. Because of the high preamp gain (>20dB), the noise power spectrum at the IF output is dominated by the noise generated by the device under test (DUT) and in the preamp itself; the contributions of both the YIG filter (A1FL1) and the mixer (A1U1) become relatively minor. Consequently, the noise figure of the 8971C is closely tied to the noise figure of the preamp. Typical noise figure performance is shown in the following table:

RF Range	Noise Figure
10 - 30 MHz	≤14.8 dB
30 - 100 MHz	≤10.8 dB
0.1 - 18.0 GHz	≤9.0 dB
18.0 - 26.5 GHz	≤12.0 dB

The amplifier is mounted on a thermally regulated plate in order to reduce temperature induced gain variations.

Input Attenuator A1AT4 (Option 002 only)

Input attenuator A1AT4 improves the match between the RF Input of the HP 8971C Noise Figure Test Set and the device under test (and the noise source during calibration). Mismatch errors degrade total measurement accuracy and therefore should be kept to a minimum.

8-Port Switch A1K1

8-port transfer switch A1K1 routes the incoming test signal through the microwave chain. In band SSB1, the switch bypasses both filters and the downconverter and routes the signal directly to the IF output. In band SSB2, the switch routes the signal through fixed frequency bandpass filter A1FL2, then into the downconverter. In band SSB3, the switch routes the signal through tunable YIG filter A1FL1, then into the downconverter. In band DSB, the switch bypasses both filters and routes the signal directly to the downconverter. See Figures 8-3, and 8-4 for details of the signal routing.

A1K1 is mechanically switched by internal solenoids when the appropriate control lines are grounded. The drive for these solenoids is derived from one-shots inside the switch body. In order to minimize power dissipation, current is applied just long enough for the contacts to switch.

Bandpass Filter A1FL2 and Attenuator A1AT2

Bandpass filter A1FL2 rejects image and other spurious signals, preventing them from reaching the RF input of mixer A1U1. Thus, only noise power at the selected frequency (1601 MHz to 2400 MHz) is downconverted to the IF. The filter has 3 dB points of 1500 MHz and 2500 MHz respectively, with mid-band insertion loss of 0.5 dB.

Attenuator A1AT2 matches the output of the bandpass filter to the RF input port of mixer A1U1 and equalizes the noise power at the IF output for the SSB2 band.

YIG Tuned Filter A1FL1 and Attenuator A1AT1

Caution

YIG Tuned Filter A1FL1 is not repairable or replaceable in the field. Do not loosen the screws. Post tuned drift compensation data will be affected. If A1FL1 needs to be replaced contact your nearest Hewlett-Packard sales and service office listed on the inside rear cover of this manual.

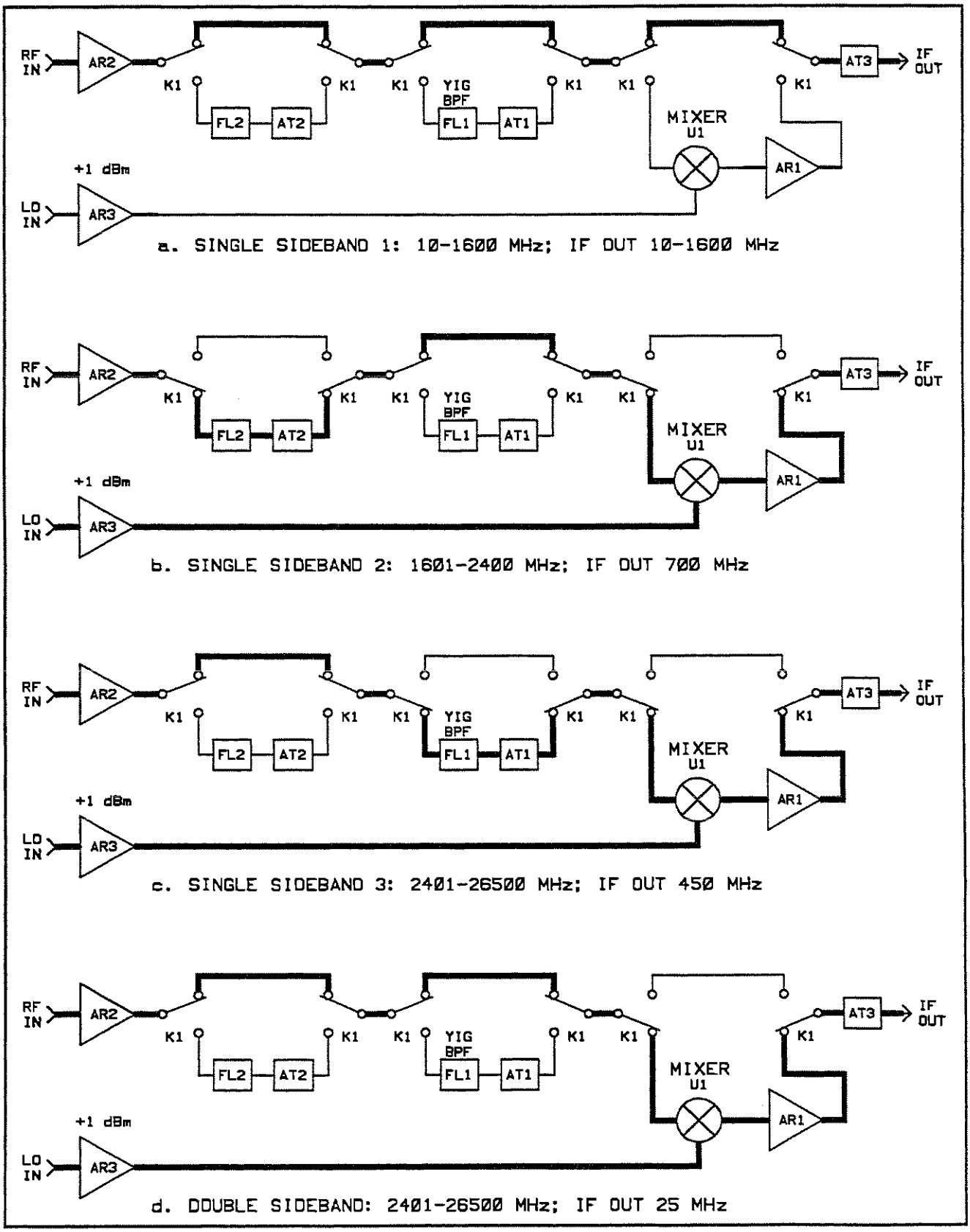


Figure 8-3. Signal Routing for Option 001 Instruments

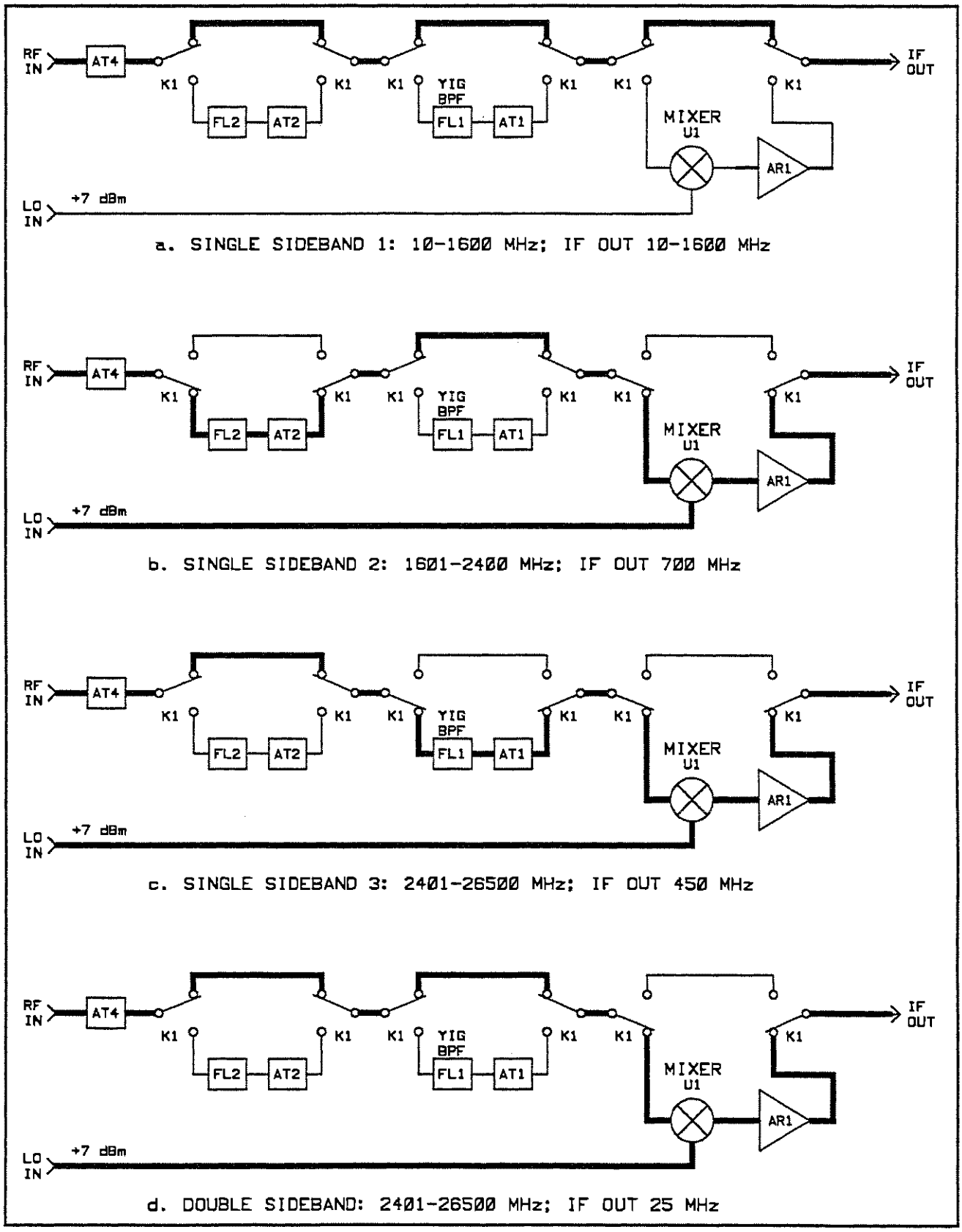


Figure 8-4. Signal Routing for Option 002 Instruments

YIG filter A1FL1 is a broadband tunable preselector with a tuning range from 2401 MHz to 26.5 GHz. Filter tuning current is supplied by the YTF current driver circuits shown on service sheet A3b. Bandwidth varies from 30 MHz to 60 MHz depending on the tuned frequency. Insertion loss is approximately 3 dB. Signals at the tuned frequency of the filter are downconverted to the IF. Signals appearing at the image frequency, as well as the odd harmonics, of the desired response are typically attenuated by over 20 dB.

Attenuator A1AT1 matches the output of the YIG filter to the RF input of mixer A1U1.

Microwave Mixer A1U1

RF signals in bands 2, 3, and 4 enter the R port of mixer A1U1 and are mixed with an external local oscillator. The HP 8970B tunes the external LO through the System Interface Bus to produce the appropriate IF.

The microwave mixer is particularly suited to its application in a noise figure measurement system. The RF port has a broadband response from 1.5–26.5 GHz. The double balanced design rejects even harmonics and AM noise appearing in the local oscillator signal. The local oscillator must meet minimum AM noise standards for use with the HP 8971C Noise Figure Test Set. The following is a list of recommended LOs:

- HP 8671B/8672A Synthesized Signal Generator
- HP 8673B/C/G Synthesized Signal Generator
- HP 8340B/8341B/8350B Sweep Oscillator

The LO power level must be at least +1 dBm at the LO INPUT of the HP 8971C with option 001. For an 8971C without option 001, the LO power level must be at least +7 dBm at the LO input. Inadequate LO power level will result in excessive system noise figure, particularly in band 3 (SSB3). Conversion loss of the mixer is typically:

RF Range (GHz)	IF (MHz)	Loss (Max dB)
1.5 to 2.5	700	10.5
2.4 to 12.0	450	8.5
12.0 to 15.0	450	8.5
15.0 to 18.0	450	10.0
18.0 to 26.5	450	10.5

LO Amplifier A1AR3 (Option 001)

Amplifier A1AR3 boosts the power at the LO input of the 8971C to provide sufficient drive power to mixer A1U1. This makes a high power local oscillator unnecessary. The gain of the LO amplifier is typically 10.5dB from 2.4 - 26.5 GHz. An internal slope network keeps the gain relatively flat over the entire frequency range to avoid overloading mixer A1U1.

IF Amplifier A1AR1

IF amplifier A1AR1 boosts the IF output of the mixer to a level that can be measured by the HP 8970B Noise Figure Meter. Nominal gain is 22 dB. Typical noise figure is 2.5 to 3.5 dB.

IF Output Attenuator A1AT3 (Option 001)

Output attenuator A1AT3 reduces the absolute power level of the noise spectrum emerging from the IF output of the HP 8971C. For noise figure systems consisting of an HP 8970B and an HP 8971C, this prevents the extra gain of preamp A1AR2 from overloading the noise figure meter.

YIG Heater A1A2Q1 & A1A2Q2

An external heater minimizes frequency drift of the YIG filter due to temperature variations. Heater transistors A1A2Q1 and A1A2Q2 are mounted to the heatsink assembly on both sides of the YIG filter. Current supplied by the heater driver circuits shown on service sheet A3c causes the heater transistors to dissipate power into the heatsink on YIG interface assembly A1A2. The temperature regulation circuitry shown on service sheet A3c stabilizes the YIG case temperature at approximately 16°C above the environment (room) temperature and regulates it to within 0.5°C. The circuit requires approximately ten minutes after initial power on to achieve regulation temperature.

YIG Temperature Sensor A1A2U1

Temperature sensor A1A2U1 monitors the temperature of the heat sink directly under the YIG filter. The DC output of the temperature sensor is 10 mV/°C. This DC signal is routed to power supply/driver assembly A3 where it is amplified and compared with a reference voltage. Refer to service sheet A3c for more details concerning temperature control.

Interconnect/Power Distribution Assembly A1A5

Interconnect/Power Distribution Assembly A1A5 performs two major functions. First, it provides an interface between 8-port switch A1K1 and the existing switch drive circuitry. Since the HP 8971B used both a 4-port and a 6-port transfer switch to accomplish what is done with a single 8-port transfer switch in the HP 8971C, various signal lines have been re-routed to alternate connector pins. The

second major function of the board is to regulate the +7 Vdc and the -5 Vdc power supplies that bias preamp A1AR2 and LO amp A1AR3 (if present).

The +7 Vdc supply is used to bias the FET drains in traveling wave amplifiers A1AR2 and A1AR3 (if present). A cable from A1A5J1 to A3J7 brings the +5 Vdc unregulated supply to the A1A5 board. This voltage, typically about +12 Vdc, is regulated by A1A5U1 to produce +7 Vdc. Regulator A1A5U1 is mounted off the board, on the instrument side frame, to improve thermal conductivity. In the event of an overvoltage condition on the regulated output, zener diode A1A5CR3 begins to conduct, triggering SCR A1A5Q1. This blows fuse A3F3 on the power supply board A3 and clamps the overvoltage through diode A1A5CR1.

The -5 Vdc supply is used to bias the gates of the FETs in traveling wave amplifiers A1AR2 and A1AR3 (if present). A cable from A1A5J1 to A3J8 brings the -15 Vdc supply to the A1A5 board. This is regulated to -5 Vdc by A1A5U2. Diode A1A5CR2 provides a discharge path around the regulator should the -15 Vdc overvoltage circuit trigger.

Display Assembly (A1A1)

Display assembly A1A1 consists of two four-segment LEDs and two DIP resistor packages. The resistors pull up the anode of each LED to +5 Vdc. A low voltage on the cathode of any LED segment causes it to illuminate. Eight small holes in the front panel allow the user to view the status.

Microwave Deck A1 Troubleshooting

General

Troubleshooting the microwave deck assembly A1 is indicated when the microwave performance of the instrument is out of specification, or when either the +7 Vdc or the -5 Vdc supply cause fuses to blow on Power Supply Assembly A3. The first of these can be determined by running Performance Tests 4-17 through 4-19 in the HP 8970B/8971B/8971C Operating Manual. The second can be determined using the procedure in Service Sheet A3d. There are three types of troubleshooting for the microwave deck assembly:

Microwave Deck Power Supply Functionality

This check test the functionality of the supplies that bias microwave amplifiers A1AR2 and A1AR3 (if present). It should be performed any time these supplies cause fuses on the A3 power supply assembly to blow. It should also be performed before any microwave component troubleshooting is undertaken since supply problems can affect amplifier performance.

Microwave Functionality

This check is generally used to locate gross (go/no-go) component failures in the microwave chain. The single exception is in the case of YIG filter A1FL1 where this test determines if the component meets specifications. This type of testing is appropriate when performance is drastically out of specification.

Performance Out of Specification

This check is used to identify components that cause instrument performance to be out of specification. The method of testing used in the Out of Specification troubleshooting section is more thorough than the method used in the Microwave Functionality troubleshooting section, but is more time consuming. Therefore, this check should only be used when Microwave Functionality is inappropriate.

Power Supply Troubleshooting

Check 1. General Supply Checks

The test equipment required for these checks is:

Digital Voltmeter	HP 3456A
Oscilloscope	HP 54111D

1. If a fuse on the A3 Power Supply Board has blown due to either the +7 Vdc or the -5 Vdc supply, proceed to the check for the corresponding supply.
2. Connect the DVM low and the oscilloscope ground to pin 2 of A1A5J2.
3. Measure each of the regulated supply voltages. If any are out of tolerance, proceed to troubleshoot the corresponding circuits. The +15 Vdc troubleshooting procedure is on Service Sheet A3d.

Supply	Measure	Output Voltage	Ripple
+7Vdc	A1A5J2 pin 8	+7.00 ±0.75 Vdc	<0.05 Vp-p
-5Vdc	A1A5J2 pin 7	-5.00 ±0.50 Vdc	<0.05 Vp-p
+15 Vdc	A1A5J2 pin 1	+15.00 ±0.75 Vdc	<0.05 Vp-p

Check 2. +7 Vdc Supply

1. If fuse A3F3 is blown, proceed to step 6.
2. Measure the voltage at A1A5J1 pin 1.

   If the voltage is less than 10.5 or greater than 15.5 Vdc, or if there is more than 1.5 Vp-p of ripple, troubleshoot the +5.1 Vdc supply as described in Service Sheet A3d.

3. Turn line power off and unplug the power distribution cable from A1A5J2. This protects traveling wave amplifiers A1AR2 and A1AR3 from any voltages that may be out of specification.

4. Turn line power on and measure the voltage across A1A5R1.

   If it is not 1.25 ±0.05 Vdc, remove power, replace regulator A1A5U1 (mounted on side wall of the instrument), and remeasure. If the voltage at A1A5J2 pin 8 is now within tolerance (+7.00 ±0.75 Vdc), proceed to step 13.

5. Turn line power off, then remove the cable that attaches regulator A1A5U1 to A1A5J5. Measure the resistance of A1A5R1 and A1A5R2. Replace any faulty components. Reconnect regulator A1A5U1, turn on power, and verify that the voltage at A1A5J2 pin 8 is within specifications. Proceed to step 13.

6. Turn line power off, unplug the power distribution cable from A1A5J2 and replace fuse A3F3.

7. Turn line power on.

   If fuse A3F3 blows, proceed to step 10.

   If fuse A3F3 does not blow, then there was probably a short on the load side of the power distribution cable. If the instrument lacks either preamp A1AR2 or LO amp A1AR3, look for potential shorts between the microwave deck and unattached plugs. (Keep in mind that the short may have been temporary.) Add additional insulation if necessary. If a short was found and fixed, proceed to sep 13.

8. Either A1AR2 or A1AR3 may have a short. The problem amplifier can be isolated by powering up each amplifier separately. Turn off line power and reconnect the power distribution cable to A1A5J2. Remove the plugs from the amplifier ends being careful not to inadvertently short the conductors to ground. Check each amplifier by plugging it in, turning on line power and looking for blown fuses. Always make sure the power is off before plugging or unplugging the power distribution cable into an amplifier. If a shorted amplifier is found, replace it and proceed to step 13.

9. If neither amplifier is completely shorted, the fuse may have blown due to excessive current. Turn line power off and unplug the power distribution cables from both amplifiers (if present). Unplug the cable connecting A3J7 to A1A5J1 at the A3J7 end. Insert an ammeter between A3J7 and A1A5J1 pin 1. Check each amplifier by plugging it in, turning on line power, and measuring the current on the ammeter. (Always make sure the power is off before plugging or unplugging the power distribution cable into an amplifier.) If the current readings are out of the range specified below, replace the amplifier and proceed to step 13.

Amplifier	Current
A1AR2 (Preamp)	≤325 mA
A1AR3 (LO Amp)	≤500 mA

10. Turn line power off. Unplug the cable connecting A3J7 to A1A5J1 and the cable between A1A5U1 and A1A5J5. Unsolder one end of A1A5CR1, and measure the resistance from A1A5J1 pin 1 to ground.

    If the resistance is less than 100 ohms, replace SCR A1A5Q1 and proceed to step 13.

11. Measure the reverse resistance of A1A5CR1 using the 10K ohm range.

    If this does not cause an over range condition, replace A1A5CR1 and proceed to step 13.

12. Replace fuse A3F3, resolder A1A5CR1 and plug the cable from A1A5U1 back into A1A5J5. Unsolder A1A5CR3, then turn on line power. Measure the voltage at A1A5J2 pin 8.

    If the voltage is +7.00 ±0.75 Vdc, replace zener diode A1A5CR3.

    If the voltage is not +7.00 ±0.75 Vdc, then there is a fault in the regulator circuitry that has caused the overvoltage protection to blow a fuse. Run through steps 4 and 5 to identify the problem.

13. Turn off line power, resolder any components and reconnect cables that may have been removed, replace any blown fuses, and return to Check 1.

Check 2. -5 Vdc Supply

1. If fuse A3F7 has blown, proceed to step 5.
2. Turn line power off and unplug the power distribution cable from A1A5J2. This protects traveling wave amplifiers A1AR2 and A1AR3 from any voltages that may be out of tolerance.
3. Turn line power on and measure the voltage across A1A5R3.

   If it is not 1.25 ±0.05 Vdc, replace regulator A1A5U2 and remeasure. If the voltage at A1A5J2 pin 7 is now within specification (-5.00 ±0.05 Vdc), proceed to step 10.

4. Turn line power off and unsolder the lead of A1A5R3 connected to regulator A1A5U2. Measure the resistance of A1A5R3 and A1A5R4. Replace any faulty components. Resolder A1A5R3, turn line power on, and verify that the voltage at A1A5J2 pin 7 is within specification. Proceed to step 10.
5. Turn line power off, unplug the power distribution cable from A1A5J2, and replace fuse A3F7.
6. Turn line power on.

If fuse A3F7 blows, proceed to step 8.

If fuse A3F7 does not blow, then there was probably a short on the load side of the power distribution cable. If the instrument lacks either preamp A1AR2 or LO amp A1AR3, look for potential shorts between the microwave deck and unattached plugs. Keep in mind that the short may have been temporary. Add additional insulation if necessary. If a short was found and fixed, proceed to step 10.

7. Either A1AR2 or A1AR3 may have a short. The problem amplifier can be isolated by powering up each amplifier separately. Turn off line power and reconnect the power distribution cable to A1A5J2. Remove the plugs from the amplifier ends being careful not to inadvertently short the conductors to ground. Check each amplifier by plugging it in, turning line power on, and looking for blown fuses. Always make sure the power is off before plugging or unplugging the power distribution cable into an amplifier. Replace the shorted amplifier and proceed to step 10.
8. Turn off line power and unplug the cable connecting A3J8 to A1A5J1. Unsolder one end of A1A5CR2. Measure the reverse resistance using the 10Kohm range of the DVM.

   If this does not cause an over range condition, replace A1A5CR2 and proceed to step 10.
9. Remove A1A5C2 and measure its resistance.

   If the capacitor is shorted, replace it.

   Otherwise, replace A1A5U2.
10. Turn off line power, resolder any components and reconnect cables that may have been removed, replace any blown fuses, and return to Check 1.

Note

The following tests assume the instrument has passed all tests on Service Sheet BD1.

Microwave Functionality Troubleshooting

General

The microwave performance of the HP 8971C can be evaluated by tracing continuous wave (CW) test signals through the microwave chain. With the knowledge of typical component gains/losses, one can quickly locate faults. This method is useful for verifying functionality and for locating problem components, but since it is based upon gain only (and not noise figure), the procedures in the Out of Specification Troubleshooting section may have to be used for final component verification. In general, however, abnormally high noise figure is associated with abnormally low gain.

Figures 8-3 (option 001) and 8-4 (option 002) detail the switch routing and active components for each band of operation. If, at this time, no particular component is suspected, proceed to Check 1. If YIG filter A1FL1 is suspected, go to Check 2. If LO amplifier A1AR3 is suspected, proceed to Check 3. If any other component is suspected, go to Check 1.

Test equipment required to perform the tests in this section include:

Noise Figure Meter	HP 8970B
Signal Generator	HP 8340B
Local Oscillator	HP 8673B with Opt 008
Power Meter	HP 436A
Power Sensor	HP 8485A
Spectrum Analyzer	HP 8566B

Check 1. Microwave Chain (Excluding YIG Filter A1FL1)

1. Connect the SIB of the HP 8970B to the HP-IB connectors of both the HP 8971C and the System LO. Make sure that the HP-IB code switch on the rear panel of the HP 8971C is set to 10.
2. Connect the RF output of the system local oscillator to the LO input of the HP 8971C.
3. Preset all special functions by pressing 0.9 SPECIAL FUNCTION.
4. Select an HP 8673B as the system LO by pressing 41.3 SPECIAL FUNCTION. (See the pull out card on the HP 8970B if another type of LO is being used.)
5. If the HP 8971C is an option 001 or option 001/002 instrument, reduce the LO drive power to +1 dBm by pressing 42.5 SPECIAL FUNCTION and 1 ENTER.
6. Disable the Fine Tune Calibration Needed error (E28) by pressing 36.2 SPECIAL FUNCTION.
7. Activate the HP 8971C by pressing 1.5 SPECIAL FUNCTION.
8. Set the RF output level of the CW test signal generator (HP 8340B) as shown in the table below, then connect the RF OUTPUT of the signal generator to the RF INPUT of the HP 8971C.

HP 8971C Option Type	Test Signal Output Level
Standard	-35 dBm
Option 001	-35 dBm
Option 002	-10 dBm
Option 001/002	-10 dBm

9. The following resources are available for troubleshooting:

   A table of Band Selection Procedures that give instructions for setting the active band on the HP 8971C.

   Figures 8-3 and 8-4, at the beginning of this section, that detail the switch routing and active components in each band.

   A table of Microwave Component Gains that lists the typical gain of each component in the signal path.

10. Troubleshooting proceeds as follows:

    Use the Band Selection Procedures to activate the band suspected of malfunctioning. If a particular frequency is suspect, choose that frequency.

    Set the CW Signal Generator to the same frequency that is used to select the band.

    Use a power meter to check the power levels along the signal path (for all components except mixer A1U1. For mixer A1U1 use the spectrum analyzer tuned to the active IF frequency. This avoids errors due to LO feedthrough. If any of the readings are inconsistent with the gain values listed, determine the extent to which the component is out of specification. Replace the component if loss is excessive. Otherwise, troubleshoot it using the procedures in the Out of Specification Troubleshooting section.

Note 

Whenever working inside the instrument with the power on use ESD precautions and be careful not to short any conductors together or to ground. This applies to the power connectors on A1AR1 and any of the components on top of amplifiers A1AR2 and A1AR3 (especially to the sockets that contact the pins on the microcircuit below).

Band	Band Selection Procedures
SSB1	Press FREQUENCY xxx ENTER where xxx is 10 to 1600 MHz
SSB2	Press FREQUENCY xxx ENTER where xxx is 1601 to 2400 MHz
SSB3	a. Press FREQUENCY xxx ENTER where xxx is 2401 to 26500 MHz b. Press 17.0 SPECIAL FUNCTION c. Components unique to SSB3 are tested in Check 2
DSB	a. Press FREQUENCY xxx ENTER where xxx is 2401 to 26500 MHz b. Press 17.1 SPECIAL FUNCTION

Component	Typical Gain	Comments
A1AR1	22 dB	
A1AR2	21 dB	
A1AR3	10.5 dB	
A1AT1	-3 dB	Measured in Check 2.
A1AT2	-7 dB	
A1AT3	-6 dB	
A1AT4	-3 dB	
A1FL1	-3 dB	Measured in Check 2.
A1FL2	-0.5 dB	
A1K1	-0.5 dB	Average mid-frequency loss Loss is higher at high frequencies If the switch loss is excessive, follow the procedures in Service Sheet A3a to verify the proper control signals are present.
A1U1	-10.5 dB	If loss of A1U1 is excessive, make sure that sufficient LO drive is applied. Check LO amplifier A1AR3 as described in Check 3.
Cabling	-0.5 dB	Average Dependent on frequency and length

Check 2. YIG Filter A1FL1, Including Attenuator A1AT1

The following procedure tests for noise figure and gain problems in SSB3 due to insertion loss in the YIG tuned filter A1FL1. Problems with YIG filter A1FL1 should occur only in band 3. First, however, use service sheet A3c to verify the YIG drive signals and heater control.

Caution

YIG Tuned Filter A1FL1 is not field repairable, or replaceable. Do not loosen the screws. Post tuned drift compensation data will be affected.If A1FL1 needs to be replaced contact your nearest Hewlett-Packard sales and service office listed on the inside rear cover of this manual.

1. Turn off power.
2. Connect equipment as follows:
   a. RF OUTPUT of signal generator to RF INPUT of HP 8971C
   b. IF OUTPUT of HP 8971C to RF INPUT of HP 8970B
   c. LO INPUT of HP 8971C to output of local oscillator
3. Turn on power.
4. Press PRESET on HP 8970B Noise Figure Meter.
5. Press 80 SPECIAL FUNCTION to put HP 8970B in voltmeter mode and turn noise source off.
6. Press 1.5 SPECIAL FUNCTION.
7. Press FREQUENCY 2401, or frequency of interest, then ENTER.
8. Tune the frequency of the input signal until a peak is obtained.
9. Press 17.1 SPECIAL FUNCTION to enter band 4 (DSB).
10. Set input signal level to obtain 1.000 volts indication on HP 8970B Noise Figure Meter.
11. Press 17.0 SPECIAL FUNCTION and verify that the voltage indication of the HP 8970B Noise Figure Meter is within the following limits:

Frequency	Voltage	YIG Filter
2.4 to 4.0 GHz	$\geq$0.47 Vdc	3 dB
4.0 to 12 GHz	$\geq$0.50 Vdc	2.5 dB
12 to 22 GHz	$\geq$0.47 Vdc	3 dB
22 to 26.5 GHz	$\geq$0.42 Vdc	4 dB

Note Voltage figures assume a worst-case attenuation of 3.5 dB for A1AT1.

12. If indications are normal, the insertion loss of components in the SSB3 signal path is within specifications. If any indications are out of tolerance, the problem may be:
    a. Attenuator AT1 has attenuation greater than 3.5 dB.
    b. YIG filter insertion loss is out of tolerance.
    c. Relay contact impedance is too high.
    d. High SWR in SSB3 signal path shown in figure 8-3c or 8-4c.

Note If SWR is a problem, the SSB3 test should have failed. If insertion loss is a problem, the SSB3 SWR should be normal and problem d is eliminated.

Check 3. LO Drive Check

1. Connect the local oscillator RF OUTPUT to the LO INPUT of the HP 8971C.
2. If the instrument has an LO amplifier (A1AR3), set the RF output level of the local oscillator to +1 dBm. Otherwise, set the RF output level to +7 dBm. (If the local oscillator has been listening to the HP 8970B system controller, it may be necessary to press the LOCAL key before setting the level.
3. Disconnect semi-rigid cable A1W11 (cable A1W1, if the instrument does not have an LO amplifier) from the mixer A1U1 and attach the power sensor where the mixer would normally be. The cable can be rotated upwards to accommodate the power sensor body.
4. Manually sweep the local oscillator from 2401 MHz to 26.5 GHz. With the proper cal factor applied the power should be greater than or equal to +10.5 dBm at all frequencies for an instrument with an LO amplifier. The power should be greater than or equal to +5.5 dBm at all frequencies for instruments without an LO amplifier.

   If the LO power drops at any frequency, first check all cabling. If the cables are bad, replace them. Otherwise, replace amplifier A1AR3 (if one was present).
5. Reconnect A1W11 (A1W1) to mixer A1U1.

Out of Specification Troubleshooting

General

These troubleshooting procedures should be used if instrument performance is out of specification and if the procedures outlined in the Microwave Functionality Troubleshooting section were either inappropriate or inconclusive.

If SWR is out of specification, proceed directly to Check 4.

If noise figure performance is out of specification, there are two possible causes. Either the components in the microwave signal path fail to meet gain and noise figure specifications, or they are not properly interconnected. This section addresses the first possibility, and the previous section addressed the second.

This method of testing uses the HP 8970B to measure the gain and noise figure of the components in the microwave chain. If a particular component is suspected, perform the instructions in the Setup section, then proceed directly to the corresponding check. Otherwise, begin with Setup and proceed sequentially; the tests are ordered in terms of increasing distance from the HP 8970B. If the tests are performed in this order, all parts of the HP 8971C used in making measurements will have been previously verified.

Note

Whenever working inside the instrument with the power on, use ESD precautions and be careful not to short any conductors together or to ground. This applies to the power connections on A1AR1 and any of the components on top of amplifiers A1AR2 and A1AR3 (especially the sockets that contact the pins on the microcircuit below.

Setup

The following is a list of test equipment required for the following checks:

Noise Figure Meter	HP 8970B
Signal Generator	HP 8673B with Opt 008
Noise Source	HP 346C

1. Connect the SIB of the HP 8970B to the HP-IB connectors of both the HP 8971C and the system LO. Make sure that the HP-IB code switch on the rear panel of the HP 8971C is set to 10.
2. Connect the RF OUTPUT of the system local oscillator to the LO INPUT of the HP 8971C.
3. Connect the IF OUTPUT of the HP 8971C to the RF INPUT of the HP 8970B.
4. Preset all special functions by pressing 0.9 SPECIAL FUNCTION.

5. Select an HP 8673B as the system LO by pressing 41.3 SPECIAL FUNCTION. See the pull-out card on the HP 8970B if another type of LO is being used.
6. If the HP 8971C is an option 001 or an option 001/002, reduce the LO drive power to +1 dBm by pressing 42.5 SPECIAL FUNCTION and 1 ENTER.
7. Disable the Fine Tune Calibration Needed error (E28) by pressing 36.2 SPECIAL FUNCTION.
8. Enter the ENR table for the noise source (Refer to Operating Manual).
9. Increase smoothing to eight by pressing INCREASE three times.
10. Press NOISE FIGURE and GAIN. Ignore any errors.

Check 1. IF Amplifier A1AR1

1. Activate control of the HP 8971C by pressing 1.5 SPECIAL FUNCTION.
2. Switch the HP 8971C to SSB2 by pressing FREQUENCY 1601 ENTER.
3. Disable control of the HP 8971C by pressing 1.0 SPECIAL FUNCTION. This should leave the HP 8971C in band SSB2.
4. If A1AT3 is present, remove it. Semi-rigid cable A1W3 should fit regardless of whether A1AT3 is attached.
5. Press START FREQ 10 ENTER.
6. Press STOP FREQ 700 ENTER.
7. Press STEP SIZE 10 ENTER. (More points can be used if desired.)
8. Connect the noise source to the RF INPUT of the HP 8970B.
9. Press CALIBRATE two times. Wait until calibration routine is completed before proceeding.
10. Remove semi-rigid cable A1W2 from the input of A1AR1.
11. Use a short piece of semi-rigid cable to connect the noise source to the input of A1AR1.
12. Connect the IF OUTPUT of the HP 8971C to the RF INPUT of the HP 8970B.
13. Press SINGLE SWEEP and verify that all noise figure indications are less than 3.5 dB and that all gain indications are greater than 20 dB.

    If any indications are out of specification, replace amplifier A1AR1. This, of course, assumes that the switch and cabling have been checked per the Microwave Functionality Troubleshooting section.

14. Replace semi-rigid cable A1W2 and reinstall attenuator A1AT3 if necessary.

Check 2. Mixer A1U1

1. Activate control of the HP 8971C by pressing 1.5 SPECIAL FUNCTION. Ignore any errors.
2. Switch the HP 8971C to band SSB3 by pressing FREQUENCY 2401 ENTER.
3. Switch the HP 8971C to DSB by pressing 17.1 SPECIAL FUNCTION.
4. Press 1.3 SPECIAL FUNCTION. This will disable the HP 8971C and prepare the HP 8970B for making a mixer measurement.
5. Press START FREQ 2400 ENTER.
6. Press STOP FREQ 26500 ENTER.
7. Press STEP SIZE 500 ENTER. More points can be used if desired.
8. Set the IF frequency to 50 MHz by pressing 3.0 SPECIAL FUNCTION and 50 ENTER. A high double sideband IF is chosen because the AM noise sidebands of the local oscillator are attenuated to an acceptable level at 50 MHz offset. For an 8673B the AM LO noise at 25 MHz offset can mask the desired noise signal.
9. Remove semi-rigid cable A1W2 from mixer A1U1 and connect the noise source where the mixer had been.
10. Press CALIBRATE two times. Wait until the calibration routine is completed before proceeding.
11. Remove the noise source and reconnect A1W2 to mixer A1U1.
12. Remove semi-rigid cable A1W8 (or A1W12 on option 002 instruments) and connect the noise source to the open switch port with a short piece of semi-rigid cable.
13. Press SINGLE SWEEP and verify that all gain indications are greater (less negative) than -11 dB (10.5 dB of mixer conversion loss + 0.5 dB of switch loss). Disregard noise figure indications as they are highly sensitive to AM noise on the local oscillator, especially at low frequencies. In some cases if the noise figure becomes excessive at a particular frequency, the HP 8970B will not give a gain reading. If this occurs, the mixer must be tested at that frequency by the method described in the Microwave Functionality Troubleshooting section (assuming, of course, that the instrument noise figure measured out of spec there). By choosing an IF frequency of 50 MHz, the likelihood of this happening is rather small.

    If any gain indications are out of specification, replace mixer A1U1. This, of course, assumes that the switch and cabling have

been checked. See the Microwave Functionality Troubleshooting section for details.

14. Replace semi-rigid cable A1W8 (or A1W12 on option 002 instruments).

Check 3. RF Preamp A1AR2 (Not on option 002)

1. Activate control of the HP 8971C by pressing 1.5 SPECIAL FUNCTION.
2. Set up for double sideband measurements by pressing 17.1 SPECIAL FUNCTION.
3. Press START FREQ 10 ENTER.
4. Press STOP FREQ 26500 ENTER.
5. Press STEP SIZE 500 ENTER (more points can be used if desired).
6. Disconnect semi-rigid cable A1W8 from preamp A1AR2 and connect the noise source where the amplifier had been.
7. Press CALIBRATE two times. Wait until the calibration routine is completed before proceeding.
8. Remove the noise source and reconnect A1W8.
9. Connect the noise source to the RF INPUT of the HP 8971C.
10. Press SINGLE SWEEP and verify that the amplifier performance is within specifications.

    If any indications are out of specification, replace amplifier A1AR2. This, of course, assumes that the input connector and A1W9 have been checked per the Microwave Functionality Troubleshooting section.

RF Range	Gain	Noise Figure
10 - 30 MHz	$\geq$20.5 dB	$\leq$14.8 dB
30 - 100 MHz	$\geq$20.5 dB	$\leq$10.8 dB
0.1 - 18.0 GHz	$\geq$20.5 dB	$\leq$9.0 dB
18.0 - 26.5 GHz	$\geq$20.5 dB	$\leq$12.0 dB

Check 4. Input SWR

Perform the input SWR Performance Test 4-17 in the HP 8970B/8971B/8971C Operating Manual. Failure to pass this test can be caused by damaged connectors, loose connections, and defective components. Note that the IF OUTPUT of the HP 8971C must be terminated in 50 ohms. There are several factors that can contribute to poor SWR performance. The importance of each depends on the instrument option.

For instruments without RF preamp A1AR2 the most likely causes are impedance mismatches at the input or the output, or defective contacts in switch A1K1. In SSB3, if the YIG filter A1FL1 is improperly tuned, the Input SWR Performance Test will fail. Improper tuning can be caused by a defective YIG, incorrect tuning calibration data, or faults in the YIG tuning circuitry.

For instrument with preamp A1AR2, the low frequency (below 13 GHz) input SWR is dominated by the match of the amplifier itself. At higher frequencies, the reverse isolation of A1AR2 degrades slightly, making the match of components following the amplifier marginally more important. In this case, these are the same factors that affect instruments without a preamp. Hence, SWR problems can usually be fixed by concentrating on the preamp and the connectors leading up to its input.

Figures 8-3 and 8-4 identify the signal paths for each band. Make sure that the connectors are properly tightened and that the front panel connectors are not damaged.

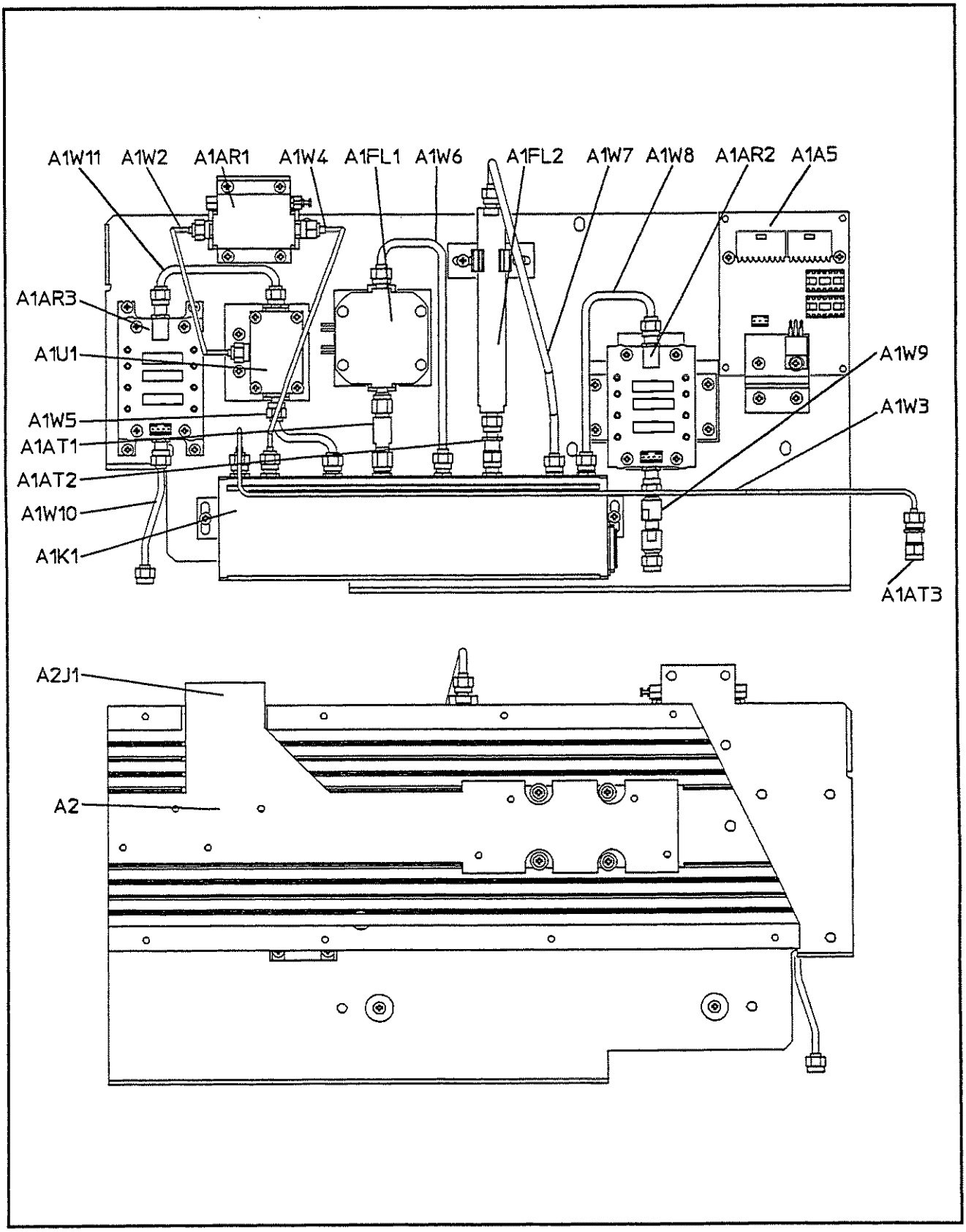


Figure 8-5. Option 001 Microwave Deck Assembly Component Locations — Top and Bottom

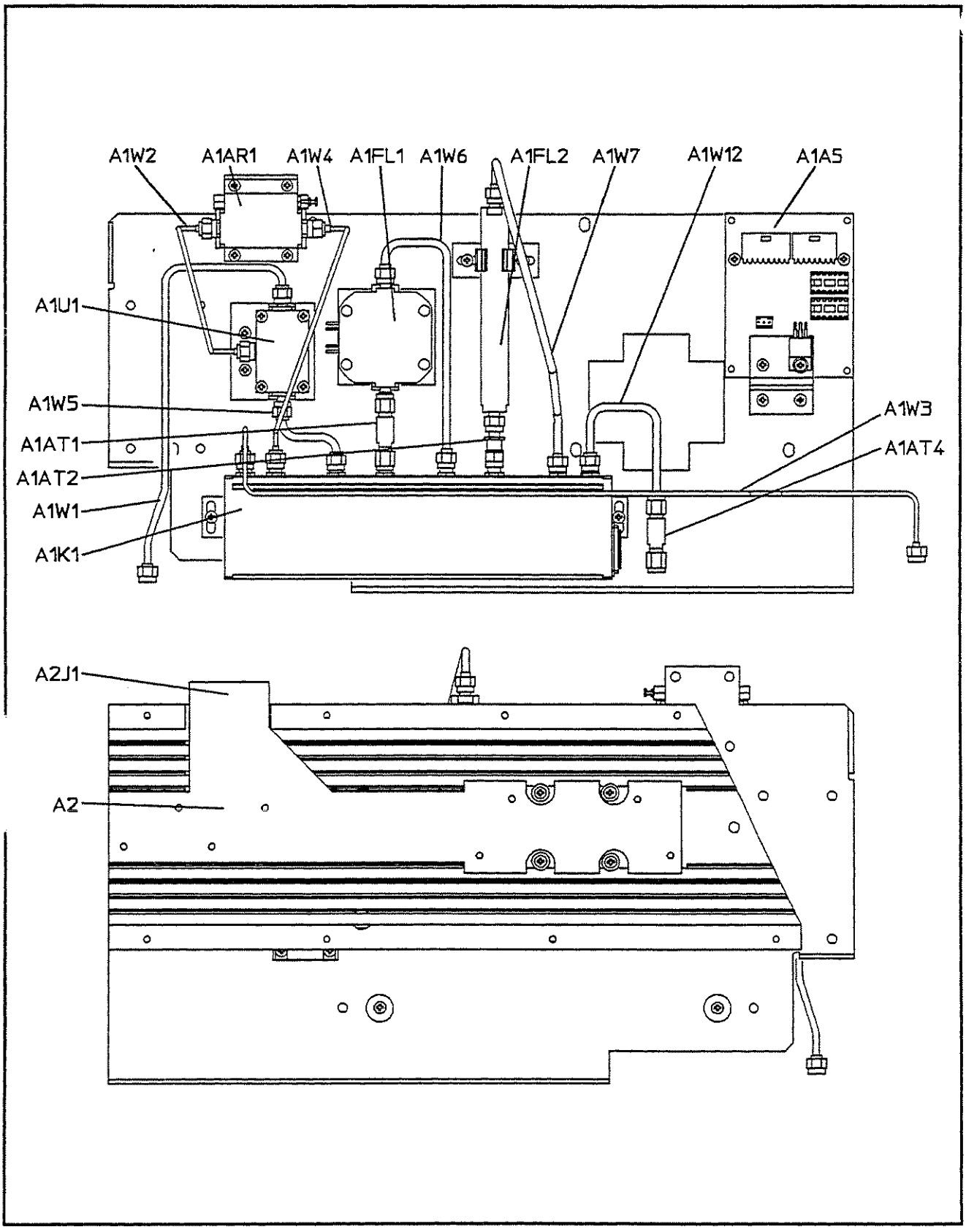
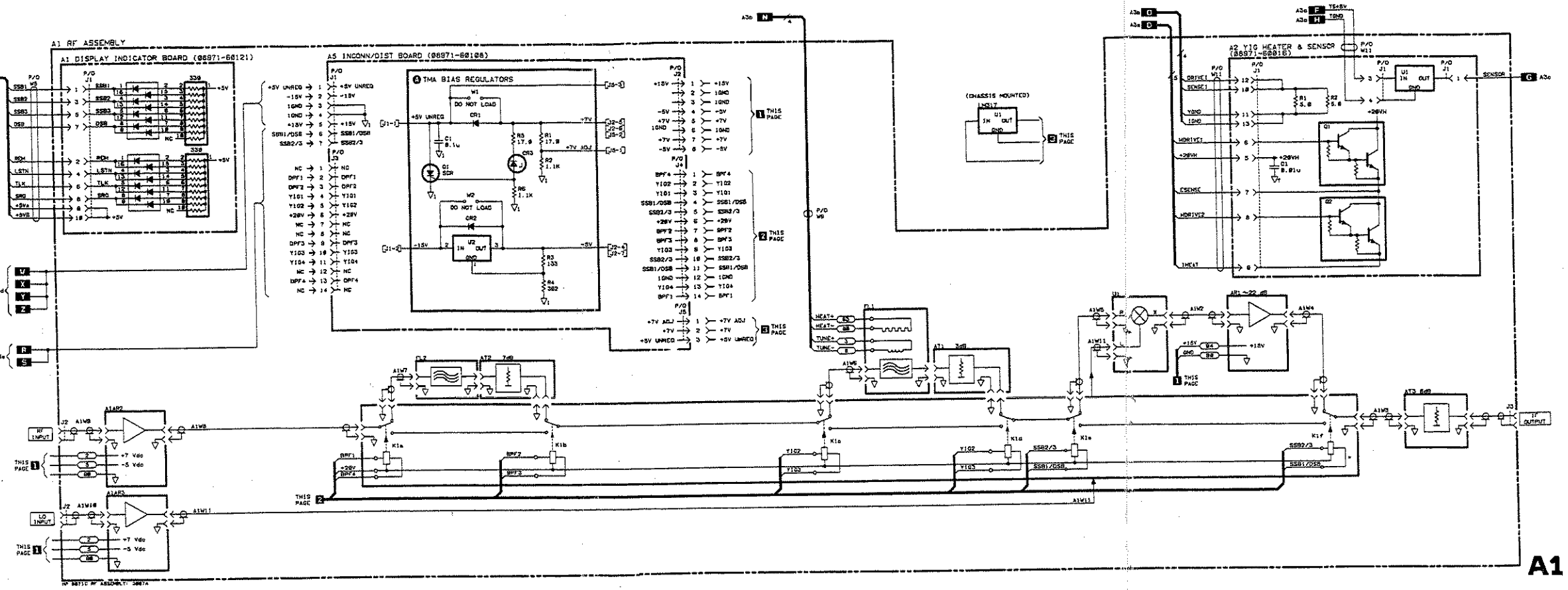


Figure 8-6. Option 002 Microwave Deck Assembly Component Locations — Top and Bottom



A1

Figure 8-7. Microwave Deck Assembly Schematic Diagram
8-49/8-50

Service Sheet A2a

Microprocessor Memory, Data, and Address Buses

References

Overall Block Diagram	Service Sheet BD1
Disassembly and Reassembly	Service Sheet A
Replaceable Parts List	Chapter 6
Illustrated Parts Breakdowns	Chapter 6
Adjustment Procedure	Chapter 5

Principles of Operation

General

The circuits shown on service sheet A2A provide the timing, calculation, and control of the HP 8971C Noise Figure Test Set. The microprocessor executes the instructions stored in ROM (Read Only Memory). Data is exchanged between the microprocessor and other circuits via one of two data buses (BD0–BD7) or (B2D0–B2D7). Circuits are enabled to respond to data on the data buses by negative true control signals. These control signals are derived from the address bus by the memory and I/O decoding circuitry. Data that must be stored is placed in RAM (Random Access Memory). Data that must be stored, after the instrument is powered down, is stored in non-volatile electrically erasable programmable read-only memory (EEPROM).

Microprocessor

Microprocessor A2U5 controls the functions of the instrument by executing the instructions stored in ROM A2U22.

Data bus D0–D7 consists of eight bidirectional lines that transfer 8-bit positive-true data to and from the microprocessor. Information on the data bus is buffered as it enters or leaves the microprocessor by data bus buffers A2U9 and A2U12. The output of each buffer forms a new 8-bit bidirectional data bus; DATA BUS 1 BD0–BD7 (A2U12) and DATA BUS 2 B2D0–B2D7 (A2U9). DATA BUS 1 (BD0–BD7) is connected to ROM A2U22, RAM A2U19, and non-volatile EEPROM A2U26. DATA BUS 2 (B2D0–B2D7) connects exclusively with circuits shown on Service Sheet A2b comprising talker/listener A2U20, system timer A2U18, A/D A2U25, and PIA A2U24.

The multiplexed bus structure described above offers two advantages. First, the kernel can be isolated from the rest of the processor circuits for free-run testing. Second, a greater margin is provided for each component's bus loading.

Address bus A0–A15 consists of sixteen unidirectional lines that transfer an address from microprocessor A2U5 to ROM A2U22, RAM A2U19, non-volatile memory A2U26, system timer A2U18, A/D A2U25, peripheral interface adapter A2U24, HP-IB interface A2U20, and address decoder A2U6.

On microprocessor A2U5, non-maskable interrupt (NMI at pin 2), interrupt request (IRQ at pin3), and fast interrupt request (FIRQ at pin 4) are used to interrupt program execution. NMI detects an interrupt from peripheral interface adapter A2U24. IRQ detects an interrupt from system timer A2U18. FIRQ is used by HP-IB interface A2U20 to interrupt microprocessor A2U5.

The active low HALT signal at pin 40 is connected to +5V. Thus, this signal never halts microprocessor A2U5.

A 4 MHz clock from clock generator A2U3 is connected to microprocessor pin 39 (EXTAL). An internal divide-by-four develops the 1 MHz system clock E (pin 34). The XTAL signal line is grounded because external timing is used.

The RESET signal at pin 37 starts microprocessor A2U5 from a power-down condition. When RESET is active (low), the microprocessor is inactive and will execute its restart instruction sequence only after detecting a rising edge, NRESET from A2U4, at pin 37.

The memory ready MRDY signal on pin 36 is connected to +5V to enable the 1 MHz system clock rate and standard microprocessor cycle time.

No direct memory access (DMA) controller is used. Thus, the active low DMA/bus request input (DMA/BREQ at pin 33) to microprocessor A2U5 is connected to +5V.

The read/write signal at pin 32 controls the direction of data transfer on the data bus. When microprocessor A2U5 is available to accept data, read/write is high, indicating that the microprocessor is in the read state. When data is being transferred out onto the data bus, read/write is low, indicating that the microprocessor is in the write state.

Memory (ROM and RAM)

ROM (Read Only Memory) A2U22 and RAM (Random Access Memory) A2U19 provide the memory for microprocessor A2U5. ROM A2U22 stores the program information. RAM A2U19 stores the fine tuning calibration table and other temporary data used during program execution.

Non-Volatile Memory

EEPROM (Electrically Erasable Programmable Read Only Memory) A2U26 stores critical data, coarse tuning calibration table and switch cycle count tables, which must be retained after the HP 8971C is

powered down. No battery back-up is necessary for A2U26, however A2U26 has a specified operating life of 10,000 write cycles; this limitation is not expected to be exceeded during the lifetime of the instrument.

System Clock Generator and Clock Divider

Crystal-controlled oscillator Y1 is the 16 MHz master clock for microprocessor A2U5. The output of Y1 is fed to divide-by-four A2U3. The 4 MHz output of A2U3 is routed to pin 39 (EXTAL) on microprocessor A2U5.

Microprocessor A2U5 has an internal divide-by-four that converts the 4 MHz signal to 1 MHz. This 1 MHz signal on A2U5 pin 34 (E) clocks the Noise Figure Test Set's digital circuitry.

Reset and Power Fail Circuit

A reset and power fail circuit (A2U4 and associated parts) provides system integrity during power-up and power-down. When power is first applied, A2U4 holds the NRESET line low until the +5V supply reaches +4.5V. A2U4 then releases the NRESET line and the microprocessor can initiate the restart sequence. The NRESET signal also connects to system timer A2U18, PIA A2U24, and HP-IB talker/ listener A2U20. NRESET forces these circuits to a known initial condition before the microprocessor initiates the restart sequence.

During power-down or power failure, A2U4 halts program execution and resets system timer A2U18, PIA A2U24, and HP-IB talker/listener A2U20, when the +5V supply drops below +4.5V.

Memory and I/O Decoder

PAL A2U6 decodes address lines A8 through A15 to generate active low select signals for each component connected to the data bus (Bus 1 and Bus 2). These select signals allow only one component to be active on the data bus at any time. A2U6 also controls data bus buffers A2U9 and A2U12 by connecting one of the two data buses to the microprocessor data bus.

Read/Write Logic

The Read/Write logic comprises NAND gates A2U15a, c and d, and inverter A2U11d. Inverted and non-inverted READ/WRITE signals are qualified with system clock E to produce the negative true Read NRD and write enable NWE signals. These signals are required by ROM, RAM and EEPROM.

The read/write logic also generates one of the two signature analysis clocks, SACLK1. NAND gate A2U15a combines system clock E with address line A15 to produce SACLK1.

Data Buffers

Directional data buffers U9 and U12 separate the main microprocessor data bus into two separate positive-true 8-bit data buses. The buffered microprocessor read/write signal provides directional control of data buffer A2U9. The active-low DIR1 signal from PAL A2U6 controls the data direction of data buffer A2U12. PAL A2U6 generates select signals for both A2U9 and A2U12.

Troubleshooting

Troubleshooting the circuits on assembly A2a is indicated if status LEDs A2DS1 and A2DS2 fail to light at turn-on, if a board malfunction is suspected, or if any of the following self tests fail:

Status LEDs 1 2 3 4 5 6	Failure	Component
0 1 0 0 0 1	Stack RAM	A2U19, A2U6
1 1 0 0 0 1	ROM checksum	A2U22
0 0 1 0 0 1	Rest of RAM	A2U19
1 0 1 0 0 1	PIA self test	A2U24, A2U6

If status LEDs fail to light, perform Check 1 and Check 2.

If the board fails a ROM checksum self test (status LEDs will read 110001), perform Check 1 and Check 3.

If the board fails any of the other three self tests, perform Check 1.

If a self test verification or a general health check is desired, Checks 4, 5, 6, and 7 may be performed.

Note

There are several times during the performance of these troubleshooting procedures that replacement of the A2 Microprocessor Assembly is advised. When replacing the A2 board assembly, be sure to transfer the settings of the YIG Code Switch (A2SW1) to the new board, as this determines the YIG post tuning drift compensation.

Test Equipment

Signature Analyzer	HP 5005B
Digital Voltmeter	HP 3456A
Oscilloscope	HP 54111D

Note

These checks assume that all power supplies have been checked according to Service Sheet BD1, Check 1.

Check 1. Power Supply Check

1. Connect the DVM Ground to test point A2TP2 (GND).
2. Verify that voltage at A2TP1 (+5V) is +5.1 ±0.05 Vdc.
3. Using the oscilloscope, verify that ripple is less than 0.05 Vp-p.
4. If the voltage or ripple are not within limits, troubleshoot the decoupling circuits shown on Service Sheet A2a and A2b.
5. If the voltages are correct, and there are no further checks to perform, replace microprocessor assembly A2. Otherwise, proceed to next test.

Check 2. Microprocessor Clock Check

1. Check the E clock signal at A2U5 pin 34. If a 1 MHz signal is present, proceed to step 3.
2. If a 4 MHz signal is present on A2U3 pin 5, proceed to step 3. Otherwise troubleshoot clock generator circuit Y1/U3.
3. If the NRESET line on A2U5 pin 37 is high, change A2U5. Otherwise troubleshoot the NRESET circuit: A2U4 and associated components.
4. If LEDs A2DS1 and A2DS2 do not light after changing A2U5, change EPROM A2U22.
5. If the LEDs still do not light on power-up, and if there are no further checks to perform, replace microprocessor assembly A2.

Check 3. ROM Checksum Failure

1. Replace ROM A2U22.
2. Turn on line power. If the ROM checksum error persists, replace the microprocessor assembly A2.

Check 4. PAL Signature Analysis Check

1. This check determines if PAL A2U6 generates the proper control signals.
2. With line power off, connect the signature analyzer pod to microprocessor assembly A2 test points shown in the following table.

Signal	A2 Test Point	Threshold	Polarity
START	A2TP7 SAGATE2	TTL	falling edge
STOP	A2TP7 SAGATE2	TTL	rising edge
CLOCK	A2U5 PIN 34	TTL	falling edge
DATA		TTL	

3. Enable free-run testing by connecting a wire between A2TP4 (FREE RUN) to A2TP2 (GND).

4. Turn on line power and verify the following signatures on PAL A2U6.

Pin	Signature
15	0125
16	0001
17	CFHH
18	4C77
19	0764
20	0001
21	0001
22	12F5
23	5FU8

If signatures are not correct, replace microprocessor assembly A2.

Check 5. Address Line Signature Analysis Test

1. With the signature analysis pod connected and free run testing enabled as in Check 4, verify address line signatures on ROM A2U22 as shown in following table.

Pin	Signature	Pin	Signature
10	5555	25	2H70
9	CCCC	24	HPP0
8	7F7F	21	1293
7	5H21	23	HAP7
6	OAFA	2	3C96
5	UPFH	26	3827
4	52F8	27	755U
3	HC89		

If the signatures are not correct, replace microprocessor assembly A2.

Turn off line power and remove jumper connecting A2TP4 (FREE RUN) to A2TP2 (GND)

Check 6. RAM Signature Analysis Check

This check determines if RAM A2U19 can be written to and read from.

1. With the power off, connect the signature analyzer timing pod to microprocessor assembly A2 test points shown in the following table.

Signal	A2 Test Point	Threshold	Polarity
START	A2TP13 SAGATE1	TTL	falling edge
STOP	A2TP13 SAGATE1	TTL	rising edge
CLOCK	A2TP10 SACLK1	TTL	rising edge
DATA		CMOS 5V	

2. Select the SA-RAM TEST by setting the A2SW2 SA-TEST switch as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•		•	•	•	•	•
1			•					

3. Turn line power on and verify a signature of U338 on A2TP12 (COMPSA).

   If signature is not correct, replace microprocessor assembly A2.

Note

If not continuing on with this procedure, exit signature analysis mode by setting SA-TEST switch A2SW2 to normal position:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

Check 7. PIA Signature Analysis check

This check determines if the PIA A2U24 responds to microprocessor control.

1. With the power off, connect the signature analyzer timing pod to microprocessor assembly A2 test points shown in the following table.

Signal	A2 Test Point	Threshold	Polarity
START	A2TP13 SAGATE1	TTL	falling edge
STOP	A2TP13 SAGATE1	TTL	rising edge
CLOCK	A2TP10 SACLK1	TTL	rising edge
DATA		TTL	

2. With the line power off, select the PIA TEST by setting SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•			•	•	•	•
1			•	•				

3. Turn line power on and verify a signature of U91C on A2TP12 (COMPSA).

   If signature is not correct, replace the microprocessor assembly A2.

4. Exit signature analysis mode by setting SA-TEST switch A2SW2 to normal position:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

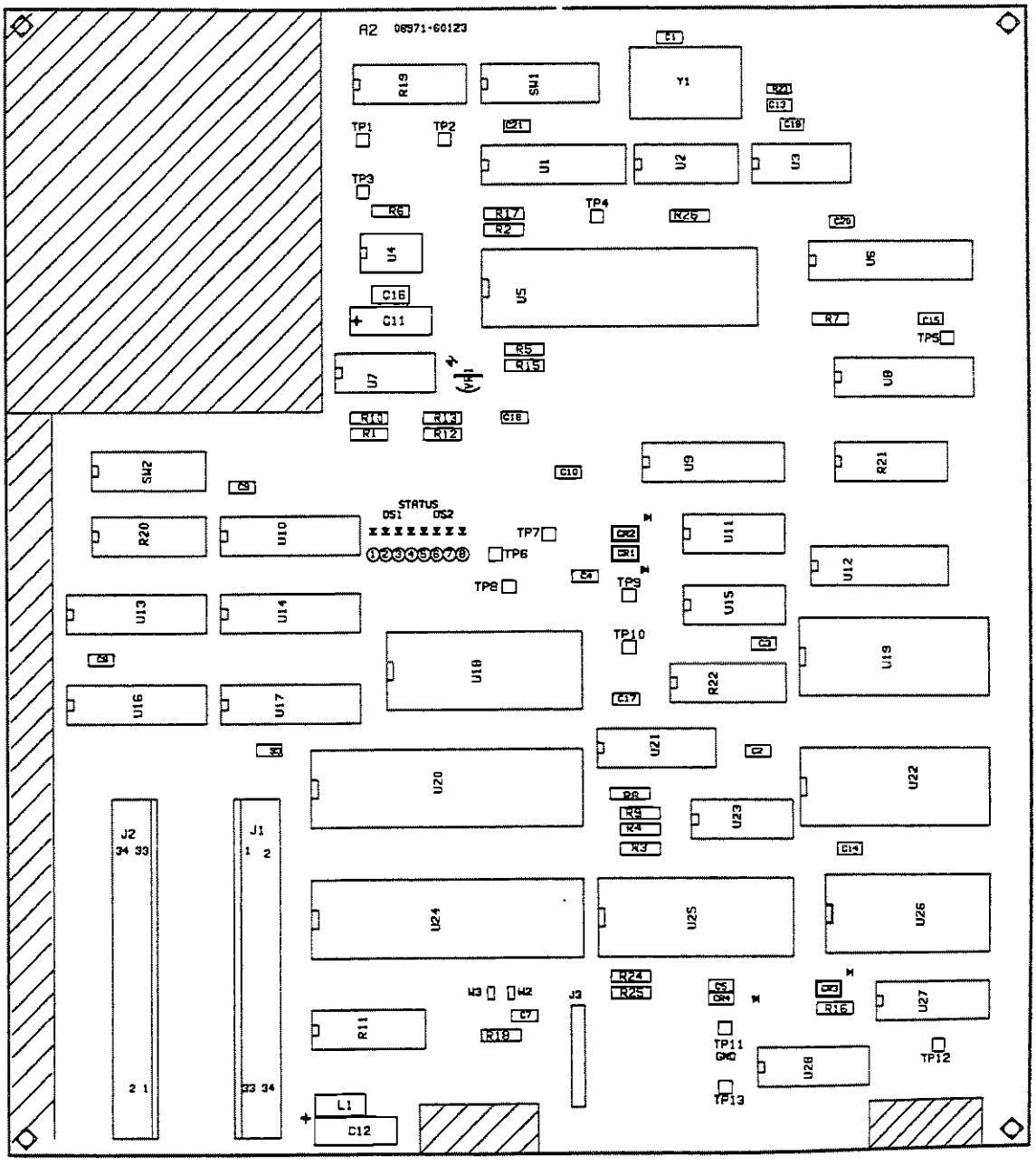
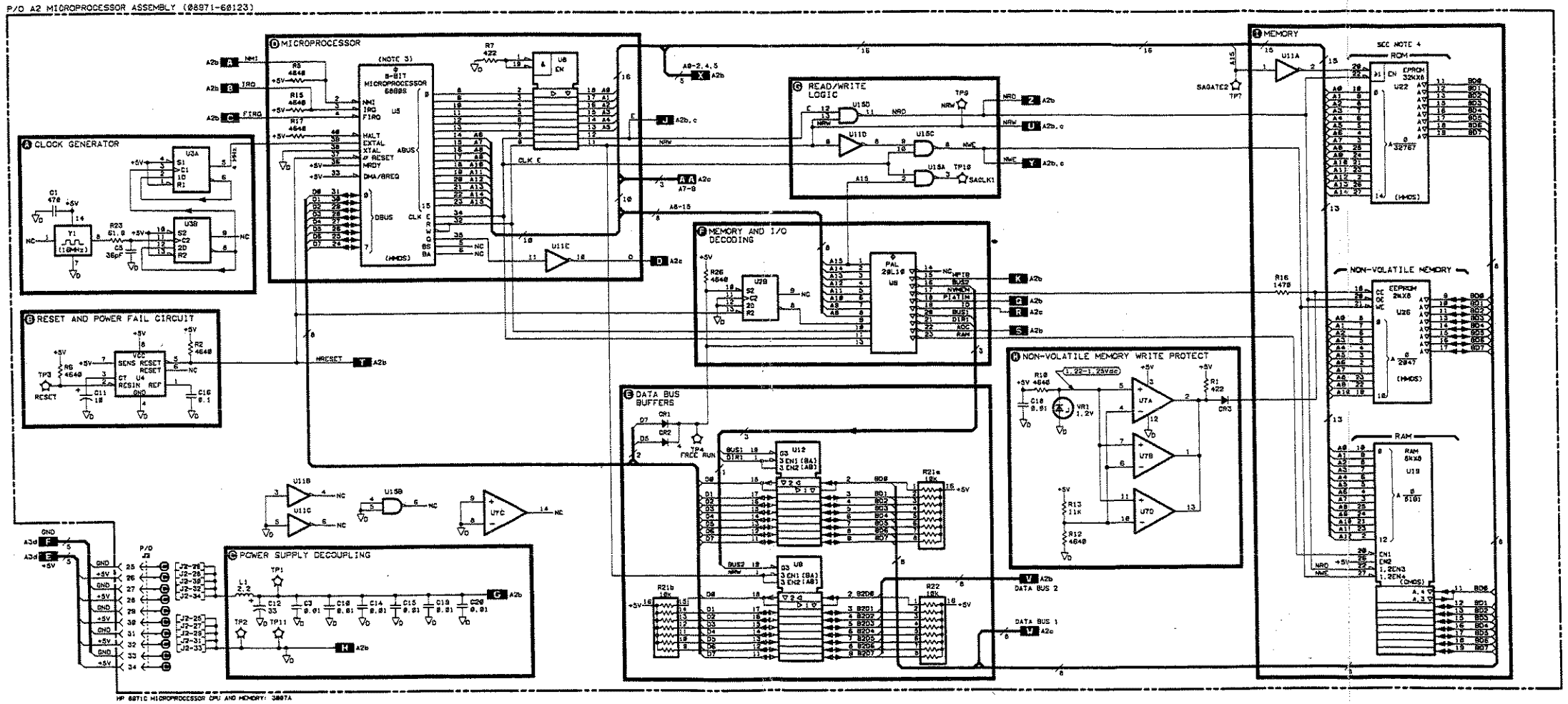


Figure 8-8. A2a Microprocessor Component Locations

8-60 This Page Intentionally Left Blank



NOTES

1. SEE TABLE AT END OF MANUAL FOR SCHEMATIC DIAGRAM NOTES.
2. ALL DIGITAL ICs ARE TTL UNLESS NOTED OTHERWISE.
3. ON A2BUS PIN 37 A LOGICAL HIGH MUST BE +4V.
4. EPROM U22 MUST BE ORDERED SEPARATELY

REFERENCE DESIGNATIONS

A2	A2 (CONT'D)
C1,3,10-16, 18-20	TP1-4,7,9-11
CR1-3	U2-8,11,12, 13,15,17, 21-23,26
J1	VR1
L1	Y1
R1,2,5-7,10, 12,13,15-17, 21-23,26	

INTEGRATED CIRCUIT VOLTAGE, GROUND AND BYPASS CAPACITOR CONNECTIONS

REFERENCE DESIGNATION	BYPASS CAP	PIN NUMBER
U2,11,15 U3	C19	+5V - 14 Vᴅ - 7
U5		+5V - 7 Vᴅ - 1
U6 U26	C26	+5V - 24 Vᴅ - 12
U7		+5V - 3 Vᴅ - 12
U8 U9 U12	C15 C19	+5V - 28 Vᴅ - 18
U19	C3	+5V - 26 Vᴅ - 14
U22	C14	+5V - 1,28 Vᴅ - 14
U27,28		+5V - 16 Vᴅ - 8

LOGIC LEVELS

INPUT	TTL	HMOS	CMOS
HIGH	>2V	>3V	>3V
LOW	<0.8V	<0.5V	<0.8V
OUTPUT			
HIGH	>2.5V	>2.4V	>3.4V
LOW	<0.4V	<0.5V	<0.4V
	± 1% MORE NEG. THAN		
	± 1% MORE POS. THAN		
OPEN	HIGH	HIGH	HIGH
GROUND	LOW	LOW	LOW

A2a

Figure 8-9. P/O Microprocessor Assembly Schematic Diagram

Service Sheet A2b/c

Microprocessor I/O and Diagnostics

References

Overall Block Diagram	Service Sheet BD1
Microprocessor	Service Sheets A2a, A2c
Power Supply/Driver	Service Sheet A3c
Disassembly and Reassembly	Service Sheet A
Replaceable Parts List	Chapter 6
Illustrated Parts Breakdowns	Chapter 6
Adjustment Procedure	Chapter 5

Principles of Operation

The circuits shown on service sheet A2b execute data transfer between microprocessor assembly A2, power supply/driver assembly A3, and the remote instrument bus (HP-IB). Digital communication with power supply/driver assembly A3 is accomplished through peripheral interface adapter (PIA) A2U24. Analog-to-digital converter A2U25 monitors several key analog voltages (YT, HV, HS, etc.) on the YIG filter driver and temperature control circuits (service sheets A3b and A3c), converting each voltage to an 8-bit digital word and placing the word on data bus 2 (B2D0–B2D7).

Talker/listener A2U20 provides the standard HP-IB interface for communicating with the HP 8970B Noise Figure Meter or an external controller over the Hewlett-Packard Interface Bus.

Diagnostic tests are enabled by changing the settings on two DIP switches, YIG CODE switch A2SW1 and SA-TEST switch A2SW2 (See Figure 8-9 or 8-11 for switch locations). YIG CODE switch A2SW1 can be used to disable the YIG filter drift correction and/or the heater control circuitry. SA-TEST switch A2SW2 selects one of ten different signature analysis tests for verifying operation of selected circuits on assemblies A2 and A3.

System Timer

System timer A2U18 periodically interrupts microprocessor A2U5 via its IRQ input (pin 3). When interrupted, microprocessor A2U5 updates the temperature control loop and the YIG filter post-tuning drift correction circuits.

System timer A2U18 generates a 1 Hz square wave which can be checked at test point A2TP8 TIMER. The actual interrupt signal is a short negative true pulse on pin 9 of A2U18. The interrupt is valid every half cycle. Thus, the temperature control and filter drift correction circuits are updated every 0.5 seconds.

Analog-to-Digital Converter (A/D)

Precise temperature control of the YIG filter is maintained by a combination of analog and digital signal processing. Analog-to-digital converter A2U25 performs the required conversion using successive approximation.

A/D converter A2U25 has 8 analog input channels. A channel is selected for conversion by address lines A0–A2 on the rising edge of the ALE strobe (pin 22). Two of the 8 analog input channels are used for temperature control — channel 5 (RT on pin 3) and channel 6 (AT on pin 4). The other channels are used for internal diagnostics and system self checks.

The falling edge of the strobe triggers A/D A2U25 to begin its 100-microsecond conversion (START on pin 6). The microprocessor waits for the End of Conversion signal (EOC) on A2U25 pin 7 to determine if the conversion is complete or has timed out. EOC is read by the microprocessor through the PB6 data line on PIA A2U24 pin 16. Results of the A/D conversion appear on the data bus when output enable (EN) on A2U25 pin 9 goes high (i.e. when both ADC and NRD are low).

Peripheral Interface Adapter (PIA)

PIA A2U24 transfers information between microprocessor A2U5 and the digital circuitry on power supply/ driver assembly A3. Lines DI0–DI7 send data to the D/A converters and display driver. Lines ADR0–3 form a 4-bit address bus for decoders A3U30 and A3U33 on power supply/driver assembly A3. An active low pulse (CB2) on A2U24 pin 19 enables the address decoders.

HP-IB Interface

HP-IB interface A2U20 manages information flow between microprocessor A2U5 and the HP-IB. A2U20 also determines the direction of flow of information through bi-directional transceivers A2U16 and A2U17.

Inputs to the Noise Figure Test Set are in the form of control and data information via the HP-IB connector on the back of the test set. Control information is input via five control lines and three handshake lines. The control lines, ATN, SRQ, REN, IFC, and EOI allow the controller or the HP 8970B to impart appropriate control information to the Noise Figure Test Set. The handshake lines, DAV, NRFD, and NDAC, provide asynchronous control for data transfer between a talker (controller or HP 8970B) and the listener (Noise Figure Test Set). See HP document 5952-0156, "Tutorial Description of the Hewlett-Packard Interface Bus", for a detailed explanation of handshake lines. Eight bidirectional data lines, DIO1 through DIO8, carry data to and from the Test Set as commanded by the HP 8970B or the controller.

The HP 8971C address is set using the 5 HP-IB DIP switches on the rear panel. During power-up, microprocessor A2U5 reads the switch settings through latch A2U13 and data bus buffer A2U12.

Signature Analysis & Diagnostics

Various signature analysis and diagnostic tests are initiated by selecting the appropriate setting on SA-TEST switch A2SW2. The switch setting is read by microprocessor A2U5 through latch A2U10,data bus BD0–BD7, and data bus buffer A2U12. Ten different signature analysis tests can be selected by setting A2SW2 bit-8 to 0, as shown in table below. Not all of the tests are used, nor are instructions for their use presented, but all are included for completeness of information.

Signature Analysis Tests

SA-TEST SWITCH: 1 2 3 4 5 6 7 8	TEST SELECTED
0 0 1 0 0 0 0 0	RAM TEST
0 0 0 1 0 0 0 0	HPIB TEST
0 0 1 1 0 0 0 0	PIA TEST
0 1 0 0 1 0 0 0	FRONT PANEL LED TEST
0 0 1 0 1 0 0 0	ADDRESS BUS TEST
0 0 0 1 1 0 0 0	uWAVE SWITCHES & READBACK
0 0 0 0 0 0 1 0	MAIN DAC TEST
0 0 1 0 0 0 1 0	SCALE DAC TEST
0 0 0 1 0 0 1 0	AMBIENT DAC TEST
0 0 1 1 0 0 1 0	HEATER DAC TEST

Note

All of the DAC tests will control the DAC being tested so that an output of 0 Volts through 1/2 maximum output will be present on the DAC output. The test checks each 'bit' of the DAC one by one, setting each bit to 1 and rest to 0. The scope pattern which can be viewed on the DAC outputs (or point that shows DAC Voltage) and will be a sequence of steps, each step being twice as large as the previous step, until the highest bit has been set and then the test will return the DAC output to 0.

With A2SW2 bit 8 set to 1, the diagnostic tests can be selected with the remaining bits.

In diagnostic mode, microprocessor A2U5 sends coded information to diagnostic LEDs A2DS1 and A2DS2. The data is latched to the LEDs by A2U14. Information that can be read using the diagnostic LEDs include the YIG CODE switch SW1 setting, the rear panel

HP-IB switch setting, all eight channels of the A/D (A2U25), and the data lines of PIA ports A and B.

With the A2SW2 switch bit 8 set to 1 and one of the following combinations selected, the LEDs on the A2 board will display the values selected to be shown in binary.

Diagnostic Tests

SA-TEST SWITCH: 1 2 3 4 5 6 7 8	Values Shown
0 0 0 0 0 0 0 1	Normal status of 8971C
1 0 0 0 0 0 0 1	YIG Code Switch Setting
0 1 0 0 0 0 0 1	Rear Panel HP-IB Switch Setting
1 1 0 0 0 0 0 1	Read A/D Chan 0, YIG Case Temp (YT)
1 1 0 0 1 0 0 1	Read A/D Chan 1, Htr DAC Voltage (HV)
1 1 0 0 0 1 0 1	Read A/D Chan 2, Htr Current Sense (HS)
1 1 0 0 1 1 0 1	Read A/D Chan 3, Ambient Offset (OV)
1 1 0 0 0 0 1 1	Read A/D Chan 4, YIG Current (VS)
1 1 0 0 1 0 1 1	Read A/D Chan 5, YIG Reg. Temp. (RT)
1 1 0 0 0 1 1 1	Read A/D Chan 6, Input Air Temp. (AT)
1 1 0 0 1 1 1 1	Read A/D Chan 7 A/D Test 120-136 Always
0 0 1 0 X X X 1	PIA Port A Data Lines
1 0 1 0 X X X 1	PIA Port B Data Lines

The diagnostic LEDs provide a quick check of these circuits without the use of an external controller.

Counter A2U28 and MUX A2U27 multiplex the eight data lines of DATA BUS 1 into a single compound signature at COMP SA test point A2TP12. This allows for a functional check of the entire data bus at one test point. PAL A2U6 controls data bus buffers A2U12 and A2U9 in such a way as to allow compound SA data line multiplexer A2U27 to always see data present at microprocessor A2U5. Thus, compound SA can be performed on both data buses.

Address decoder A2U21 derives the control signals for this circuit (NMXCLK and NMXSET). Counter A2U28 generates BCD 0–7 on data lines S0–S2. The S0–S2 lines address MUX A2U27 to select one of the eight data lines (BD0–7) for presentation at COMP SA test point A2TP12.

Three test points are provided for gating the signature analysis meter. Gate signals are applied to A2TP13 for compound SA, A2TP6 for normal SA, and A2TP7 for miscellaneous tests.

Troubleshooting

Troubleshooting the circuits on assembly A2b/c is indicated if an A/D malfunction is suspected, or if any of the following self tests fail:

Status LEDs 1 2 3 4 5 6	Failure	Component
1 0 1 0 0 1	PIA	A2U24, A2U6
0 0 0 1 0 1	A/D	A2U25 or +5V ref on A3
1 0 0 1 0 1	HP-IB	A2U20
0 1 0 1 0 1	Timer	A2U18, A2U6, A2U5

If an A/D malfunction is suspected, or if the A/D self test fails, perform Check 1 and Check 2.

If the board fails any of the other three self tests, perform Check 1.

If a self test verification or general health check is desired, Checks 3 and 4 may be performed.

Note

There are several times during the performance of these troubleshooting procedures that replacement of the A2 Microprocessor Assembly is advised. When replacing the A2 board assembly, be sure to transfer the settings of the YIG Code Switch (A2SW1) to the new board, as this determines the YIG post tuning drift compensation.

Test Equipment

Signature Analyzer	HP 5005B
Digital Voltmeter	HP 3456A
Oscilloscope	HP 54111D

Note

These checks assume that all power supplies have been checked according to Service Sheet BD1, Check 1.

Check 1. Power Supply Check

1. Connect DVM ground to test point A2TP2 (GND).
2. Verify that the voltage at A2TP1 (+5V) is 5.1 ±0.05 Vdc.
3. Using the oscilloscope, verify that the ripple is less than 0.05 Vp-p.
4. If the voltage or ripple are not within limits, troubleshoot the power supply decoupling circuits shown on service sheets A2a and A2b.
5. If the voltages are correct and there are no further checks to perform, replace microprocessor assembly A2. Otherwise, proceed to the next test.

Check 2. A/D Reference Check

1. Connect DVM ground to test point A2TP2 (GND).
2. Verify voltage at A3TP7 (+5V REF) is +5V ±0.05 Vdc.
3. If the voltage is not within this range, proceed to the Temperature Control Reference Voltage Check of Service Sheet A3c.
4. Verify that the voltage between A2U25 pin 12 (+) and A2U25 pin 16 (-) is +5.0 ±0.05 Vdc.

   If it is not, check the continuity of the ribbon cable between A2 and A3.

   If the voltage is in range, replace the microprocessor board A2.

Check 3. PIA Signature Analysis Check

This check determines if the PIA A2U24 responds to microprocessor control.

1. With the power off, connect the signature analyzer timing pod to microprocessor assembly A2 test points shown in the following table.

Signal	A2 Test Point	Threshold	Polarity
START	A2TP13 SAGATE1	TTL	falling edge
STOP	A2TP13 SAGATE1	TTL	rising edge
CLOCK	A2TP10 SACLK1	TTL	rising edge
DATA		TTL	

2. With the line power off, select the PIA TEST by setting SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•			•	•	•	•
1			•	•				

3. Turn line power on and verify a signature of U91C on A2TP12 (COMPSA).

   If signature is not correct, replace the microprocessor assembly A2.

Check 4. HP-IB Signature Analysis Check

This check determines if HP-IB Talker/Listener A2U20 responds to microprocessor control.

1. With the power off, connect the signature analyzer timing pod to microprocessor assembly A2 test points shown in the following table.

Signal	A2 Test Point	Threshold	Polarity
START	A2TP13 SAGATE1	TTL	falling edge
STOP	A2TP13 SAGATE1	TTL	rising edge
CLOCK	A2TP10 SACLK1	TTL	rising edge
DATA		TTL	

2. With the line power off, select the HP-IB TEST by setting SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•		•	•	•	•
1				•				

3. Turn line power on and verify a HP-IB Test signature of 35U4 on A2TP12 (COMPSA).

   If signature is not correct, replace the microprocessor assembly A2.

4. Exit signature analysis mode by setting SA-TEST switch A2SW2 to normal position:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

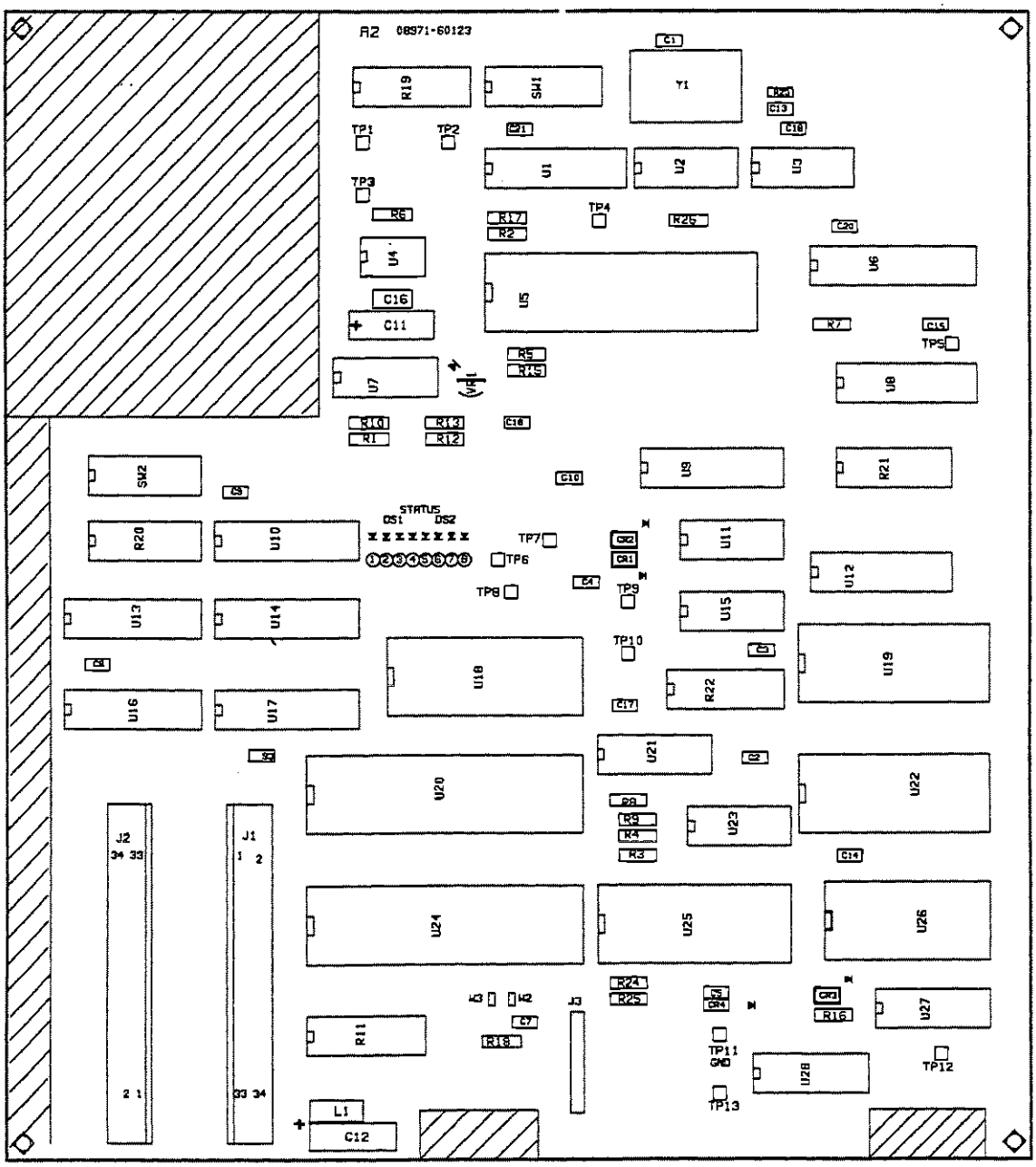
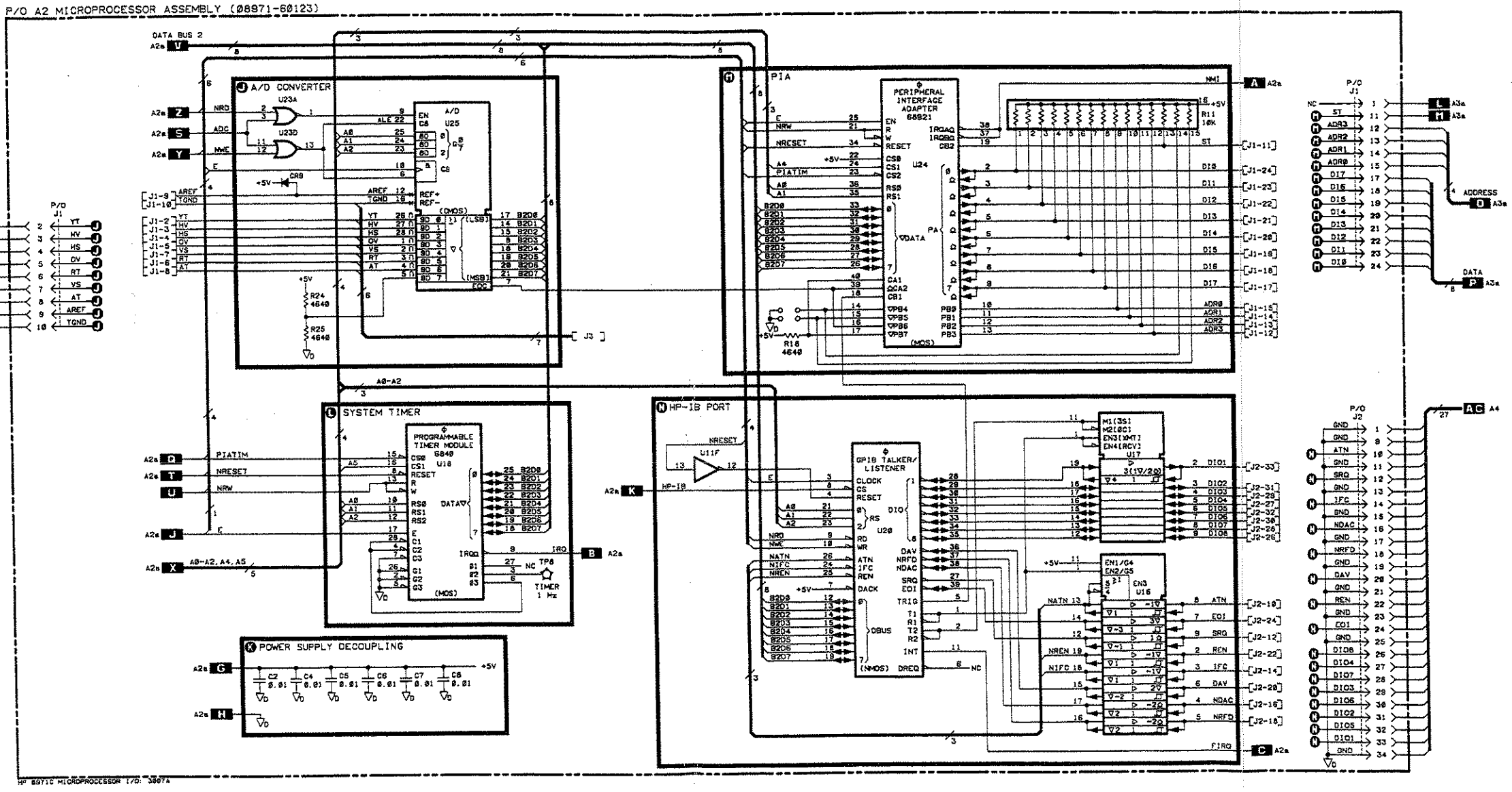


Figure 8-10. A2b Microprocessor Component Locations



HP 8971C MICROPROCESSOR I/O: 3807A

NOTES

1. SEE TABLE IN MANUAL FOR SCHEMATIC DIAGRAM NOTES.
2. ALL DIGITAL ICs ARE TTL UNLESS NOTED OTHERWISE.
3. UNLESS OTHERWISE NOTED: 18,355 RESISTANCE IN OHMS.

REFERENCE DESIGNATIONS

A2	A2 (CONT.)
C2, 4-8	TP8
J1, 2	U11, 16-18, 23,
R11, 18, 24, 25	25-28

LOGIC LEVELS

INPUT	TTL	MOS	CMOS	NMOS
HIGH	>2V	>2V	>3V	>2V
LOW	<0.8V	<0.8V	<0.9V	<0.8V
OUTPUT				
HIGH	>2.5V	>2.4V	>2.4V	>2.4V
LOW	<0.4V	<0.4V	<0.4V	<0.4V
	< 1S MORE NEG. THAN			
	> 1S MORE POS. THAN			
OPEN	HIGH	HIGH	HIGH	HIGH
GROUND	LOW	LOW	LOW	LOW

INTEGRATED CIRCUIT VOLTAGE, GROUND AND BYPASS CAPACITOR CONNECTIONS

REFERENCE DESIGNATION	BYPASS CAP	PIN NUMBER
U11 U23	— C2	+5V - 14 ▽ - 7
U16 U17	C8 ---	+5V - 20 ▽ - 10
U18	C4	+5V - 14 ▽ - 1
U28	C8	+5V - 40 ▽ - 20
U24	C7	+5V - 20 ▽ - 1
U25	C5	+5V - 11 ▽ - 13

A2b

Figure 8-11. P/O Microprocessor Assembly Schematic Diagram
8-71/8-72

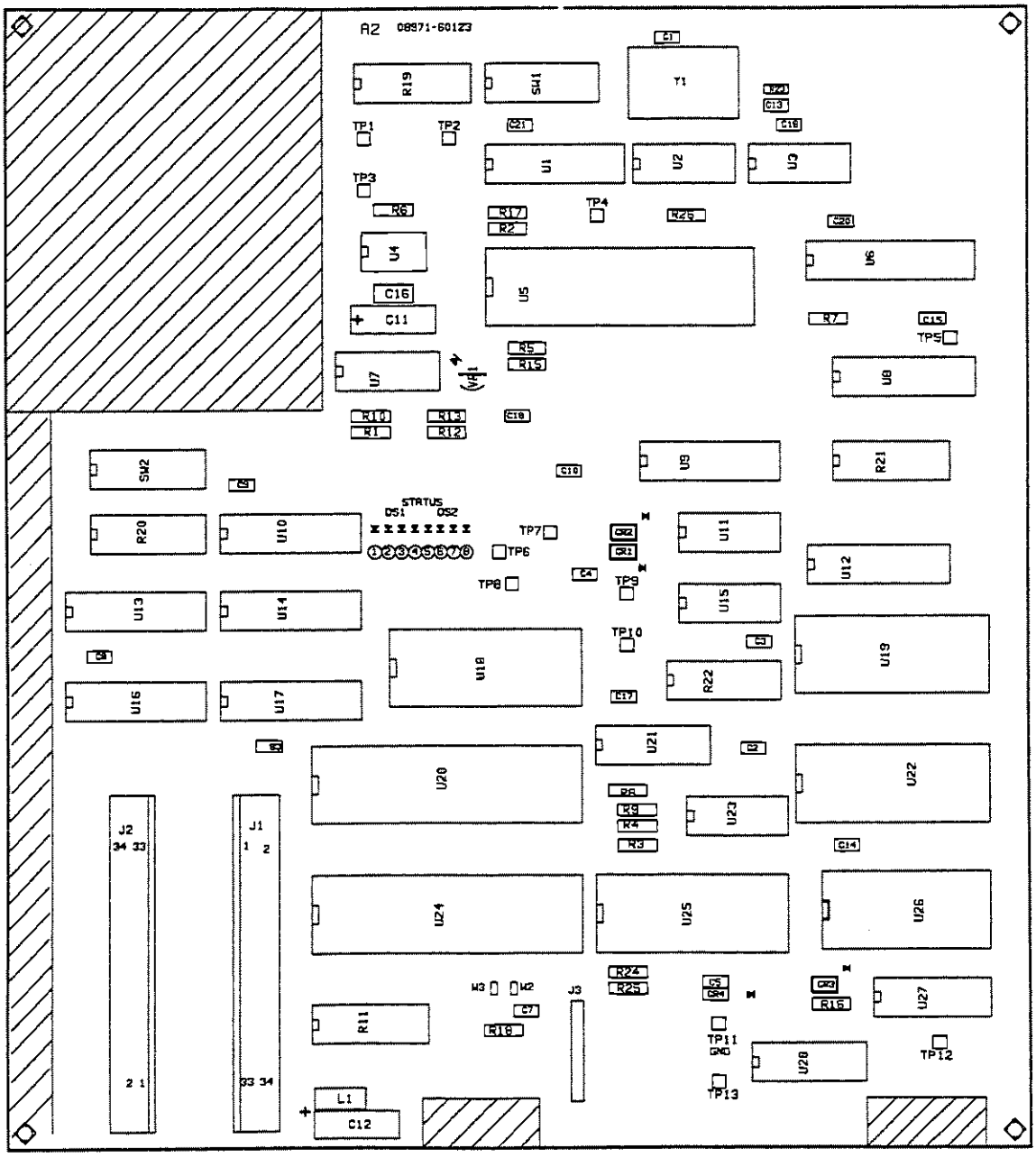
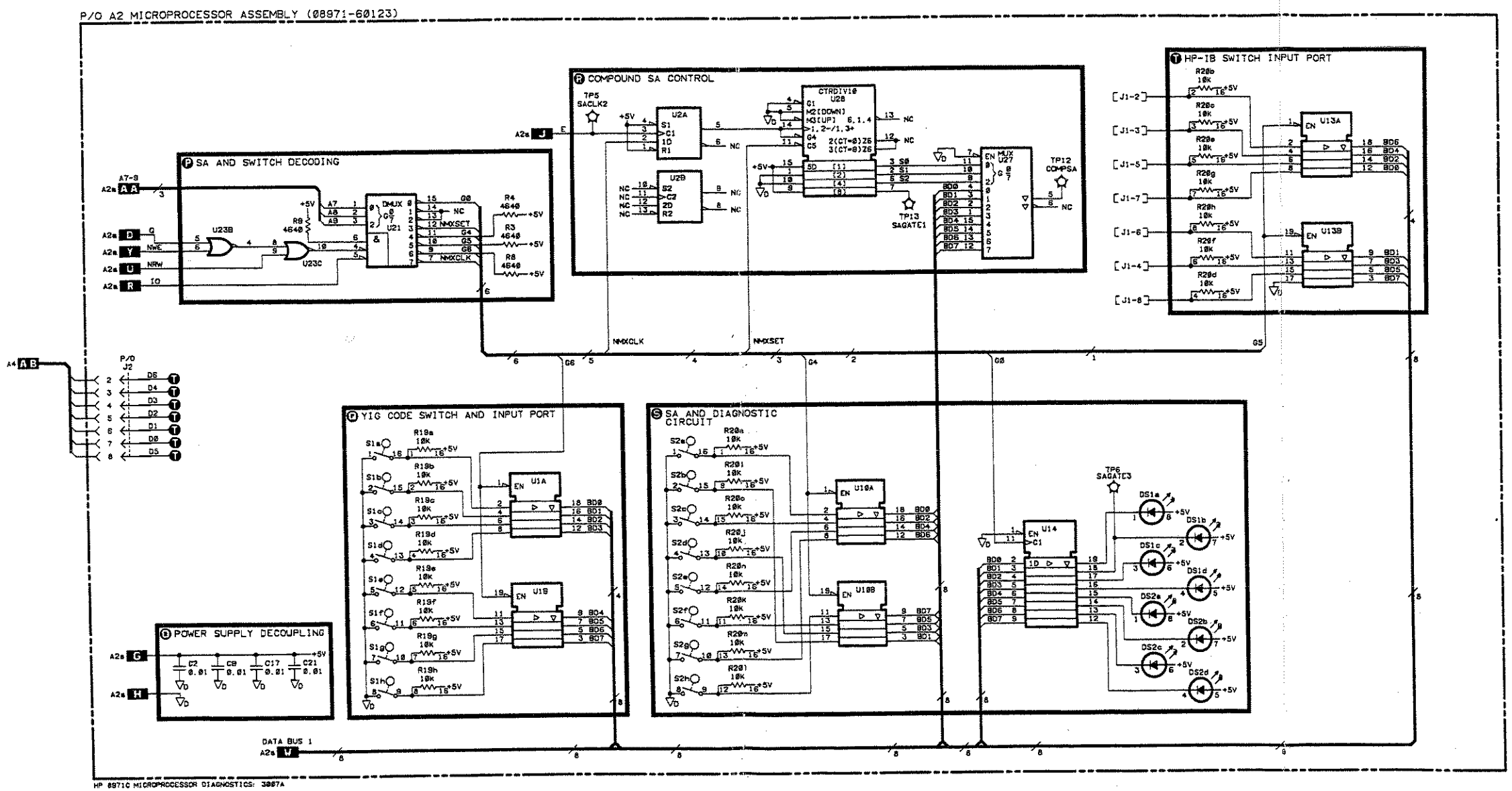


Figure 8-12. A2c Microprocessor Component Locations

8-74 This Page Intentionally Left Blank



NOTES

1. SEE TABLE AT END OF MANUAL FOR SCHEMATIC DIAGRAM NOTES.
2. ALL DIGITAL ICs ARE TTL UNLESS NOTED OTHERWISE.

REFERENCE DESIGNATIONS

A2	A2 (CONT.)
C9,17,21 DS1,2 J2 R3,4,8,9,19, 20	S1,2 TP5,6,12,13 U1,2,18,13, 14,21,23,27, 28

LOGIC LEVELS

INPUT	TTL	MOS	CMOS	NMOS
HIGH	>2V	>2V	>7V	>2V
LOW	<0.8V	<0.8V	<0.8V	<0.8V
OUTPUT				
HIGH	>2.5V	>2.4V	>2.4V	>2.4V
LOW	<0.4V	<0.4V	<0.4V	<0.4V
	< 15 MORE NEG. THAN			
	> 15 MORE POS. THAN			
OPEN	HIGH	HIGH	HIGH	HIGH
GROUND	LOW	LOW	LOW	LOW

INTEGRATED CIRCUIT VOLTAGE, GROUND AND BYPASS CAPACITOR CONNECTIONS

REFERENCE DESIGNATION	BYPASS CAP	PIN NUMBER
U1 U18 U13 U14	C21 C9 --- ---	+5V - 28 ▽ - 10
U2 U23	--- C2	+5V - 14 ▽ - 7
U21 U27 U28	C17 --- ---	+5V - 16 ▽ - 8

A2c

Figure 8-13. P/O Microprocessor Assembly Schematic Diagram

Service Sheet A3a

Microprocessor, Switch Driver, and Interface Processor

References

Overall Block Diagram	Service Sheet BD1
Microprocessor	Service Sheets A2a, b, c
Disassembly and Reassembly	Service Sheet A
Replaceable Parts List	Chapter 6
Illustrated Parts Breakdowns	Chapter 6

Principles of Operation

The switch driver/interface circuitry provides the interface for all digital I/O signals between microprocessor assembly A2 and the A3 control circuits. It also provides the drive and detection circuits for microwave relay A1K1 and display assembly A1A1.

Data Transfer

Data transfer between microprocessor assembly A2 and power supply/driver assembly A3 is by positive-true, 8-bit input data bus DI0-DI7. Data latches U21, U18, U19, U22, U31, U34, U32, U35 and DACs U8, U10, and U17 on assembly A3 are addressed from a negative-true latch select signal generated by 4-bit-to-16-bit address decoder A3U30/U33. Latch select addresses ADR0 to ADR3 are presented to A3U30/U33 from peripheral interface adapter A2U24. Negative true signal ST from A2U24 enables the decoding and latching of the 4-bit address.

Display Driver

The A1A2 LED displays are driven from 8-bit non-inverting data latch A3U34. A low on the output allows current through the applicable LED indicator. A high output turns off the LED.

Microwave Relay Driver

A microwave relay driver, comprised of latch A3U31 and gates A3U24, A3U25, A3U26, A3U27, and A3U29, operates microwave switch A1K1. This switch, shown on service sheet A1, routes the Noise Figure Test Set input signal through the appropriate microwave path. Switch data is latched by 8-bit data latch A3U31. A3U28c enables NAND drivers A3U24–27 and A3U29 when a logic low is present on its input. A3U28a, b and d invert the drive signal to provide a complementary drive for actuating the switch return coils. NAND drivers A3U24-27 and A3U29 are high-voltage, open-collector drivers capable of sinking enough current to directly drive relay solenoids. Diode array A3CR30 is capable of clamping any transients caused by cutting off the drive current to the relay

solenoids. In the 8971C (as opposed to the 8971B), the circuitry that actually drives the relay solenoids is included in the switch itself. Thus the importance of high current drive and transient clamping is diminished for this version of the instrument.

Relay Readback

Note

Relay drive circuits have been built into the microwave switch (A1K1) used in the 8971C to simplify drive requirements and improve switch reliability. Since the control lines to the switch now connect to silicon circuits instead of coils (as they did in the 8971B), relay readback can no longer be used to determine the state of the switch. Thus, the relay readback circuits serve no useful purpose in the 8971C and are described here only for completeness.

Relay readback circuitry monitors the open and closed coil drive contacts. Voltage dividers A3R86–91 divide the +20 Vdc common voltage to +4.1 Vdc for a closed drive contact. This is sensed as a logic high by 8-bit data latches A3U32 and A3U35. An open drive contact is a logic low to the readback latches. A3U32 and A3U35 output data bits DI0-DI7, which are routed through PIA A2U24 and data bus buffer A2U9 to microprocessor A2U5. Microprocessor A2U5 reads the relay readback data to determine if the relay has switched to the desired state.

Troubleshooting

If any of the following conditions occur, troubleshoot the circuits on assembly A3a:

1. Operational errors in assembly A1, indicating a defective microwave relay path.
2. Failure on the A1A1 display assembly.

If the following tests on the A3a circuits indicate correct operation, then the trouble is elsewhere.

Test Equipment

Digital Voltmeter	HP 3456A
Noise Figure Meter	HP 8970B
Signature Analyzer	HP 5005B

Check 1. Signature Setup

1. Prior to troubleshooting the A3a switch driver circuits, signature analysis will insure that correct data is being received by the microprocessor interface circuits.
2. Turn line power off and connect signature analyzer timing pod to microprocessor assembly A2 test points shown in the following table.

Signal	A2 Test Point	Threshold	Polarity
START	A2TP6 SAGATE3	TTL	falling edge
STOP	A2TP6 SAGATE3	TTL	rising edge
CLOCK	A2TP5 SACLK2	TTL	falling edge
DATA		CMOS 5V	

Check 2. Address Decoder

1. Select the A3a address bus test on the microprocessor assembly A2 by setting the A2SW2 SA-TEST switch as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•		•		•	•	•
1			•		•			

2. Turn on line power and verify the following signatures on address decoder A3U30 and A3U33:

Device	Pin	Signature	Device	Pin	Signature
A3U30	1	43C9	A3U33	1	43C9
	2	4U63		2	4U63
	3	4669		3	4669
	4	HP66		4	03H1
	5	03H1		5	0000
	6	3PF1		6	HP66
	7	C4P2			
	9	1HC4			
	10	AA5C			
	11	84CA			
	12	P7U6			
	13	8C49		13	73U3
	14	179F		14	HF79
	15	F0HH		15	7030

3. If output signatures are incorrect, check the input signatures. If input signatures are valid, replace A3U30 or A3U33 as applicable and remeasure.
4. If the signatures are still incorrect, replace the destination IC.

Check 3. Display Driver

1. Select the front panel LED signature test by turning off line power and setting A2SW2 SA-TEST switch as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•		•	•		•	•	•
1		•			•			

2. Turn on line power and verify the following A3U34 signatures:

Note Signatures on A3U34 should be taken with the signature analyzer data threshold set to TTL.

Pin	Signature	Pin	Signature
1	0000	19	8872
2	2052	18	6A97
3	HA21	17	30P4
4	U253	16	4H24
5	FH76	15	3U17
6	C084	14	H898
7	67HH	13	6C4H
8	3F46	12	54FP
9	7UPF		
11	CC66		

3. If the output signatures are invalid, check the input signatures. If input signatures are valid, disconnect the cable connected to A3J3 and remeasure.
4. If the output signatures are now valid, the malfunction is in display assembly A1A1. Proceed to service sheet A1 to troubleshoot A1A1. If signatures are still invalid, replace A3U34.
5. Reconnect cable A3J3 and reset the signature analyzer to CMOS 5V data threshold.

Check 4. Microwave Relay Driver

1. Turn off line power. Select the Microwave Switch Driver signature test by setting SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•			•	•	•
1				•	•			

2. Disconnect ribbon cable assembly from A1A5J4 to prevent unnecessary switching of the relays.

3. Turn on line power and verify the following signatures on Latch A3U31;

Pin	Signature	Pin	Signature
1	Gnd	19	P535
2	H714	17	7H36
3	AU31	15	P42A
4	9704	12	0000
5	3870		
6	549F		
7	3870		
8	3870		
9	3870		
11	6P67		

4. If output signatures are invalid, check input signatures.
5. If input signatures are valid replace A3U31 and remeasure.
6. Turn off line power and reconnect the ribbon cable assembly at A1A5J4.
7. Exit signature analysis mode by setting SA-TEST switch A2SW2 to normal position:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

8. Turn line power back on.
9. Connect an HP-IB cable from 8970B SYSTEM INTERFACE BUS connector to the HP-IB connector of the HP 8971C Noise Figure Test Set.
10. Turn on line power to both instruments.
11. On the HP 8970B Noise Figure Meter press:

PRESET

45.0 SPECIAL FUNCTION	Enable HP 8971C commands
46.1 SPECIAL FUNCTION	Disable LO commands on SIB
1.5 SPECIAL FUNCTION	Measurement mode 5
36.2 SPECIAL FUNCTION	Disable YIG tune warnings

12. Verify that the proper drive voltages are present for band SSB1 by pressing FREQUENCY 10, ENTER, and measuring the appropriate points shown in the table on the following page.

Note The signal band, and therefore the switch state, are determined by selecting the frequency on the Noise Figure Meter.

Driver IC	SSB1	SSB2	SSB3	DSB
U29 pin 5		>+2.2V	<+1V	<+1V
U27 pin 5		<+1V	>+2.2V	>+2.2V
U27 pin 3		<+1V	>+2.2V	>+2.2V
U29 pin 3		>+2.2V	<+1V	<+1V
U25 pin 5		<+1V	>+2.2V	<+1V
U24 pin 5		>+2.2V	<+1V	>+2.2V
U24 pin 3		>+2.2V	<+1V	>+2.2V
U25 pin 3		<+1V	>+2.2V	<+1V
U26 pin 5	>+2.2V	<+1V	<+1V	<+1V
U26 pin 3	<+1V	>+2.2V	>+2.2V	>+2.2V

Note Probing pins 3 and 5 of drivers A3U24-27, and A3U29 can cause false triggering of the drive circuits inside the microwave switch. This can cause the relays to engage, producing a clicking sound. This is normal and does not indicate a malfunction.

13. Verify that the proper drive voltages are present for band SSB2 by pressing FREQUENCY 2000, ENTER, and measuring the appropriate points shown in the table.
14. Verify that the proper drive voltages are present for band SSB3 by pressing FREQUENCY 3000, ENTER, and measuring the appropriate points indicated in the table.
15. Verify that the proper drive voltages are present for band DSB by pressing FREQUENCY 3000, ENTER; 17.1 SPECIAL FUNCTION, and measuring the appropriate points indicated in the table.
16. Reset to SSB3 by pressing the Noise Figure Meter keys, 17.0 SPECIAL FUNCTION
17. If any of the output levels are incorrect, check the input logic levels. A3U28 enable pin 6 should be high. Drive pins (A3U24–27, 29 pins 1 and 7) should be inverted from the expected output state, low for >+2.25V and high for <+1V.
18. If input levels are correct and outputs are wrong, replace the applicable relay driver IC: A3U24-27 or A3U29.
19. If the output levels are correct, determine if the microwave switch responds correctly to the drive signals. A quick way to determine if the switch is NOT functioning properly is to listen for the click of the solenoids as the instrument is switched between SSB1, SSB2, SSB3, and DSB. In order to properly verify functionality, path resistances should be measured with the DVM. See service

sheet A1 for a diagram (Figure 8-3 or 8-4) detailing which paths are active in each band.

20. If no sound is heard, verify the continuity of the ribbon cable between A1A5J4 and the microwave switch, the ribbon cable between A3J4 and A1A5J3, and the cable harness between A3J10 and A1A5J1.
21. If the cables check out properly, replace the microwave switch.

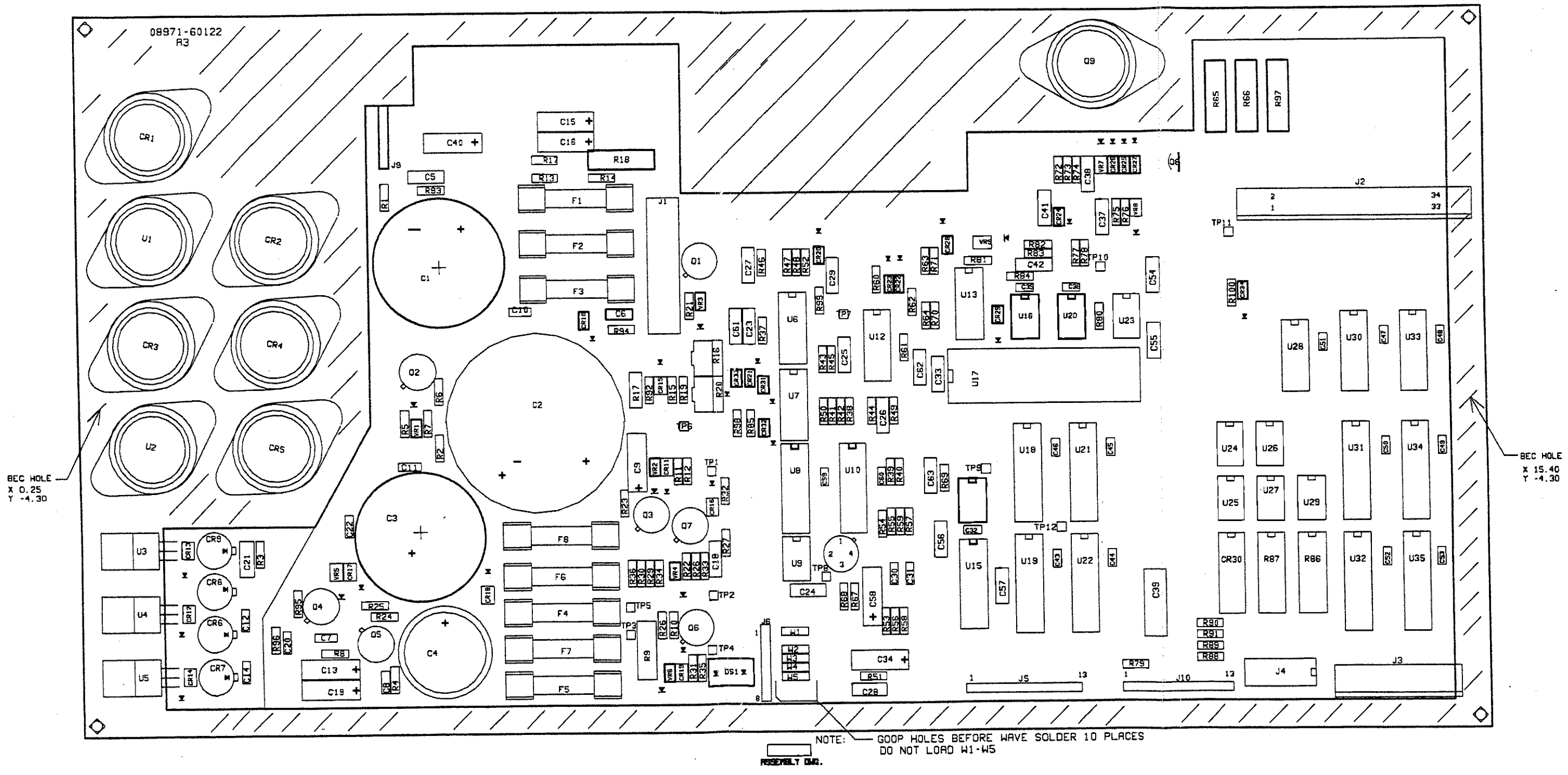
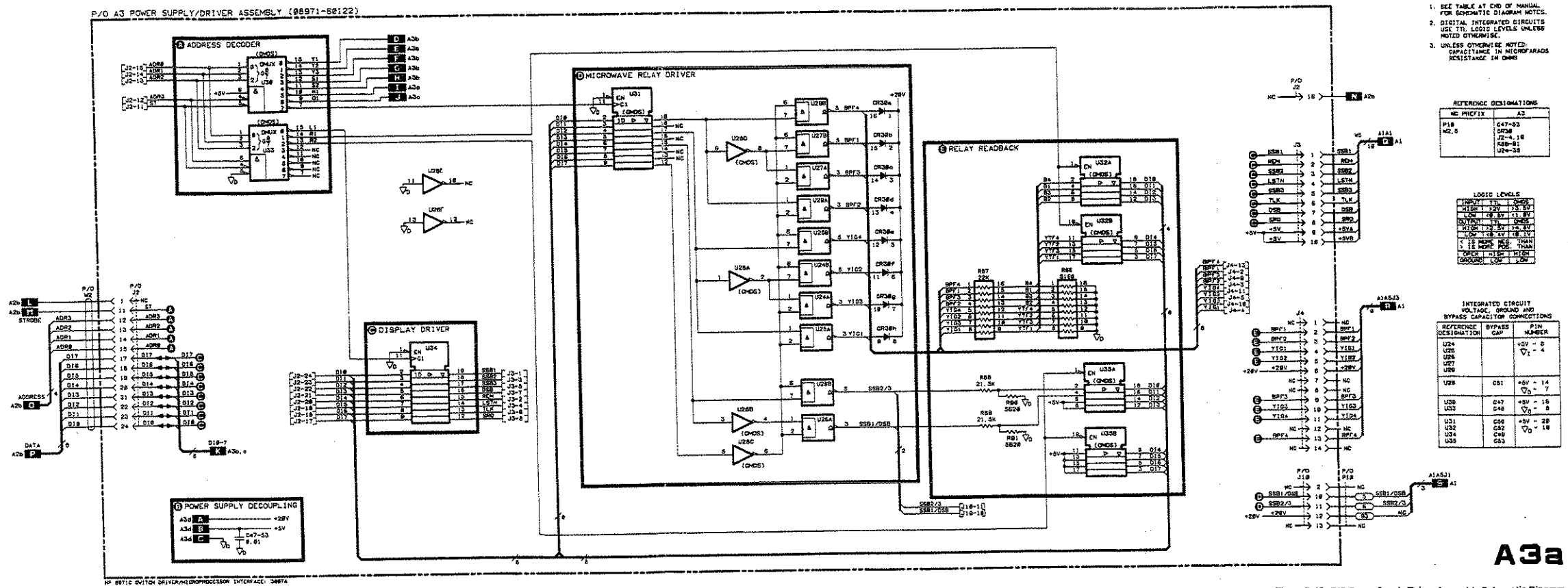


Figure 8-14. A3a Power Supply/Driver Assembly Component Locations



NOTES

1. SEE TABLE AT END OF MANUAL FOR SCHEMATIC DIAGRAM NOTES.
2. DIGITAL INTEGRATED CIRCUITS USE TTL LOGIC LEVELS UNLESS NOTED OTHERWISE.
3. UNLESS OTHERWISE NOTED: CAPACITANCE IN MICROFARADS RESISTANCE IN OHMS

REFERENCE DESIGNATIONS

NC PREFIX	A3
P18	C47-53
W2,5	CR38
	J2-4,18
	R58-81
	U24-38

LOGIC LEVELS

INPUT	TTL	CMOS
HIGH	+2V	3.5V
LOW	+0.8V	+1.5V
OUTPUT	TTL	CMOS
HIGH	>2.5V	>4.5V
LOW	<0.4V	<0.1V
1 IS MORE POS. THAN		
1 IS MORE NEG. THAN		
OPEN	HIGH	HIGH
GROUND	LOW	LOW

INTEGRATED CIRCUIT VOLTAGE, GROUND AND BYPASS CAPACITOR CONNECTIONS

REFERENCE DESIGNATION	BYPASS CAP	PIN NUMBER
U24 U25 U26 U27 U29		+2V = 8 ∇_L = 4
U28	C51	+5V = 14 ∇_D = 7
U30 U33	C47 C48	+5V = 16 ∇_D = 8
U31 U32 U34 U35	C50 C52 C49 C53	+5V = 28 ∇_D = 18

A3a

Figure 8-15. P/O Power Supply/Driver Assembly Schematic Diagram

Service Sheet A3b

YIG Filter Driver

References

Overall Block Diagram	Service Sheet BD1
Disassembly and Reassembly	Service Sheet A
Replaceable Parts List	Chapter 6
Illustrated Parts Breakdowns	Chapter 6

Principles of Operation

The input range of the Noise Figure Test Set is 0.01 to 26.5 GHz. In single sideband mode above 2.4 GHz (SSB3), a YIG Tuned Filter (YTF) selects the appropriate sideband for measurement. The YTF is tuned to the measurement frequency by a precision DC current from the YTF current driver. This precision DC tuning current is derived from digital data supplied by the HP 8970B.

YTF Voltage Reference

The YTF reference is a heater-stabilized, low-drift DC voltage which provides a stable reference for all the tuning circuits. The nominal value, −6.95 Vdc, is the reference for multiplying digital-to-analog converter (D/A) A3U15. This 12-bit (0 to 4095) D/A, followed by inverting amplifier A3U14, inverts and attenuates the −6.95 Vdc to output a positive full-scale reference voltage for 16-bit YIG tuning D/A A3U17. Input bits DS0–DS11 are captured from the 8-bit input data bus through latches A3U19 and A3U22. The full-scale voltage required by the system is determined from the coarse tuning calibration sequence controlled by the HP 8970B Noise Figure Meter. The actual voltage is set to give the YTF Tune D/A (A3U17) a step size of 0.5 MHz/bit. Full-scale voltage (TP9 VFS referenced to TP12 GND) can be between +2.57 and +2.89 Vdc depending on component tolerances of YTF driver A3Q8/Q9 and YTF A1FL1.

YTF Tune D/A

Multiplying 16-bit digital-to-analog converter (D/A) A3U17 tunes the YTF in 0.5 MHz steps. Latches A3U18 and A3U21 capture the 16-bits of information from data lines DI0-DI7. Address decoder A3U30 outputs strobe Y1 which commands latch A3U21 to capture the 8 least significant bits. Similarly, after the data on the bus has been changed, address decoder A3U30 outputs strobe Y2 which commands latch A3U18 to capture the 8 most significant bits. Address decoder A3U30 now outputs strobe Y3 which loads all 16-bits of tuning data (DY0–DY15) from A3U21 and A3U18 into D/A converter A3U17. Full-scale voltage VFS is attenuated by the YTF D/A to form the output voltage Drive V, TP10, relative to TP12 GND. This is the voltage used by the YTF current driver to tune the YTF. Unity-gain amplifiers A3U16 and A3U20 buffer the YTF D/A internally derived floating references. Drive V voltage

will always lie between the voltage segment bracketed by these two amplifiers. A3U13a converts +15 Vdc to −5 Vdc, which is necessary to bias the YTF D/A. Voltage at TP10 will be between the voltage at TP12 GND and TP9 VFS in 65536 steps, nominally 41.7 μV/bit. The actual value used to set the YTF to each measurement frequency is determined by a fine tuning routine controlled by the HP 8970B Noise Figure Meter. The fine tuning routine aligns the YTF with the system local oscillator and the Noise Figure Meter.

YTF Current Driver

YTF current driver A3U23/A3Q8/A3Q9 buffers the tuning voltage from YTF tune D/A A3U17 and converts it to a precision tuning current for the YTF. Amplifier A3U23 provides the high gain and negative feedback necessary to keep the sense voltage at the inverting input equal to the drive voltage from YTF Tune D/A A3U17. The sense voltage is developed across sense resistors A1A2R1 and A1A2R2. Transistors A3Q9 and A3Q8 boost current to assure that the current in sense resistors A1A2R1 and A1A2R2 is the same as the collector current and hence the current in the YTF tuning coil. The sense resistors are Kelvin type, minimizing errors due to voltage drops across trace resistance. Ground reference A3TP12 is also set at this point for all the YTF Driver circuits. Depending on current in the YTF this ground may be several tenths of a volt higher than chassis ground. During switching, resistor A3R72 and diodes A3VR7, A3CR25, and A3CR26 limit the transient voltage from A3U23 to +8.2 Vdc for increasing steps and −1.5 Vdc for decreasing steps. This limited voltage is input to the slow rise time circuit of A3R73 and A3C37 to limit the tuning current slew rate. Slow controlled tuning lowers the collector voltage generated by the large inductance of the YTF when tuning current is reduced. A3R74, A3C38, and A3R78 stabilize the loop by compensating for phase shifts. A3R77 compensates for DC drift. A3R79 and A3C39 prevent the tuning current from ringing during switching. Zener diode A3VR8 provides a discharge path to collapse the field generated by the YTF tuning coil in the event of a rapid decrease in tuning current. If the collector-to-base voltage of A3Q9 exceeds 39 Vdc, A3Q9 is turned on through A3VR8 to bleed current from the YTF tuning coil. This should not occur during normal operation as the slew rate limit circuit controls the voltage generated by YTF A1FL1. A3CR27 prevents damage to A3Q8 if this fault occurs.

Overcurrent Protection

An overcurrent protection circuit, A3U13 and associated components, keeps the YTF current driver from drawing excessive current from the +20 Vdc power supply during fault conditions. A3U13c is a unity gain buffer which senses the voltage across YTF current sense resistors A1A2R1 and A1A2R2. A3U13d compares the voltage to a +2.5 Vdc reference at its non-inverting input. If the buffered voltage is less then +2.5 Vdc, A3U13d output current flows through A3VR9, A3CR28, and A3R81. Diode A3CR24 is reverse biased, removing

it from the YTF current driver circuits. If the buffered voltage is greater then +2.5 Vdc, indicating greater than 1A in the YTF tuning coil, A3U13d drops, allowing A3CR24 to conduct current through A3R72, thus reducing the base voltage to A3Q8 until the YTF tuning current is less than 1A.

Troubleshooting

Troubleshooting circuits of Assembly A3b is indicated if the Noise Figure Test Set reports a YIG Coil Sensitivity Failure (Status LEDs will read 010011), or there is a failure on assembly A1 in SSB3. If the tests on the A3b circuits indicate correct operation, then the trouble is elsewhere.

Test Equipment

Digital Voltmeter	HP 3456A
Noise Figure Meter	HP 8970B
Signature Analyzer	HP 5005B

Check 1. Data Latch Signature Checks

1. Prior to troubleshooting the A3b YIG Filter Driver circuits, insure correct data is being sent from microprocessor assembly A2 to the A3 data latches (service sheet A3a).
2. Turn line power off and connect signature analyzer timing pod to the microprocessor assembly A2 test points listed in the following table.

Signal	A2 Test Point	Threshold	Polarity
START	A2TP6 SAGATE3	TTL	falling edge
STOP	A2TP6 SAGATE3	TTL	rising edge
CLOCK	A2TP5 SACLK2	TTL	falling edge
DATA		CMOS 5V	

3. Select the Scale D/A signature test on microprocessor assembly A2 by setting SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•		•	•	•		•
1			•				•	

4. Turn on line power and verify following output signatures of tuning data latch A3U19 and A3U22.

Tuning Data Latch A3U19

Pin	Input Signature	Pin	Output Signature
1	0000	19	PH31
2	33P9	18	212F
3	UF1H	17	PF82
4	881H	16	0075
5	FF02	15	P15F
6	49F8	14	FUFC
7	0A36	13	21H8
8	UF7C	12	FA10
9	P603		

Tuning Data Latch A3U22

Pin	Input Signature	Pin	Output Signature
1	0000	19	7553
2	33P9	18	PH13
3	UF1H	17	ACFO
4	881H	16	APFU
5	FF02		
6	49F8		
7	0A36		
8	UF7C		
9	P603		
11	1414		

5. If output signatures are incorrect, check input signatures. If input signatures are valid, replace A3U19 or A3U22 as applicable and remeasure. If output signatures are still invalid, replace D/A converter A3U15.
6. Select the YTF Tune D/A signature test by turning off line power and setting SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•		•
1							•	

7. Turn on line power and verify the following signatures:

Data Latch A3U21

Pin	Input Signature	Pin	Output Signature
1	Gnd	19	F3OH
2	AOF6	18	975U
3	3969	17	2C1O
4	P17U	16	H579
5	1OA5	15	AP28
6	OFA3	14	OF34
7	C2HC	13	F7C5
8	195P	12	838H
9	A3A6		
11	OC41		

Data Latch A3U18

Pin	Input Signature	Pin	Output Signature
1	Gnd	19	588A
2	AOF6	18	H2F7
3	3969	17	7U7C
4	P17U	16	HO5P
5	1OA5	15	O48P
6	OFA3	14	CU98
7	C2HC	13	4096
8	195P	12	FO86
9	A3A6		
11	8HC9		

8. If output signatures are incorrect, check input signatures.

   If input signatures are correct, replace A3U21 or A3U18 as applicable and remeasure.

   If output signatures are still incorrect, D/A converter A3U17 is probably loading the outputs; replace A3U17.

9. Turn off line power and reset SA-TEST switch A2SW2 to normal operating position:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

10. Turn on line power.

Check 2. YTF Voltage Reference

1. Connect DVM HI to A3TP9 VFS and DVM LO to A3TP12 GND. Voltage should be between +2.414 and +2.912 Vdc. If within these limits continue to Check 3 to check YTF tune D/A A3U17.
2. Connect DVM HI to A3TP8 −6.95V and DVM LO to A3TP12 GND. If the voltage is −6.8 to −7.1 Vdc continue to step 4.
3. Connect DVM HI to A3TP6 GND to verify that the Y ground is connected to chassis ground. The reading should be 0.00 to 0.05 Vdc. If this reading is out of range, inspect cable assembly A3J5 and Yig Interface Assembly A1A2 for Y ground continuity. Resistance between A3TP12 GND and A3TP6 GND should be < 0.5 ohm with Noise Figure Test Set line power off.

   If ground measurements are within limits, replace voltage reference A3U11.

   Turn on line power and return to step 1.
4. Measure the voltage between A3TP12 GND and A3U14 pin 2. If voltage is between -0.005Vdc and 0.005 Vdc, proceed to step 5.

   If voltage is less than -0.005Vdc or greater than 0.005 Vdc, replace op-amp A3U14 and remeasure.

   If voltage is still less than -0.005Vdc or greater than 0.005 Vdc, replace D/A A3U15.
5. If voltage at A3TP9 VFS is not within the range +2.414 to +2.912 Vdc, replace op-amp A3U14 and remeasure.

Check 3. YTF Tune D/A

1. Check 1 and Check 2 must be done prior to Check 3.
2. Connect the DVM HI to A3TP10 DRIVE V and DVM LO to A3TP12 GND. If voltage is between +0.183 and +0.220 Vdc, proceed to Check 4.
3. Prior to troubleshooting YTF Tune D/A A3U17, measure the voltage at the inputs of YTF current driver amplifier A3U23 to insure that A3U17 is not being loaded down. If A3U23 pin 2 is not equal to A3U23 pin 3 ±0.005 Vdc, proceed to Check 4 to troubleshoot the YTF Current Driver.
4. Use the logic probe of the signature analyzer to verify the following input bit pattern:

U17 Pin No.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	0	0	0	1	0	0	1	1	0	1	1	0	0	0	0	0

5. If this pattern is incorrect, check operation of Microprocessor Assembly A2 in accordance with Service Sheet A2a.

Note This is a code of 4960 decimal, which corresponds to the power-up YTF frequency of 2401 MHz.

6. Check D/A converter A3U17 pin 31 for +0.150 to +0.182 V and A3U17 pin 27 for +0.300 to +0.364 Vdc. If either voltage is not within limits, replace A3U17.
7. Troubleshoot buffer amplifiers A3U16 and A3U20. The outputs at pin 6 of each amplifier should be equal to the input at pin 3 ±0.005 Vdc. If the outputs are not equal to the inputs, the problem is D/A converter A3U17 or amplifiers A3U16 and A3U20. First replace amplifier A3U16 and A3U20. If the voltage DRIVE V is not +0.183 to +0.220 Vdc, replace D/A converter A3U17.

Check 4. YTF Current Driver

1. Checks 1 through 3 should be verified prior to this.
2. Measure the voltage at overcurrent protection comparator A3U13 pin 14. If voltage is greater than +8.9 Vdc proceed to step 3 to troubleshoot YIG driver A3Q8/Q9.

   The overcurrent protection circuit is interacting with the YTF driver. Troubleshoot the overvoltage protection circuit by checking voltages against those shown in functional block J on the schematic. Replace faulty components.
3. Troubleshoot YTF Current Driver A3Q8/Q9 and associated components by checking the voltages in the instrument against those shown in functional block I on the schematic. Replace faulty components.

   If a faulty YTF is suspected, turn line power off, remove cable from A3J10, and measure resistance between cable pins 1 and 3. Resistance should be 10 ±2 ohms. If it is not then YTF A1FL1 is defective. YTF A1FL1 should not be replaced in the field as this invalidates post tuning compensation set at the factory. YTF replacement should be done only at the factory.

   Leave J10 disconnected. Connect a jumper between A3J10 pins 1 and 3. Turn line power on and verify that all YTF Driver voltages are as noted on Service Sheet A3b.

Note The voltage at A3Q9 collector will now be +20 Vdc.

4. This check has verified YIG filter driver operation at 2401 MHz. If the Noise Figure Test Set does not operate at 2401 MHz, then the problem exists in the microwave chain, part of Assembly A1.

Check 5. YIG Filter Driver Verification

1. Insure the A3b YIG filter driver is operating over its full range by tuning it from 3000 MHz to 26500 MHz using an HP 8970B Noise Figure Meter to control the Noise Figure Test Set.

   Connect an HP-IB cable from the 8970B SYSTEM INTERFACE BUS connector on the rear panel of the Noise Figure Meter to the HP-IB connector on the back of the Noise Figure Test Set.

2. Turn on line power for both instruments.

3. On the Noise Figure Meter press:

PRESET	
46.1 SPECIAL FUNCTION	Disable LO commands on SIB
1.5 SPECIAL FUNCTION	Measurement mode 5
36.2 SPECIAL FUNCTION	Disable YIG tune warnings
FREQUENCY 3000 ENTER	3000 MHz
FREQ INCR 3000 ENTER	Increment of 3000 MHz

4. Connect DVM HI to A3TP11 SENSE V and DVM LO to A3TP12 GND.

5. Measure and record voltages as Noise Figure Test Set is tuned by the Noise Figure Meter increment UP key. Press FREQUENCY 26500 ENTER to make the final measurement.

Frequency (MHz)	A3TP11 Voltage
3000 MHz	_____ (Record Measurement)
6000 MHz	2 × 3000 MHz value ±0.05 Vdc
9000 MHz	3 × 3000 MHz value ±0.05 Vdc
12000 MHz	4 × 3000 MHz value ±0.05 Vdc
15000 MHz	5 × 3000 MHz value ±0.10 Vdc
18000 MHz	6 × 3000 MHz value ±0.10 Vdc
21000 MHz	7 × 3000 MHz value ±0.10 Vdc
24000 MHz	8 × 3000 MHz value ±0.10 Vdc
26500 Mhz	8.83 × 3000 MHz value ±0.10 Vdc

If voltages differ from expected values, check operation of YIG driver circuits to insure A3TP10 DRIVE V voltage is increasing and YTF driver circuits are not limiting.

Note

If any components on the A3b YIG filter driver are changed, or if A1FL1, A1A2R1 or R2 have been replaced, calibrate the YTF with the Noise Figure Meter prior to using the Noise Figure Test Set.

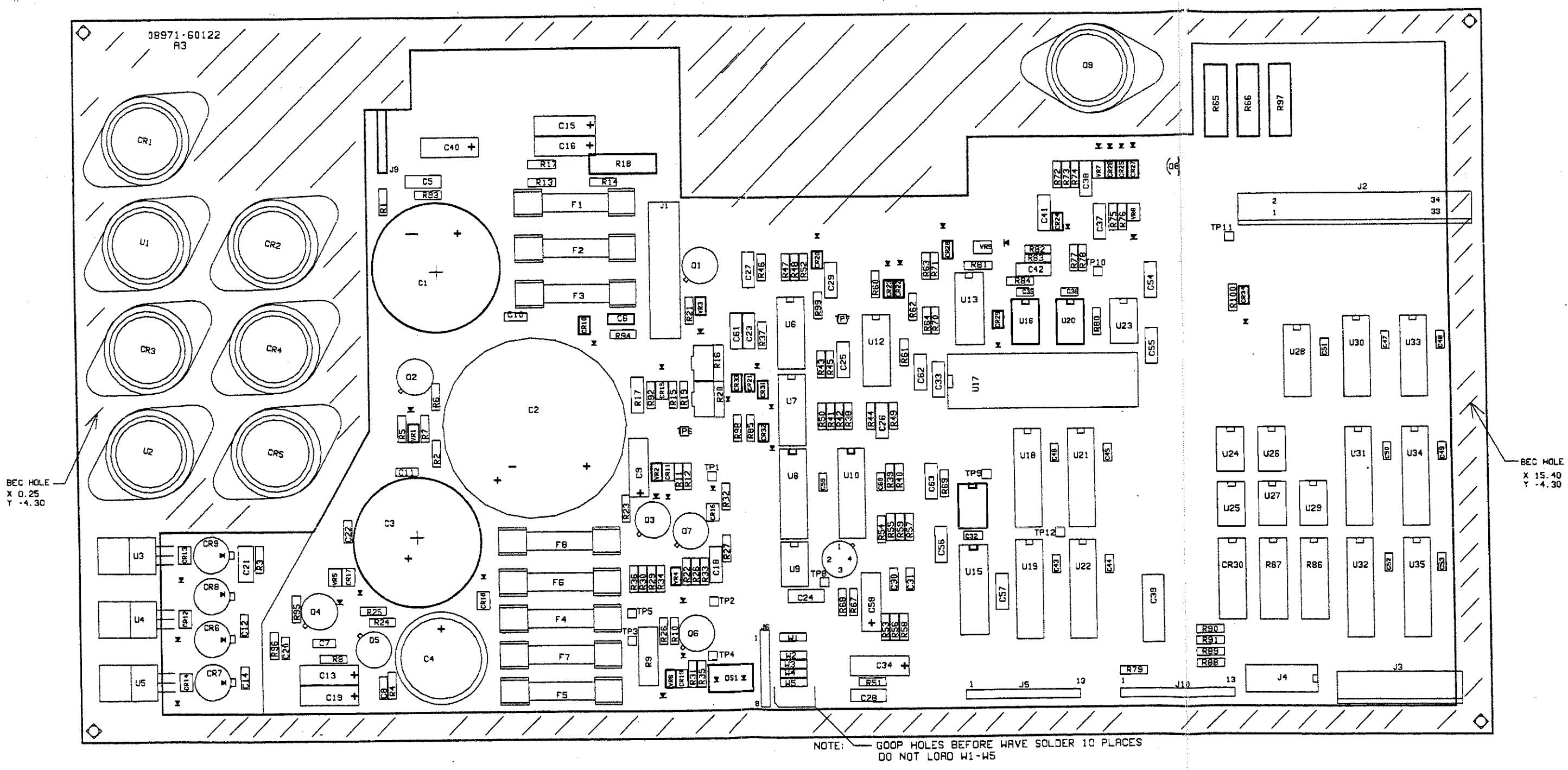
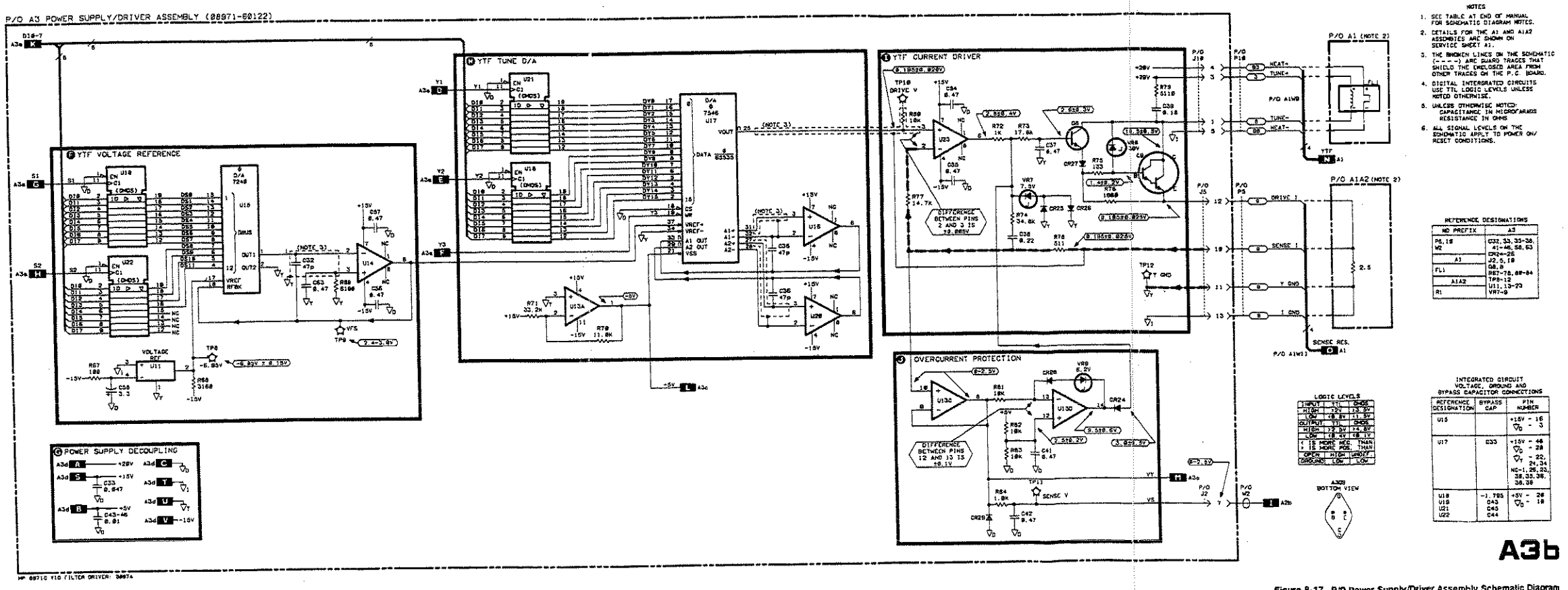


Figure 8-16. A3b Power Supply/Driver Component Locations
8-97/8-98



A3b

Figure 8-17. P/O Power Supply/Driver Assembly Schematic Diagram
8-99/8-100

Service Sheet A3c

Temperature Control

References

Overall Block Diagram	Service Sheet BD1
Microprocessor I/O and Diagnostics	Service Sheet A2b
Disassembly and Reassembly	Service Sheet A
Replaceable Parts List	Chapter 6
Illustrated Parts Breakdowns	Chapter 6

Principles of Operation

The A3c temperature control circuits work with microprocessor assembly A2 and YIG Heater Interface Assembly A1A2 to provide closed-loop temperature regulation of YIG tuned filter (YTF) A1FL1. Temperature-related tuning anomalies of the YTF are minimized by keeping the temperature constant.

The loop regulates the temperature of heat sink assembly A1A2 against a temperature reference determined by microprocessor assembly A2. By measuring input air temperature with temperature sensor U2, and adding an offset value, the microprocessor determines the regulation set point, typically 16°C above ambient, to which the YTF temperature is regulated. This temperature is represented by the DC voltage output from 8-bit digital-to-analog converter (D/A) A3U10. High-gain amplifier A3U6c amplifies the voltage differential between the temperature reference and the output of heat sink temperature sensor A1A2U1. Microprocessor A2U5 samples the amplified difference voltage RT with 8-bit analog-to-digital converter A2U25 on assembly A2. It determines whether to apply more or less heat to the A1A2 heat sink and returns correction data via PIA A2U24. A2U24 routes correction data DI0–DI7 to D/A converter A3U8. A3U8 converts the correction data to a DC voltage which drives amplifier A3U12B, which in turn drives heat sink transistors A1A2Q1/Q2. Transistors A1A2Q1/Q2 dissipate power on the heat sink to increase temperature. Air flow from the fan cools the heat sink when power to the transistors is reduced. The temperature is regulated when the heat sink sensor voltage amplified by A3U6b equals the voltage set by temperature reference D/A A3U10.

A change in instrument ambient temperature of more than ±5°C from the temperature reference can deregulate the YTF temperature and necessitate resetting the reference temperature. This condition can be detected and reset by an HP-IB controller, or by the HP 8970B Noise Figure Meter. Approximately 10 minutes is required for the temperature to stabilize after a new reference is set. As cooling is done by fan air flow across the heat sink, the removal of instrument covers may affect the temperature control loop, but typically, the loop will still function.

Temperature Control Reference Voltage

A3U9 and A3U6A form a precision +5.000 ±0.025 Vdc reference for the temperature control circuitry. This voltage is the full-scale reference for 8-bit A/D converter A2U25 and 8-bit D/A converters A3U8 and A3U10. A separate temperature control ground T is used for all temperature control circuitry and is connected to chassis ground at the star ground junction in the A3d power supply.

Ambient Temperature Sensor

Temperature sensor U2, located on the sheet metal input air duct near the fan, outputs a DC voltage that varies with ambient air temperature at a rate of 10 mV/°C. This voltage is buffered and amplified by amplifier A3U6d. The output of the amplifier, designated AT (ambient temperature), is routed to A/D converter A2U25 on microprocessor assembly A2. A/D converter A2U25 converts AT to an 8-bit digital word which is placed on bus 2 (B2D0–B2D7) and routed to the microprocessor A2U5. Upon receiving the data representing AT, the microprocessor determines what correction, if any, is necessary in the heater current to maintain the YIG temperature; makes the appropriate calculations, and passes the correction data through PIA A2U28 onto the data lines DI0 and DI7.

A2U28 also addresses address counter A3U30, which generates strobe H1 to heater driver D/A A3U8. H1 enables A3U8, which converts DI0–DI7 to a DC voltage. This voltage drives heatsink transistors A1A2Q1/Q2 via amplifier A3U12b.

Heater Driver

The heater driver circuit controls the current drawn by heater transistors A1A2Q1 and A1A2Q2. Eight-bit heater D/A converter A3U8 converts DI0–DI7 data from microprocessor A2U5 to a 0 to 5 Vdc output (19.5 mV/step) which is attenuated by A3R39 and A3R40 to a 0 to 1.5 Vdc range. Amplifier A3U12b buffers this voltage and drives heater transistor A1A2Q1 which amplifies the drive current until the voltage across sense resistors A3R65, A3R66, and A3R97 equals the input drive voltage. Amplifier A3U12A adjusts the collector-emitter voltage of heater transistor A1A2Q2 to be identical to that of A1A2Q1, assuring equal power dissipation in the two devices and symmetrical heat on the YTF.

Heater current clamp A3U12c/A3U12d prevents excessive +20 Vdc current from being drawn by the heater circuit. The drive voltage to A3U12b is reduced when the YTF driver A3Q8/Q9 is drawing excessive current. Monitoring the VY output from A3U13c, amplifier A3U13b sets a voltage reference to A3U12d that decreases as the YTF is tuned to higher frequency. If the heater drive voltage exceeds this level, A3U12d reduces the drive by conducting current through diode A3CR22 and A2R39. If the heater drive voltage is less than

the clamp level set by A3U13b, A3CR22 is reverse biased and the clamp circuit does not affect the heater drive voltage.

Troubleshooting

Troubleshooting the circuits of Assembly A3c is indicated if any of the following Noise Figure Test Set self test errors are detected:

Status LEDs 1 2 3 4 5 6	Failure
0 0 0 1 0 1	A/D Chip
1 1 0 0 1 1	Heater D/A Readback
0 0 1 0 1 1	Heater D/A Sense Readback
1 0 1 0 1 1	Temperature Reference D/A Readback
0 1 1 0 1 1	YIG Temperature Regulation Readback
1 1 1 0 1 1	Unrealistic Input Air Temperature

A failure in operation of the temperature control circuits may also be indicated by inability of the Noise Figure Test Set to perform a fine tune calibration as part of the HP 8970B Noise Figure Meter calibration or in request to Special Functions 36.3 or 36.4. After approximately 20 minutes this is reported as Noise Figure Meter error 105.

Note

The fan must be operating for heater control loop to function.

Microprocessor A2 YIG CODE A2SW1 switch 7 must be set to 1 for the loop to function at power-up.

Noise Figure Test Set rear panel HP-IB TEST 1 switch must be set to 0 and TEST 2 switch set to 1 to allow operation after detection of self test errors.

Test Equipment

Digital Voltmeter	HP 3456A
Noise Figure Meter	HP 8970B
Oscilloscope	HP 54111D
Signature Analyzer	HP 5005B

Check 1. Error Determination

The purpose of this check is to determine appropriate troubleshooting checks from error indications.

- A/D Chip Failure signified by error code 000101. Proceed to check 3 and retest after correcting problem.
- Unrealistic Input Air Temp Failure signified by error code 111011. Proceed to check 4 and retest after correcting problem.

- Temp Reference D/A Readback Failure signified by error code 101011. Proceed to check 2, then check 5. Retest after correcting fault.
- YIG Temperature Regulation Readback Failure signified by error code 011011. Proceed to check 2, check 5, then check 6. Retest after correcting faults.
- Heater D/A Readback Failure signified by error code 110011. Proceed to check 2 then check 7. Retest after faults have been removed.
- Heater D/A Sense Readback Failure signified by error code 001011. Proceed to check 2, check 7, then check 8. Retest after all faults have been removed.
- Inability to regulate temperature, indicated by Noise Figure Meter error 105 during Noise Figure Test Set fine tuning. Insure there are no self test errors at power-on, then troubleshoot at check 9.

Check 2. D/A Converter Signature Checks

1. Prior to troubleshooting on the A3c temperature control circuits, use signature analysis to insure correct data is being sent from the Microprocessor Assembly A2 to the A3c D/A converters.

   Turn line power off and connect signature analyzer timing pod to the following microprocessor assembly A2 test points:

Signal	A2 Test Point	Threshold	Polarity
START	A2TP6 SAGATE3	TTL	falling edge
STOP	A2TP6 SAGATE3	TTL	rising edge
CLOCK	A2TP5 SACLK2	TTL	falling edge
DATA		CMOS 5V	

2. Select the Reference D/A signature test on Microprocessor assembly A2 by setting SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•		•	•		•
1				•			•	

   Turn on line power and verify the following signatures on temperature reference D/A A3U10:

D/A Converter A3U10

Pin	Input Signature	Pin	Input Signature
17	768A	10	79C3
16	Gnd	9	U5AF
15	F978	8	U5H9
14	Gnd	7	A4FU
13	0008	6	46HU
12	4976	1	0000
11	147F		

If input signatures are invalid, troubleshoot either address decoder A3U30 pin 9, or PIA A2U24.

If the trouble still cannot be located, temperature reference D/A converter A3U10 may be loading PIA A2U24. Replace A3U10.

3. Select the heater D/A signature test by turning off line power and setting SA-TEST A2SW2 switch as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•			•	•		•
1			•	•			•	

Turn on line power and verify the following signatures on heatsink D/A converter A3U8:

D/A Converter A3U8

Pin	Input Signature	Pin	Input Signature
17	791H	10	92HP
16	0000	9	04CH
15	4C72	8	AHUH
14	0000	7	4UA9
13	2200	6	2951
12	P112	3	791H
11	FCF5	1	0000

If input signatures are invalid, A3U8 may be loading the drive component. Replace A3U8 and retest. If input signatures are still invalid, replace microprocessor assembly A2.

4. Turn off line power and reset SA-TEST switch A2SW2 to normal operating position.

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

5. Turn on line power.

Check 3. Temperature Control Reference Voltage

The purpose of this check is to verify operation of +5.0V reference A3U9/A3U6a.

1. Connect DVM HI to A3TP7 5V REF and DVM LO to A3R65 T ground (lead closest to rear panel, see figure 8-17).

   If voltage is +5.00 ±0.05 Vdc, proceed to check 4. If voltage is not +5.00 ±0.05 Vdc, proceed to step 2.

2. Measure voltage from A3U9 pin 6 to A3R65 T ground.

   If voltage is +5.00 ±0.05 Vdc, check A3U6, A3R37, A3C23. Replace defective component(s) and return to step 1.

   If voltage is not +5.00 ±0.05 Vdc, turn off line power, unsolder one end of A3R37, turn on line power and remeasure.

   If voltage is still not +5.00 ±0.05 Vdc, replace A3U9, resolder A3R37, and return to step 1.

3. Resolder A3R37, then isolate what is loading reference by turning off line power and disconnecting A3J2. Turn on line power. If voltage at A3TP7 5V REF is now +5.00 ±0.05 Vdc verify that the cable between A2J1 and A3J2 has no inter-line shorts. If the cable checks out properly, replace microprocessor assembly A2.

   If the voltage at A3TP7 is still not +5.00 ±0.05Vdc, the problem is probably a shorted component on Assembly A3c. Replace A3U6 and retest. If voltage does not come back to +5.00 ±0.05 Vdc, sequentially remove A3U7, A3U8, then A3U10; removal of one of these components should restore voltage to +5.00 ±0.05 Vdc.

   Replace the defective component and continue at step 4.

4. Measure reference voltage on microprocessor assembly A2 between A2U25 pin 12 (+) and A2U25 pin 16 (−).

   If not +5.00 ±0.05 Vdc, verify the continuity of the cable between A2J1 and A3J2. If the cable checks out, replace the microprocessor assembly A2. Otherwise, replace the cable.

Check 4. Ambient Temperature Sensor

The purpose of this check is to check ambient temperature sensor U2 for realistic output.

Note

An Unrealistic Input Air Temperature error (self test error code 111011 will only occur if the microprocessor reads an input temperature greater than 76 C (170 F).

1. Connect the DVM LO to A3R65 T ground (lead closest to rear panel, see Figure 8-17).

   Measure the voltage at A3U6 pin 14. If indication is 1.1 to 1.7 Vdc, proceed to step 3.

Note

Voltage is proportional to the case temperature of sensor U2 located on metal divider near fan assembly. Sensor output is 0.2 Vdc at 20°C, and increases 0.01 Vdc per degree Celsius. Conversion by A3U6 is 0.0564 volts per degree Celsius. Output of A3U6 is 1.1 to 1.7 Vdc at room temperature 20 to 30°C (68 to 86°F).

If voltage is not reasonable, measure sensor voltage at A3U6 pin 12. If voltage is not within the range +0.2 to +0.3 Vdc at room temperature, check the voltage at A3J9 pin 4. If this voltage is +5.1 ±0.4 Vdc, replace A3U2, otherwise check A3R46 and A3C27.

2. Measure voltage at A3U6 pin 14 and divide by measured voltage at A3U6 pin 12. The resulting number is the gain of U6. If gain is 5.64 ±0.1 proceed to step 3. Troubleshoot gain error by verifying correct values of resistors A3R47 and A3R48. Replace if out of tolerance more than 5 percent. If A3R47 and A3R48 are correct, check A3CR20 and A3U6, replace if necessary.

3. Verify that microprocessor assembly A2 is receiving the correct input by reading the A/D converter code.

   Set SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0			•	•	•			
1	•	•				•	•	•

   Record the lit STATUS LEDs and convert indication from binary to decimal, LED 1 being LSB and LED 8 MSB.

   Indication multiplied by 0.0195 Vdc/bit should be equal to the input from A3U6 pin 14; this corresponds to 0.346°C per bit.

   If conversion is incorrect, refer to service sheet A2b for troubleshooting.

4. Return SA-TEST switch A2SW2 to normal operating position:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

Check 5. Temperature Reference D/A

The purpose of this check is to verify operation of temperature reference D/A A3U10

Note

A Temperature Reference D/A Readback Failure (self test error code 101011) occurs if the A/D measurement of A3U10 pin 2 (A/D line 0V) exceeds 4 bits when A3U10 is set to 0, or if it is less than 230 bits or greater than 250 bits when A3U10 is set to 240.

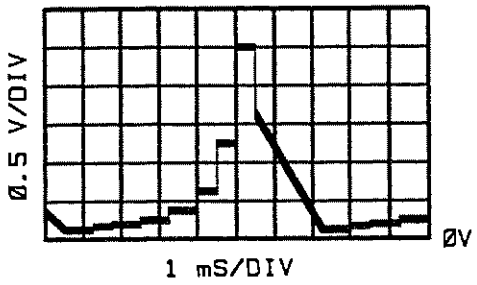
1. Check 2 step 2 should be performed prior to step 2 below.
2. Set microprocessor assembly A2 SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•		•	•		•
1				•			•	

Connect oscilloscope to temperature reference D/A A3U10 pin 2. Use DC coupling at 0.5 volt per division and 1 ms per division. Oscilloscope should show waveform below. Each of the 8 input bits is individually set then cleared, creating an eight-level staircase where each step is twice the previous value, starting at 0 Vdc.

The smallest step is 0.0195V. The ramp following the last step, 2.5V, is controlled by A3R42 and A3C26 and is unimportant. Glitches on transitions are also unimportant.



Check 5 Temperature Reference D/A Waveform

If waveform is not correct, replace D/A A3U10.

Exit test mode by turning off line power and resetting SA-TEST switch A2SW2 to normal position:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

3. The microprocessor is responsible for setting the temperature reference D/A for a 16°C rise over ambient. To determine that the proper value is set, turn on line power, measure and record voltage at A3U6 pin 14. Measure voltage at D/A A3U10 pin 2 and subtract value from voltage measured at A3U6 pin 14.

   If difference is not 0.9 ±0.1 Vdc, which corresponds to a 16°C rise, the microprocessor board A2 may be faulty. Proceed to Service Sheet A2b

Check 6. Heatsink Temperature Amplifier and Difference Amplifier

The purpose of this check is to verify operation of heatsink amplifier A3U6b and high gain difference amplifier A3U6c.

Note

A YIG Temperature Regulator Readback Failure (self test error 011011) occurs if difference amplifier does not flip between 0 and 5 Vdc at A/D converter A2U25 when temperature reference D/A A3U10 is set 0.2 Vdc below then 0.2 Vdc above the voltage from heat sink temperature amplifier.

1. Measure voltage at A3U6 pin 5 with reference to A3R65 T ground. If voltage is 0.15 to 0.50 Vdc, continue with step 4.

   Insure temperature sensor A1A2U1 is receiving the correct bias by verifying +5.1 ±0.4 Vdc at A3J5 pin 1 and ground at A3J5 pin 4. If bias is not in this range, troubleshoot A3R51, A3C28, and heatsink sensor A1A2U1 before continuing.

2. If voltage at A3U6 pin 5 is less than 0.15 Vdc, the heatsink temperature is less than 15 degrees C (59 F), which is unrealistic for room temperature operation.

   Troubleshoot by measuring A3U6b pin 5 to insure it is not loading down heatsink sensor A1A2U1. Replace A3U6 if necessary.

   If the problem cannot be located on the Assembly A3, proceed to service sheet A1 to troubleshoot heatsink sensor A1A2U1.

3. If voltage at A3U6 pin 5 is greater than 0.5 Vdc, this corresponds to a heatsink temperature greater than 50 degrees C (122 F), which is unrealistic for normal operation.

a. If A3U6 pin 5 voltage is greater than +5.1 Vdc supply level, A3U6 is pulling A1A2U1 high. Troubleshoot A3U6 and remove fault.

b. Measure voltage from A3TP11 SENSE V to A3TP12 GND. If voltage is greater than 0.3 Vdc, YIG tuned filter A1FL1 is faulty and may be supplying extra heat to the heatsink. Proceed to service sheet A3b to troubleshoot the YIG Tuned Filter Driver.

c. Turn off heatsink heaters by turning off line power, setting A2SW1 YIG CODE switch 7 to 0, and then turning on line power. If voltage across A3R65 is greater than 0.1 Vdc, proceed to check 8 to troubleshoot heater driver.

If A3U6 pin 5 is greater than 0.5 Vdc, replace A1A2U1. Refer service sheet A1.

d. Reset A2SW1 YIG CODE switch 7 to 1, then turn line power off and on before continuing.

4. Determine gain of A3U6b by dividing the measured output voltage at A3U6 pin 7 by the input voltage at pin 5.

If gain is 5.64 ±0.10, proceed to step 5.

If gain is not within limits, determine the cause of gain error by checking A3R49 and A3R50; replace faulty component before continuing.

5. Verify that microprocessor assembly A2 is receiving the correct voltage level by reading the A/D converter code as specified below.

Set A2SW2 SA-TEST switches as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0			•	•	•	•	•	
1	•	•						•

Record the lit STATUS LEDs and convert indication from binary to decimal, LED 1 being LSB and LED 8 MSB.

Indication multiplied by 0.0195 Vdc/bit, should be equal to the input voltage from A3U6 pin 7.

If conversion is incorrect, correct before proceeding. Refer to service sheet A2b for troubleshooting procedure.

Turn line power off. Return SA-TEST switch A2SW2 to normal:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

6. Turn line power off then on. If Noise Figure Test Set error code 011011 does not appear proceed to check 7.

   If a YIG Regulator Temperature Failure (self test error code 011011) has occurred, indicating the difference amplifier is not able to switch its output to either +5.0 or 0.0 Vdc given the correct inputs, proceed as follows:

   a. Troubleshoot by turning off line power, and unsoldering lead of A3R41 which is connected to A3U6 pin 7. Use a jumper wire to connect this lead to +15 Vdc at A3TP3.

   b. Turn line power on and measure voltage at A3U6 pin 8. If voltage is more negative than −10 Vdc, proceed to step 6c. If voltage is less negative than −10 Vdc, amplifier A3U6c is faulty; find and replace defective components.

   c. Measure voltage at A3U7 pin 3. If it is 0.0 ±0.1 Vdc, proceed to step 6d.

      If the voltage was not 0.0 ±0.1 Vdc, ground clamp A3U7c is not functioning. Troubleshoot by comparing measured voltages to those listed below and replace defective components.

Component	Pin	Voltage (Vdc)
A3U7	6	+5
	5	+5
	7	+5.7
	3	0
	2	0
	1	0
	10	0
	9	0
	8	0.69
A3U6c	8	-13.5

   d. Turn line power off and connect wire attached to A3R41 to −15 Vdc at A3TP5. Turn on line power and measure voltage at A3U6 pin 8. If voltage is greater than +10 Vdc proceed to step 6e. If less than +10 Vdc, amplifier A3U6 is faulty; find and replace defective components.

   e. Measure voltage at A3U7 pin 3. If voltage is +5.0 ±0.2 Vdc, the circuit is functioning; proceed to step 6f.

If voltage is not within limits, the +5.0 Vdc clamp circuit is faulty. Troubleshoot by comparing measured voltages to those listed below. Replace faulty components.

Component	Pin	Voltage (Vdc)
A3U7	6	+5
	5	+5
	7	+4.3
	3	+5
	2	+5
	1	+5
	10	0
	9	0
	8	+0.7
A3U8	8	+13.5

f. Turn off line power and return instrument to its normal state.

Resolder A3R41.

Reset A2SW2 SA-TEST switch bit 7 to 1.

Turn on line power to verify Noise Figure Test Set self test error is removed.

Check 7. Heater D/A

The purpose of this check is to verify the operation of heater D/A A3U8.

Note

A Heater D/A Readback Failure (self test error code 110011) occurs if the A/D measurement of A3U8 pin 2 (A/D line HV) exceeds 4 bits when A3U8 is set to 0, or if it is less than 230 bits or greater than 250 bits when A3U8 is set to 240.

1. Check 2 step 3 should be verified prior to step 2.
2. Set microprocessor assembly A2 SA-TEST switch A2SW2 as follows:

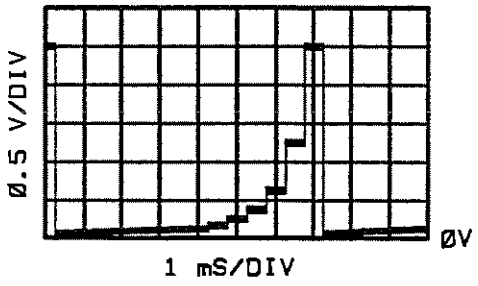
SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•			•	•		•
1			•	•			•	

Connect oscilloscope to A3U8 pin 2. Output waveform shall be as shown below. Each of the 8 input bits is individually set then

cleared, creating an eight-level staircase where each step is twice the previous value, starting at 0 Vdc.

The smallest step is 0.0195V. Glitches at the transitions are unimportant.



Check 7 Heater D/A Waveform

If waveform is not correct, replace A3U8.

Exit test mode by resetting SA-TEST switch A2SW2 to normal:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

3. Turn on line power and measure voltage at A3U8 pin 2.

   If Noise Figure Test Set self test error code 110011 does not occur, heater D/A circuits are operational.

   If error code 110011 is shown on the front panel LEDs, A/D converter A2U25 could be defective. Refer to Service Sheet A2b for troubleshooting procedure.

Check 8. Heater Driver

The purpose of this check is to ensure that heater transistors A1A2Q1 and A1A2Q2 are delivering correct power to heatsink A1.

Note

A Heater D/A Sense Readback Failure (self test error code 001011) occurs if the A/D measurement of the voltage across A3R65 exceeds 5 bits when A3U8 is set to 0, or if it is less than 65 bits or greater than 80 bits when A3U8 is set to 240.

1. Turn off line power and set A2SW1 YIG CODE switch 7 to 0.

   Turn on line power and verify A3U8 pin 2 is 0 Vdc. If it is not, troubleshoot according to procedure in check 7.

2. Measure voltages listed below for the heaters in the low power state.

   Ensure heater clamp circuit A3U12c/12d is not interfering with the drive signal. Measure voltage across diode A3CR22. If A3CR22 is forward biased (anode approximately 0.3V positive with respect to anode), remove fault in clamp circuit before continuing.

Component	Pin	Voltage (Vdc)
A3U8	2	0
A3U12	5	0
	6	0
	7	+0.54
	3	+5
	2	+5
	1	+10.5
	9	0
	10	0
	8	0
	13	+1.75
	12	+1.75
	14	+2.2
Q1	collector	+10
	base	+0.5
	emitter	0
Q2	collector	+20
	base	+10.5
	emitter	+10

   If no faults were found, continue to step 4.

3. Verify that removing the fault has corrected the self test error by turning line power off, then on to initiate the test. If Noise Figure Test Set self test error code 001011 does not occur, then proceed to check 9.

4. Turn off line power and connect wire from A3TP7 5V REF to anode of A3CR22.

   Set switch 7 of SA-TEST A2SW1 to 0.

   Turn on line power and verify voltages as listed below.

Note

Heater current clamp A3U12c/U12d limits drive voltage to 1.8 ±0.2 Vdc. A failure in this circuit may blow fuse A3F8. If this happens, remove wire from A3TP7 and return to step 2 to determine faulty components.

Component	Pin	Voltage (Vdc)
A3U12	5	+1.75
	6	+1.75
	7	+3.2
	3	+6.3
	2	+6.3
	1	+12.8
	13	+1.75
	12	+1.75
	14	+1.38
	9	+1.75
	10	+1.75
	8	+1.75
A3U13	6	0
	7	+1.75

If no faults were found, continue troubleshooting at step 6.

5. Correct faults and remove wire from A3TP7 to verify operation. Turn line power off then on to verify that Noise Figure Test Set self test error code 001011 is removed.

6. If error is still present, insure microprocessor A/D converter A2U25 is correctly reading voltage level HS from heater sense resistors A3R97, R65, and R66.

   a. Turn line power off. Set SA-TEST switch A2SW2 to view A/D converter A2U25 reading on the heater sense resistors.

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0			•	•	•		•	
1	•	•				•		•

   b. Turn on line power. Error code 001011 will be displayed as fault is still present. After 5 seconds the reading of the A/D heater sense channel HS will be displayed in binary on A2 STATUS LEDs.

   Record LED indication and convert to decimal.

   For 0 volts at A3U12 pin 5 (normal power up), the A/D A2U25 indication should be less than 5.

   For 1.8 volts at A3U12 pin 5 (TP7 connected to A3CR22 anode), A/D indication should be 87 to 97

   If indications are out of range, the problem is in A/D converter A2U25. Refer to service sheet A2b.

c. Return SA-TEST switch A2SW2 to normal operating position.

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

d. Reset switch 7 of A2SW1 to 1.

Check 9. Inability to Regulate Temperature — Final Check-out

The purpose of this check is to determine why temperature control loop is unable to regulate temperature.

Note

Error indication will be Noise Figure Meter error 105 when attempting to fine tune the Noise Figure Test Set with Special Function 36.2 inactive.

With microprocessor assembly A2SW2 SA-TEST switch in normal position, LED1 will be lit if the heater is unregulated.

It is normal for the heater to be unregulated before the Noise Figure Test Set is completely warmed up (about 10 minutes).

1. All Noise Figure Test Set self test errors must be removed before proceeding.
2. Insure A2SW1 YIG CODE switch 7 is set to 1 to enable heater control loop.

   Verify microprocessor is reading switch setting correctly by viewing switch setting on the A2 STATUS LEDs. Set SA-TEST switch A2SW2 as follows:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0		•	•	•	•	•	•	
1	•							•

   If STATUS LED 7 is not lit, troubleshoot A2 switches on service sheet A2b.

   Turn line power off. Return A2SW2 SA-TEST switch to normal position:

SA-TEST Switch A2SW2

	1	2	3	4	5	6	7	8
0	•	•	•	•	•	•	•	
1								•

3. Turn line power off then on to reset heater control loop.

   A2S2 STATUS LED 1 should light indicating temperature is not regulated. Wait 10 minutes for loop to regulate. If LED 1 goes out, loop is functioning and Noise Figure Test Set may be restored to its normal operating condition.

Note

Under certain conditions the absence of the top cover can hinder heater loop lock. In order to aid the locking process, the top cover should be installed. LED 1 can be observed through the ventilation grill at the rear of the instrument.

4. STATUS LED 1 remains lit. Measure voltage across A3R65. If voltage is greater than 1.4 Vdc, proceed to step 5.

   If voltage is varying between 0.0 and 1.5 Vdc (oscillations at a slow rate) proceed to step 6.

   If voltage is between 0.1 and 1.4 Vdc, the problem is on microprocessor assembly A2. Troubleshoot using service sheet A2b.

   If voltage is less than 0.1 Vdc, the heatsink temperature is higher than it should be.

   a. Measure case voltage of A3Q9. If voltage is not greater than +18 Vdc, troubleshoot YIG driver in accordance with service sheet A3b.

   b. Insure fan is running and fan drive voltage is +9 Vdc, measured at A3TP5 9V.

   c. Measure voltage at A3U10 pin 2. Convert to degrees Celsius by multiplying by 17.73. If result is less than 10°C above ambient, return to check 4.

   d. Measure voltage at A3U6 pin 7 and convert to degrees Celsius by multiplying by 17.73. If result is more than 22°C above ambient, replace sensor A1A2U1.

5. A3R65 voltage is greater than 1.4 Vdc implying heatsink temperature is lower than expected.

   a. Measure voltage at A3U10 pin 2. Convert to degrees Celsius multiplying by 17.73. If result is greater than 22°C above ambient, return to check 4.

   b. Measure voltage at A3U6 pin 7 and convert to degrees Celsius by multiplying by 17.73. If result is less than 10°C

above ambient, heatsink sensor A1A2U1 is probably faulty. Troubleshoot using procedure in check 6.

c. Fault could be that heater transistors A1A2Q1 and A1A2Q2 are not thermally connected to heatsink. Remove heatsink using procedure on service sheet A1 and insure transistors are screwed tightly to the heatsink. Reinstall heatsink after checking.

6. If A3R65 voltage is slowly oscillating, fault could be that heatsink sensor A1A2U1 is not making good thermal contact with heatsink.

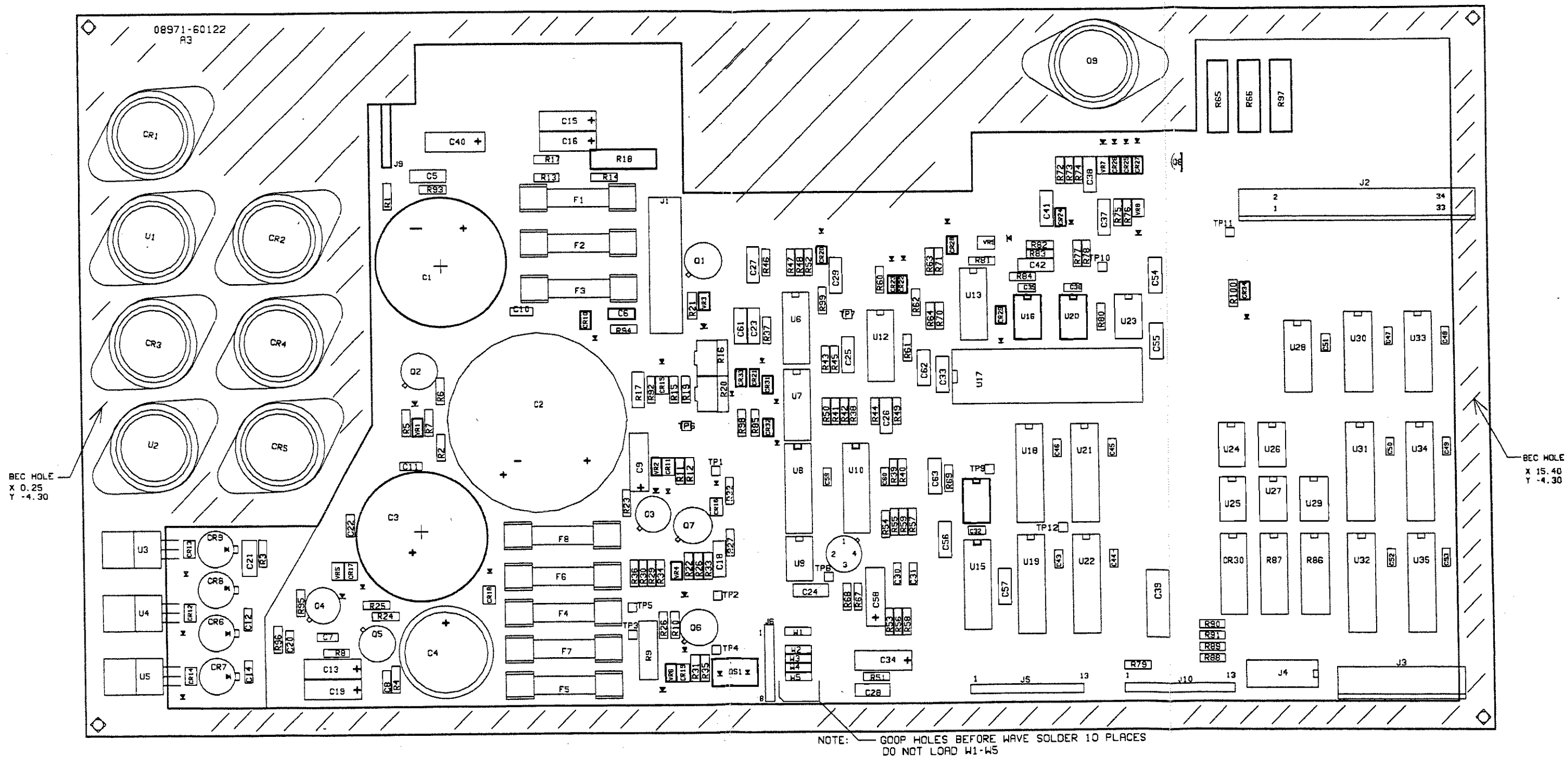


Figure 8-18. A3c Power Supply/Driver Component Locations
8-119/8-120

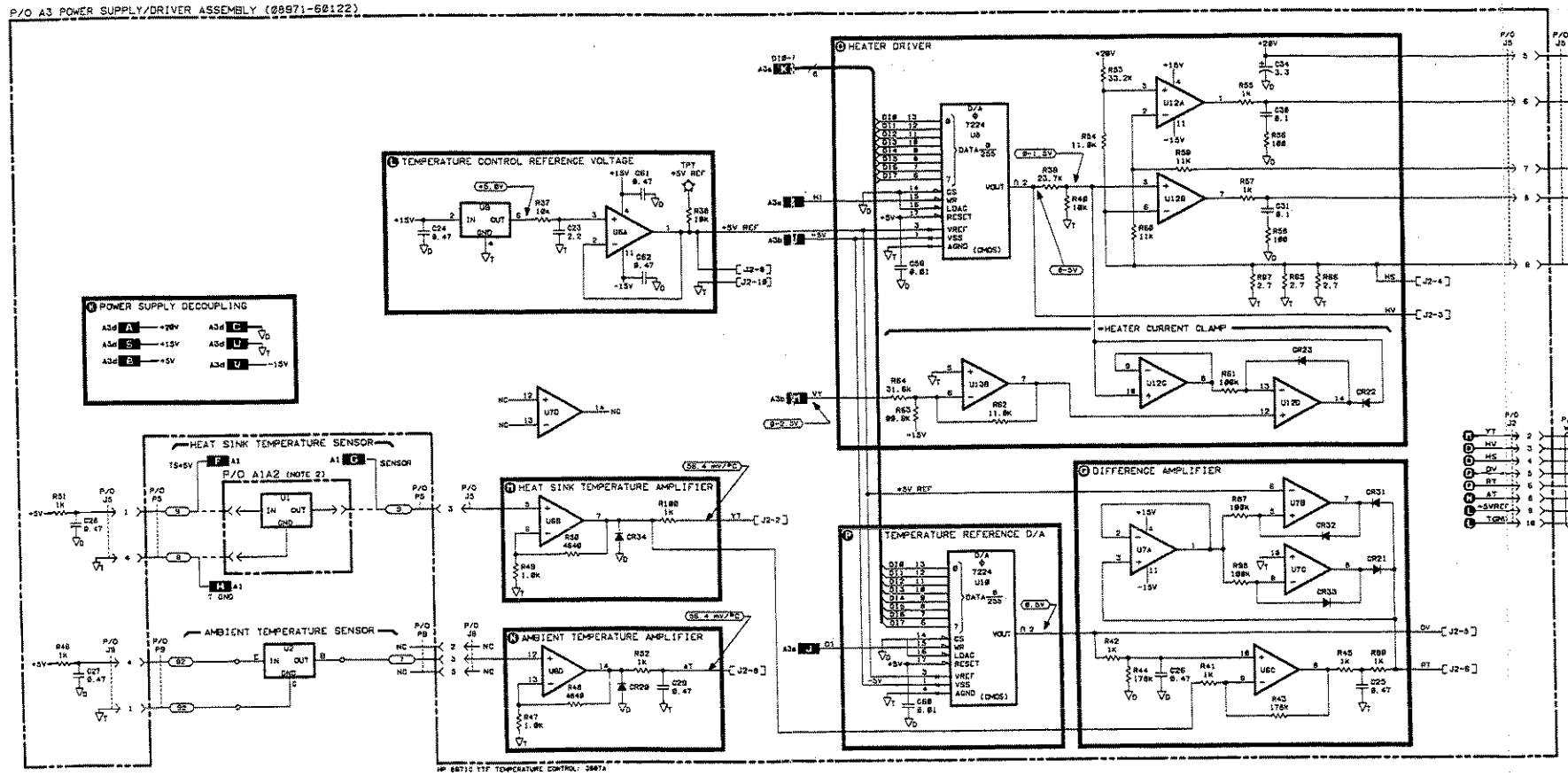


Figure 8-19. P/O Power Supply/Driver Assembly Schematic Diagram
8-121/8-122

Service Sheet A3d

Power Supply

References

Overall Block Diagram	Service Sheet BD1
Disassembly and Reassembly	Service Sheet A
Replaceable Parts List	Chapter 6
Illustrated Parts Breakdowns	Chapter 6

Principles of Operation

The power supply provides DC power to operate the various circuits in the Noise Figure Test Set. The +5.1 Vdc is used for the controller and logic circuits. The +15 and −15 Vdc supplies operate the linear circuits in the Test Set. The unregulated +15 Vdc supply is also regulated to +9 Vdc for powering the fan. The -15 Vdc and unregulated +5.1 Vdc supplies are regulated on the Interconnect/ Distribution Board (A1A5) to provide bias voltages for microwave amplifiers A1AR2 and A1AR3. The +20 Vdc supply operates the A1 microwave switches and powers the A3b YTF driver and the A3c temperature control circuits. All supplies share a common AC power source. The input line voltage can be set to 110, 120, 220, or 240 Vac. Primary fuse F1 is selected to match the operating line voltage. Selection of the line voltage is made on line power module U1, which contains a line filter and a voltage selector pinout card. Line power is routed through line switch S1 and thermal cutout switch S3 to power transformer T1. T1 provides 3 secondary voltages to feed the 3 full-wave bridge rectifiers.

+5.1 Vdc Power

At nominal line voltage, 12.5 Vac is input to +5.1 Vdc full-wave bridge rectifier A3CR1/A3CR2, giving an unregulated voltage of 12.8 Vdc. A3F1 and A3F2 protect the transformer in the event of a secondary short. Capacitor A3C1 filters the unregulated +12.8 Vdc. Adjustable regulator A3U1 regulates the +12.8 Vdc to +5.1 ±0.05 Vdc measured at TP1 (5.1V) relative to TP6 (GND). LED A3DS1e (+5.1V) indicates the supply is up. In the event of overvoltage on the regulated output, either by failure of the +5.1 Vdc regulator or by connection to a higher voltage, zener diode A3VR3 conducts, triggering SCR A3Q1. This blows fuse A3F3 and forward biases diode A3CR10, pulling down the +5.1 Vdc regulated output and removing voltage from the load circuits. +5.1 Vdc is connected to all load circuits through jumper A3W2 and is distributed on an internal layer of the A3 printed circuit board.

+15 Vdc Power

At nominal line voltage, 43 Vac is input to +15 Vdc full-wave rectifier A3CR8/A3CR9. The output, approximately 25 Vdc, is filtered by A3C3 and then regulated by A3U4 to +15 ±0.75 Vdc.

A current overload blows fuse A3F6. Overvoltage on the output of the regulator turns on zener diode A3VR5, which trips SCR A3Q4. Regulated output is brought down by the SCR, blowing fuse A3F6. Conduction through diode A3CR12 brings down a higher voltage supply if it were connected to the +15 Vdc regulated output. LED A3DS1b (+15V) lights if the supply is active.

−15 Vdc Power

43 Vac is input to −15 Vdc full-wave rectifier A3CR6/A3CR7, giving an unregulated output of −25 Vdc. A3C4 filters the −25 Vdc. A3U5 regulates the −25 Vdc to −15.00 ±0.75 Vdc. Zener diode A3VR6 conducts if over-voltage occurs on the −15 Vdc regulated output. A3Q6 then fires SCR A3Q5, which blows fuse A3F7 and brings the regulated output down via A3CR14. LED A3DS1a (−15V) signifies that the −15 Vdc supply is operational.

+20 Vdc Power

28 Vac is input to +20 Vdc full-wave bridge rectifier A3CR3/A3CR4. The rectified output, approximately 31 Vdc, is filtered by A3C2 and input to adjustable regulator A3U2. Variable resistor A3R20 sets the regulated output to +20.0 ±0.1 Vdc. Fuse A3F8 blows in the normal manner for current overload. A3F8 also blows for failures resulting in overvoltage on the regulated output. In this case, overvoltage turns on zener diode A3VR4, firing SCR A3Q3 and blowing fuse A3F8. If the line voltage is set incorrectly on the pinout card in line power module U1, high voltage which could damage the instrument is detected by the line overvoltage protection circuit. Zener diode A3VR1 conducts and trips SCR A3Q2, shorting +20 Vdc and opening main line fuse F1. Overvoltage protection for the +20 Vdc regulator A3U2 is provided by voltage detector A3VR2. If an overvoltage condition occurs SCR A3Q7 fires, shorting the voltage across A3U2. LED indicator A3DS1d (+20V) is lit if the +20 Vdc supply is active.

+9 Vdc

+9 Vdc drives the DC fan. Input to the +9 Vdc regulator is the unregulated +25 Vdc that drives the +15 Vdc regulator. A3U3 supplies +9.00 ±0.75 Vdc to the fan through jumper A3W3. LED indicator A3DS1c (+9V) is lit if the +9 Vdc supply is active.

Grounding

Several grounds are used to isolate the various circuits. All grounds are tied together and to the instrument chassis at star ground point S at the rear of the power supply printed circuit board. B ground is the power supply regulator ground reference. C is the power supply rectifier diode ground. Each power supply secondary filter capacitor has a separate direct ground connection to S. D is the logic ground and is distributed on an internal layer of the printed circuit board. I is a high-current ground for the various analog circuits. Y is the

precision ground reference for the A3b YTF driver circuits and is connected to I at the YTF driver sense resistors on YIG interface assembly A1A2. Disconnection of the A1A2 assembly from A3 will cause this ground to float. T is the reference ground for the A3c temperature control circuits and is connected to I ground near heater sense resistors A3R65, A3R66, and A3R97.

Troubleshooting

Troubleshooting is indicated for Assembly A3d when a power supply is malfunctioning.

Test Equipment

Digital Multimeter	HP 3456A
Oscilloscope	HP 54111D

Check 1. General Voltage Checks

The purpose of this check is to verify which DC voltage levels are present.

Warning

Dangerous voltages are present in line power module U1 and at the inputs to line transformer T1.

Filter capacitors will hold charge for several minutes after line power is removed. Before removing or installing fuses, monitor voltage across capacitors allowing time to discharge to < 1 Vdc.

1. If no supplies power up, as indicated by LED monitors A3DS1a - DS1e, proceed to Check 2, Total Power Failure.
2. If any fuses on Assembly A3 are blown, proceed to Check 3, Blown Secondary Fuses.
3. Connect DVM LO and oscilloscope ground to test point A3TP6 GND.

   Measure each of the regulated DC outputs to determine which of the supplies is malfunctioning.

Note

LED displays indicate a supply is up, but are not accurate enough to determine if supply is in tolerance.

Supply	Measure	Output Voltage	Ripple
+5.1V	A3TP1	+5.10 ±0.05 Vdc	<0.05 Vp-p
+15V	A3TP3	+15.00 ±0.75 Vdc	<0.05 Vp-p
−15V	A3TP4	−15.00 ±0.75 Vdc	<0.05 Vp-p
+20V	A3TP2	+20.00 ±0.10 Vdc	<0.05 Vp-p
+9V	A3TP5	+9.00 ±0.75 Vdc	not specified

4. Proceed to appropriate troubleshooting section if any or all supplies are out of tolerance.

Check 2. Total Power Failure

The purpose of this check is to identify the cause of all supplies being down.

1. Cautiously check the temperature of the power supply heatsink. If it is very hot, line thermal cutout switch S3, located on heatsink near fan, may have opened. Allow time to cool and reapply line power. If the Noise Figure Test Set now powers up, identify cause of excess heat or lack of fan cooling, correct the problem, and return to Check 1.
2. Disconnect Noise Figure Test Set from line source and ensure that voltage selector pinout card in line power module U1 is set for the correct line voltage.

   If setting is incorrect, remove pinout card from U1 and insert it in the proper position for the operating line voltage. Turn on line power. If all supplies come up, return to Check 1.
3. Check main line fuse F1. If F1 has blown, replace with the appropriate value for the operating line voltage. Turn on line power. If all supplies come up, return to Check 1; the fuse may have blown due to improper line card selection.
4. Check main line fuse F1 again. If fuse F1 has not blown, go to next step.
5. Check +20V secondary for shorted components.

   Turn off line power and measure
   and A3CR4 SCR

Note

Proper operation of the line overvoltage protection may be verified by removing A3CR4 and A3CR5. Connect an external current-limited power supply (set to less than 0.1A) to A3R5 and A3TP6 GND. Increase supply voltage to 45 Vdc; SCR A3Q2 should not trip.

Troubleshoot to replace faulty components if SCR A3Q2 trips.

6. Disconnect Noise Figure Test Set from primary line source. Check for continuity in the line primary thermal switch S3 and line power switch S1.

   If the resistance exceeds 0.5 ohm, replace the faulty switch. Turn on line power. If supplies come up, return to Check 1.

7. Turn off line power. Remove fuses A3F4, A3F5, and A3F8.

   Turn on line power and measure each of the secondary voltages of the unloaded transformer on the back side of connector A3J1, as tabulated below.

Secondary	Measurement Points	Volts AC
+5.1 V	A3J1 pin 1 to pin 2	13.75 ±1.5
±15V	A3J1 pin 7 to pin 8	42.5 ±2.5
+20 V	A3J1 pin 4 to pin 5	27.5 ±4.0

8. If any voltage is out of tolerance, replace transformer T1.
9. Replace fuses and reconnect all cables and connectors before troubleshooting the regulator assemblies.

Check 3. Blown Secondary Fuses

The purpose of this check is to determine the cause of blown secondary fuses.

Warning

Before replacing secondary fuses or components turn power off and allow enough time for filter capacitors to discharge. This can take several minutes.

1. Inspect fuses A3F3, A3F6, A3F7, and A3F8. If only one of these is blown, proceed to the check for the corresponding power supply.

Note

The +15V and +9V supplies share fuse A3F6. If A3F6 is blown, start with the +15V check, then proceed to the +9V check.

If two or more fuses have blown, there are several possibilities:

a. The loss of one supply due to an actual fault caused by another supply. In the 8971C, if the -15V supply fails, the +20V supply will fail shortly thereafter.

   If both the -15V and +20V supplies are down, replace fuses A3F7 and A3F8. Turn on line power and observe power monitor LEDs A3DS1a and DS1d. If the -15V monitor (DS1a) goes out about 1/2 second before the +20V supply monitor, proceed to the -15V check. Otherwise proceed to possibility b.

b. Two or more supplies may be shorted together. Try to locate the short (it may have been momentary) and replace the fuses. If supplies come up when line power is turned on, return to Check 1.

   If fuses continue to blow and no shorts were found, proceed to possibility c.

c. Two or more supplies have individual problems. Perform the check for each supply.

2. Inspect fuses A3F1 and A3F2. If neither is blown proceed to step 3.

   a. Turn off line power and remove fuse A3F3. Measure resistance from A3C1 to A3TP6 GND. If resistance does not reach 100 ohms in 1 minute, replace A3C1 and fuses, and turn line power on. If fuses do not blow, proceed to step 4.

Note

DVM may take a long time to stabilize, as A3C1 needs time to charge.

   b. Remove A3CR1 and A3CR2. Measure the reverse resistance of the diodes with the DVM manually set to the 10K ohm range. If this does NOT cause an over range indication, replace the faulty diode(s). Otherwise, reinstall A3CR1, A3CR2, and A3F3 and replace A3F1 and A3F2.

3. Inspect fuses A3F4 and A3F5. If neither is blown, proceed to step 4.

   a. With line power off, remove fuses A3F6 and A3F7. Measure resistance from A3C3+ to A3TP6 (GND); see following note. If the resistance does not reach 100 ohms in 1 minute, replace A3C3 and fuses and turn on line power. If fuses do not blow, go to step 4.

   Turn line power off. Remove fuses A3F4 and A3F5. Measure resistance from A3C4 to A3TP6 (GND); see note below. If the resistance does not reach 100 ohms in 1 minute, replace A3C4 and fuses, and turn on line power. If fuses do not blow, go to step 4.

Note Resistance indication may take a long time to stabilize as capacitors must charge.

b. With line power off, remove A3CR6 - CR9. Measure the reverse resistance with the DVM manually set to the 10K ohm range. If this does NOT cause an over range indication, replace the faulty diode. Otherwise, reinstall A3CR6 - CR9 and replace A3F4 and A3F5.

4. Insure that the correct fuses are installed and leads of any replaced components are clipped close enough to the board to prevent shorting to the bottom cover.

   Verify that turning on the line power does not blow fuses A3F1, F2, F3, or F4.

   Return to Check 1 to determine if all faults have been corrected.

Check 4. +5.1 Vdc Power

The purpose of this check is to verify that the +5.1 Vdc supply is at the correct level.

1. If +5.1 Vdc level is +5.1 ± 0.5 Vdc, proceed to step 5. If fuse A3F3 is blown, proceed to step 3.
2. Turn on line power and measure DC voltage at cathode (case) of A3CR2. If voltage is +10.5 to +15.5 Vdc with < 1.5V peak-to-peak ripple, proceed to step 4.
   a. If ripple is excessive, replace A3C1, remeasure, then return to step 1.
   b. If the voltage is out of specified range, verify that the voltage selector card in line module U1 is set for the correct line voltage.

      If the setting is incorrect, remove the card and reinsert it in the proper position for the operating line voltage, then return to step 1.
   c. Measure AC voltage between A3F1 and A3F2. If less than 11 Vac, replace transformer T1.
   d. If AC voltage is greater than 11 Vac and DC is less than +10.5 Vdc, diodes A3CR1 and A3CR2 may be open. Measure forward and reverse resistance of the diodes. Replace if faulty.
3. Troubleshooting blown fuse A3F3. Turn line power off and remove A3F3.
   a. Disconnect the cable from A3J7 to A1A5J1. Replace fuse A3F3, then turn on the line power. If the fuse does not blow, troubleshoot the A1A5 board per service sheet A1, then proceed to step 3g.

b. With line power off, unsolder the anode (A) of A3Q1. Measure the resistance from the case of A3Q1 to ground.

If the resistance is less than 100 ohms, replace A3Q1 and fuse A3F3, then turn power on. If the fuse does not blow, proceed to step 3g.

If the resistance is greater than 100 ohms, resolder the anode of A3Q1.

c. With line power off, measure the reverse resistance of A3CR10 using the 10K ohm range. If this does NOT cause an over range indication, replace A3CR10 and fuse A3F3, then turn line power on. If the fuse does not blow, go to step 3g.

d. Turn off line power, remove regulator A3U1 and replace fuse A3F3. If the fuse still blows when line power is applied, then a voltage greater than +5V may be connected to the load.

The +15 Vdc, +9 Vdc, or +20 Vdc supply may be shorted to the +5.1 Vdc output. In this case, diode A3CR10 should have conducted when the SCR A3Q1 was turned on and the offending supply should have been shorted.

If the +5.1V supply is shorted to another supply, remove the short before continuing. Resolder regulator A3U1 and turn line power on. Proceed to step 3g if fuse does not blow.

Warning  **Do not disable protection circuitry A3VR3/A3Q1 as logic circuits may be damaged if high voltage is present on +5.1 Vdc line.**

e. Turn off line power and unsolder the power supply side of jumper A3W2. Reinstall regulator A3U1 if it was removed. Replace fuse A3F3, turn line power on and measure voltage at A3TP1 5.1V.

If the voltage is 5.0 ±0.5 Vdc, proceed to step 3f.

If fuse A3F3 did not blow, but regulator did not power up to 5.0 ±0.5 Vdc, proceed to step 4 to troubleshoot regulator.

If fuse A3F3 again blew, the problem may be with overvoltage protection network A3VR3/A3Q1. Replace fuse A3F3 and unsolder lead of zener diode A3VR3. Turn on line power. If voltage at A3TP1 5V is greater than +5.5 Vdc proceed to step 4 to troubleshoot regulator.

If voltage is less than +5.5 Vdc, replace A3VR3 and turn line power on to verify regulator powers up. Proceed to step 3g.

f. If the regulator did power up with the load disconnected, there is a short on the +5.1V line. Find the short on the A2 or A3 assemblies and remove it.

Note It may be helpful to connect an external current-limited power supply, set to +5.1 Vdc and 1A, to jumper A3W2 and A3TP6 GND to isolate short. Leave Noise Figure Test Set line power off and turn the external supply on to locate short.

g. If necessary, resolder A3W2 and reconnect the cable from A3J7 to A1A5J1. Return to step 1.

4. Troubleshooting regulator A3U1.

   a. Turn line power on and measure voltage across resistor A3R13. If it is not 1.25 ±0.05 Vdc, replace regulator A3U1 and remeasure.

      Continue at step 5 if voltage comes up to +5.0 ±0.5 Vdc.

   b. With line power off, check the voltage control network by unsoldering the lead of A3R13 connected to A3U1. Measure resistance of A3R13 and replace if it is not 200 ±10 ohms. Measure resistance from junction of A3R13 and A3R14 to ground. Isolate and replace faulty component if reading is not 625 ±100 ohms.

      Resolder A3R13.

5. Adjusting regulator.

   Measure voltage from A3TP1 (5.1V) to A3TP6 (GND). Adjust resistor A3R16 (5.1V ADJ) until voltage is 5.10 ±0.05 Vdc.

Check 5. +15 Vdc Power

1. Check fuse A3F6. If it has blown, proceed to step 3.
2. Turn on line power and measure dc voltage at A3F6. If voltage is +21 to +30 Vdc with < 1.5V peak-to-peak ripple proceed to step 4.

   a. If ripple is too high, replace A3C3, remeasure, then proceed to step 4.

   b. If the voltage is out of the specified range, verify that the voltage selector card in line module U1 is set for the correct line voltage.

      If the setting is incorrect, remove the card and reinsert it in the proper position for the operating line voltage, then return to step 1.

   c. If dc voltage is low, measure ac voltage between A3F4 and A3F5. If less than 40 Vac, replace transformer T1.

   d. If voltage is greater than 40 Vac, and dc voltage is less than +21V, diodes A3CR8 and/or A3CR9 may be open. Measure forward and back resistance, replace if faulty.

3. Troubleshooting blown fuse A3F6. Turn line power off and replace A3F6 if it is open. Turn on line power. If fuse does not blow, problem was most likely a momentary short. Inspect back side of PC board for traces which could have shorted to bottom cover. Proceed to step 4 if fuse A3F6 is not blown.

   a. Unplug line cord and disconnect fan connector A3J9, near fan.

      Plug in line cord and turn on line power. If fuse A3F6 still blows, unplug line cord and reconnect connector A3J9. Continue to step 3b.

      If fuse did not blow, problem is excessive current to the fan. Replace fan assembly and continue at Check 1 to locate other faults.

   b. Turn line power switch off, remove fuse A3F6 (if it is not blown), unsolder the anode (A) of A3Q4, and measure the resistance from A3Q4 anode (case) to A3TP6 (GND).

      If resistance is less than 100 ohms, replace A3Q4 and fuse A3F6. Turn line power on. If fuse does not blow continue to step 4.

      If the resistance exceeds 100 ohms, resolder the anode of A3Q4.

   c. Turn off line power and measure reverse resistance across diode A3CR12 using the 10K ohm range on DVM. If this does NOT cause an over range condition, replace A3CR12 and fuse A3F6. Turn line power on, if the fuse does not blow, proceed to step 4.

   d. Turn off line power and measure the reverse resistance across diode A3CR13 using the 10K ohm range on DVM. If this does NOT cause an over range indication, replace A3CR13 and fuse A3F6. Turn on line power, if fuse does not blow proceed to step 4.

   e. With line power off, unsolder and remove regulators A3U3 and A3U4. Replace fuse A3F6 and turn line power on. If A3F6 does not blow when line power is turned on, replace regulator A3U4 and proceed to step 3f.

      A blown fuse is most likely caused by a short to a voltage greater than +18V on the regulated +15 Vdc load. Find the fault and remove it.

      Replace removed components and return to Check 1 to verify operation.

   f. With line power off, unsolder zener diode A3VR5 and measure its resistance. If diode is shorted (zero resistance in both directions), replace and return to Check 1.

   g. Reinstall regulator A3U3, replace fuse A3F6, and turn on line power.

If the fuse blows, either A3U3 or A3CR17 are bad. Replace any faulty components, reinstall any previously removed components, and return to Check 1.

h. Reinstall regulator A3U4 and zener diode A3VR5 if they were removed. Unsolder power supply side of jumper A3W4. Turn line power on and measure voltage at A3TP3 (15V). If fuse A3F6 does not blow proceed to step 3i.

Regulator A3U4 is most likely bad, replace and remeasure.

If voltage comes up to +15 ±1 Vdc, reconnect A3W4 and return to Check 1.

i. If the fuse still blows and voltage is approximately +15 Vdc, the problem is a short on the load.

Find the short on Assembly A3 and remove it.

Note

It may be helpful to connect an external current-limited power supply, set to + 15 Vdc and 0.5A, to jumper A3W4 and A3TP6 GND to isolate short. Leave Noise Figure Test Set line power off and turn on external supply to locate short.

j. Replace jumper A3W4 and continue at Check 1.

4. Measure voltage at A3TP3 (15V). If voltage is not between +14.25 and +15.75 Vdc, turn line power off and replace regulator A3U4.

Turn line power on and verify that voltage is correct. Return to Check 1.

Check 6. +9 Vdc Power

1. If fuse A3F6 is blown, go to Check 5 step 3.
2. Measure unregulated voltage at A3F6. If it is not +21 to 30 Vdc, with less than 1V peak-to-peak ripple, proceed to Check 5 step 2.
3. Measure voltage at A3TP5 (+9V). If voltage is greater than +8.25 Vdc, proceed to step 5.

Turn off line power. Measure load resistance from jumper A3W3 to ground. If it is less than 50 ohms, locate and remove short.

Turn on line power. If A3TP5 voltage is +8.25 to +9.75 Vdc, proceed to step 8.

4. Turn off line power and disconnect A3J9 near fan.

Turn on line power and measure voltage at A3TP5 (+9V). If voltage now is greater than +8.25 Vdc the fan assembly is faulty. Replace fan assembly and return to Check 1.

5. Turn on line power and measure voltage across A3R95. If voltage is 1.2 to 1.3 Vdc, proceed to step 6.

If voltage across A3R95 is not within specified range, the regulator is faulty. Replace A3U3 then proceed to step 7.

6. Turn line power off and unsolder lead of A3R95 connected to A3U3. Measure resistances of A3R95 and A3R96 and replace faulty resistor.
7. Replace all components that were removed and verify voltage at A3TP5 (+9V). Return to Check 1.

Check 7. −15 Vdc Power

1. Check fuse A3F7. If it has blown, proceed to step 3.
2. Turn on line power and measure rectified voltage at A3F7. If voltage is −21 to −30 Vdc with < 1.5V peak-to-peak ripple proceed to step 4.
   a. If ripple is excessive, replace A3C4, remeasure, then return to step 1.
   b. If the voltage is out of the specified range, verify that the voltage selector card in line module U1 is set for the correct line voltage

      If the setting is incorrect, remove the card and reinsert it in the proper position for the operating line voltage, then return to step 1.
   c. If dc voltage is low, measure secondary ac between A3F4 and A3F5. If reading is less than 40 Vac, replace transformer T1.
   d. If ac voltage is greater than 40 Vac and rectified dc is less than −21V, diodes A3CR6 and/or A3CR7 may be open. Measure and replace if faulty.
3. Troubleshooting blown fuse A3F7.
   a. Replace fuse A3F7 and turn on line power. If A3F7 does not blow the problem was most likely a momentary short. Inspect back side of PC board for component leads which may have shorted to bottom cover. Proceed to step 4 if fuse was not blown.
   b. Disconnect the cable from A3J8 to A1A5J1. Replace fuse A3F7 and turn on line power. If the fuse does not blow, troubleshoot board A1A5 per service sheet A1, then proceed to step 3f.

      With line power off, unsolder the cathode (C) of A3Q5. Measure the resistance between the case and cathode of A3Q5.

      If the resistance is less than 100 ohms, replace A3Q5 and fuse A3F7. Turn on line power. If the fuse does not blow, proceed to step 3f.

      If the resistance exceeds 100 ohms, resolder the cathode of A3Q5.

c. With line power off measure the reverse resistance of diode A3CR14 using the 10K ohm range on the DVM. If this does NOT cause an over range indication, replace A3CR14 and fuse A3F7 and turn on line power. If the fuse does not blow, proceed to step 3f.

d. Unsolder power supply jumper A3W5. Turn on line power. If fuse does not blow, proceed to step 3e.

Problem is either regulator A3U5 or overvoltage detector A3VR6. Unsolder anode of A3VR6 and turn on line power. If voltage at A3TP4 is more negative than −15.75 Vdc, replace regulator A3U5.

If voltage is less negative than −15.75 Vdc, the cause of blown fuse A3F7 is the overvoltage detection circuit. Troubleshoot A3VR6, A3Q6, A3Q5, and associated resistors.

e. If fuse did not blow in step 3d with A3W5 removed, problem is with −15 Vdc load drawing excessive current. Read the following note and troubleshoot A3 Assembly to find a short and replace faulty components.

Note

It may be helpful to connect an external current-limited power supply, set to −15 Vdc and 0.5A, to jumper A3W5 and A3TP6 GND to locate short. Leave Noise Figure Test Set line power off and turn on external power supply to find short.

f. If necessary, reinstall A3W4 and reconnect the cable between A3J8 and A1A5J1. Go to check 1.

4. Measure voltage at A3TP4 (−15V). If voltage is not −14.25 to −15.75 Vdc, replace regulator A3U5.

Verify that output voltage is −15.00 ±0.75 Vdc, and return to Check 1.

Check 8. +20 Vdc Power

1. If A3TP2 +20V voltage is +20 ±3 Vdc, proceed to step 5 for adjustment.

If fuse A3F8 is blown, proceed to step 3 to troubleshoot.

2. Turn on line power and measure dc voltage at cathode (case) of A3CR5. If voltage is between 25 to 45 Vdc with < 1.5V peak-to-peak ripple proceed to to step 4.

a. If ripple is greater than 1.5V peak to peak at A3CR5, replace A3C2, remeasure, and return to step 1.

b. If the voltage is out of the specified range, verify that the voltage selector card in line module U1 is set for the correct line voltage.

If the setting is incorrect, remove the card and reinstall it in the proper position for the operating line voltage, then return to step 1.

c. If dc voltage is low, measure ac on bottom side of A3 PC board from A3J1 pin 4 to A3J4 pin 5.

If reading is less than 24 Vac, replace transformer T1.

d. If ac voltage is greater than 24 Vac and rectified dc voltage is less than 25 Vdc, diodes A3CR3, A3CR4, and/or A3CR5 may be open. Measure and replace if faulty.

3. Troubleshooting blown fuse A3F8.

a. Replace fuse and turn on line power.

If fuse does not blow, the problem was most likely a momentary short. Inspect the back side of the PC board for component leads that may have shorted to the bottom cover. Return to step 1.

b. Turn line power off, remove fuse A3F8 and desolder the anode (A) of A3Q3. Measure resistance from A3Q3 anode (case) to ground.

If reading is less than 100 ohms, replace A3Q3 and A3F8. Turn power on. If fuse does not blow return to step 1.

If the resistance exceeds 100 ohms, resolder the anode of A3Q3.

c. With line power off, measure reverse resistance of diode A3CR11 using 10K ohm range on DVM. If this does NOT cause an over range condition, replace A3CR11 and fuse A3F8, then turn on line power.

Return to step 1 if fault is found which prevents fuse A3F8 from blowing when line power is turned on.

d. Remove regulator A3U2, install new fuse A3F8 and turn line power on. If fuse does not blow continue at step 3e.

Turn off line power and check for correct operation of A3Q3 and A3VR4 circuits by unsoldering power supply side of jumper A3W1 and connecting an external current-limited power supply + to A3CR16 cathode and − to ground. Set current limit to 100 mA. Connect DVM to A3TP2. With line power off, slowly increase external power supply voltage until A3Q3 begins to conduct (indicated by sudden jump in external supply current). If DVM indicates less than 22V at start of conduction, replace A3VR4.

Now short A3CR16 cathode to ground, connect external power supply + to A3CR11 cathode, and slowly increase voltage to 25V. If A3Q7 conducts (a short to ground), replace A3VR2.

Remove external power supply and disconnect short across A3CR16. If the fault was located, replace fuse, components,

and then turn on line power to verify fuse no longer blows. If fuse does not blow, continue to step 1.

e. With line power off, unsolder power supply side of jumper A3W1 and reinstall regulator A3U2.

Turn on line power. If fuse A3F8 does not blow continue to step 3f.

If fuse blows, troubleshoot by measuring resistances of A3R17 and network of A3R18, R19, and R20. If resistances are not correct, replace faulty components.

A3R17	=	121 ±5 ohms
A3R18 to ground	=	1.5k to 2.0k ohms

If resistances are correct replace A3U2.

f. If fuse A3F8 did not blow with load removed. The problem is too high load current. Read the following note and find short on Assembly A3.

Note

It may be helpful to connect an external current-limited power supply, set to +20 Vdc and 2A, to unsoldered jumper A3W1 and A3TP6 (GND) to isolate short. Leave Noise Figure Test Set line power off and turn the external supply on to locate short.

Replace A3W1 and continue at step 1.

4. Troubleshooting regulator A3U2.

Turn line power on and measure voltage across resistor A3R17. If it is not 1.25 ±0.05 Vdc, replace regulator A3U1 and remeasure.

Continue to step 5 if regulated power is +20 ±3 Vdc.

5. Adjusting regulator.

Measure voltage from A3TP2 (20V) to A3TP6 (GND). If necessary, adjust A3R20 until voltage is +20.0 ±0.1 Vdc.

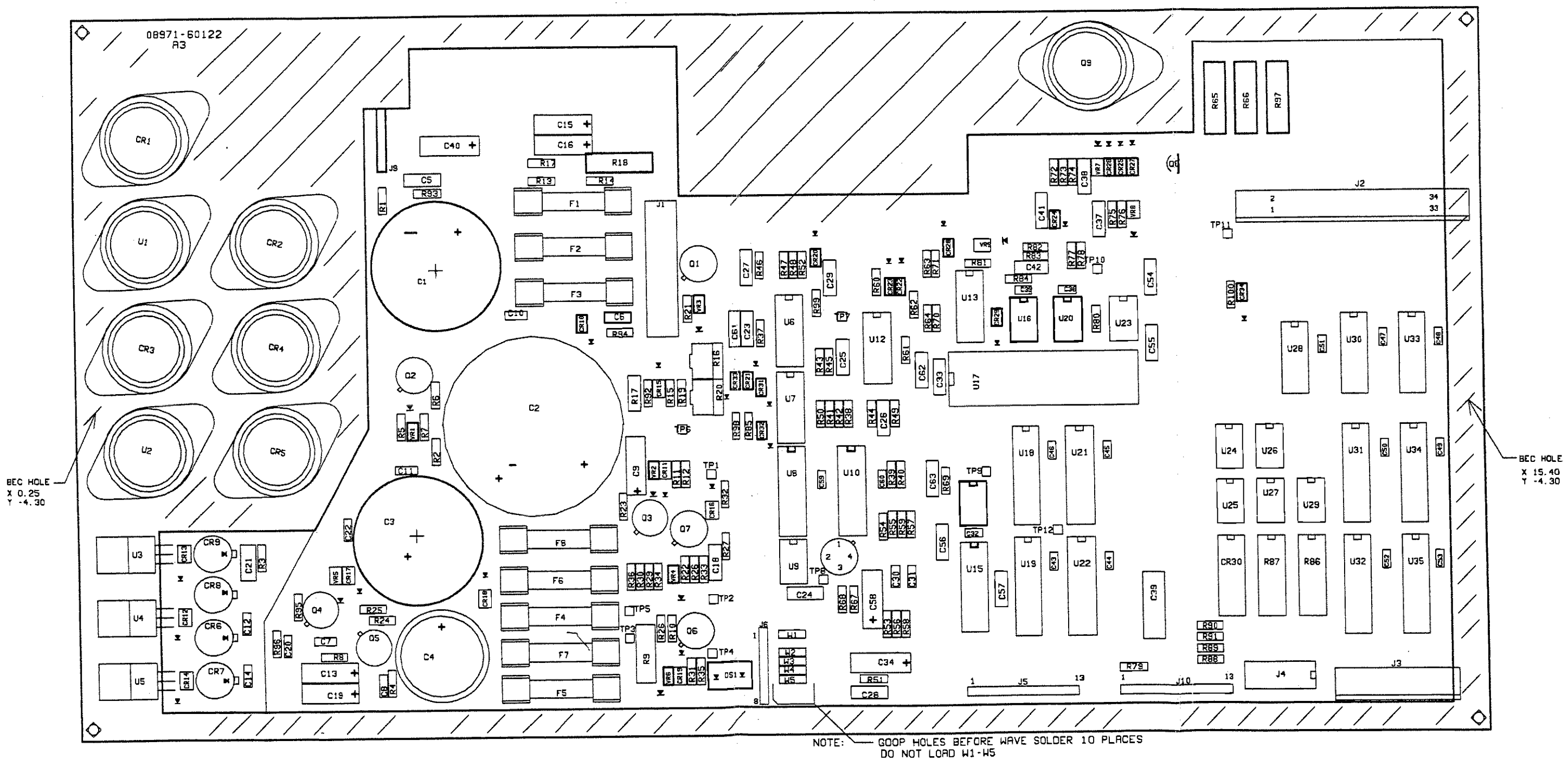


Figure 8-20. A3d Power Supply/Driver Component Locations
8-139/8-140

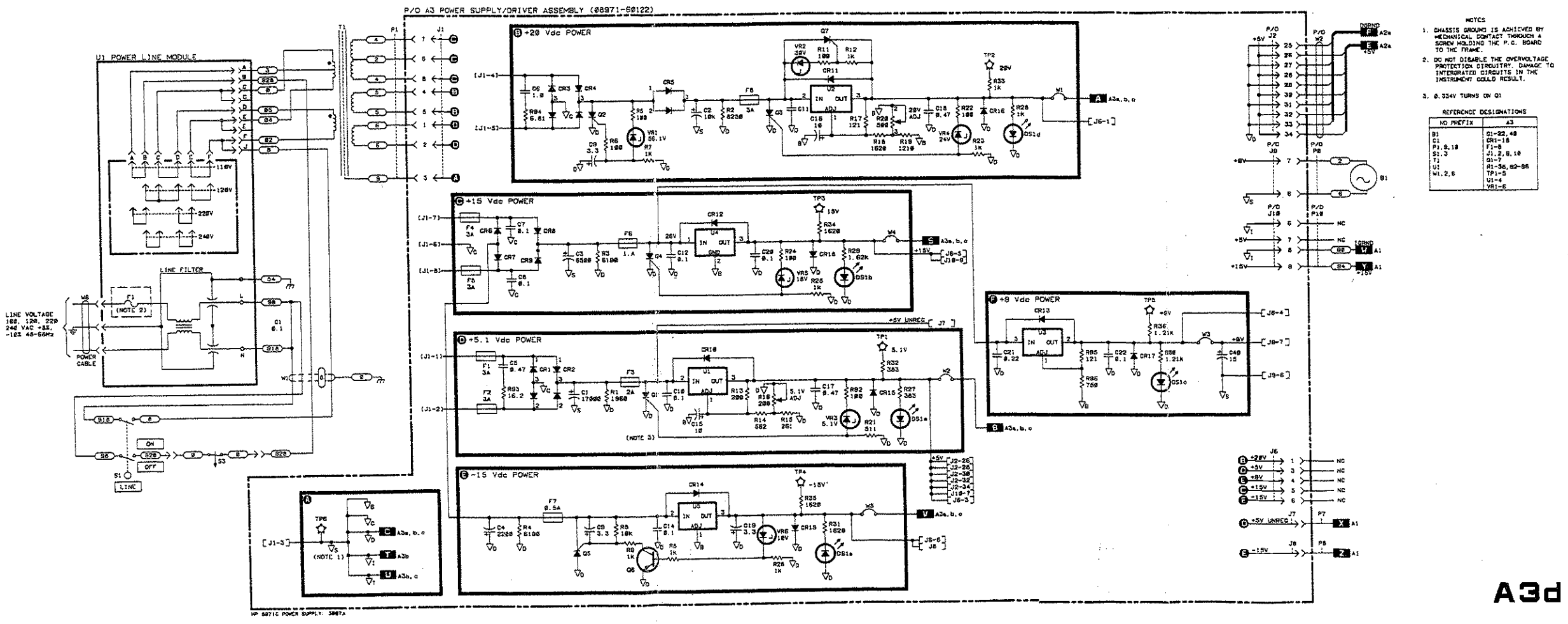


Figure 8-21. P/O Power Supply/Driver Assembly Schematic Diagram
8-141/8-142

Disassembly Procedures

Warning **Before beginning any disassembly procedure, be sure that the line (Mains) voltage is disconnected. Voltages exist that can cause personal injury.**

Caution Damage to APC3.5 RF connectors can degrade instrument performance. Be careful when removing or replacing components or cables with these connectors.

Be aware of self-tapping screws and captive nuts. Stripped threads can cause grounding problems if that screw or nut is used as a ground point.

Top and Bottom Covers

1. Position the instrument with the appropriate cover up.
2. Remove the two plastic standoffs at the rear of the instrument.
3. Unscrew the Pozidriv screw at the middle of the rear edge of the cover. This is a captive screw and will cause the top cover to move away from the frame.
4. Slide the cover away from the front frame and remove it.
5. To replace the cover slide it into position, engage the screw and tighten. Be careful that the front edge of the cover fits into the slot provided.

A1 Microwave Assembly

Refer to figure 6-3 "A1 Microwave Assembly Removal" and follow this procedure:

1. Remove the rear feet.
2. Remove the top and bottom covers.
3. Pry the plastic trim strip from the top of the front frame.
4. Turn the instrument rightside up. Locate the line switch and the attached cable. Two screws secure the line switch to the bottom of the front frame and one screw holds a cable tie which holds the cable to the right side frame. Remove the right handle and side trim. Remove the first cable tie.
5. Turn the instrument on its side with the line switch up.
6. While holding the instrument (so it will not fall over) remove 5 screws (MP86 to 91) from the bottom edge and three screws from the top edge of the front frame. Remove 8 screws (4 in front and 4 in back, MP77–MP84) holding the large black heat sink to the bottom chassis.
7. Turn the instrument right side up and carefully move the line switch and attached cable up and away from the A1 Assembly.

8. Disconnect all other attached cables from other assemblies.
9. Slide out the front panel and A1 Microwave Assembly as one piece from the front of the frame.
10. Microwave Assembly installation is the reverse of removal.

A1J1, A1J2, A1J3 Front Panel RF Connectors

Refer to figure 6-4.

1. Remove the A1 Microwave Assembly as described above.
2. Loosen the hex nut behind the connector.
3. For A1J1 or A1J3 (Output connectors), disconnect the semi-rigid cable from the rear of the connector.
4. For A1J2 (LO Input connector), disconnect A1AT3 attenuator at the rear of the connector.
5. Remove the connector.
6. To replace the connector, reverse steps 1 through 4.

Note

Note that the LO INPUT and RF OUTPUT connectors have an adapter. The adapter must be positioned so that the bosses on the front of the adapter are aligned with the holes in the panel.

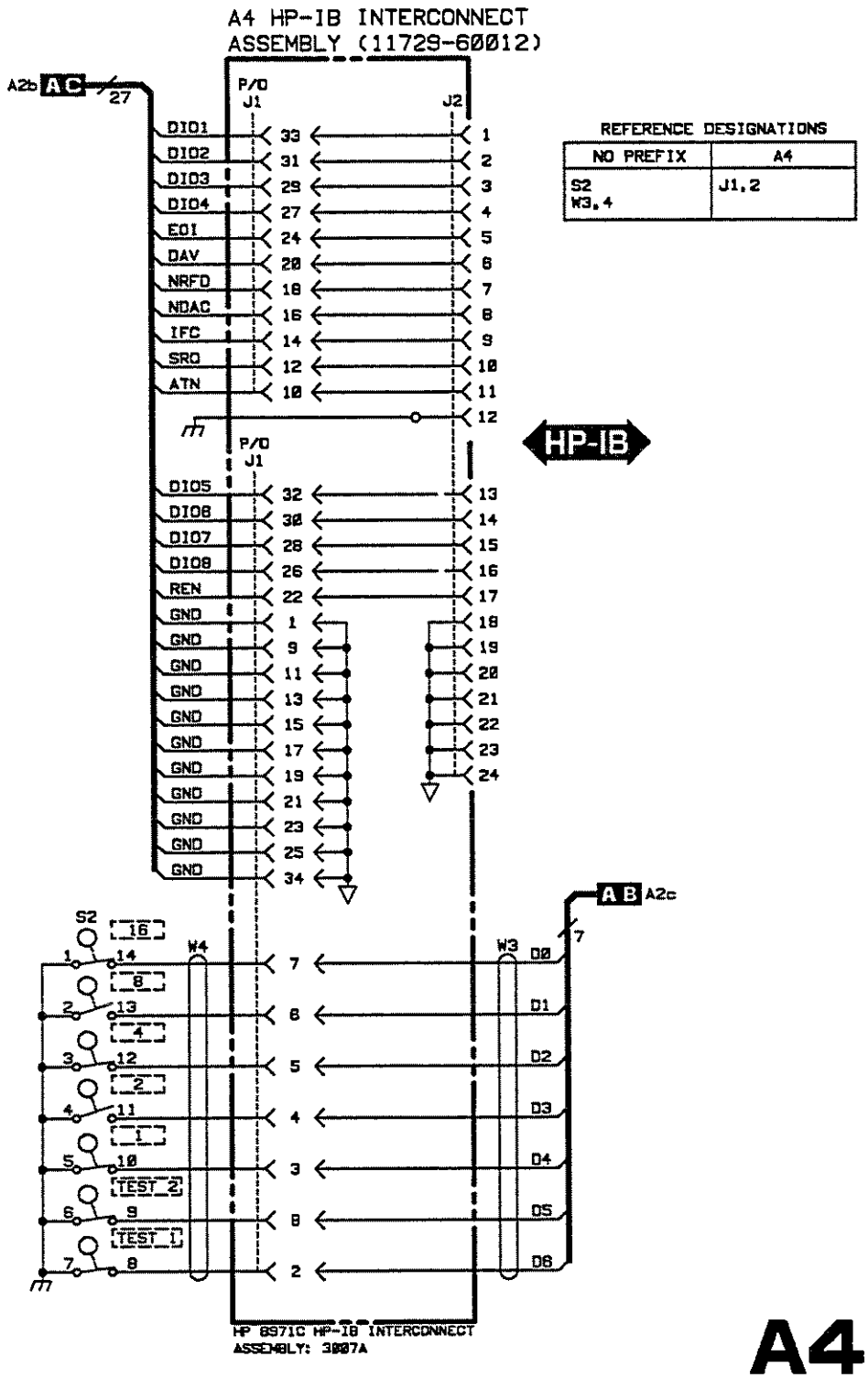


Figure 8-22. A4 HP-IB Interconnect Assembly

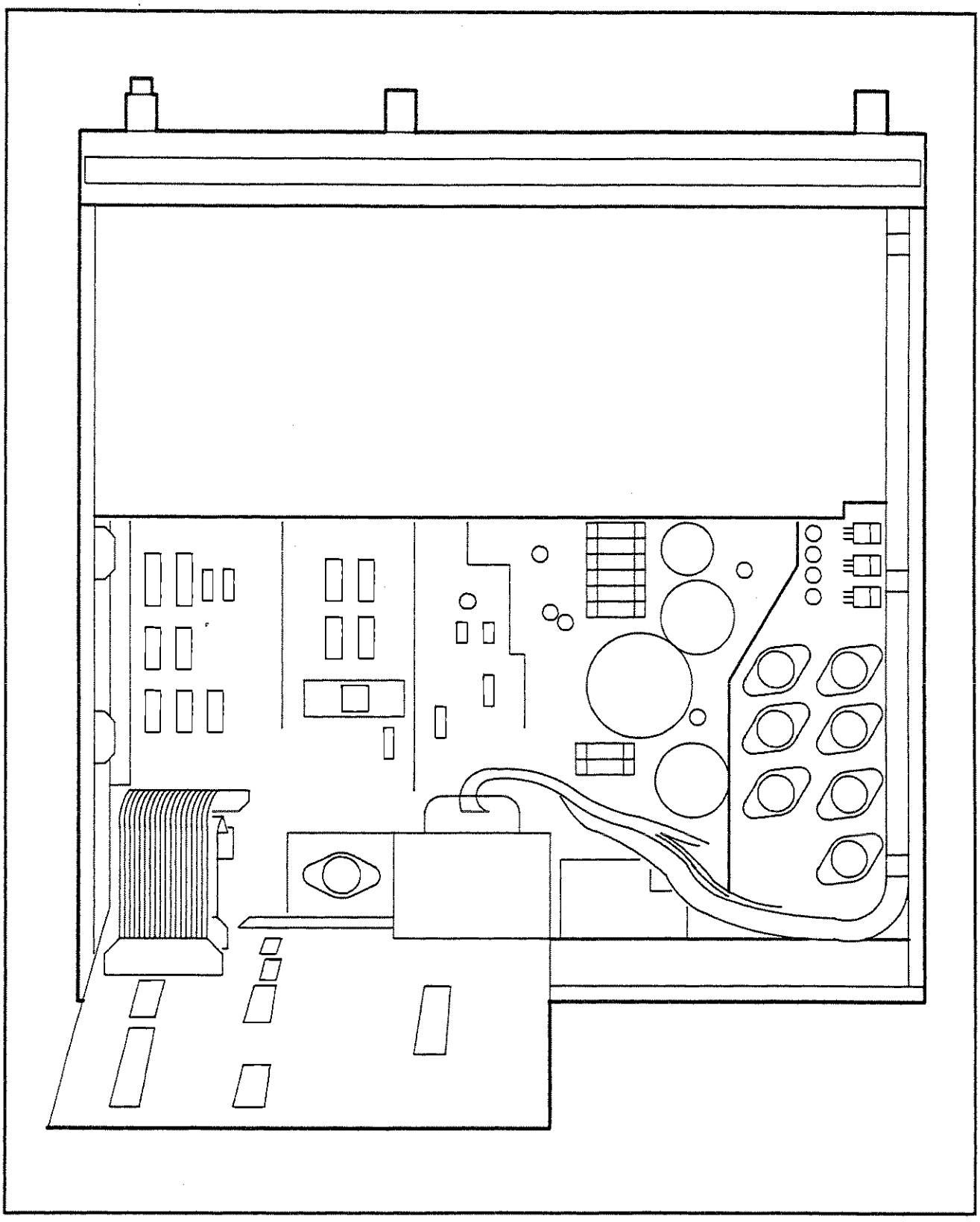


Figure 8-23. Instrument Service Postion