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Agilent Technologies
Innovating the HP Way

June 8, 2000

Dear Customer,

As of November 1, 1999, four of Hewlett-Packard's businesses, test and measurement, semiconductor products, health care solutions, and chemical analysis became a new company, Agilent Technologies. Now, many of your Hewlett-Packard products and services are in the care of Agilent Technologies.

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Sincerely,

Rebranding Team

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HP 8904A
MULTIFUNCTION SYNTHESIZER
(Including Options 001, 002, 003, and 004)

Service Manual

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed:

SERIAL PREFIXES

2712A to 2948A and all MAJOR changes that apply to your instrument.

rev.01JUL91

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

Fourth Edition

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

Service Manual HP Part 08904-90008

Other Documents Availiable:
Operation and Calibration Manual HP Part 08904-90007
Operation and Application Guide HP Part 5953-8491
Microfiche Service Manual HP Part 08904-90020
Microfiche Operation/Calibration Manual HP Part 08904-90019

Printed in U.S.A.: June 1992

HEWLETT PACKARD

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1 Regulatory Information

(Updated March 1999)

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Safety Considerations

GENERAL

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

This product has been designed and tested in accordance with *IEC Publication 1010*, "Safety Requirements for Electronic Measuring Apparatus," and has been supplied in a safe condition. This instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

SAFETY EARTH GROUND

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

SAFETY SYMBOLS


Indicates instrument damage can occur if indicated operating limits are exceeded.


Indicates hazardous voltages.


Indicates earth (ground) terminal

WARNING **A WARNING note 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 A CAUTION note denotes a hazard. It calls attention to an operation 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 an CAUTION note until the indicated conditions are fully understood and met.

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Safety Considerations for this Instrument

WARNING **This product is a Safety Class I instrument (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

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 auto transformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the power source.

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

No operator serviceable parts in this product. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.

Servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the product from all voltage sources while it is being opened.

The power cord is connected to internal capacitors that my remain live for 5 seconds after disconnecting the plug from its power supply.

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

Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage.

This product is designed for use in Installation Category II and Pollution Degree 2 per *IEC 1010* and *IEC 664* respectively. FOR INDOOR USE ONLY.

This product has autoranging line voltage input, be sure the supply voltage is within the specified range.

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To prevent electrical shock, disconnect instrument from mains (line) before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Ventilation Requirements: When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4° C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

Product Markings

CE - the CE mark is a registered trademark of the European Community. A CE mark accompanied by a year indicated the year the design was proven.

CSA - the CSA mark is a registered trademark of the Canadian Standards Association.

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Section 6
REPLACEABLE PARTS

6-1. INTRODUCTION TO THIS SECTION

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

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

Table 6-1 lists the reference designation letters for electrical parts in the instrument. The letter designations found in Table 6-1 are coupled with numeric designations to provide a unique reference designation for each part in the instrument. For example A3R1 is the reference designation of a particular resistor R1 on assembly A3. Designators with no letter are mechanical parts.

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

6-3. REPLACEABLE PARTS LIST

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

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

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

c. Mechanical parts with reference designations in numeric order.

Ordering Parts.

Instrument Serial Numbers.

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

NOTE

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

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How to Order

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

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

NOTE

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

Replaceable Parts List Updating (Manual Updates)

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

Hewlett-Packard offers a Documentation Update Service that will provide you with further updates as they become available. If you operate or service instruments of different serial prefixes, we strongly recommend that you join this service immediately to ensure that you manual is kept current. For more information, refer to the Documentation Update Service reply card included in this manual, or call: Technical Writing Department (509) 922-4001,

or write:

Hewlett-Packard Company
Technical Writing Department
24001 E. Mission - TAF C-34
Spokane, WA 99220

6-4. MECHANICAL AND CHASSIS PART LOCATIONS AND REFERENCE DESIGNATIONS

Most mechanical parts are identified in Figures 6-1 to 6-6. These figures are located at the end of this section. To find the part number and description of a mechanical part, find the part in one of the drawings, and then look up the item number in Table 6-3 (mechanical part numbers are listed under Miscellaneous Parts toward the end of Table 6-3).

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Table 6–1. *Reference Designations*

REFERENCE DESIGNATIONS

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

Table 6–2. *Abbreviations (1 of 2)*

ABBREVIATIONS

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

NOTE

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

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Table 6–2. *Abbreviations (2 of 2)*

MOD .... modulator
MOM ..... momentary
MOS ..... metal-oxide semiconductor
ms ..... millisecond
MTG ..... mounting
MTR ..... meter (indicating device)
mV ..... millivolt
mVac ..... millivolt, ac
mVdc ..... millivolt, dc
mVpk ..... millivolt, peak
mVp-p ..... millivolt, peak-to-peak
mVrms ..... millivolt, rms
mW ..... milliwatt
MUX ..... multiplex
MY ..... mylar
μA ..... microampere
μF ..... microfarad
μH ..... microhenry
μmho ..... micromho
μs ..... microsecond
μV ..... microvolt
μVac ..... microvolt, ac
μVdc ..... microvolt, dc
μVpk ..... microvolt, peak
μVp-p ..... microvolt, peak-to-peak
μVrms ..... microvolt, rms
μW ..... microwatt
nA ..... nanoampere
NC ..... no connection
N/C ..... normally closed
NE ..... neon
NEG ..... negative
nF ..... nanofarad
NI PL ..... nickel plate
N/O ..... normally open
NOM ..... nominal
NORM ..... normal
NPN ..... negative-positive-negative
NPO ..... negative-positive zero (zero temperature coefficient)
NRFR ..... not recommended for field replacement
NSR ..... not separately replaceable
ns ..... nanosecond
nW ..... nanowatt
OBD .... order by description
OD ..... outside diameter
OH ..... oval head
OP AMPL ..... operational amplifier
OPT ..... option
OSC ..... oscillator
OX ..... oxide
oz ..... ounce
Ω ..... ohm
P ..... peak (used in parts list)
PAM ..... pulse-amplitude modulation
PC ..... printed circuit
PCM .... pulse-code modulation; pulse-count modulation
PDM ..... pulse-duration modulation
pF ..... picofarad
PH BRZ .... phosphor bronze
PHL ..... Phillips
PIN ..... positive-intrinsic-negative
PIV ..... peak inverse voltage
pk ..... peak
PL ..... phase lock
PLO .... phase lock oscillator
PM ..... phase modulation
PNP ..... positive-negative-positive
P/O ..... part of
POLY ..... polystyrene
PORC ..... porcelain
POS ..... positive; position(s) (used in parts list)
POSN ..... position
POT ..... potentiometer
p-p ..... peak-to-peak
PP ..... peak-to-peak (used in parts list)
PPM ..... pulse-position modulation
PREAMPL ..... preamplifier
PRF ..... pulse-repetition frequency
PRR .... pulse repetition rate
ps ..... picosecond
PT ..... point
PTM ..... pulse-time modulation
PWM ..... pulse-width modulation
PWV ..... peak working voltage
RC ..... resistance-capacitance
RECT ..... rectifier
REF ..... reference
REG ..... regulated
REPL ..... replaceable
RF ..... radio frequency
RFI ..... radio frequency interference
RH ... round head; right hand
RLC ..... resistance-inductance-capacitance
RMO ..... rack mount only
rms ..... root-mean-square
RND ..... round
ROM ..... read-only memory
R&P ..... rack and panel
RWV ..... reverse working voltage
S ..... scattering parameter
s ..... second (time)
... . second (plane angle)
S-B ..... slow-blow (fuse) (used in parts list)
SCR ..... silicon controlled rectifier; screw
SE ..... selenium
SECT ..... sections
SEMICON .... semiconductor
SHF .... superhigh frequency
SI ..... silicon
SIL ..... silver
SL ..... slide
SNR .... signal-to-noise ratio
SPDT ..... single-pole, double-throw
SPG ..... spring
SR ..... split ring
SPST ..... single-pole, single-throw
SS ..... Service Sheet
SSB ..... single sideband
SST ..... stainless steel
STL ..... steel
SQ ..... square
SWR .... standing-wave ratio
SYNC ..... synchronize
T ..... timed (slow-blow fuse)
TA ..... tantalum
TC ..... temperature compensating
TD ..... time delay
TERM ..... terminal
TFT ..... thin-film transistor
TGL ..... toggle
THD ..... thread
THRU ..... through
TI ..... titanium
TOL ..... tolerance
TRIM ..... trimmer
TSTR ..... transistor
TTL ..... transistor-transistor logic
TV ..... television
TVI .... television interference
TWT ..... traveling wave tube
U ..... micro (10^{-6}) (used in parts list)
UF ..... microfarad (used in parts list)
UHF ..... ultrahigh frequency
UNDEF ..... undefined
UNREG ..... unregulated
V ..... volt
VA ..... voltampere
Vac ..... volts, ac
VAR ..... variable
VCO ..... voltage-controlled oscillator
Vdc ..... volts, dc
VDCW ..... volts, dc, working (used in parts list)
V(F) ..... volts, filtered
VFO ..... variable-frequency oscillator
VHF ..... very-high frequency
Vpk ..... volts, peak
Vp-p ..... volts, peak-to-peak
Vrms ..... volts, rms
VSWR ..... voltage standing wave ratio
VTO ..... voltage-tune oscillator
VTVM ..... vacuum-tube voltmeter
V(X) ..... volts, switched
W ..... watt
W/ ..... with
WIV ..... working inverse voltage
WW ..... wirewound
W/O ..... without
YIG ..... yttrium-iron-garnet
Z_o ..... characteristic impedance

NOTE

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

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A1						
2712A to 2917A						
A1 †				SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT		
2923A and above						
A1	08904-60201	4	1	KEYBOARD ASSEMBLY	28480	08904-60201
W1				NOT SEPARATELY REPLACEABLE		
A2						
2712A to 2942A						
A2	08904-60102	4	1	DIGITAL ASSEMBLY (NEW)	28480	08904-60102
A2	08904-69102	2	1	DIGITAL ASSEMBLY (RESTORED)	28480	08904-69102
2948A and above						
A2	08904-60202	5	1	DIGITAL ASSEMBLY (NEW)	28480	08904-60202
A2	08904-69202	3	1	DIGITAL ASSEMBLY (RESTORED)	28480	08904-69202
2712A to 2942A						
A2BT1	1420-0281	2	1	BATTERY 2.8V .46A-HR LI/S-DIOX PIN	28480	1420-0281
	3050-0990	7	3	WASHER-FL NM NO.000 .04-IN-ID .25-IN-ID	28480	3050-0990
2712A to 2942A						
A2BT1	1420-0338	0	1	BATTERY 3V 1.2A-HR LITHIUM POLYCARBON	28480	1420-0338
2712A to 2732A						
A2U12 †				REFER TO SECTION 7		
A2U13 †				REFER TO SECTION 7		
2737A to 2942A						
A2U12†	08904-87010	9	1	EPROM	28480	08904-87010
A2U13	08904-87008	5	1	EPROM	28480	08904-87008
2737A to 2940A						
A2U12	08904-87009	6	1	EPROM	28480	08904-87009
2742A and above						
A2U12	08904-87011	0	1	EPROM	28480	08904-87011
2737A and above						
A2U13				NO LONGER SEPARATELY REPLACEABLE		

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

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Table 6-3. *Replaceable Parts*

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3						
2712A to 2942A						
A3	08904-60103	5	1	OUTPUT ASSEMBLY (NEW)	28480	08904-60103
A3	08904-69103	3	1	OUTPUT ASSEMBLY (RESTORED)	28480	08904-69103
2948A and above						
A3	08904-60203	6	1	OUTPUT ASSEMBLY (NEW)	28480	08904-60203
A3	08904-69203	4	1	OUTPUT ASSEMBLY (RESTORED)	28480	08904-69203
A3C1				NOT ASSIGNED		
A3C2	0180-0116	1	11	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C3	0160-4832	4	35	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C4	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C5	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C6	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C7				NOT ASSIGNED		
A3C8	0160-4535	4	9	CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C9				NOT ASSIGNED		
A3C10	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C11	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C12	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C13	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C14	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C15-27				NOT ASSIGNED		
A3C28	0160-0575	4	1	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C29	0160-6875	9	1	CAPACITOR-FXD 850PF +-1% 100VDC CER	28480	0160-6875
A3C30	0160-6876	0	1	CAPACITOR-FXD 7200PF +-1% 100VDC CER	28480	0160-6876
A3C31	0160-6877	1	1	CAPACITOR-FXD 64PF +-1% 100VDC CER 0+-30	28480	0160-6877
A3C32	0160-6878	2	1	CAPACITOR-FXD 293PF +-1% 100VDC CER	28480	0160-6878
A3C33	0160-3879	7	5	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C34	0160-6880	6	1	CAPACITOR-FXD 584PF +-1% 100VDC CER	28480	0160-6880
A3C35	0160-6881	7	1	CAPACITOR-FXD 1360PF +-1% 100VDC CER	28480	0160-6881
A3C36	0160-6882	8	1	CAPACITOR-FXD 1290PF +-1% 100VDC CER	28480	0160-6882
A3C37	0160-6883	9	1	CAPACITOR-FXD 438PF +-1% 100VDC CER	28480	0160-6883
A3C38	0160-3875	3	1	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A3C39				NOT ASSIGNED		
A3C40	0160-4835	7	16	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C41	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C42	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C43	0160-4822	2	1	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A3C44	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C45	0160-4812	0	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A3C46	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C47	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C48	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C49				NOT ASSIGNED		
A3C50	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C51	0160-6884	0	1	CAPACITOR-FXD 270PF +-1% 100VDC CER	28480	0160-6884
A3C52-63				NOT ASSIGNED		
A3C64	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C65-70				NOT ASSIGNED		
A3C71	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C72	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C79	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C82	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3C83—89				NOT ASSIGNED		
A3C90	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C93	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C94—200				NOT ASSIGNED		
A3C201	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C202	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C203	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C204	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C205	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C206	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C207	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C208	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C209	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C210	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C211	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C212	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C213	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C214	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C215	0160-4791	4	2	CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A3C216	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C217	0160-4807	3	1	CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A3C218	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C219	0160-4789	0	3	CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A3C220	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C221	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C222	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C223				NOT ASSIGNED		
A3C224	0160-3563	6	1	CAPACITOR-FXD 10UF +-5% 50VDC MET-POLYC	28480	0160-3563
A3C225	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C226	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C227	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C228	0160-0572	1	1	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A3C229	0160-0573	2	1	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A3C230	0160-4040	6	1	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4040
A3C231				NOT ASSIGNED		
A3C232	0160-4383	0	1	CAPACITOR-FXD 6.8PF +-.5PF 200VDC CER	20932	5024E0200RD689D
A3C233—299				NOT ASSIGNED		
A3C300	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C301	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A3C302	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C303	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C304	0160-4791	4		CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A3C305—400				NOT ASSIGNED		
A3C401	0160-4795	8	3	CAPACITOR-FXD 4.7PF +-.5PF 100VDC CER	28480	0160-4795
A3C402	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835

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

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Table 6-3. *Replaceable Parts*

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3C403	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C404	0160-4835	7		CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A3C405	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C406	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C407	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C408	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C409	0160-4547	8	2	CAPACITOR-FXD 150PF +-5% 200VDC CER	28480	0160-4547
A3C410	0160-4526	3	2	CAPACITOR-FXD 42PF +-5% 200VDC CER 0+-30	28480	0160-4526
A3C411	0160-4493	3	1	CAPACITOR-FXD 27PF +-5% 200VDC CER 0+-30	28480	0160-4493
A3C412	0160-4526	3		CAPACITOR-FXD 42PF +-5% 200VDC CER 0+-30	28480	0160-4526
A3C413	0160-4547	8		CAPACITOR-FXD 150PF +-5% 200VDC CER	28480	0160-4547
A3C414—420				NOT ASSIGNED		
A3C421	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C422	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C423	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C424	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C425	0121-0451	3	1	CAPACITOR-V TRMR-AIR 1.7-11PF 175V	74970	187-0106-028
A3C426	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A3C425—430				NOT ASSIGNED		
A3C431	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C432	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C433	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C434	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C435	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C436	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C437	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C438	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C439				NOT ASSIGNED		
A3C440	0160-4801	7	7	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C441	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C442	0160-4795	8		CAPACITOR-FXD 4.7PF +-.5PF 100VDC CER	28480	0160-4795
A3C443	0160-4795	8		CAPACITOR-FXD 4.7PF +-.5PF 100VDC CER	28480	0160-4795
A3C444	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C445	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C446	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C447	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C448	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C449—499				NOT ASSIGNED		
A3C500	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C501	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C502	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C503	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C504	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A3C505	0160-4824	4	1	CAPACITOR-FXD 680PF +-5% 100VDC CER	28480	0160-4824
A3CR1—5				NOT ASSIGNED		
A3CR6	1901-0028	5	4	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A3CR7	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A3CR8	1901-0050	3	25	DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3CR10-16				NOT ASSIGNED		
A3CR17	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR19-25				NOT ASSIGNED		
A3CR26	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A3CR27	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A3CR28-201				NOT ASSIGNED		
A3CR202	1901-0518	8	5	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR203	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR204	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR205	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR206				NOT ASSIGNED		
A3CR207	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR208				NOT ASSIGNED		
A3CR209	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR210	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR211	1902-0627	2	5	DIODE-CUR RGLTR 1N5312 100V DO-7	04713	1N5312
A3CR212	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR213-299				NOT ASSIGNED		
A3CR300	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR301	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR302-403				NOT ASSIGNED		
A3CR404	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR405	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR406	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR407	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR408	1901-0873	8	4	DIODE-HV RECT 600V 1A	28480	1901-0873
A3CR409	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A3CR410	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A3CR411	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A3CR412-414				NOT ASSIGNED		
2712A to 2747A						
A3CR415	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR416	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR417	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR418	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
2817A and above						
A3CR415	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A3CR416	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A3CR417	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A3CR418	1901-0880	7		DIODE-GEN PRP 125MA DO-35	28480	1901-0880
A3CR419	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR420	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR421	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR422	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR423	1902-0627	2		DIODE-CUR RGLTR 1N5312 100V DO-7	04713	1N5312
A3CR424	1902-0627	2		DIODE-CUR RGLTR 1N5312 100V DO-7	04713	1N5312
A3CR425	1902-0627	2		DIODE-CUR RGLTR 1N5312 100V DO-7	04713	1N5312
A3CR426	1902-0627	2		DIODE-CUR RGLTR 1N5312 100V DO-7	04713	1N5312
A3CR427	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR428	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3CR429	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3CR430	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	9N171	1N4150
A3J1	1251-8601	7	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	28480	1251-8601
A3J2				NOT ASSIGNED		
A3J3	1251-4670	2	3	CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
	1258-0141	8	3	JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A3J4	1250-0835	1	3	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A3J5	1250-0835	1		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A3J6	1250-0835	1		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A3J7	1251-4670	2		CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
	1258-0141	8		JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
2712A to 2942A						
J8				NOT ASSIGNED		
2948A and above						
A3J8	1251-4670	2		CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
	1258-0141	8		JUMPER-REMOVABLE FOR 0.025 IN SQ PINS (ADDED FOR OPTION 006)	28480	1258-0141
A3J9-J200				NOT ASSIGNED		
A3J201	1251-4670	2		CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
	1258-0141	8		JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A3J202-J399				NOT ASSIGNED		
A3J400	1250-0836	2	2	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0836
A3J401	1250-0836	2		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0836
A3K1	0490-1608	5	9	RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K2	0490-1608	5		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K3	0490-1608	5		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K4	0490-1608	5		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K5	0490-1608	5		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K6	0490-1608	5		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K7				NOT ASSIGNED		
A3K8	0490-1190	0	1	RELAY 2C 5VDC-COIL .5A 125VAC	28480	0490-1190
A3K9				NOT ASSIGNED		
A3K10	0490-1608	5		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K11	0490-1608	5		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K12-400				NOT ASSIGNED		
A3K401	0490-1608	5		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	88330	R9131-1
A3K402	0490-1501	7	2	RELAY-REED 2A 2A 100VDC 5VDC-COIL 200VA	15636	R8777-1
A3K404	0490-1501	7		RELAY-REED 2A 2A 100VDC 5VDC-COIL 200VA	15636	R8777-1
A3L1	9100-3560	6	2	INDUCTOR RF-CH-MLD 5.6UH 5%	28480	9100-3560
A3L2	9100-3548	0	2	INDUCTOR RF-CH-MLD 470NH 5%	28480	9100-3548
A3L3	9100-3548	0		INDUCTOR RF-CH-MLD 470NH 5%	28480	9100-3548
A3L4	9100-1675	0	2	INDUCTOR RF-CH-MLD 8.2MH 5%	28480	9100-1675
A3L5	9100-1675	0		INDUCTOR RF-CH-MLD 8.2MH 5%	28480	9100-1675
A3L6	9100-1640	9	1	INDUCTOR RF-CH-MLD 160UH 5%	28480	9100-1640
A3L7	08904-80001	4	1	CL-V MIN 74.1UH	28480	08904-80001
A3L8	08904-80005	8	1	CL-V MIN 72.6UH	28480	08904-80005
A3L9	08904-80002	5	1	CL-V MIN 60.7UH	28480	08904-80002
A3L10	9100-1663	6	1	INDUCTOR RF-CH-MLD 2.7MH 5%	28480	9100-1663
A3L11	08904-80003	6	1	CL-V MIN 58.1UH	28480	08904-80003
A3L12	9100-3551	5	1	INDUCTOR RF-CH-MLD 1UH 5%	28480	9100-3551
A3L13-200				NOT ASSIGNED		
A3L201	9100-3560	6		INDUCTOR RF-CH-MLD 5.6UH 5%	28480	9100-3560
A3L401	9140-0454	5	1	INDUCTOR RF-CH-MLD 18UH 5% .166DX.385LG	28480	9140-0454
A3L402	9100-3315	9	1	INDUCTOR RF-CH-MLD 820NH 5%	28480	9100-3315
A3MP1	1205-0213	4	4	HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0213
A3MP2	1205-0213	4		HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0213
A3MP3	1205-0213	4		HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0213
A3MP4	1205-0213	4		HEAT SINK SGL TO-5/TO-39-CS	28480	1205-0213
A3MP5	0340-0834	0	4	INSULATOR-XSTR POLYI	28480	0340-0834

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3MP6	0340-0834	0		INSULATOR-XSTR POLYI	28480	0340-0834
A3MP7	0340-0834	0		INSULATOR-XSTR POLYI	28480	0340-0834
A3MP8	0340-0834	0		INSULATOR-XSTR POLYI	28480	0340-0834
A3Q1	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD = 500MW	04713	2N2222A
A3Q2	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD = 400MW	04713	2N2907A
A3Q3-13				NOT ASSIGNED		
A3Q14	1854-0809	9	1	TRANSISTOR NPN 2N2369A SI TO-18 PD = 360MW	28480	1854-0809
A3Q15	1853-0405	9	2	TRANSISTOR PNP SI PD = 300MW FT = 850MHZ	04713	2N4209
A3Q16Δ	1853-0659	5	8	TRANSISTOR PNP SI PD = 625MW FT = 200MHZ	28480	1853-0659
A3Q17Δ	1854-1177	6	12	TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q18Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q19Δ	1853-0659	5		TRANSISTOR PNP SI PD = 625MW FT = 200MHZ	28480	1853-0659
A3Q20	1853-0405	9		TRANSISTOR PNP SI PD = 300MW FT = 850MHZ	04713	2N4209
A3Q21Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q22-32				NOT ASSIGNED		
A3Q33Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q34-200				NOT ASSIGNED		
A3Q201Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q202Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q203Δ	1853-0659	5		TRANSISTOR PNP SI PD = 625MW FT = 200MHZ	28480	1853-0659
A3Q204Δ	1853-0659	5		TRANSISTOR PNP SI PD = 625MW FT = 200MHZ	28480	1853-0659
A3Q205Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q206Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q207Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q208Δ	1853-0659	5		TRANSISTOR PNP SI PD = 625MW FT = 200MHZ	28480	1853-0659
A3Q209	1855-0276	6	2	TRANSISTOR J-FET 2N4416A N-CHAN D-MODE	04713	2N4416A
A3Q210	1855-0276	6		TRANSISTOR J-FET 2N4416A N-CHAN D-MODE	04713	2N4416A
A3Q300Δ	1853-0659	5		TRANSISTOR PNP SI PD = 625MW FT = 200MHZ	28480	1853-0659
A3Q301Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q302-400				NOT ASSIGNED		
A3Q401	1854-0813	5	2	TRANSISTOR NPN 2N3501S SI TO-39 PD = 1W	28480	1854-0813
A3Q402	1853-0462	8	2	TRANSISTOR PNP 2N3635 SI TO-39 PD = 1W	01295	2N3635
A3Q403	1853-0462	8		TRANSISTOR PNP 2N3635 SI TO-39 PD = 1W	01295	2N3635
A3Q404	1854-0813	5		TRANSISTOR NPN 2N3501S SI TO-39 PD = 1W	28480	1854-0813
A3Q405Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q406Δ	1853-0659	5		TRANSISTOR PNP SI PD = 625MW FT = 200MHZ	28480	1853-0659
A3Q407Δ	1854-1177	6		TRANSISTOR NPN SI PD = 625MW FT = 200MHZ	28480	1854-1177
A3Q408Δ	1853-0659	5		TRANSISTOR PNP SI PD = 625MW FT = 200MHZ	28480	1853-0659
A3R1	1810-0204	6	1	NETWORK-RES 8-SIP 1.0K OHM X 7	11236	750-81-R1K
A3R2	0698-7236	7	2	RESISTOR 1K 1% .05W F TC = 0+-100	24546	C3-1/8-T0-1001-F
A3R3	0757-0417	8	2	RESISTOR 562 1% .125W F TC = 0+-100	24546	CT4-1/8-T0-562R-F
A3R4	0698-7248	1	8	RESISTOR 3.16K 1% .05W F TC = 0+-100	24546	C3-1/8-T0-3161-F
A3R5	0698-7248	1		RESISTOR 3.16K 1% .05W F TC = 0+-100	24546	C3-1/8-T0-3161-F

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3R6—8				NOT ASSIGNED		
A3R9	0698-7205	0	5	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A3R10	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A3R11—39				NOT ASSIGNED		
A3R40	0698-6782	6	5	RESISTOR 250 .1% .125W F TC=0+-25	28480	0698-6782
A3R41	0698-6782	6		RESISTOR 250 .1% .125W F TC=0+-25	28480	0698-6782
A3R42	0698-8819	4	1	RESISTOR 3.83 1% .125W F TC=0+-100	28480	0698-8819
A3R43	0698-6782	6		RESISTOR 250 .1% .125W F TC=0+-25	28480	0698-6782
A3R44	0698-6782	6		RESISTOR 250 .1% .125W F TC=0+-25	28480	0698-6782
A3R45	0698-7268	5	1	RESISTOR 21.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2152-F
A3R46				NOT ASSIGNED		
A3R47	0698-6782	6		RESISTOR 250 .1% .125W F TC=0+-25	28480	0698-6782
A3R48	0698-6320	8	1	RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A3R49	0698-7260	7	4	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A3R50	0698-7280	1	1	RESISTOR 68.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6812-F
A3R51	0698-7232	3	7	RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A3R52	0698-7256	1	2	RESISTOR 6.81K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6811-F
A3R53	0698-7208	3	1	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-68R1-F
A3R54	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A3R55	0698-7283	4	1	RESISTOR 90.9K 1% .05W F TC=0+-100	24546	C3-1/8-T0-9092-F
A3R56	0698-7229	8	5	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A3R57	0698-7231	2	1	RESISTOR 619 1% .05W F TC=0+-100	24546	C3-1/8-TO-619R-F
A3R58	0698-7212	9	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-TO-100R-F
A3R59	0698-7239	0	1	RESISTOR 1.33K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1331-F
A3R60	0698-7243	6	1	RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3R61	0698-7219	6	2	RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-TO-196R-F
A3R62	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A3R63	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A3R64	0698-7188	8	2	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-TO-10R-F
A3R65	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-TO-10R-F
A3R66	0698-7259	4	1	RESISTOR 9.09K 1% .05W F TC=0+-100	24546	C3-1/8-T0-9091-F
A3R67	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3R68	0698-7209	4	1	RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-TO-75R0-F
A3R69	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3R70	0699-2234	7	1	RESISTOR 7.968K .1% .125W TF TC=0+-25	19701	5033R
A3R71	0699-2235	8	2	RESISTOR 1.133K .1% .125W TF TC=0+-25	19701	5033R
A3R72	0699-2235	8		RESISTOR 1.133K .1% .125W TF TC=0+-25	19701	5033R
A3R73	0699-0106	8	1	RESISTOR 1.875K .1% .125W F TC=0+-25	28480	0699-0106
A3R74	0699-2237	0	2	RESISTOR 1.667K .1% .125W TF TC=0+-25	19701	5033R
A3R75	0699-2237	0		RESISTOR 1.667K .1% .125W TF TC=0+-25	19701	5033R
A3R76	0698-6616	5	2	RESISTOR 750 .1% .125W F TC=0+-25	28480	0698-6616
A3R77	0698-6348	0	6	RESISTOR 3K .1% .125W F TC=0+-25	28480	0698-6348
A3R78	0698-6348	0		RESISTOR 3K .1% .125W F TC=0+-25	28480	0698-6348
A3R79—111				NOT ASSIGNED		
A3R112	0699-2233	6	2	RESISTOR 50.4 .1% .5W TF TC=0+-25	19701	5053R
A3R113	0699-2236	9	1	RESISTOR 6.4K .1% .125W TF TC=0+-25	19701	5033R

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3R114	0699-2233	6		RESISTOR 50.4 .1% .5W TF TC=0+-25	19701	5053R
A3R115—121				NOT ASSIGNED		
A3R122	0698-7276	5	1	RESISTOR 46.4K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4642-F
A3R123	0698-7252	7	1	RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-F
A3R124				NOT ASSIGNED		
A3R125	0698-7266	3	1	RESISTOR 17.8K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1782-F
A3R126	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	CT4-1/8-T0-562R-F
A3R127—135				NOT ASSIGNED		
A3R136	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A3R139	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A3R140				NOT ASSIGNED		
A3R141	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3R142	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-TO-196R-F
A3R143—200				NOT ASSIGNED		
A3R201	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A3R202	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A3R203	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A3R204	0698-7232	3		RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-TO-681R-F
A3R205	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A3R206	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A3R207	0698-7256	1		RESISTOR 6.81K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6811-F
A3R208	0698-7257	2	1	RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-F
A3R209	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0+-100	24546	CT4-1/8-T0-751-F
A3R210	0698-6616	5		RESISTOR 750 .1% .125W F TC=0+-25	28480	0698-6616
A3R211	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A3R212	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A3R213	0698-7225	4	1	RESISTOR 348 1% .05W F TC=0+-100	24546	C3-1/8-TO-348R-F
A3R214				NOT ASSIGNED		
A3R215				NOT ASSIGNED		
A3R216	0698-7277	6	5	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A3R217	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A3R218	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A3R219	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A3R220	0698-7284	5	1	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A3R221	0698-7198	0	1	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-26R1-F
A3R222	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-TO-215R-F
A3R223	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A3R224	2100-3296	8	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 17-TRN	28480	2100-3296
A3R225	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3R226	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3R227	0757-0394	0	3	RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3R228	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A3R229	2100-3659	7	2	RESISTOR-TRMR 20K 10% C TOP-ADJ 17-TRN	28480	2100-3659
A3R230	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3R231	0698-7275	4	1	RESISTOR 42.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4222-F
A3R232	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A3R233	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A3R234—299				NOT ASSIGNED		
A3R300	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3R301	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3R302—399				NOT ASSIGNED		
A3R400	0698-8821	8	4	RESISTOR 5.62 1% .125W F TC=0+-100	28480	0698-8821
A3R401	0698-8821	8		RESISTOR 5.62 1% .125W F TC=0+-100	28480	0698-8821
A3R402	0698-8821	8		RESISTOR 5.62 1% .125W F TC=0+-100	28480	0698-8821
A3R403				NOT ASSIGNED		
A3R404	0698-7240	3	4	RESISTOR 1.47K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1471-F
A3R405	0698-7267	4	4	RESISTOR 19.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1962-F
A3R406	0698-7267	4		RESISTOR 19.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1962-F
A3R407	0698-7240	3		RESISTOR 1.47K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1471-F
A3R408	0698-7240	3		RESISTOR 1.47K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1471-F
A3R409	0698-7267	4		RESISTOR 19.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1962-F
A3R410	0698-7267	4		RESISTOR 19.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1962-F
A3R411	0698-7240	3		RESISTOR 1.47K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1471-F
A3R412	0698-6362	8	3	RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A3R413	0698-6317	3	2	RESISTOR 500 .1% .125W F TC=0+-25	03888	PME55-1/8-T9-500R-B
A3R414	0698-6317	3		RESISTOR 500 .1% .125W F TC=0+-25	03888	PME55-1/8-T9-500R-B
A3R415	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A3R416	0698-8822	9	1	RESISTOR 6.81 1% .125W F TC=0+-100	28480	0698-8822
A3R417	0757-0462	3	2	RESISTOR 75K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7502-F
A3R418	2100-3659	7		RESISTOR-TRMR 20K 10% C TOP-ADJ 17-TRN	28480	2100-3659
A3R419	0757-0401	0	2	RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-TO-101-F
A3R420	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	CT4-1/8-TO-101-F
A3R421	0698-6362	8		RESISTOR 1K .1% .125W F TC=0+-25	28480	0698-6362
A3R422	0757-0462	3		RESISTOR 75K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-7502-F
A3R423	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3R424	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A3R425—445						
A3R446	0698-6624	5	2	RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A3R447	0699-1728	2	2	RESISTOR 2.652K .1% .12W	28480	0699-1728
A3R448	0698-6624	5		RESISTOR 2K .1% .125W F TC=0+-25	28480	0698-6624
A3R449	0699-1728	2		RESISTOR 2.652K .1% .12W	28480	0699-1728
A3R450				NOT ASSIGNED		
A3R451				NOT ASSIGNED		
A3R452	0698-3430	5	4	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A3R453	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A3R454	0699-1726	0	2	RESISTOR 1.150K .1% .12W	28480	0699-1726
A3R455	0698-6348	0		RESISTOR 3K .1% .125W F TC=0+-25	28480	0698-6348
A3R456	0698-6348	0		RESISTOR 3K .1% .125W F TC=0+-25	28480	0698-6348
A3R457	0698-6348	0		RESISTOR 3K .1% .125W F TC=0+-25	28480	0698-6348

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3R458	0698-6348	0		RESISTOR 3K .1% .125W F TC=0+-25	28480	0698-6348
A3R459	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A3R460	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A3R461	0699-1726	0		RESISTOR 1.150K .1% .12W	28480	0699-1726
A3R462-465				NOT ASSIGNED		
A3R466	0757-0379	1	4	RESISTOR 12.1 1% .125W F TC=0+-100	19701	5033R-1/8-T0-12R1-F
A3R467	0757-0379	1		RESISTOR 12.1 1% .125W F TC=0+-100	19701	5033R-1/8-T0-12R1-F
A3R468	0757-0379	1		RESISTOR 12.1 1% .125W F TC=0+-100	19701	5033R-1/8-T0-12R1-F
A3R469	0757-0379	1		RESISTOR 12.1 1% .125W F TC=0+-100	19701	5033R-1/8-T0-12R1-F
A3R470	0811-3726	4	2	RESISTOR 25.42 .1% .75W PW TC=0+-20	91637	NS-1/2
A3R471	0811-3726	4		RESISTOR 25.42 .1% .75W PW TC=0+-20	91637	NS-1/2
A3R472-489				NOT ASSIGNED		
A3R490	0698-8827	4	2	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
2712A to 2747A						
A3R491	0757-0123	3		RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
2817A and above						
A3R491	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	28480	0757-0199
A3R492	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
2712A to 2747A						
A3R493	0757-0123	3		RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A3R494	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
A3R495	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1781-F
2817A and above						
A3R493	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	28480	0757-0199
A3R494	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A3R495	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2611-F
A3R496	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3R497	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CT4-1/8-T0-51R1-F
A3R498				NOT ASSIGNED		
A3R499	0698-8821	8		RESISTOR 5.62 1% .125W F TC=0+-100	28480	0698-8821
A3T1	08904-80004	7	1	XFMR POT CORE	28480	08904-80004
A3T2-399				NOT ASSIGNED		
A3T400	9100-4444	7	1	TRANSFORMER-RF INPUT IMP.:50 OHMS; INPUT	15542	T1-1T-X65
A3TP1	1251-0600	0	10	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP9-401				NOT ASSIGNED		
A3TP402	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP403	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3U1				NOT ASSIGNED		
A3U2	1820-2488	3	1	IC FF TTL ALS D-TYPE POS-EDGE-TRIG	01295	SN74ALS74AN
A3U3				NOT ASSIGNED		
A3U4	1820-3465	8	2	IC FF TTL ALS D-TYPE POS-EDGE-TRIG COM	01295	SN74ALS174N
A3U5	1820-3465	8		IC FF TTL ALS D-TYPE POS-EDGE-TRIG COM	01295	SN74ALS174N

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

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Table 6-3. *Replaceable Parts*

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A3U6	1826-1013	0	1	D/A 12-1/2-BIT 24-DIP-C BPLR	24355	AD565AJD
A3U7				NOT ASSIGNED		
A3U8	1858-0047	5	2	TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A3U9	1826-1049	2	1	IC OP AMP PRCN 8-DIP-C PKG	06665	OP-27GZ
A3U10	*1858-0047*	*5*		*TRANSISTOR ARRAY 16-PIN PLSTC DIP*	*13606*	*ULN-2003A*
A3U11—15						
A3U16	1810-0556	1	1	DELAY LINE ACTIVE DELAY LINE; TTL	07393	TTLDL-60(SELECTED)
A3U17—200						
A3U201	1901-1011	8	1	DIODE-ARRAY 25MA VF DIFF=5MV	28480	1901-1011
A3U202	1826-1067	4	2	IC INSTM AMPL CUR 10-DIP-P PKG	27014	LH0002CN
A3U203	1826-1557	7	1	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-C PKG	27014	LF356BJ
A3U204—400						
A3U401	1826-1665	8	3	IC OP AMP HS 8-DIP-C PKG	27014	LM6361J(SELECTED)
A3U402	1826-1665	8		IC OP AMP HS 8-DIP-C PKG	27014	LM6361J(SELECTED)
A3U403	1826-1665	8		IC OP AMP HS 8-DIP-C PKG	27014	LM6361J(SELECTED)
A3U404	1826-1067	4		IC INSTM AMPL CUR 10-DIP-P PKG	27014	LH0002CN
A3U405—407				NOT ASSIGNED		
A3U408	1826-0759	9	1	IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A3VR1—18				NOT ASSIGNED		
A3VR19	1902-0967	3	1	DIODE-ZNR 24V 5% DO-35 PD=.4W TC=+.094%	28480	1902-0967
A3VR20—30				NOT ASSIGNED		
A3VR31	1902-0962	8	1	DIODE-ZNR 15V 5% DO-35 PD=.4W TC=+.087%	28480	1902-0962
A3VR32—200				NOT ASSIGNED		
A3VR201	1902-0957	1	2	DIODE-ZNR 9.1V 5% DO-35 PD=.4W TC=+.069%	28480	1902-0957
A3VR202—205				NOT ASSIGNED		
A3VR206	*1902-0957*	*1*		*DIODE-ZNR 9.1V 5% DO-35 PD=.4W TC=+.069%*	*28480*	*1902-0957*
A3VR207				NOT ASSIGNED		
A3VR208	1902-0944	6	1	DIODE-ZNR 2.7V 5% DO-35 PD=.4W TC=-.044%	28480	1902-0944
A3VR209—400				NOT ASSIGNED		
A3VR401	1902-1397	5	2	VOLTAGE SUPPRESSOR VR=10.2V BV=11.4V MIN	04713	1N6273A
A3VR402	1902-1397	5		VOLTAGE SUPPRESSOR VR=10.2V BV=11.4V MIN	04713	1N6273A

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A4						
A4	08904-61001	4	1	POWER SUPPLY ASSEMBLY	28480	08904-61001
A5						
A5	1990-1197	8	1	LCD ASSEMBLY	28480	1990-1197
A6						
2712A TO 2942A						
A6				NOT ASSIGNED		
2948A and above						
A6	08904-60104	6	1	TRANSFORMER BOARD (ADDED FOR OPTION 006)	28480	08904-60104
A6C1	0160-4822	2	1	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A6C2	0160-4810	8		CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4810
A6C3	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A6J1	1250-0836	2	4	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0836
A6J2	1250-0836	2		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0836
A6J3	1250-0836	2		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0836
A6J4	1250-0836	2		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0836
A6J5	1252-2235	3		CONNECTOR-POST TYPE .100-PIN-SPCG 6-CONT	28480	1252-2235
A6R1	2100-0545	4	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TURN	32997	3292X-1-102
A6R2	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1001-F
A6R3	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0+-100	24546	CT4-1/8-T0-751-F
A6R4	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A6R5	2100-3755	4	1	RESISTOR-TRMR 50 10% C SIDE-ADJ 17-TURN	28480	2100-3755
A6R6	0698-8823	0	1	RESISTOR 8.25 1% .125W F TC=0+-100	28480	0698-8823
A6R7	0757-0180	2	1	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A6VR1	1902-0960	6	2	DIODE-ZNR 12V 5% DO-35 PD=.4W TC=+.077%	28480	1902-0960
A6VR2	1902-0960	6	2	DIODE-ZNR 12V 5% DO-35 PD=.4W TC=+.077%	28480	1902-0960

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
A7–A9				NOT ASSIGNED		

A10

Note: The A10 and A3 Assemblies are identical. Refer to A3 for individual component part numbers.

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
				Miscellaneous Parts		
B1	08904-61010	5	1	FAN ASSY 12VDC	28480	08904-61010
F1	2110-0003	0	1	FUSE 3A 250V NTD 1.25X.25 UL (INCLUDED WHEN ORDERING W1)	75915	312003
2712A to 2917A						
S1	3101-2216	3	1	SWITCH-PB DPDT ALTING 4A 250VAC (INCLUDED WHEN ORDERING W1)	28480	3101-2216
	5041-1682	9	1	KEYCAP FOR LINE SWITCH (INCLUDED WHEN ORDERING W1)		
2923A and above						
S1	3101-2216	3	1	SWITCH-PB DPDT ALTING 4A 250VAC (INCLUDED WHEN ORDERING W1)	28480	3101-2216
	0371-3802	3	1	KEYCAP FOR LINE SWITCH (INCLUDED WHEN ORDERING W1)		
T1	9100-4833	8	1	AUDIO TRANSFORMER	28480	9100-4833
2712A to 2917A						
W1	08904-61005	8		WIRING HARNESS	28480	08904-61005
2923A and above						
W1	08904-61022	9	1	WIRING HARNESS (LINE POWER/A4P1 TO POWER SWITCH)	28480	08904-61022
W2	08904-61007	0	6	COAX CABLE BNC-PCB (A3J400 TO REAR PANEL OUT 1 HIGH)	28480	08904-61007
W3	08904-61007	0	6	COAX CABLE BNC-PCB (A3J401 TO REAR PANEL OUT 1 LOW)	28480	08904-61007
W4	08904-61007	0	6	COAX CABLE BNC-PCB (OPTION 002/004) (A10J400 TO REAR PANEL OUT 2 HIGH)	28480	08904-61007
W5	08904-61007	0	6	COAX CABLE BNC-PCB (REAR PANEL OUTPUT) (OPTION 002/004) (A10J401 TO REAR PANEL OUT 2 LOW)	28480	08904-61007
W6	08904-61007	0	6	COAX CABLE BNC-PCB (A3J400 TO FRONT PANEL OUT 1 HIGH)	28480	08904-61007
W7	08904-61007	0	6	COAX CABLE BNC-PCB (A3J401 TO FRONT PANEL OUT 1 LOW)	28480	08904-61007
W8	08904-61007	0	6	COAX CABLE BNC-PCB (ADDED FOR OPTION 002) (A10J400 TO FRONT PANEL OUT 2 HIGH)	28480	08904-61007
W9	08904-61007	0	6	COAX CABLE BNC-PCB (ADDED FOR OPTION 002) (A10J401 TO FRONT PANEL OUT 2 LOW)	28480	08904-61007
W10	08904-61007	0	6	COAX CABLE BNC-PCB REAR PANEL 10 MHZ EXT REF IN TO A2J101)	28480	08904-61007
W11	08904-61007	0	6	COAX CABLE BNC-PCB (A2J102 TO REAR PANEL 10 MHZ REF OUT)	28480	08904-61007
W12	08904-61009	3	1	LINE VOLTAGE SELECTION CABLE REAR PANEL VOLTAGE SELECT TO A4P4)	28480	08904-61009
W13	08904-61003	6	1	RIBBON CABLE (24 CONDUCTOR) REAR PANEL HP-IB TO A2J3)	28480	08904-61003

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

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Table 6-3. *Replaceable Parts*

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
W14	08904-61004	7	1	RIBBON CABLE (16 CONDUCTOR) REAR PANEL DIGITAL PORT TO A2J4)	28480	08904-61004
W15	08904-61006	9	1	POWER SUPPLY WIRING HARNESS (A4P3 TO A2J7)	28480	08904-61006
W16	08904-61008	1	1	RIBBON CABLE (34 CONDUCTOR) (A2J5 TO A3J1)	28480	08904-61008
W17	08904-61008	1	1	RIBBON CABLE (34 CONDUCTOR) (ADDED FOR OPTION 002) (A2J6 TO A10J1)	28480	08904-61008
2912A to 2942A *W18-W25* *2948A and above*				NOT ASSIGNED		
W18	5061-4837	4	1	COAX CABLE FEMALE SMC-SMC (ADDED FOR OPTION 006) (A3J400 TO A6J1)	28480	5061-4837
W19	5061-4837	4	1	COAX CABLE FEMALE SMC-SMC (ADDED FOR OPTION 006) (A3J401 TO A6J2)	28480	5061-4837
W20	08904-61015	0	1	COAX CABLE (ADDED FOR OPTION 006) (A6J4 TO FRONT PANEL CH1 LOW)	28480	08904-61015
W21	08904-61015	0	1	COAX CABLE (ADDED FOR OPTION 006) (A6J3 TO FRONT PANEL CH1 HIGH)	28480	08904-61015
W22	08904-61007	0	1	COAX CABLE BNC-PCB (ADDED FOR OPTION 005) (A2J12 TO REAR PANEL RESET INPUT)	28480	08904-61007
W23	08904-61007	0	1	COAX CABLE BNC-PCB (ADDED FOR OPTION 005) (A2J11 TO REAR PANEL RESET OUTPUT)	28480	08904-61007
W24	08904-61007	0	1	COAX CABLE BNC-PCB (ADDED FOR OPTION 005) (A2J10 TO SYNC CLOCK IN)	28480	08904-61007
W25	08904-61007	0	1	COAX CABLE BNC-PCB (ADDED FOR OPTION 005) (A2J9 TO SYNC CLOCK OUT)	28480	08904-61007

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
1	08904-00010	7	1	REAR PANEL SILKSCREEN LABEL	28480	08904-00010
2712A to 2942A						
2	08904-61012	7	1	DECK ASSY	28480	08904-61012
2948A and above						
2	08904-61014	1	1	DECK ASSY	28480	08904-61016
3	0361-1020	2	4	RIVET-BLIND PL-STEM DOME-HD .125DIA	90201	AD42AH
4	0361-1020	2		RIVET-BLIND PL-STEM DOME-HD .125DIA	90201	AD42AH
5	0361-1020	2		RIVET-BLIND PL-STEM DOME-HD .125DIA	90201	AD42AH
6	0361-1020	2		RIVET-BLIND PL-STEM DOME-HD .125DIA	90201	AD42AH
7	1252-2245	5	2	SCREW LOCK KIT-AMP CHAMP CONN	00779	554808-1
8	1252-2245	5		SCREW LOCK KIT-AMP CHAMP CONN	00779	554808-1
9	2190-0007	2	2	WASHER-LK INTL T NO. 6 .141-IN-ID	78189	1906-00-00-2580
10	2190-0007	2		WASHER-LK INTL T NO. 6 .141-IN-ID	78189	1906-00-00-2580
11	0361-1259	9	2	RIVET-BLIND DR-PIN DOME-HD .162DIA	28480	0361-1259
12	0361-1259	9		RIVET-BLIND DR-PIN DOME-HD .162DIA	28480	0361-1259
13	0590-1251	6	8	NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD	00000	ORDER BY DESCRIPTION
14	1510-0038	8	1	BINDING POST ASSY SGL THD-STUD	28480	1510-0038
15	2190-0068	5	2	WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
16	0590-1251	6		NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD	00000	ORDER BY DESCRIPTION
17	2190-0068	5		WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
18	6960-0132	1	8	PLUG-HOLE .500D	28480	6960-0132
19	6960-0132	1		PLUG-HOLE .500D	28480	6960-0132
20	6960-0132	1		PLUG-HOLE .500D	28480	6960-0132
21	6960-0132	1		PLUG-HOLE .500D	28480	6960-0132
22	2190-0027	6	1	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0027
23	2950-0006	3	1	NUT-HEX-DBL-CHAM 1/4-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
24	1251-7788	9	2	SCREWLOCK FEMALE-AMP HD CONN	00779	205818-2
25	1251-7788	9		SCREWLOCK FEMALE-AMP HD CONN	00779	205818-2
26	2190-0584	0	2	WASHER-LK HLCL 3.0 MM 3.1-MM-ID	28480	2190-0584
27	2190-0584	0		WASHER-LK HLCL 3.0 MM 3.1-MM-ID	28480	2190-0584
28	2190-0068	6		WASHER LK .505-ID (ADDED FOR OPTION 004)	00000	ORDER BY DESCRIPTION
29Δ				NOT ASSIGNED		
30	2190-0068	6		WASHER LK .505-ID (ADDED FOR OPTION 004)	00000	ORDER BY DESCRIPTION
31Δ				NOT ASSIGNED		
32	0590-1251	6	1	NUT-SPCL 15/32 32 (ADDED FOR OPTIONS 004 AND 005)	28480	0590-1251
33	2190-0068	6		WASHER LK .505-ID (ADDED FOR OPTION 004)	00000	ORDER BY DESCRIPTION
34	0590-1251	6	1	NUT-SPCL 15/32 32 (ADDED FOR OPTIONS 004 AND 005)	28480	0590-1251
35	2190-0068	6		WASHER LK .505-ID (ADDED FOR OPTION 004)	00000	ORDER BY DESCRIPTION

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

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Table 6-3. *Replaceable Parts*

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
2712A to 2917A						
36 †				SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT		
37 †				SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT		
38 †				SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT		
39 †				SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT		
2923A and above						
36	08904-61021	8	1	PANEL, FRONT AY	28480	08904-61021
37				NOT SEPARARETLY REPLACEABLE		
38	08904-40006	5	1	KEYPAD PUNCHED	28480	08904-40006
39	08904-00021	0	1	SHIELD DISPLAY	28480	08904-00021
40	0515-1851	4	21	SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
41	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
42	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
43	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
44	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
45	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
46	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
2712A to 2917A						
47 †	0515-1851	4		SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT		
2923A and above						
47				NOT ASSIGNED		
48	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
49	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
2712A to 2917A						
50 †	0515-1851	4		SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT		
2923A and above						
50				NOT ASSIGNED		
51	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
52	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
53	0590-1251	6		NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD (EXCEPT OPTION 006)	00000	ORDER BY DESCRIPTION
53	2950-0035	8		NUT-HEX-DBL-CHAM 15/32-32-THD (USED FOR OPTION 006)	00000	ORDER BY DESCRIPTION
54	0590-1251	6		NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD (EXCEPT OPTION 006)	00000	ORDER BY DESCRIPTION
54	2950-0035	8		NUT-HEX-DBL-CHAM 15/32-32-THD (USED FOR OPTION 006)	00000	ORDER BY DESCRIPTION
55	6960-0132	1		PLUG-HOLE .500D	28480	6960-0132

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
56	6960-0132	1		PLUG-HOLE .500D	28480	6960-0132
57△				NOT ASSIGNED		
58△				NOT ASSIGNED		
59	2950-0035	8		NUT-HEX-DBL-CHAM 15/32-32-THD (USED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
59	2950-0035	8		NUT-HEX-DBL-CHAM 15/32-32-THD (USED FOR OPTION 006)	00000	ORDER BY DESCRIPTION
60	0590-1251	6		NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD (USED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
60	2950-0035	8		NUT-HEX-DBL-CHAM 15/32-32-THD (USED FOR OPTION 006)	00000	ORDER BY DESCRIPTION
61	5001-0539	9	2	TRIM SIDE FRT F (SEE SECTION 7)	28480	5001-0539
62	5001-0539	9		TRIM SIDE FRT F (SEE SECTION 7)	28480	5001-0539
63	5041-8801	8	4	FOOT FULL-1/2MOD (SEE SECTION 7)	28480	5041-8801
64	5041-8801	8		FOOT FULL-1/2MOD (SEE SECTION 7)	28480	5041-8801
65	5041-8801	8		FOOT FULL-1/2MOD (SEE SECTION 7)	28480	5041-8801
66	5041-8801	8		FOOT FULL-1/2MOD (SEE SECTION 7)	28480	5041-8801
67	5041-8803	0	1	TRIM STRIP (SEE SECTION 7)	28480	5041-8803
68	5180-1871	2		LBL BLK SERIAL	28480	5180-1871
69	08904-00016	3	1	COVER TOP (SEE SECTION 7)	28480	08904-00016
70	08904-00017	4	1	COVER BOTTOM (SEE SECTION 7)	28480	08904-00017
71	1460-1345	5	2	TILT STAND SST	28480	1460-1345
72	1460-1345	5		TILT STAND SST	28480	1460-1345
2712A to 2917A						
73 †	0515-0367	5	2	SCREW-MACHINE ASSEMBLY M2.5 X 0.45 SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT	00000	ORDER BY DESCRIPTION
74 †	0515-0367	5		SCREW-MACHINE ASSEMBLY M2.5 X 0.45 SEE SECTION 7 FOR FRONT PANEL RETROFIT KIT	00000	ORDER BY DESCRIPTION
2923A and above						
73				NOT ASSIGNED		
74				NOT ASSIGNED		
75	0515-1234	7	10	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
76	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
77	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
78	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
79	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
80	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
81	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
2712A to 2917A						
82	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
83	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
2923A and above						
82				NOT ASSIGNED, SEE ITEM 145		
83				NOT ASSIGNED		

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
84	0515-1234	7		SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
85	0361-1265	7	4	RIVET-BLIND PL-STEM DOME-HD .125DIA	90201	AD44H
86	0361-1265	7		RIVET-BLIND PL-STEM DOME-HD .125DIA	90201	AD44H
87	0361-1265	7		RIVET-BLIND PL-STEM DOME-HD .125DIA	90201	AD44H
88	0361-1265	7		RIVET-BLIND PL-STEM DOME-HD .125DIA	90201	AD44H
89	5021-8415	9	1	FRAME, FRONT	28480	5021-8415
90	0515-1860	5	6	SCREW-MACHINE ASSEMBLY M3.5 X 0.6	28480	0515-1860
91	0515-1860	5		SCREW-MACHINE ASSEMBLY M3.5 X 0.6	28480	0515-1860
92	0515-1860	5		SCREW-MACHINE ASSEMBLY M3.5 X 0.6	28480	0515-1860
93	0515-1860	5		SCREW-MACHINE ASSEMBLY M3.5 X 0.6	28480	0515-1860
94	0515-1860	5		SCREW-MACHINE ASSEMBLY M3.5 X 0.6	28480	0515-1860
95	1400-0249	0	7	CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
96	1400-0249	0		CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
97	1400-0249	0		CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
98	1400-0249	0		CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
99	1400-0249	0		CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
100	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 004)	28480	1400-0249
101	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 004)	28480	1400-0249
102	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 004)	28480	1400-0249
103	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
104	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
105	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
106	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
107	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
108	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
109	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
110	0515-1851	4		SCREW-MACHINE ASSEMBLY M3 X 0.5 6MM-LG	28480	0515-1851
111	08904-61013	8	1	AY-SHLD OUT PUT	28480	08904-61013
112	2190-0585	1	1	WASHER-LK HLCL 3.5 MM 3.6-MM-ID (ADDED FOR OPTION 002)	28480	2190-0585
113	0515-0955	7	1	SCREW-MACH M3.5 X 0.6 30MM-LG PAN-HD (ADDED FOR OPTION 002)	28480	0515-0955
114	0380-1914	3	7	SPACER-RND 19-MM-LG 5.6-MM-ID 10-MM-OD (ADDED FOR OPTION 002)	06540	19666-N0056
115	0380-1914	3		SPACER-RND 19-MM-LG 5.6-MM-ID 10-MM-OD (ADDED FOR OPTION 002)	06540	19666-N0056
116	0380-1914	3		SPACER-RND 19-MM-LG 5.6-MM-ID 10-MM-OD (ADDED FOR OPTION 002)	06540	19666-N0056
117	0380-1914	3		SPACER-RND 19-MM-LG 5.6-MM-ID 10-MM-OD (ADDED FOR OPTION 002)	06540	19666-N0056
118	0380-1914	3		SPACER-RND 19-MM-LG 5.6-MM-ID 10-MM-OD (ADDED FOR OPTION 002)	06540	19666-N0056
119	0380-1914	3		SPACER-RND 19-MM-LG 5.6-MM-ID 10-MM-OD (ADDED FOR OPTION 002)	06540	19666-N0056

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

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
120	0380-1914	3		SPACER-RND 19-MM-LG 5.6-MM-ID 10-MM-OD (ADDED FOR OPTION 002)	06540	19666-N0056
121	0380-1929	0	1	SPACER-RND 19-MM-LG 4-MM-ID 3.5MM-THD (ADDED FOR OPTION 002)	06540	19616-B-0040-28
122	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 004)	28480	1400-0249
123	7120-4295	6	1	LABEL-WARNING 1-IN-WD 2-IN-LG AL	28480	7120-4295
124	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 004)	28480	1400-0249
125	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 004)	28480	1400-0249
126	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 004)	28480	1400-0249
127	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 004)	28480	1400-0249
128	1400-0249	0		CABLE TIE .062-.625-DIA .091-WD NYL	28480	1400-0249
129	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 002)	28480	1400-0249
130	08904-61013	8	1	OUTPUT ASSEMBLY SHIELD (ADDED FOR OPTION 002)	28480	08904-61013
131	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
132	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
133	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
134	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
135	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
136	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
137	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
138	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 002)	00000	ORDER BY DESCRIPTION
2712A to 2817A *139* *2822A and above* *139*	08904-00015	2	1	NOT ASSIGNED INSULATOR, EPOXY GLASS	00000	ORDER BY DESCRIPTION

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

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Table 6-3. *Replaceable Parts*

Reference Designation	HP Part Number	C D	Qty.	Description	Mfr. Code	Mfr. Part Number
2712A to 2917A						
140				NOT ASSIGNED		
141				NOT ASSIGNED		
2923A and above						
140				NOT SEPARATELY REPLACEABLE		
141				NOT SEPARATELY REPLACEABLE		
2912A to 2917A						
142-145				NOT ASSIGNED		
2923A and above						
142	08904-00022	1	1	LINE SWITCH BRACKET	28480	08904-00022
*143*Δ	0515-2028	6	2	SCREW-MACH M2.5 X 0.45 4MM-LG	28480	0515-0954
*144*Δ	0515-0954	6	2	SCREW-MACH M2.5 X 0.45 4MM-LG	28480	0515-0954
145	0515-1234	7	9	SCREW-MACH M3.5 X 0.6 8MM-LG	28480	0515-1234
2912A to 2942A						
146-148				NOT ASSIGNED		
2948A and above						
146	3050-0891	7	3	WASHER-FL MTLC 3.0MM 3.3MM-ID	00000	ORDER BY DESCRIPTION
147	3050-0891	7	3	WASHER-FL MTLC 3.0MM 3.3MM-ID	00000	ORDER BY DESCRIPTION
148	3050-0891	7	3	WASHER-FL MTLC 3.0MM 3.3MM-ID	00000	ORDER BY DESCRIPTION
149				NOT ASSIGNED		
2912A to 2942A						
150-166				NOT ASSIGNED		
2948A and above						
150	08904-80015	0	1	LABEL FOR OPTION 006	28480	08904-80015
151	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 006)	00000	ORDER BY DESCRIPTION
152	0515-1851	4	1	SCREW 3.0 6 SEM PNTX (ADDED FOR OPTION 006)	00000	ORDER BY DESCRIPTION
153	0515-1860	5		SCREW-MACHINE ASSEMBLY M3.5 X 0.6 (ADDED FOR OPTION 006)	28480	0515-1860
154	0515-1860	5		SCREW-MACHINE ASSEMBLY M3.5 X 0.6 (ADDED FOR OPTION 006)	28480	0515-1860
155	0515-1860	5		SCREW-MACHINE ASSEMBLY M3.5 X 0.6 (ADDED FOR OPTION 006)	28480	0515-1860
156	0515-1860	5		SCREW-MACHINE ASSEMBLY M3.5 X 0.6 (ADDED FOR OPTION 006)	28480	0515-1860
157	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 005)	28480	1400-0249
158	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 005)	28480	1400-0249
159	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 005)	28480	1400-0249
160	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 005)	28480	1400-0249
161	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 005)	28480	1400-0249
162	08904-80017	2	1	LABEL FOR OPTION 005	28480	08904-80017
163				NOT ASSIGNED		
164				NOT SEPARATELY REPLACEABLE		
165	1400-0249	0	1	CABLE TIE .062D .09W (ADDED FOR OPTION 006)	28480	1400-0249
166	08904-00012	9	1	BOARD PULLER	28480	08904-00012

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

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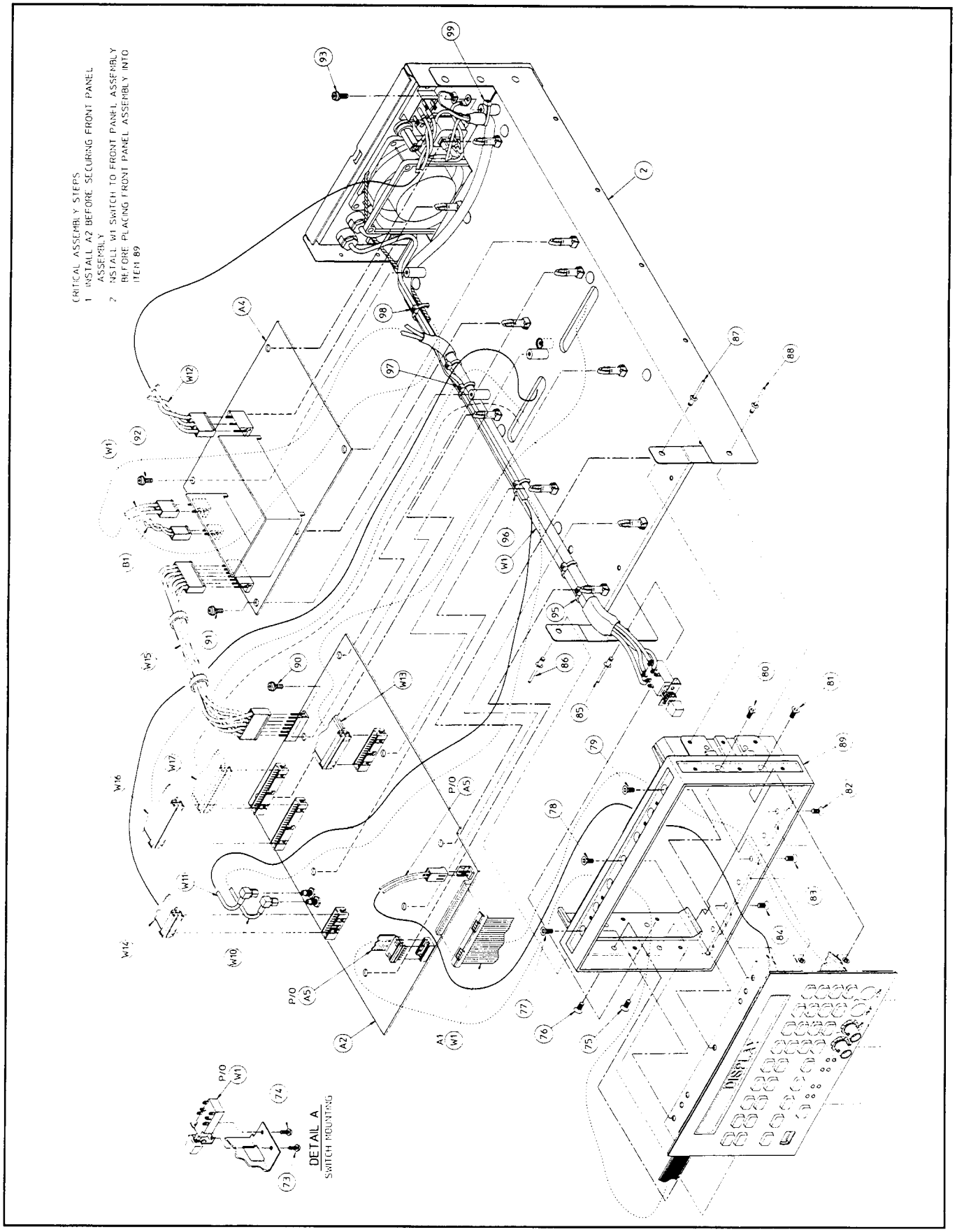


Figure 6–1. *Main Deck Assembly - Top, (2712A to 2917A), See Section 7 for Front Panel Retrofit Kit.*

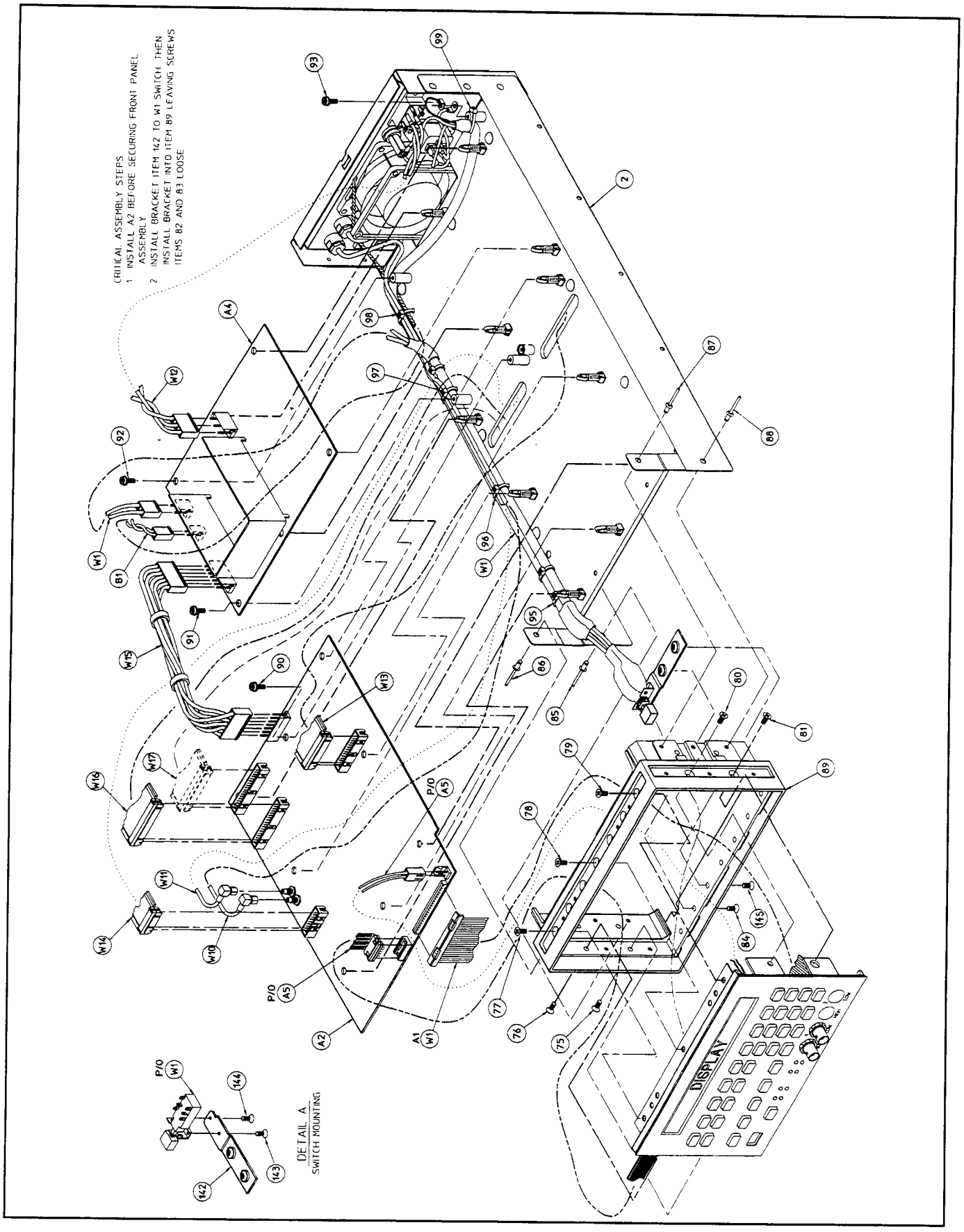


Figure 6–1. *Main Deck Assembly – Top, (2923A and above)*

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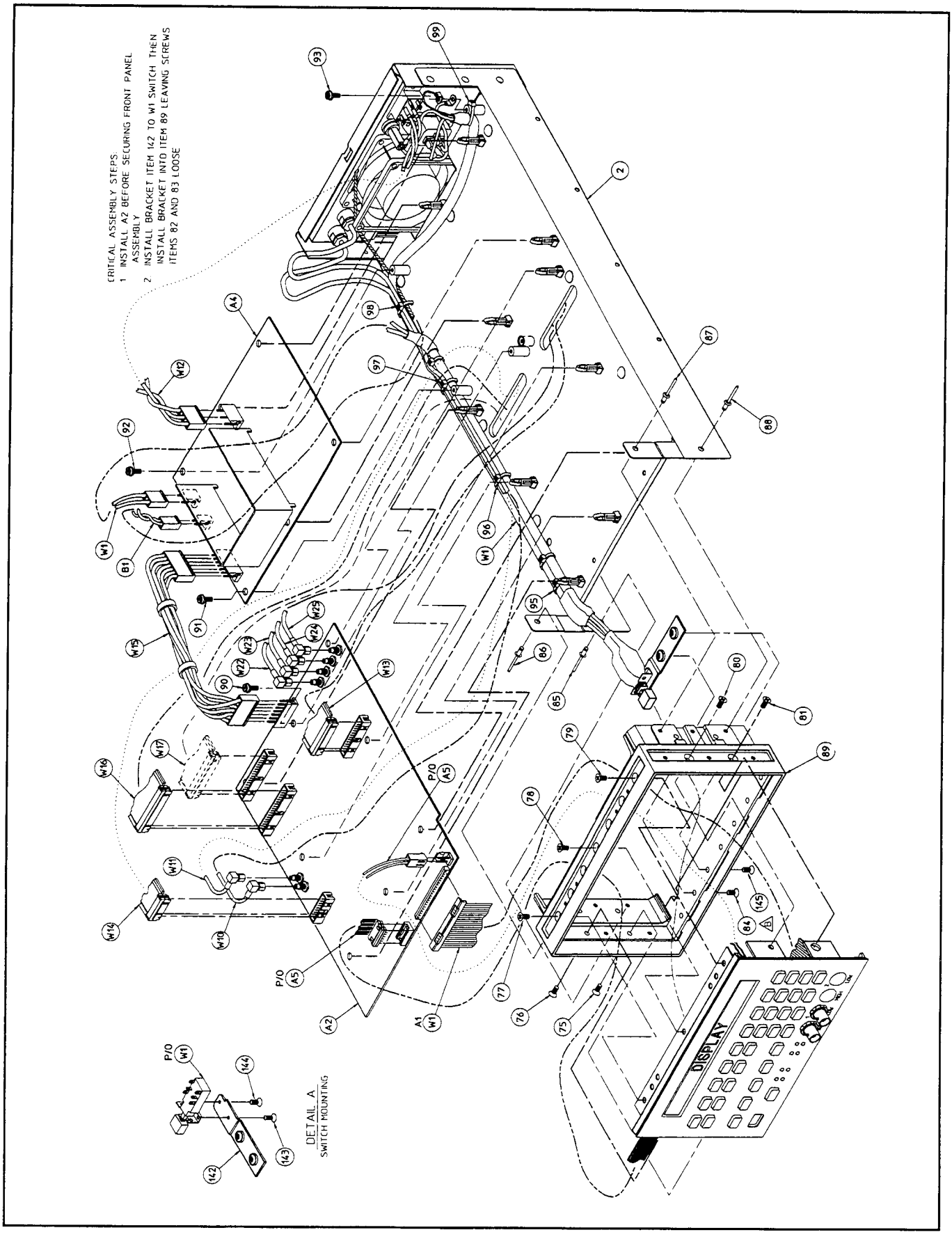


Figure 6–1. *Main Deck Assembly – Top, Option 005 (2948A and above)*

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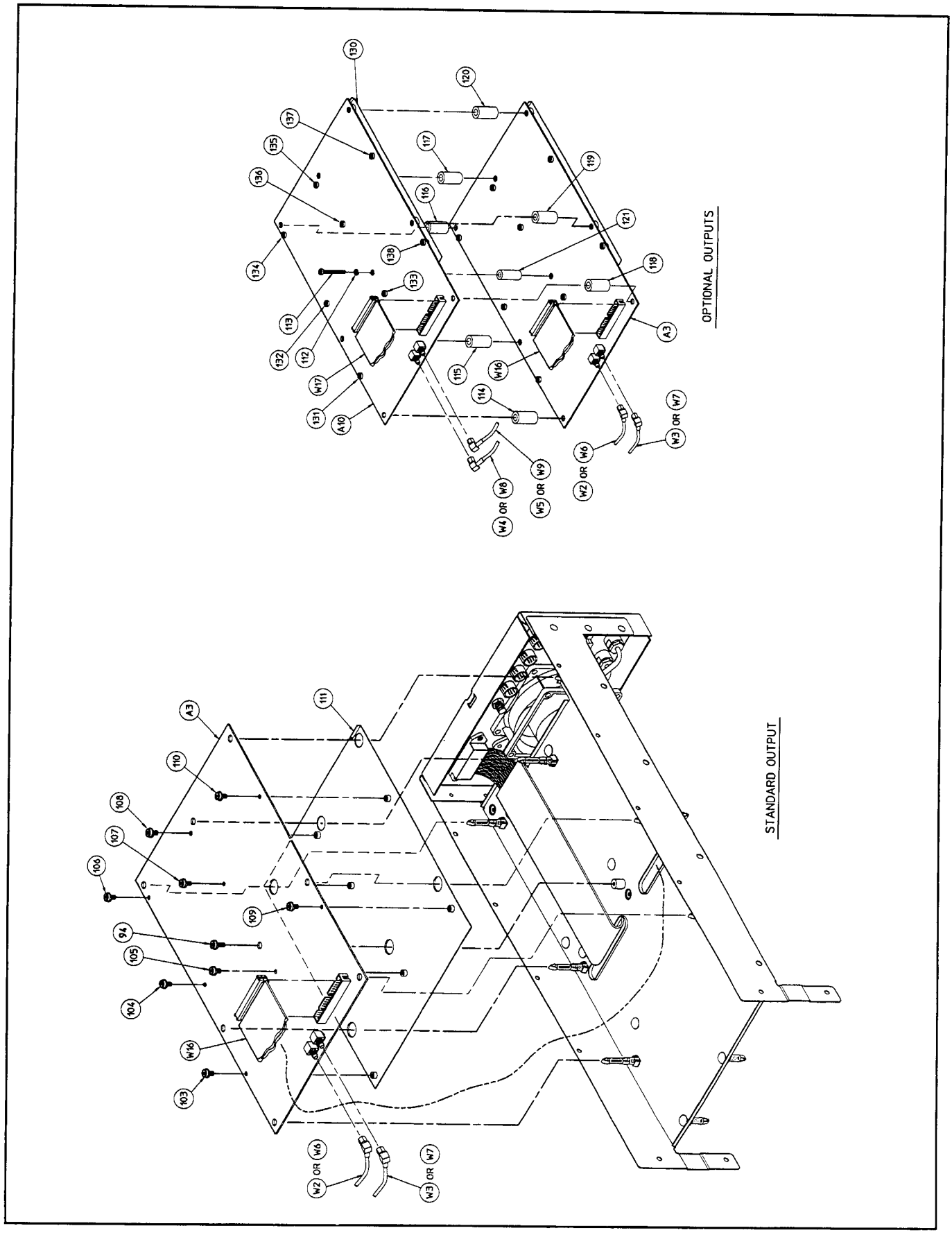
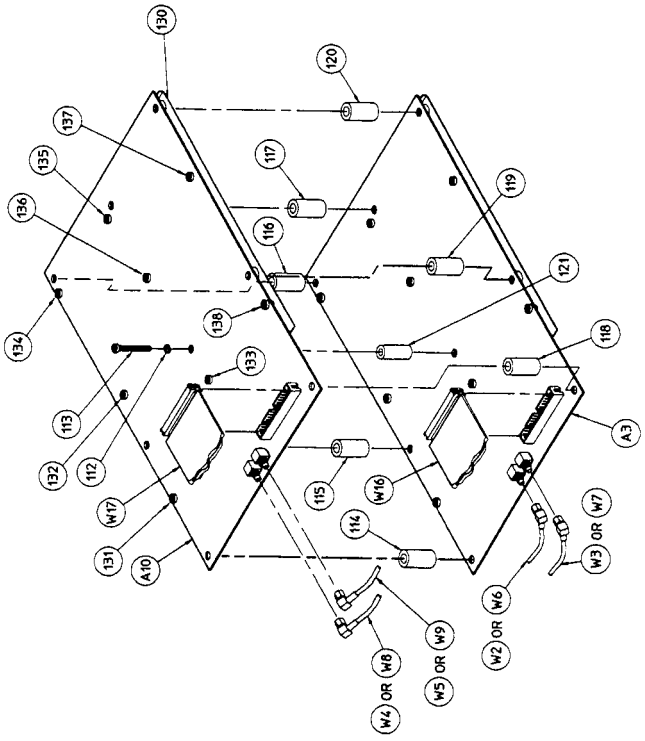


Figure 6–2. *Main Deck Assembly – Bottom*

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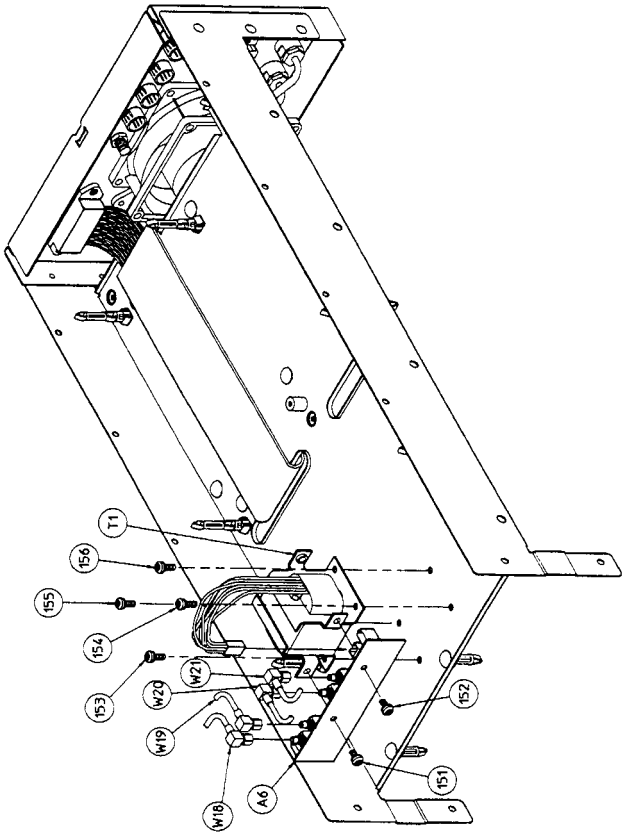


Figure 6–2. *Main Deck Assembly – Bottom, Option 006 (2948A and above)*

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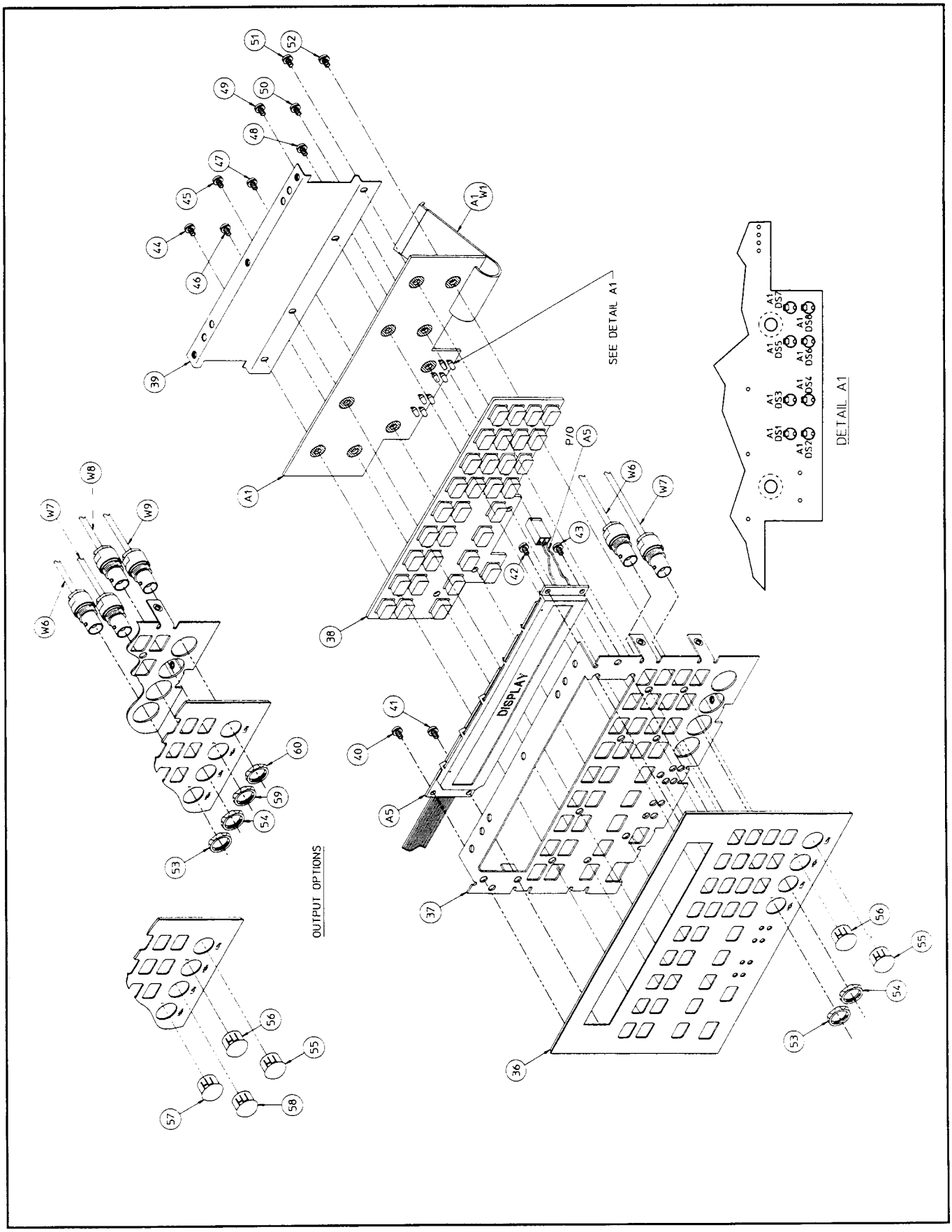


Figure 6–3. *Front Panel Assembly, (2712A to 2917A), See Section 7 for Front Panel Retrofit Kit.*

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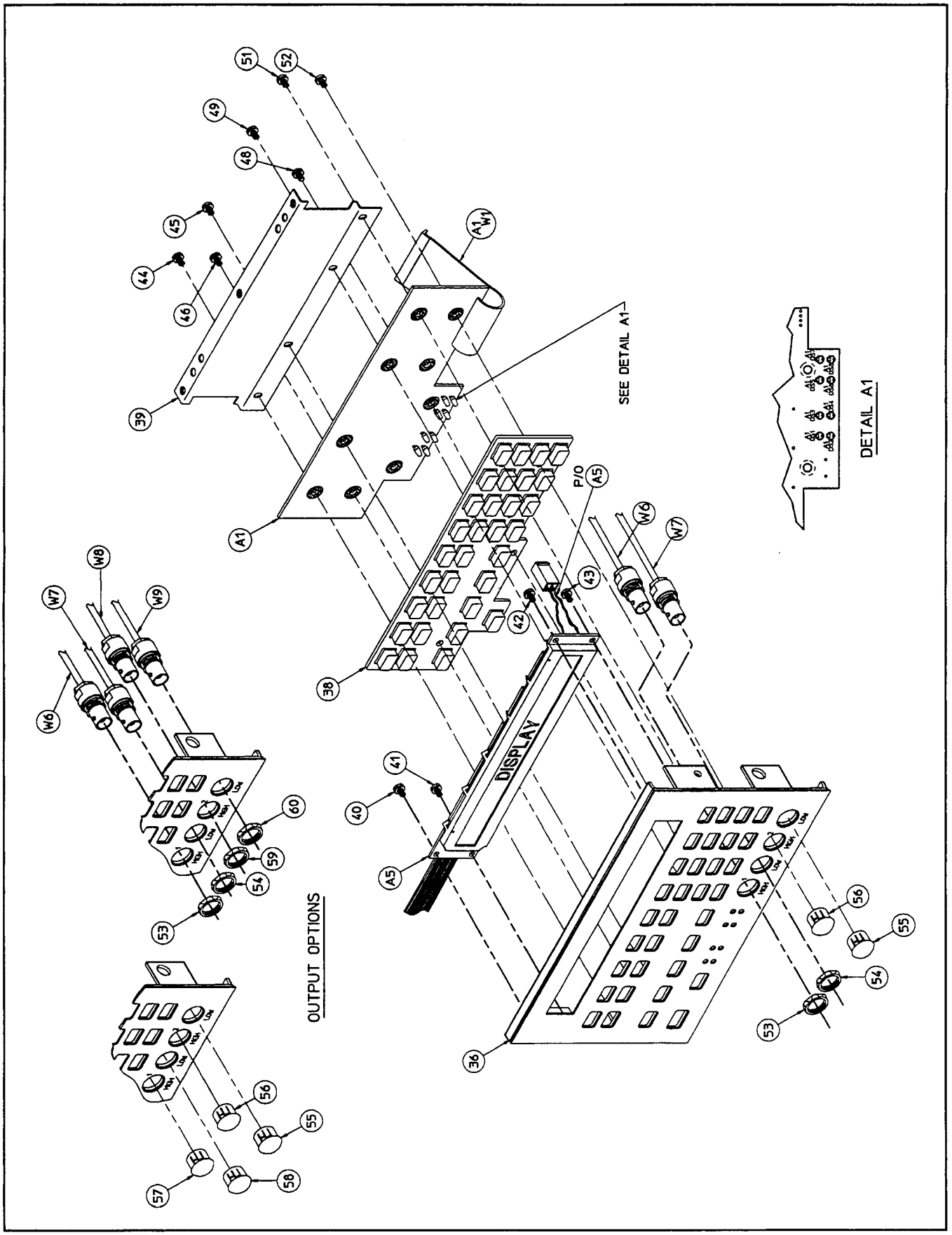


Figure 6–3. *Front Panel Assembly, (2923A and above)*

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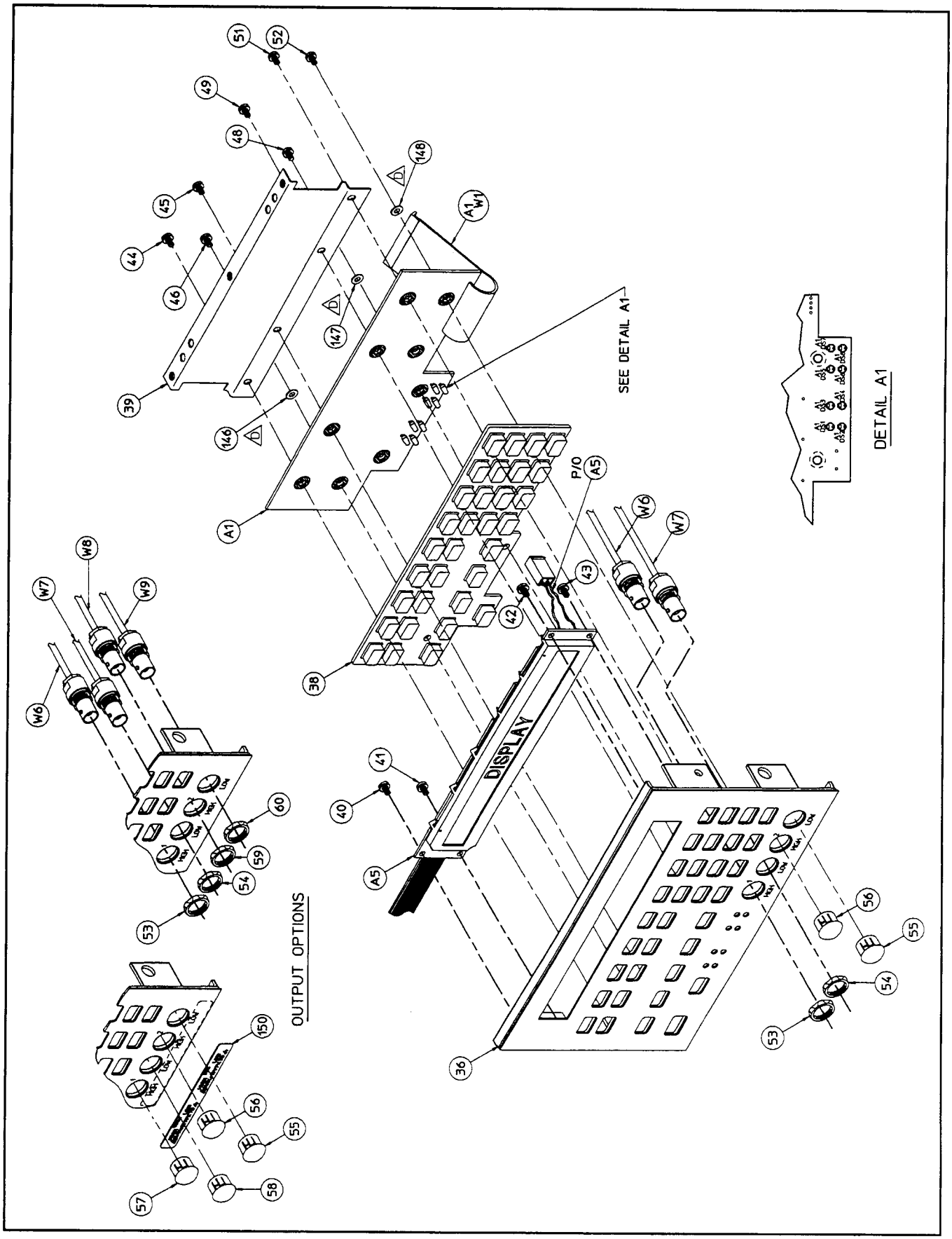


Figure 6–3. *Front Panel Assembly, Option 006 (2948A and above)*

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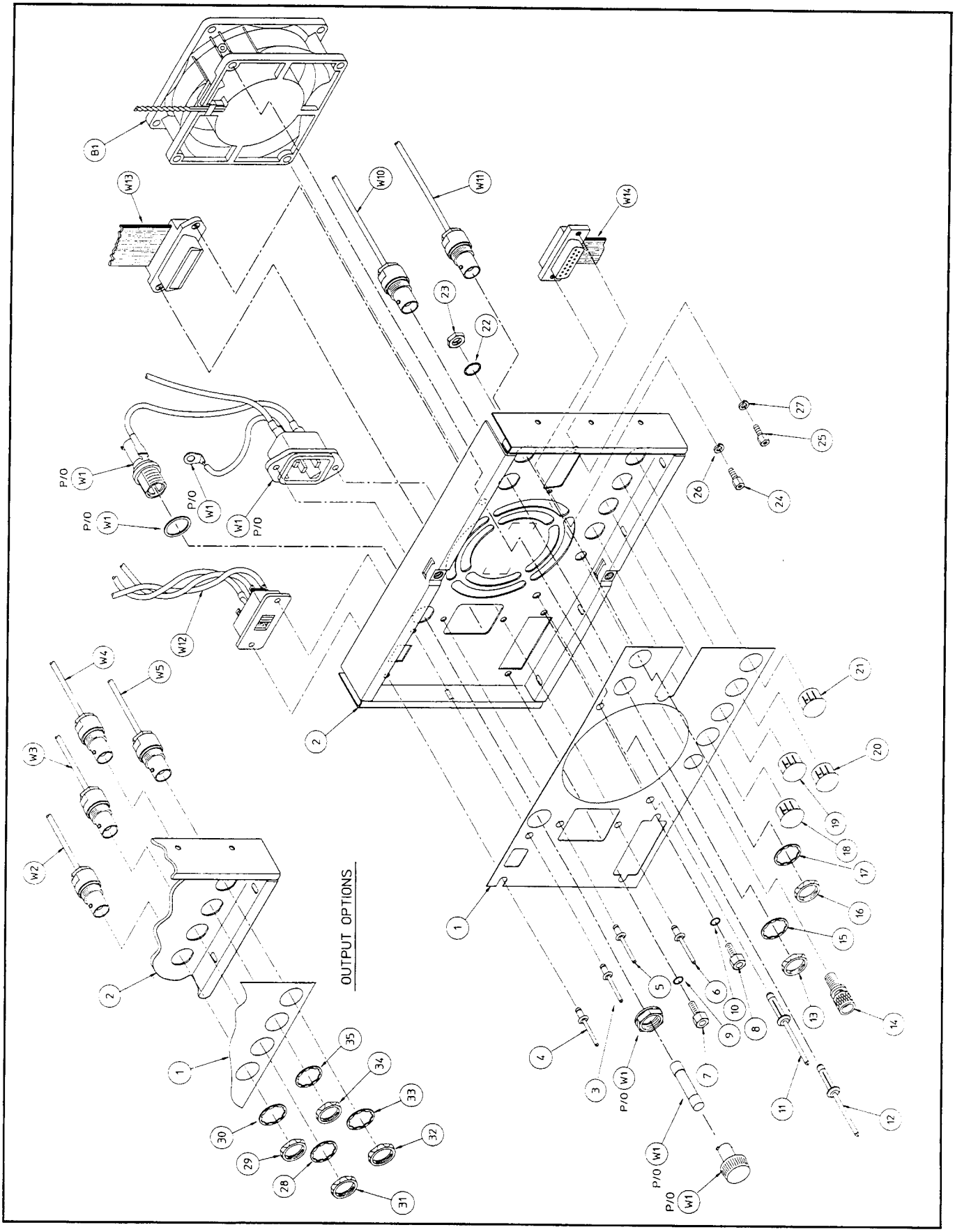


Figure 6–4. *Rear Panel Assembly*

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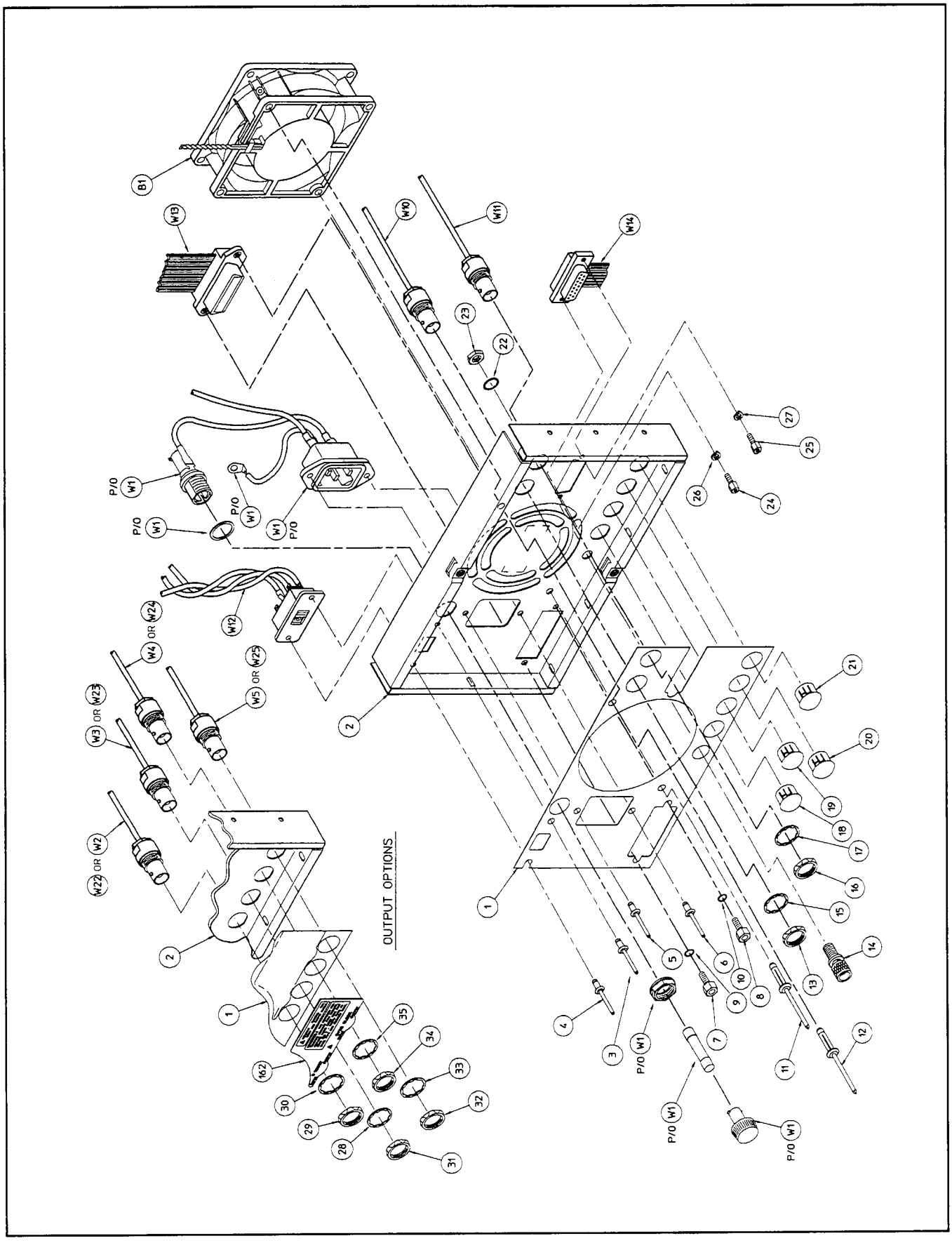


Figure 6–4. *Rear Panel Assembly, Option 005 (2948A and above)*

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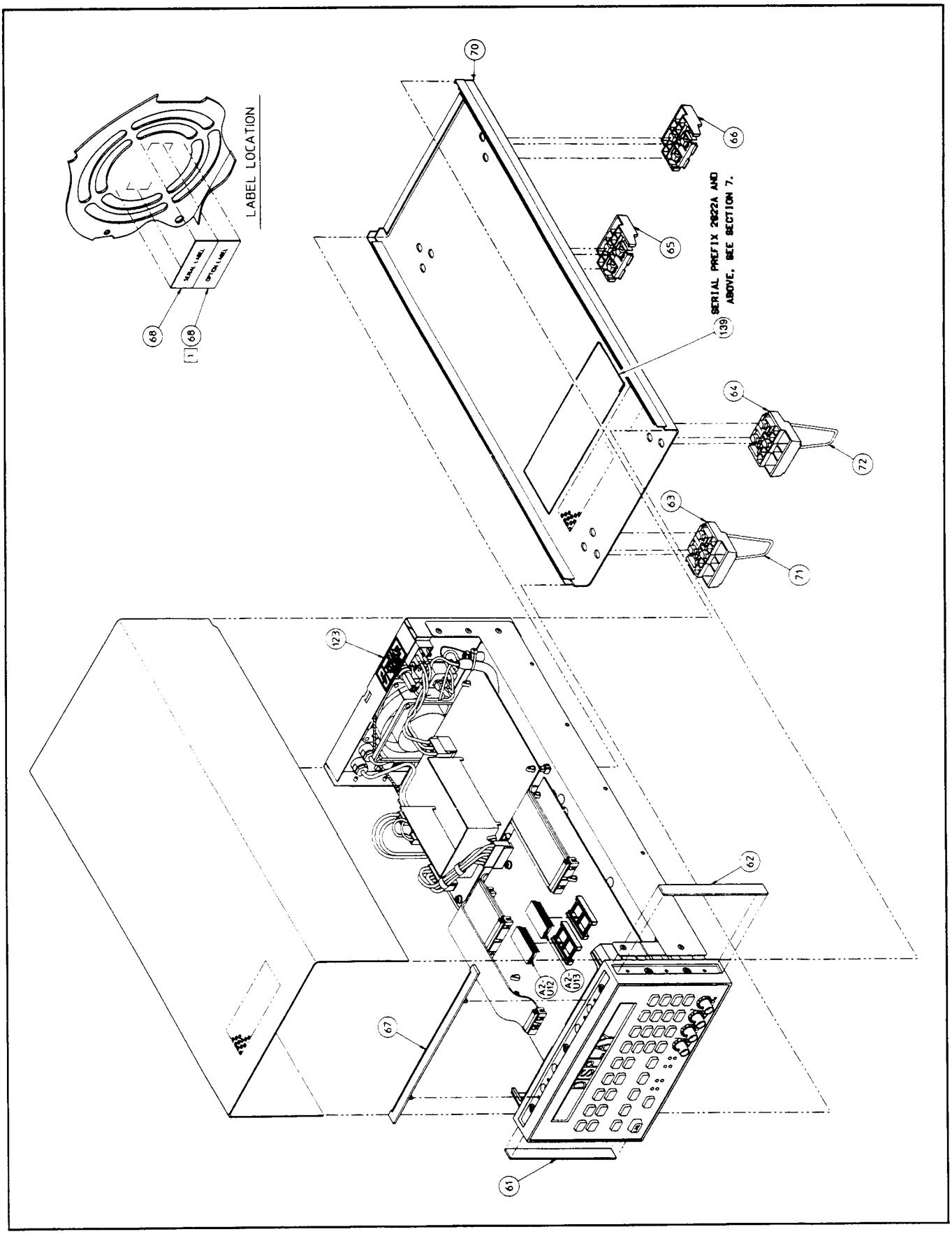


Figure 6–5. *Covers, Labels, and ROMs*

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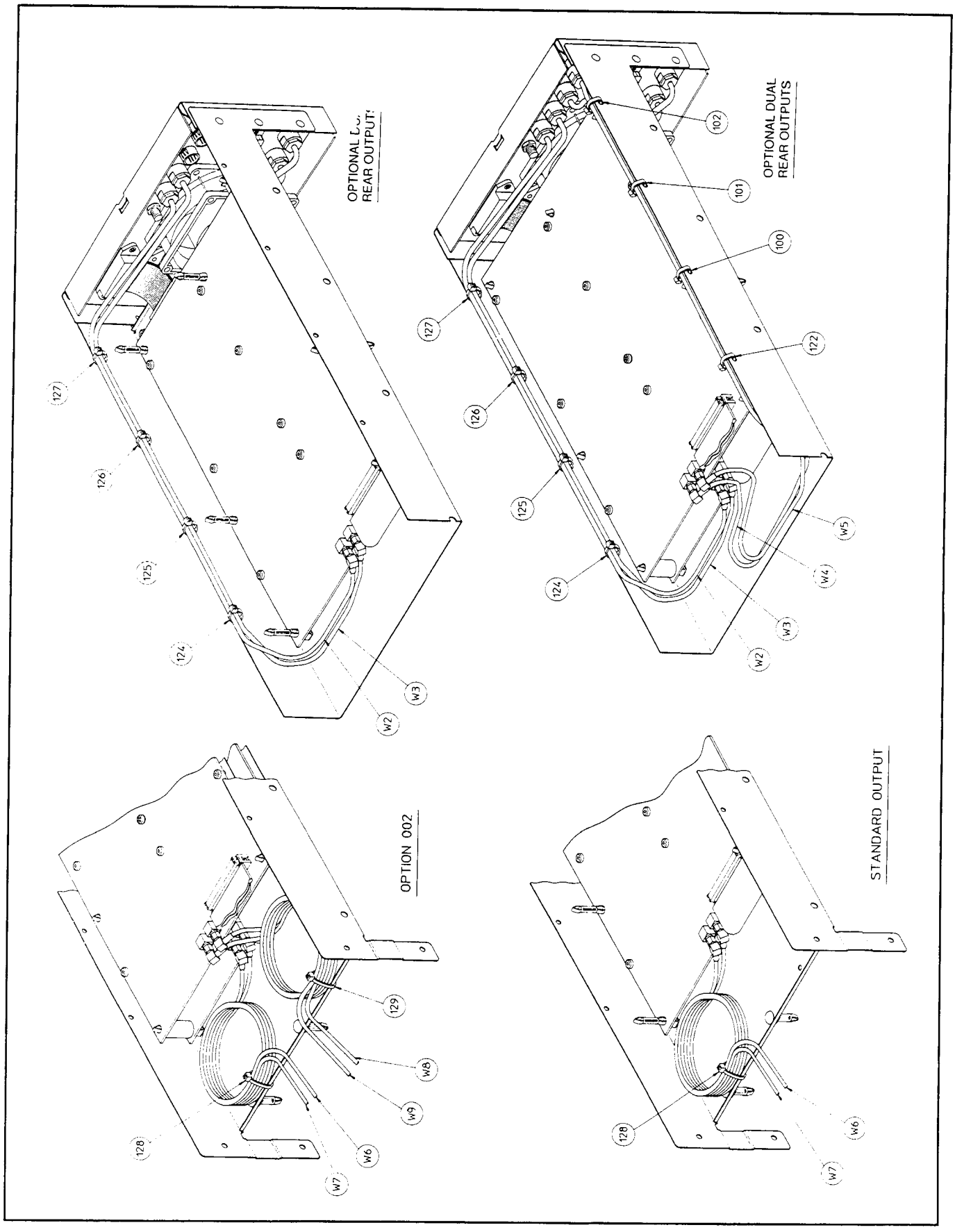


Figure 6–6. *Output Cables (1 of 2)*

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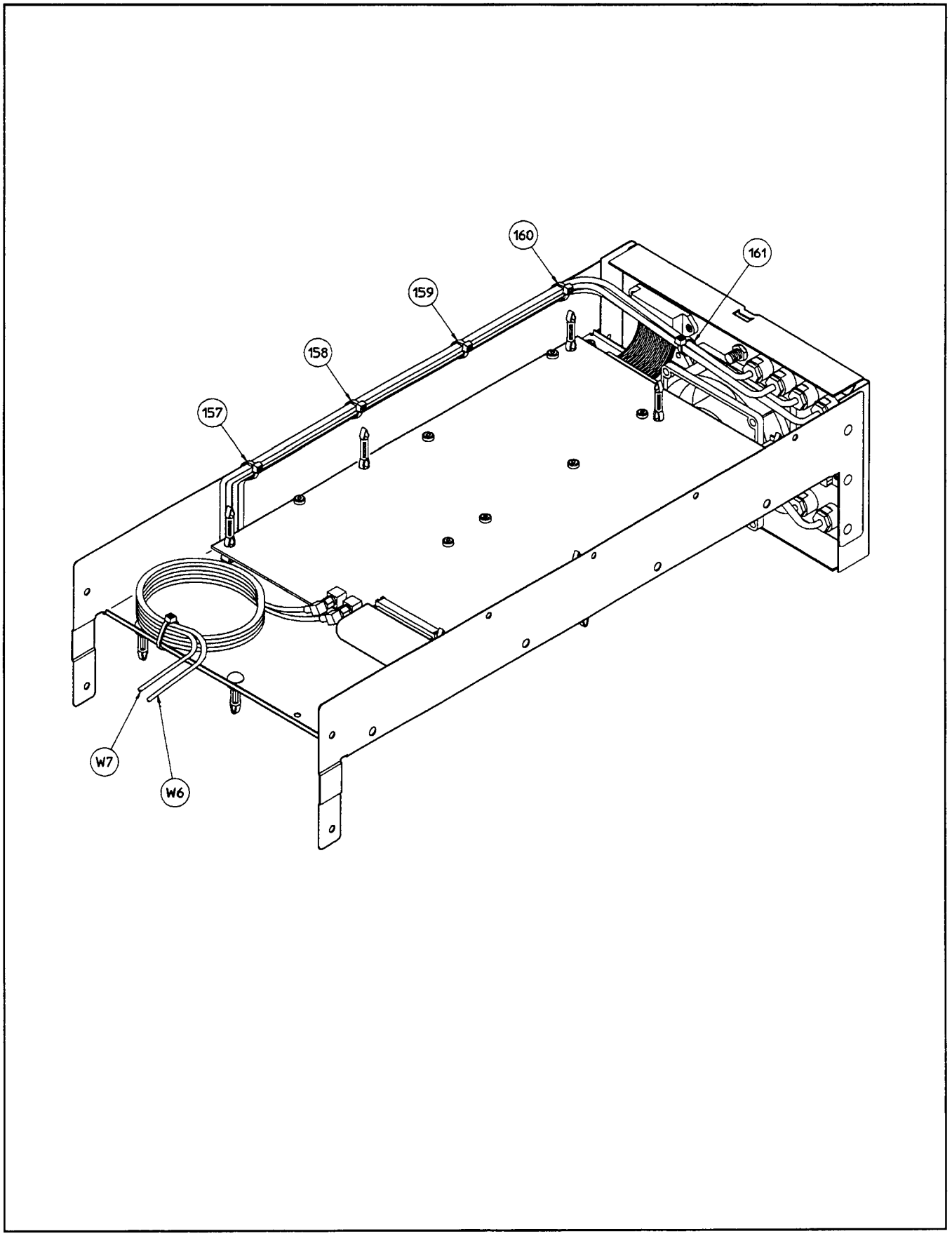


Figure 6–6. *Output Cables, Option 005 (2948A and above) (2 of 2)*

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Section 7
INSTRUMENT CHANGES

7-1. INTRODUCTION TO THIS SECTION

This section contains instrument modification recommendations and procedures that could improve the performance and reliability of your instrument. Refer to *Instruments Covered by This Manual* in section 1 of the HP 8904A *Operation and Calibration Manual* for important information about serial number coverage.

7-2. OPTION CONVERSIONS

It is sometimes desirable to add or delete options in the instrument after the initial purchase. In the HP 8904A Multifunction Synthesizer this can be done as indicated in the following table.

Option Number	Retrofitability for Instrument Serial Prefix Range	
	2942A and below	2948A and above
001	Yes	Yes
002	Yes	Yes
003	Yes	Yes
004	Yes	Yes, except in combination with Option 005 or 006
Delete 004	Yes	Yes
005	No	Yes, except in combination with Option 004
006	No	Yes, except in combination with Option 004

To retrofit Option 001 (three internal channels, channel A modulation, summation, and sequence capability), order HP 11816A from your local Hewlett-Packard Sales office.

To retrofit Option 002 (second internal synthesizer and output), order HP 11817A from your local Hewlett-Packard Sales office.

To retrofit Option 003 (fast hop and digital modulation capability), order HP 11818A from your local Hewlett-Packard Sales office.

To retrofit Option 004 (front-panel connectors moved to rear panel), follow the instructions in section titled *Front-to-Rear-Panel Output Conversion.* This option cannot be added in combination with Option 005 (multi-instrument phase synchronization) or 006 (balance output).

To delete Option 004 (rear-panel connectors moved to front panel), follow the instructions in the section titled *Rear-to-Front-Panel Output Conversion.*

To retrofit Option 005 (multi-instrument phase synchronization), order HP 11827A from your local Hewlett-Packard Sales office. Only instruments with serial prefix 2948A and above can be retrofit with this option. If the instrument has Option 004 (front-panel connectors moved to rear panel), the rear-panel connectors will need to be moved to the front panel.

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To retrofit Option 006 (balance output), order HP 11837A from your local Hewlett-Packard Sales office. Only instruments with serial prefix 2948A and above can be retrofit with this option. The added balanced output will replace one of the outputs already in the instrument if it has Option 002 (second internal synthesizer and output). If the instrument has Option 004 (front-panel connectors moved to rear panel), the rear-panel connectors will need to be moved to the front panel.

7-3. INSTRUMENT MODIFICATIONS

Instrument modifications include firmware updates and hardware modifications. For information on firmware updates refer to the following table and to the section titled *Firmware Updates*.

Serial Prefix	Revision Code	Firmware History
2732A and below	20987A and 22987A	The first two editions of firmware had several problems and were incomplete, though useable. It is recommended that all instruments be upgraded to Revision 22987A with HP 08904-87010 as A2U12*.
2737A to 2942A	22987A	Problems noted in the previous firmware revision were fixed. However, the following problem has been noted: When used with HP-IB controllers which process HP-IB commands very fast, the instrument may hang up the HP-IB when the instrument is a talker. This problem can be corrected by upgrading to Revision 22987A with HP 08904-87010 as A2U12*.
2948A and above	27887A	Problems noted in the previous firmware revisions were fixed. Programs for operating Options 005 and 006 were added. Two enhancements were added to Option 001: Hop RAM sequencing and FM stereo. A physical re-design of the controller was made which does not permit this added firmware to be retrofitted into older instruments.

*Two revisions of firmware share the same revision code: 22987A. The older revision has part number HP 08904-87007 for ROM A2U12; the newer revision has part number HP 08904-87010.

For information on recommended hardware modifications refer to the following table and to the section titled *Hardware Modifications*.

Serial Prefix	Nature of Modification
2737A and below	Modification for possible ground wire shock hazard.
2747A and below	Modification for output overvoltage protection improvement.
2817A and below	Modification for potential power supply short.
2917A and below	Modification for front panel assembly.

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7–4. FRONT-TO-REAR-PANEL OUTPUT CONVERSION

Description

This procedure describes how to convert an instrument with front-panel output connectors (that is, a standard instrument) to one with rear-panel connectors (that is, Option 004). The procedure applies to instruments with one pair of outputs or two (that is, Option 002).

The modifications requires partial disassembly of the instrument (removing covers and routing of cables). No soldering is required. Modification should be done in a static protected environment. After modification, two performance tests must be run.

Parts Required

The following parts are required and may be ordered by contacting the nearest Hewlett-Packard Sales Office.

Table 7–1. *Parts for HP 8904A Front-to-Rear-Panel Output Conversion*

Option	Quantity	Description	HP Part Number
Standard	2	Plastic Hole-Plug	6960-0132
Option 002	4	Plastic Hole-Plug	6960-0132
Standard	2	Lock Washer 0.505 inch ID	2190-0068
Option 002	4	Lock Washer 0.505 inch ID	2190-0068
	8	Cable Tie	1400-0249
	1	Label Blank	5180-1871

Tools Required

The following tools are needed to modify the instrument:

9/16 inch, 6 point Nut Driver
No. 2 Pozidriv Screwdriver
Diagonal Cutters
Needle-nose Pliers

Modification Procedure

Removing Bottom Cover

1. Turn the instrument off and unplug the power cord.
2. Lay the instrument on its top and unscrew the Pozidriv screw in the middle of the rear edge of the bottom cover. This is a captive screw and will cause the bottom cover to push away from the frame. Slide the cover back about 6.5 mm (0.25 inch) and lift it off.

Preparing the Chassis

1. Remove the nuts from the present front-panel outputs with the 9/16 inch nut driver. Do not press against the front panel with the tool or scoring of the panel may occur.
2. Remove the cable tie around the loop of slack coaxial cable in the instrument by cutting it with the diagonal cutters being careful not to score the soft insulation on the cables.
3. Remove the necessary plastic hole-plugs in the rear panel by approaching them from inside the chassis with the needle-nose pliers and squeezing-in the small holding tangs on opposite sides of the plug. Grasp the front of the plug with your fingers to pull it away from the panel. Do not attempt to pry the plug out from the panel or the panel surface may get scarred.

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Cable Routing

1. Refer to figures 7–1, 7–2 and 7–3. Remove the BNC connector ends from the front panel one at a time and insert them into the corresponding openings in the rear panel.
2. After all of the connectors have been transferred to the rear panel, secure the cables to the side rail as shown in figure 7–3 using the new cable ties.
3. Install one new lock washer and one new nut on each connector.
4. Tighten the nuts on the BNC connectors hand tight using the nut driver. (The holes in the panel are D shaped and therefore prevent the connector from turning without having to tighten the nuts excessively.)
5. Verify that the SMC connections on the A3 Output Assembly and, if the instrument has Option 002, the A10 Output Assembly are tight.

Final Steps

1. Insert the new plastic hole-plugs into the front-panel output openings by carefully working the plugs into the holes with your fingers. The plugs fit tightly and will require some pressure to get them started in the holes.
2. Replace the bottom cover by reversing the removal procedure.
3. Type or write the date and option number on the new blank label in the following form: `day/month/year: Opt. 004`. Peel off the protective backing and stick the label on the rear panel. (Do not place the label over the existing serial number tag.)

Operation Verification

1. Connect the power cord and turn the instrument on.
2. The instrument should beep immediately upon power up and then again about 4.5 seconds later. The display should read

```
*    HP 8904A  Main Selection Level    *
f1 Channel Config.
```

3. Key in the following keys. (This will set up 5 V dc on the OUTPUTS 1 HIGH connector and ground the LOW connector.)

   f1 (Channel Config.)
   NEXT
   SHIFT FLOAT 1 OFF
   WAVE FORM ⎓
   AMPTD 5 V

4. Connect a DC voltmeter, set to measure a 5 V dc signal, to the OUTPUTS 1 HIGH connector. The voltmeter should read approximately 5 V dc.
5. If the instrument is equipped with a second output, Option 002, key in

   NEXT
   SHIFT FLOAT 2 OFF
   WAVE FORM ⎓
   AMPTD 5 V

6. Connect the DC voltmeter to the OUTPUTS 2 HIGH connector. The voltmeter should read approximately 5 V dc.
7. Perform the *AC and DC Amplitude Accuracy Test* and the *AC Amplitude Flatness Test*. (Refer to the HP 8904A *Operation and Calibration Manual.*)

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7-5. REAR-TO-FRONT-PANEL OUTPUT CONVERSION

Description

This procedure describes how to convert an instrument with rear-panel output connectors (that is, Option 004) to one with front-panel connectors (that is, a standard instrument). The procedure applies to instruments with one pair of outputs or two (that is, Option 002).

The modifications requires partial disassembly of the instrument (removing covers and routing of cables). No soldering is required. Modification should be done in a static protected environment. After modification, two performance tests must be run.

Parts Required

The following parts are required and may be ordered by contacting the nearest Hewlett-Packard Sales Office.

Table 7-2. *Parts for HP 8904A Rear-to-Front-Panel Output Conversion*

Option	Quantity	Description	HP Part Number
Standard	2	Plastic Hole-Plug	6960-0132
Option 002	4	Plastic Hole-Plug	6960-0132
	3	Cable Tie	1400-0249

Tools Required

The following tools are needed to modify the instrument:

9/16 inch, 6 point Nut Driver
No. 2 Pozidriv Screwdriver
Diagonal Cutters
Needle-nose Pliers

Modification Procedure

Removing Bottom Cover

1. Turn the instrument off and unplug the power cord.
2. Lay the instrument on its top and unscrew the Pozidriv screw in the middle of the rear edge of the bottom cover. This is a captive screw and will cause the bottom cover to push away from the frame. Slide the cover back about 6.5 mm (0.25 inch) and lift it off.

Preparing the Chassis

1. Remove the nuts from the present rear-panel outputs with the 9/16 inch nut driver. Do not press against the rear panel with the tool or scoring of the panel may occur.
2. Remove the cable ties that secure the coaxial output cables to the sideframe by cutting them with diagonal cutters being careful not to score the soft insulation on the cables.
3. Remove the necessary plastic hole-plugs in the front panel by approaching them from inside the chassis with the needle-nose pliers and squeezing-in the small holding tangs on opposite sides of the plug. Grasp the front of the plug with your fingers to pull it away from the panel. Do not attempt to pry the plug out from the panel or the panel surface may get scarred.

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Cable Routing

1. Refer to figures 7–1, 7–2 and 7–3. Remove the BNC connector ends from the rear panel one at a time and insert them into the corresponding openings in the front panel.
2. After all of the connectors have been transferred to the front panel, loop the cables and secure them to the front of the deck using the new cable ties as shown in figure 7–3.
3. Install one nut on each connector.
4. Tighten the nuts on the BNC connectors hand tight using the nut driver. (The holes in the panel are D shaped and therefore prevent the connector from turning without having to tighten the nuts excessively.)
5. Verify that the SMC connections on the A3 Output Assembly and, if the instrument has Option 002, the A10 Output Assembly are tight.

Final Steps

1. Insert the new plastic hole-plugs into the rear-panel output openings by carefully working the plugs into the holes with your fingers. The plugs fit tightly and will require some pressure to get them started in the holes.
2. Replace the bottom cover by reversing the removal procedure.
3. Remove the Option 004 label from the rear panel.

Operation Verification

1. Connect the power cord and turn the instrument on.
2. The instrument should beep immediately upon power up and then again about 4.5 seconds later. The display should read

```
*    HP 8904A  Main Selection Level    *
f1 Channel Config.
```

3. Key in the following keys. (This will set up 5 V dc on the OUTPUTS 1 HIGH connector and ground the LOW connector.)

   f1 (Channel Config.)
   NEXT
   SHIFT FLOAT 1 OFF
   WAVE FORM ⎓
   AMPTD 5 V

4. Connect a DC voltmeter, set to measure a 5 V dc signal, to the OUTPUTS 1 HIGH connector. The voltmeter should read approximately 5 V dc.
5. If the instrument is equipped with a second output, Option 002, key in

   NEXT
   SHIFT FLOAT 2 OFF
   WAVE FORM ⎓
   AMPTD 5 V

6. Connect the DC voltmeter to the OUTPUTS 2 HIGH connector. The voltmeter should read approximately 5 V dc.
7. Perform the *AC and DC Amplitude Accuracy Test* and the *AC Amplitude Flatness Test.* (Refer to the HP 8904A *Operation and Calibration Manual.*)

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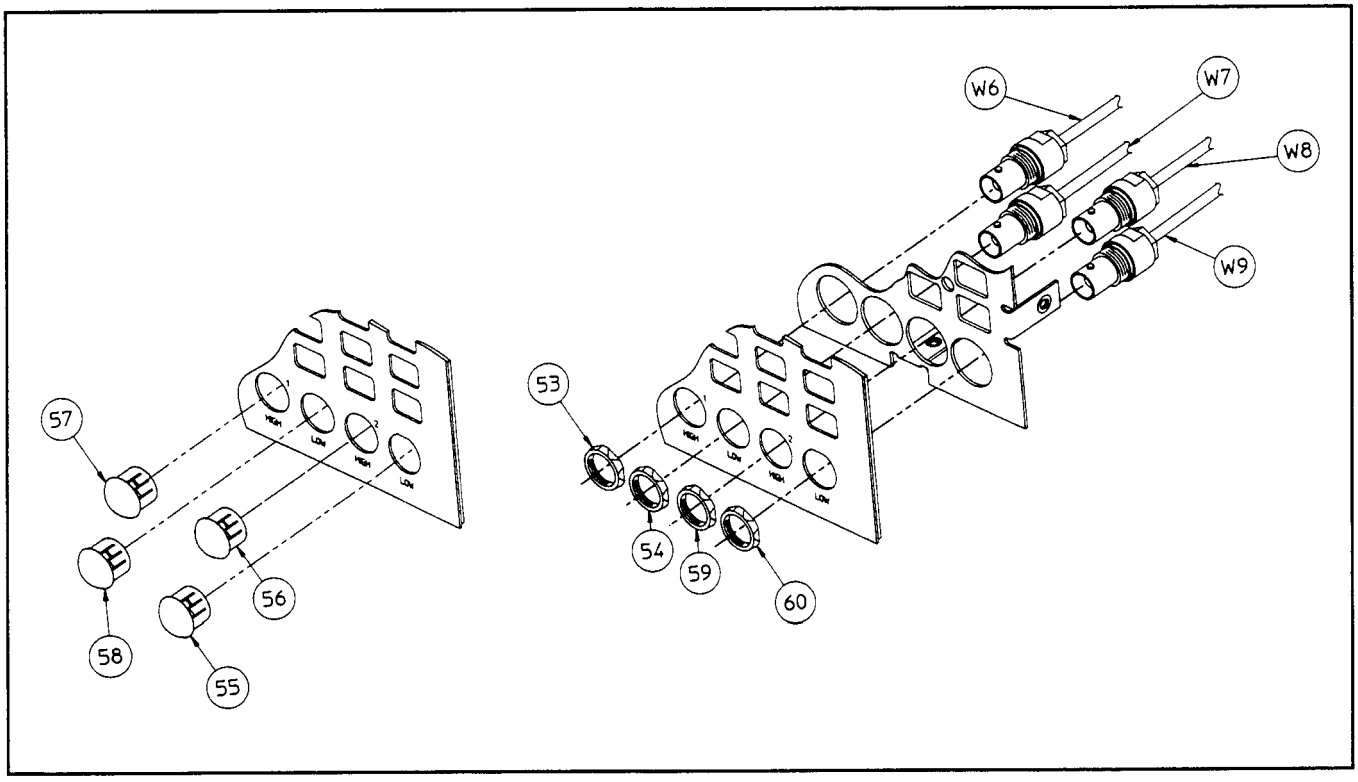


Figure 7–1. *Front Panel Output Hardware*

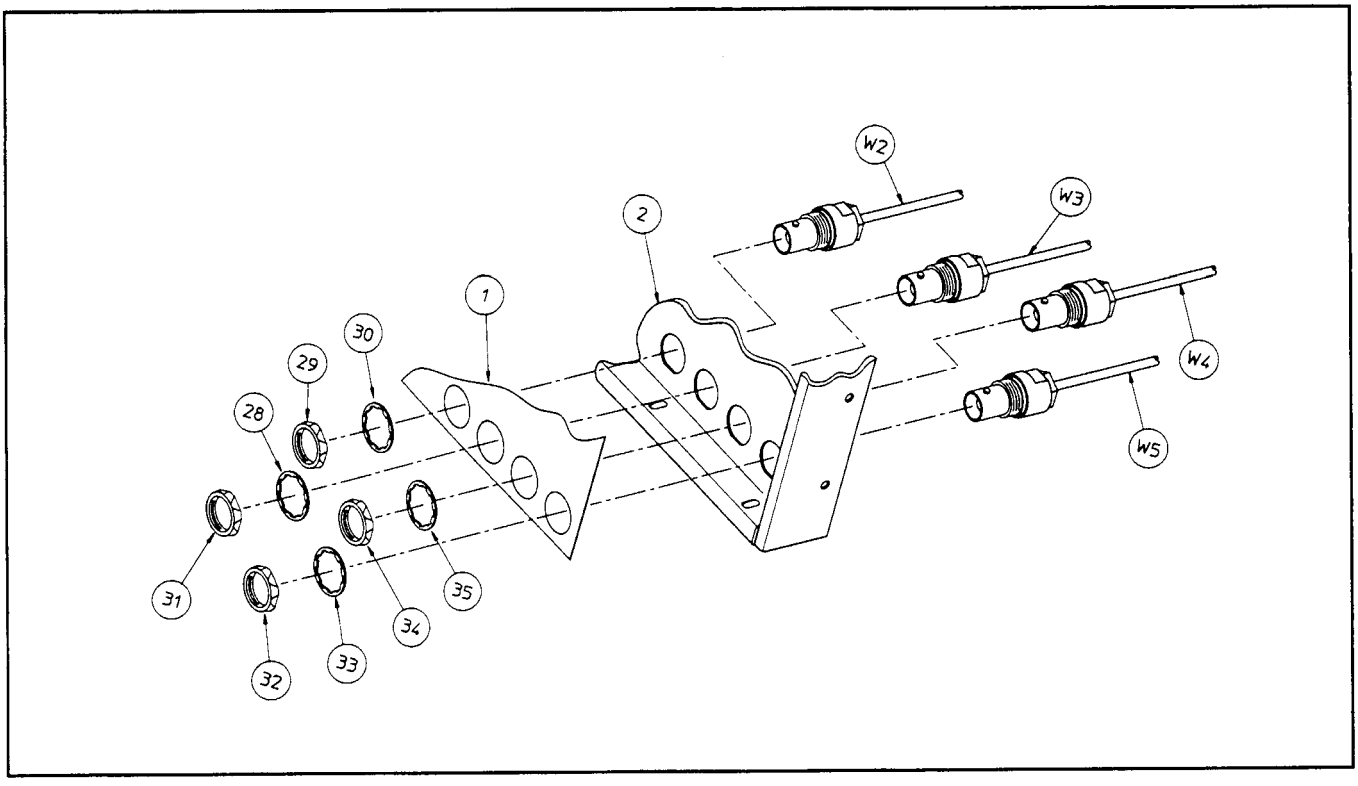


Figure 7–2. *Rear Panel Output Hardware*

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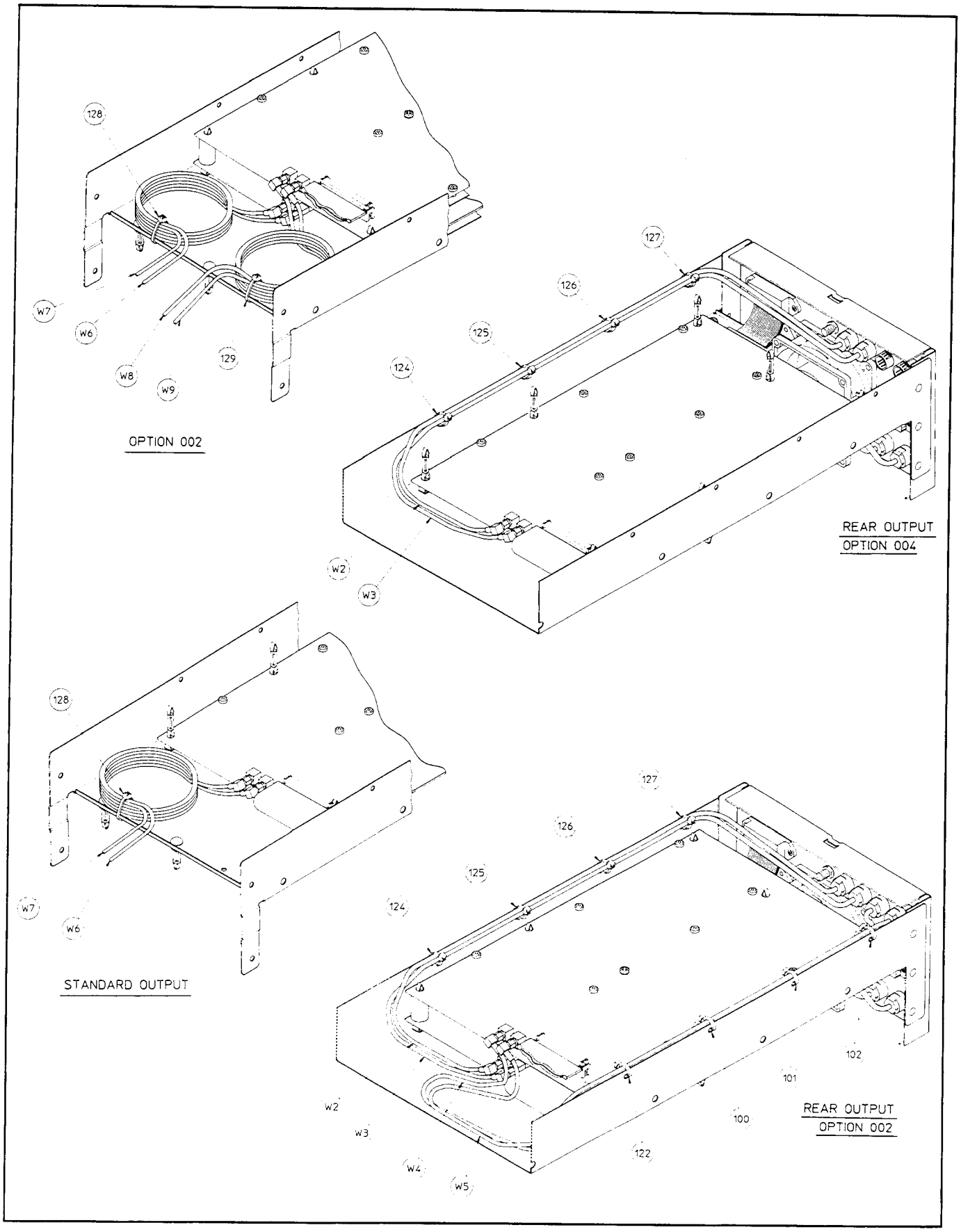


Figure 7–3. *Output Cable Routing (All Options)*

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7–6. FIRMWARE UPDATES (A2U12 AND A2U13)

The firmware is changed whenever anomalies are found in the instrument's operation which can be corrected by altering the Controller's program. Firmware is also changed to add new features, which may only be changes in the program, or which may also result from instrument hardware changes.

Replacing the ROMs

Use the following procedure to install new ROMs:

CAUTION

The ROMs (A2U12 and A2U13) are static sensitive devices. Take precautions against electrostatic discharge (ESD) before handling these components.

NOTE

In instruments with serial prefix 2942A and below, the firmware is stored in two ROMs (A2U12 and A2U13). In instruments with serial prefix 2948A and above, the firmware is stored only in one ROM (A2U12). (A2U13 serves a different function.)

1. Unplug the power cord.
2. Remove the top cover. The cover may be tightly secured in the groove of the bottom cover. If the top cover does not pull off easily after backing out the screw on the rear edge, back out the screw on the rear edge of the bottom cover also.
3. For instruments with serial prefix 2942A and below, in locate U12 and U13 on the A2 assembly (front horizontal board). For instruments with serial prefix 2948A and above, locate only U12. They are in sockets. The reference designator is labeled beside the IC.
4. Pry out the old ROM or ROMs with a blade-type screwdriver.
5. Plug in the new ROM or ROMs in the correct sockets and with the correct pin orientation.
6. Check the operation of the instrument.

Serial Prefix 2740A and below:

The recommended replacement for A2U12 is HP Part 08904-87010. The recommended replacement for A2U13 is HP Part 08904-87008. If either A2U12 or A2U13 fails, replace the other part also if its part number differs.

Serial Prefix 2742A and above:

The recommended replacement for A2U12 is HP Part 08904-87011. The recommended replacement for A2U13 is HP Part 08904-87009.

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7-7. MODIFICATION FOR POSSIBLE GROUND WIRE SHOCK HAZARD

(Serial Prefix 2737A and below)

WARNING

On some instruments with serial prefix 2737A and below, the grounding wire from the rear-panel line socket to the metal chassis may not have been wrapped and soldered in compliance with strict safety standards. This condition does not create a safety hazard under normal use; however, a safety hazard can develop if the following two conditions occur.

(1) If the ground wire ever sustains heavy current long enough, the solder on the connections can erode, weaken, and eventually cause the connections to loosen. Should ground contact break, the chassis can no longer be guaranteed to be at ground potential.

(2) With ground contact interrupted, the chassis could become "hot" if the neutral or high lines of the power cord come in contact with the chassis through some other fault. The chassis then becomes a shock hazard.

With proper wrapping and soldering of the ground connections, the ground wire will maintain a reasonable mechanical connection even though the solder has deteriorated.

This information explains how to check for the possible shock hazard and how to correct it. The check for the shock hazard is by simple visual inspection. Corrective action, if needed, consists of replacing the ground wire with attention paid to wrapping and soldering it to its solder lugs. Replacement of the wire should be made by someone with wire soldering skills.

The following parts may be required:

Description	Quantity	HP Part Number
Solder Lug	2	0360-0036
Cable Tie	1	1400-0249
Wire (Green/Yellow)	10 cm	8150-2919

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Checking for the Shock Hazard

1. Unplug the power cord from its rear-panel socket.
2. Remove the instrument's top cover by backing out the screw in the center of the rear edge of the cover. This is a captive screw and will cause the cover to push away from the frame.
3. Refer to figure 7–4. Locate the ground wire. It has green insulation with a yellow stripe and is inside the rear panel in the right rear corner of the instrument beneath the red and silver warning label.
4. Carefully slit the black shrink tubing over the ground wire connection to the line socket. A sharp X-acto knife is recommended. (The shrink tubing will not be replaced.)
5. Inspect the soldered wire connection on both ends of the ground wire and compare the wire wrapping to figure 7–5. One end of the wire goes to the chassis ground lug and the other end to the socket ground connection on the rear-panel line socket.
6. If the solder joints are properly wrapped and soldered, replace the top cover and make a quick check of the operation of the instrument.

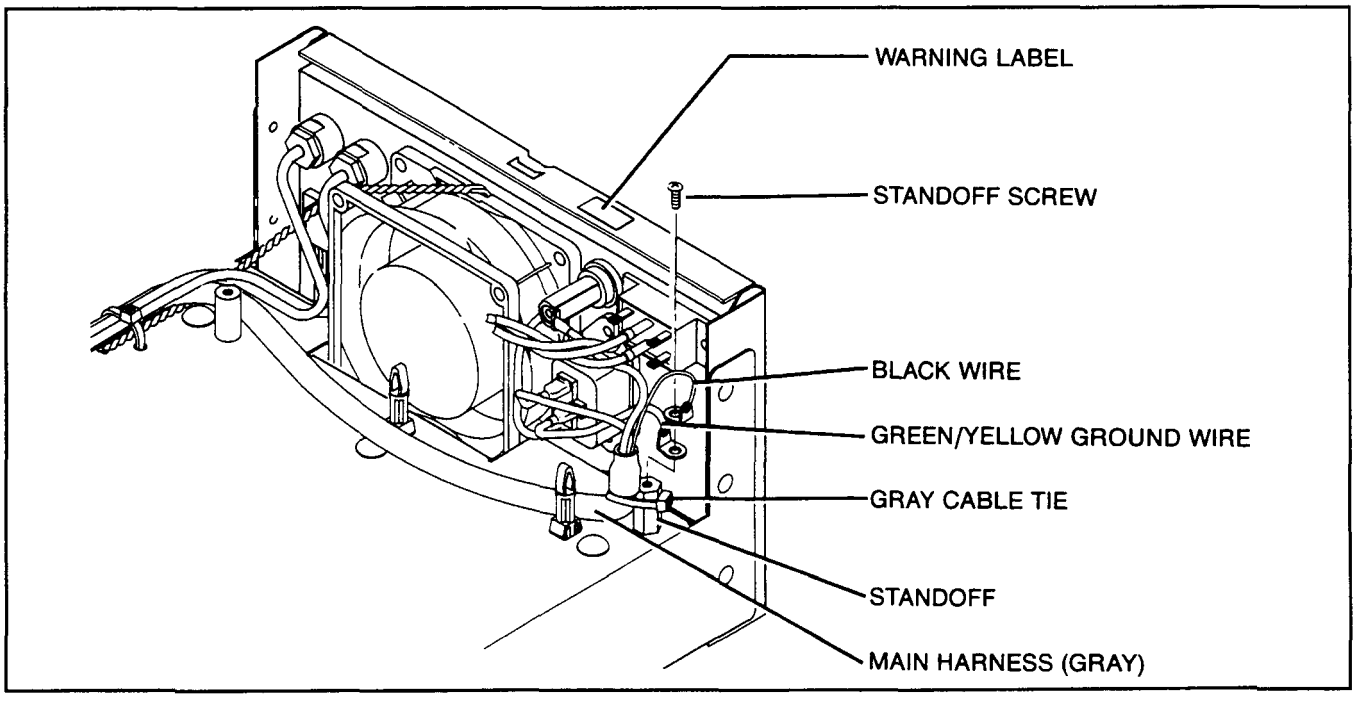


Figure 7–4. *Parts Location (Shown with Power Supply Removed)*

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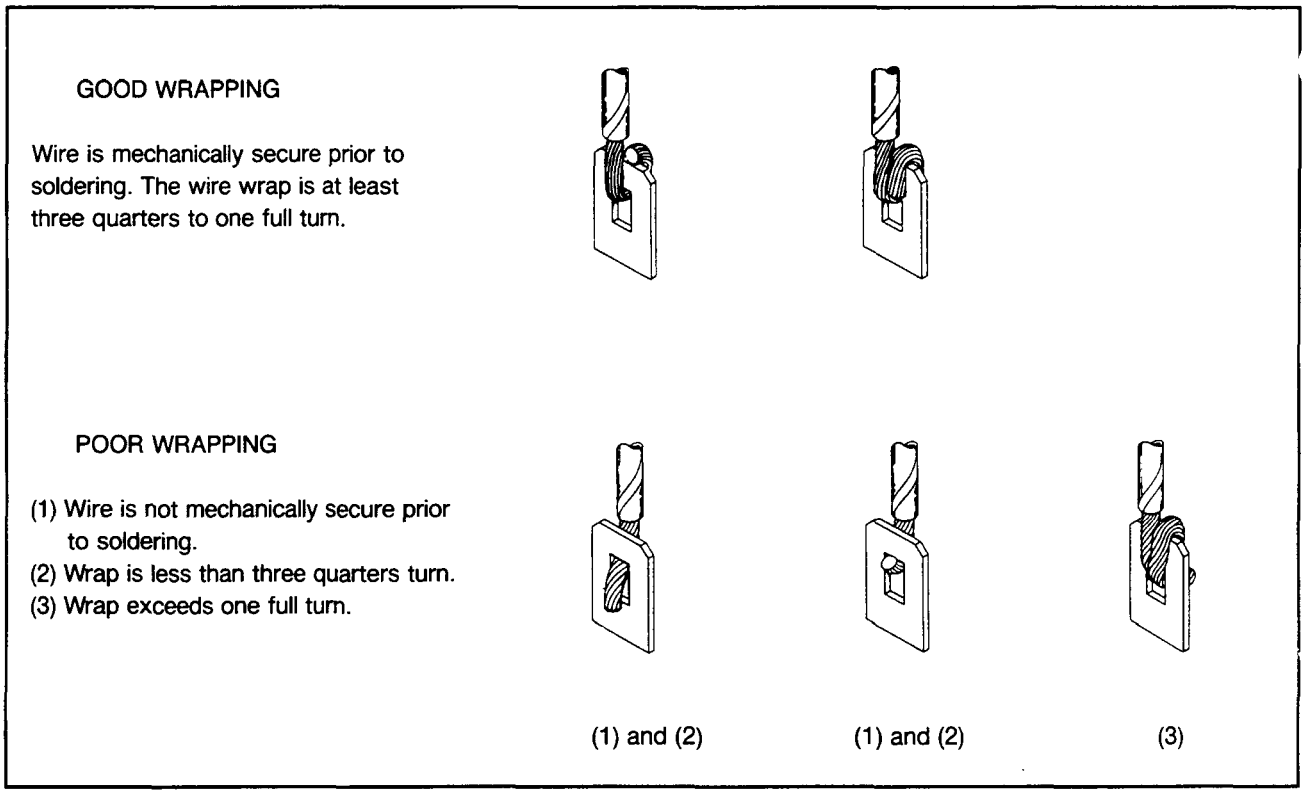


Figure 7–5. *Ground Wire Wrapping*

Replacing the Ground Wire

1. If the wrap on either end of the ground wire is not within specification, the ground wire must be replaced.
2. Remove the screw holding the ground wire to the instrument standoff. (Use a T10 or T15 Torx screwdriver as needed.)
3. Cut the gray cable tie which secures the main wire harness to the standoff with a pair of diagonal wire cutters. Avoid cutting into the insulating sheath of the harness.
4. With the main harness free, move it up and to the left so as not to interfere with soldering.
5. Heat the soldering iron. You will also need a roll of solder wick.
6. On the line cord socket, heat the solder on the lug where the ground wire is attached and apply the solder wick. At the same time move the ground wire around and pull the ground wire out of the lug. Avoid touching any of the loose wires with the soldering iron.
7. Cut an 8 cm (3.2 inch) length of new 18 gauge ground wire (HP 8150-2919). Strip 8 mm (5/16 inch) of insulation from each end of the wire.
8. Wrap and solder one end of the stripped ground wire onto a new solder lug (HP 0360-0036). Refer to figure 7-5 for wrapping details.
9. Insert the other end of the new ground wire into the empty lug on the line cord socket. After the wire is properly wrapped, solder it in place.

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NOTE

It is possible that the 22 gauge black wire may break while replacing the new ground wire. If it does, strip 8 mm (5/16 inch) of insulation from it and properly wrap and solder it to a second new lug.

10. Replace the screw in the standoff, inserting the screw through the lug with the black wire first and then through the lug with the new ground wire. Tighten the screw.
11. Put the main wiring harness next to the standoff and secure both together with a gray cable tie (HP 1400-0249). Cut off the excess tie wrap lead. Make sure the box on the tie wrap is toward the inside of the instrument.
12. Replace the top cover and make a quick check of the operation of the instrument.

7-8. MODIFICATION FOR OUTPUT OVERVOLTAGE PROTECTION IMPROVEMENT

(Serial Prefix 2747A and below)

The output overvoltage protection circuit of the HP 8904A Multifunction Synthesizer has a potential problem. On instruments with serial prefix 2747A and below, excessive leakage in four clamp diodes (A3CR415 to A3CR418) shifts the trip point of the circuit to a voltage too high to protect the output against inadvertent application of high reverse voltage.

No failures due to this problem have been observed, but all instruments with serial prefix 2747A and below should be modified.

Modify the instruments as directed below. (Refer to Service Sheet SS4 for schematic and component locator.)

1. Order the parts listed in the table below.
2. Replace diodes A3CR15 through A3CR18 with part number 1901-0880.
3. Replace A3R494 and A3R95 (1780Ω) with part number 0698-0085 (2610Ω).
4. Replace A3R491 and A3R493 (34.8 kΩ) with part number 0757-0199 (21.5 kΩ).
5. If the instrument has Option 002, a second output, the same modification should be made to the A10 assembly.

Parts List

HP Part Number	CD	Qty*	Description
0698-0085	0	2	Fixed Resistor, 2610Ω
0757-0199	3	2	Fixed Resistor, 21.5 kΩ
1901-0880	7	4	Diode
* If the instrument has Opt 002, order twice this quantity.			

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7-9. MODIFICATION FOR POTENTIAL POWER SUPPLY SHORT

(Serial Prefix 2817A and below)

A problem has been noted in HP 8904A Multifunction Synthesizers with Option 002 (a second output) and with serial prefix 2817A and below. In these instruments it is possible for the heatsinks on the output transistors on the A10 Output Assembly (installed only in Option 002) to touch the bottom cover when the instrument is jarred. If the instrument is jarred often enough, the anodization (an insulator) on the heatsinks will wear through and could make electrical contact with the cover. Should this occur while the instrument is on, a 16 V power supply may short to ground. This may cause the power supply fuse to blow or it may intermittently cause the following error to be displayed:

```
!! Reference Loop Reports Out Of Lock !!
```

To prevent or solve this problem, it is recommended that an insulator (HP part 08904-00015) be installed on the inside of the bottom cover. The insulator has a peal-off adhesive backing. Place it just behind the front perforations. It should cover any scuff marks left by the heatsinks.

7-10. CABINET PARTS COLOR CHANGE

(Serial Prefix 2914A and above)

NOTE

Serial prefix 2914A changes the color of the instrument covers and accessories. The old color cover and accessories are no longer available. If your instrument has serial prefixes 2913A and below, and you must replace one of these parts, we recommend that you order the full set of covers and accessories. Affected cabinet parts are items 61-67, and items 69-70 (see table 6-3).

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7–11. MODIFICATION FOR FRONT PANEL ASSEMBLY

(Serial Prefix 2712A to 2917A)

INTRODUCTION

HP part number 08904-61023 contains the parts to replace the front panel in HP 8904A Multifunction Synthesizers with serial prefix 2917A or below. The front-panel keys in these instruments may have a tendency to intermittently stay down when pressed. This problem cannot usually be cured by mechanical adjustment of front-panel parts or by replacement of individual parts.

The kit is easy to install and requires no special tools. The contents of the kit are listed in table 7-3. The A5 LCD Display is not included in the kit and must be transferred from the old front-panel assembly.

Table 7-3. *Parts List for HP 08904-61023 Front-Panel Kit*

Qty	Description	HP Part Number	CD
1	Keycap	0371-3802	3
11	Screw, 3.0x6 mm, Panhead, Torx, with Captive Lockwasher	0515-1851	4
2	Screw, 2.5x4 mm, Flathead, Pozidriv	0515-2028	9
3	Flatwasher, 3 mm ID	3050-0891	7
4	Hole Plug, 0.5 inch Diameter	6960-0132	1
1	Display Shield	08904-00021	4
1	Line Switch Bracket	08904-00022	1
1	Keypad	08904-40006	5
1	Keyboard Assembly (A1)	08904-60201	4
1	Front Panel Assembly	08904-61021	8

INSTALLATION PROCEDURE

Removing Covers

CAUTION

Use standard electrostatic discharge (ESD) precautions when working around electrostatic-sensitive components such as on the display and digital assemblies.

NOTE

Refer to the figures in Section 6 of the HP 8904A Service Manual *and figure 7-6 in this installation note for part identification and location.*

1. Turn the instrument off and unplug the power cord.
2. Remove the top and bottom covers by unscrewing the screw in the middle of the rear edge of the covers. This is a captive screw and will cause the cover to push away from the frame.

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Removing the Front Panel

3. Unplug the two connectors on the top front edge of the A2 Digital Assembly that are attached to the A5 LCD Display. (Refer to figure 6–3. The two cables are labeled as P/O A5.)
4. Remove the top trim strip (item 67 in figure 6–5) and two side strips (items 61 and 62) from the front-panel frame.
5. Remove the 10 screws (items 75 through 84 in figure 6–1, 2712A to 2917A) that secure the front-panel assembly to the front frame (item 89).
6. Pull the front panel part way out until it is easy to access A1W1. (Refer to figure 6–1. A1W1 is the remaining wide ribbon cable at the front of the A2 Digital Assembly.) Unplug the cable from the A2 assembly.
7. Pull the front panel further out to reveal the two T-8 Torx screws with lockwashers (items 73 and 74 in figure 6–1) securing the line switch to the bottom of the front panel then remove the two screws. (The screws will not be reused.)
8. Remove the front-panel BNC connectors from the front panel. (There may be four, two, or no connectors depending on the presence of Option 002 and Option 004.) Be sure to identify which cable goes in which hole. (A simple identification scheme is to put the nut back on the connectors for the "HIGH" outputs only.) The front panel should now be free of the instrument.
9. Remove the "LINE" keycap from the line switch. The switch's stem is easily snapped or pulled out of the switch's body. When removing the keycap, do not allow the stem to flex and do not hold the body of the switch. Pull the keycap straight out.
10. Press the new, unlabeled keycap (HP 0371-3802) on the line switch.

Transferring the A5 LCD Display

11. Remove the four Torx screws with lockwashers (items 44, 45, 49, and 51 in figure 6–3) securing the old display shield (item 39) to the old front panel and remove the display shield.
12. Remove the four Torx screws with lockwashers (items 40 through 43 in figure 6–3) securing the A5 LCD Display to the old front panel and remove the display. (The screws will not be reused.)
13. Remove the four Torx screws and captive lockwashers securing the new display shield to the new front panel and temporarily remove the new display shield.
14. Install the LCD display on to the new front panel securing it with the four new screws and captive lockwashers (HP 0515-1851) from the kit. Tighten the screws to 0.6 N·m (5 in·lb).
15. Re-install the new display shield on to the new keyboard with the four screws and captive lockwashers removed in step 13. Alignment of the shield is critical. The shield should be pulled up as high as the screw slots will allow. Tighten the screws to 1.1 N·m (9 in·lb).

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Installing the Front Panel

16. Remove any existing, unneeded hole plugs from the new front-panel assembly.
17. Install the line switch bracket supplied in the kit (HP 08904-00022, item 142 in figure 7-6, Detail A herein) on to the line switch using the two Pozidriv screws supplied in the kit (HP 0515-2028, items 143 and 144). Tighten the screws to 0.6 N·m (5 in·lb).
18. Install the line switch bracket on to the front frame using two of the screws (items 84 and 145 in figure 7-6) securing the old front panel to the frame (item 89). Do not tighten the screws at this time.
19. Connect the wide ribbon cable (A1W1 in figure 1) from the new keyboard to the front of the A2 Digital Assembly. Be careful not to bend any pins.
20. Place the new front panel into the frame and loosely secure the assembly to the frame on the top and sides with the original screws. Check that the cables to the front panel and the line switch keycap are positioned correctly before pushing the front panel completely into the frame.
21. Tighten the screws in the frame in the following sequence: item 76, 80, 81, 75, 78, 77, then 79. Tighten the screws to 1.3 N·m (11 in·lb). If the top screws bind, remove the front panel and try repositioning the display shield installed in step 15.
22. Position the line switch in the frame and the hole in the front panel then tighten the securing screws (items 84 and 145). Tighten the screws to 1.3 N·m (11 in·lb).
23. Re-install the BNC connectors to the new front panel as applicable. Be sure the connectors go to the proper front-panel holes.
24. Reconnect the two connectors from the A5 LCD Display to the A2 Digital Assembly.

Final Assembly and Testing

25. Re-install the top and side trim strips and the covers.
26. Check the general functioning of the instrument by performing the Basic Functional Checks in the *Operation and Calibration Manual.* Also, check the functioning of all front-panel keys and the line switch.

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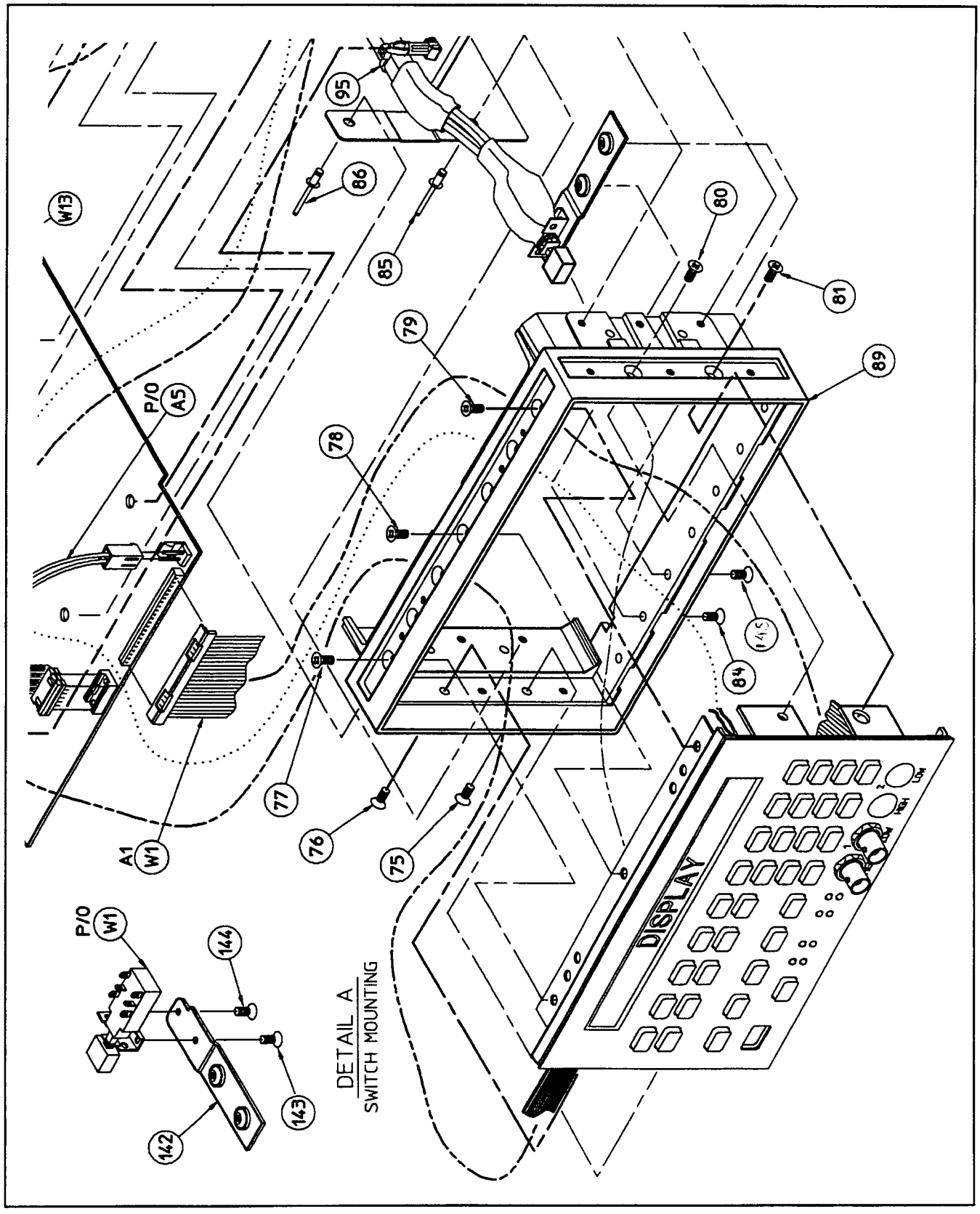


Figure 7-6. *Front-Panel Assembly, (2923A and above)*

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Section 8
SERVICE

8-1. INTRODUCTION TO THIS SECTION

This section contains information for troubleshooting and repairing the Multifunction Synthesizer. Included are principles of operation, troubleshooting checks, and schematic diagrams for selected circuits.

8-2. HOW THE SECTION IS ORGANIZED

Section 8 contains the following:

- Safety Considerations
- Service Tools, Helps, and Information
- Schematic Symbology and Diagram Notes
- Principles of Operation
- Troubleshooting
- Selected Schematic Diagrams and Component Locators (Foldouts SS1 through SS4)

8-3. SAFETY CONSIDERATIONS

Before Applying Power

Verify that the instrument is set to match the available line voltage and that the correct fuse is installed. An uninterrupted safety earth ground must be provided from the main power source to the instrument input wiring terminals, power cord, or supplied power cord set. In addition, verify that a common ground exists between the Multifunction Synthesizer and all test equipment.

Safety

Pay attention to warnings and cautions. They must be followed both for your protection and to avoid damage to the equipment.

WARNING

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

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WARNING

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

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

High voltages inside the instrument. *Areas with line voltages inside the instrument include the rear panel, power supply, and the line switch cable harness. AC voltages as high as 300 V pp can be present on the backlighting drive to the LCD display. (The drive circuitry is on the front right corner of the A2 Digital Assembly.)*

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

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

Disposing of the memory backup battery. *The memory backup battery on the A2 Digital Assembly is a lithium battery. (A2 is the large, horizontal circuit board under the top cover near the front of the instrument. The battery itself is near the front right corner of the board.) The following procedure is recommended for its disposal:*

Discharge the battery by soldering a 50 kΩ resistor across both battery terminals. Complete discharge will occur after one year, at 25°C.

Under Resource Conservation Recovery Act (RCRA) regulations, the completely discharged battery is considered "nonhazardous." However, the user must be responsible for individual state and country regulations for battery disposal.

CAUTION

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

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8-4. SERVICE TOOLS, HELPS, AND INFORMATION

Printed Circuit Board Extractor

A Printed Circuit Board Extractor (HP 08904-00012) is supplied as part of this manual. It eases removal of the A3 and A10 Output Assemblies. It hooks under the board or the metal board shield so the board can be pulled off the mounting studs.

Assembly, Parts, and Cable Locations

The exploded view drawings at the end of Section 6 will assist in locating circuit board assemblies, cables, and mechanical hardware.

For the A3 and A10 assemblies only, the locations of individual components mounted on printed-circuit boards are shown adjacent to the schematic diagram on the appropriate service sheet. The part reference designator is the assembly designator plus the part designator. For example, A3R9 is resistor R9 on the A3 assembly. For specific component descriptions and ordering information, refer to Table 6-3, *Replaceable Parts,* in Section 6. Mechanical chassis parts have reference designators with no prefix letter.

Other Service Documents

Service Notes, Manual Updates, and other service literature are available through Hewlett-Packard. For further information about Manual Updates, refer to Volume 1, paragraph 1-11.

Recommended Test Equipment and Accessories

Test equipment and test accessories required to maintain the Multifunction Synthesizer are listed in Table 1-2. Equipment other than that listed may be used if it meets the listed critical specifications.

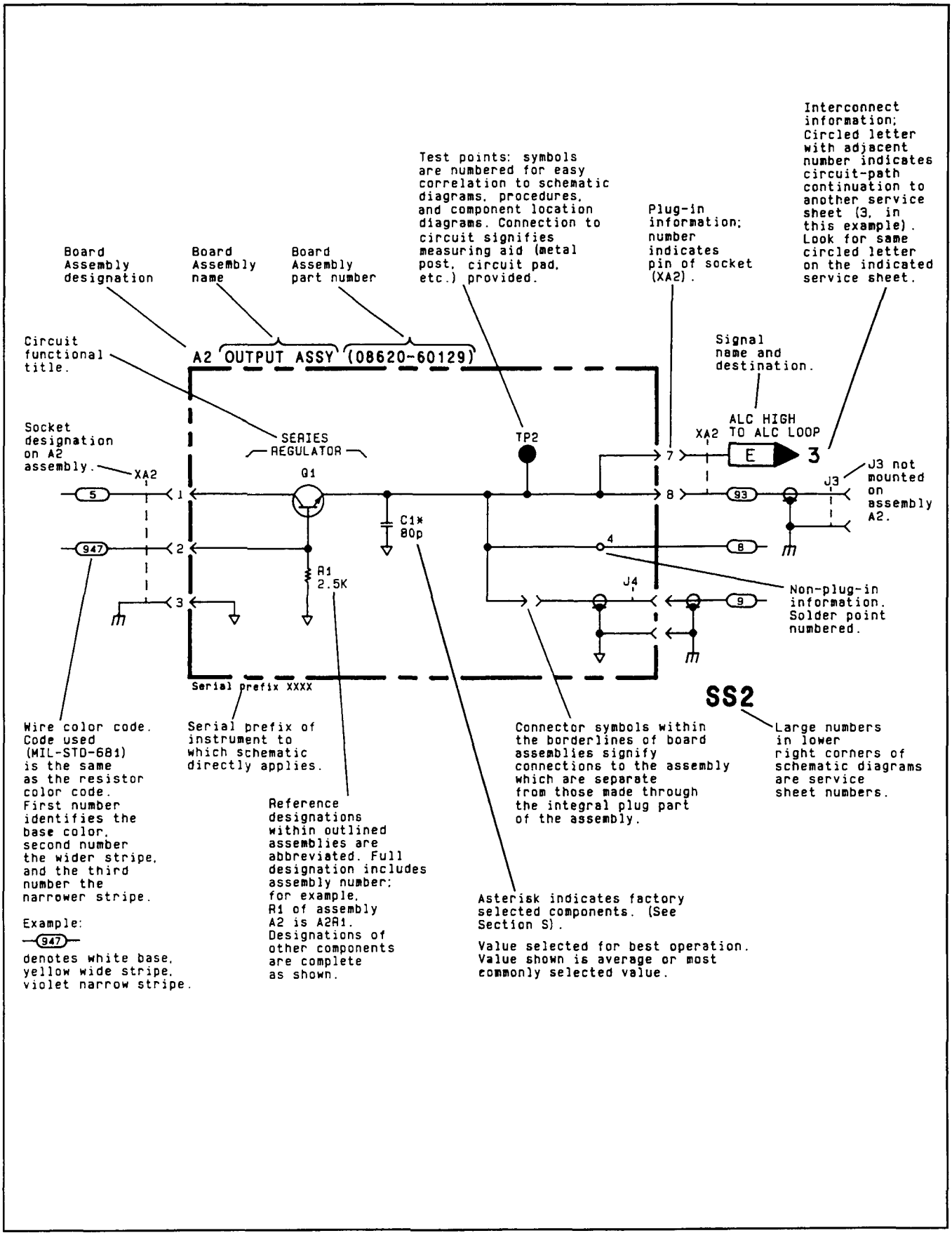
8-5. SCHEMATIC SYMBOLOGY AND SCHEMATIC DIAGRAM NOTES

Table 8-1 summarizes the symbology used in presenting many devices found in the instrument. The logic symbols used in this manual are based on the Institute of Electrical and Electronic Engineers (IEEE) in IEEE-STD 91-1984, *Graphic Symbols for Logic Functions*. This publication may be purchased from:

Institute of Electrical and Electronic Engineers
345 East 47th Street
New York, NY 10017

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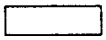
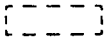
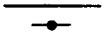
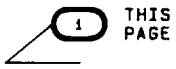
Table 8–1. *Schematic Diagram Notes (1 of 11)*



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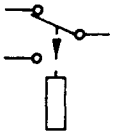
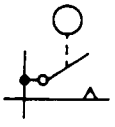
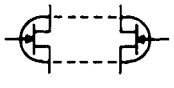
Table 8–1. *Schematic Diagram Notes (2 of 11)*

Values for all components are marked in units of farads, henries, and ohms unless otherwise specified.

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

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Table 8–1. *Schematic Diagram Notes (3 of 11)*

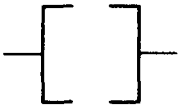
	Indicates multiple paths represented by only one line. Letters or names identify individual paths. Numbers indicate number of paths represented by the line.
	Coaxial or shielded cable.
	Ferrite bead. (Increases the self-inductance of the conductor passing through the bead.)
	Relay. Contact moves in direction of arrow when energized.
	Indicates a pushbutton switch with a momentary (ON) position.
	Feedthrough capacitor. (Acts as a feedthrough terminal when mounted on a chassis or a frame.)
	Indicates a PIN diode.
	Indicates a current regulation diode.
	Indicates a voltage regulation diode.
	Indicates a capacitive (varactor) diode.
	Indicates a Schottky (hot-carrier) diode.
	Light-emitting diode.
	Multiple transistors in a single package—physical location of the pins is shown in package outline on schematic.
	Identification of logic families as shown (in this case, ECL).

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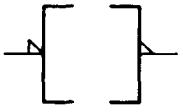
Table 8–1. *Schematic Diagram Notes (4 of 11)*

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Input and Output Indicators



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



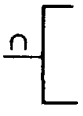
Polarity Indicator—The active state is a relatively low voltage level.



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



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



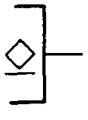
Analog Input—Input that is a continuous signal function (e.g., a sine wave).



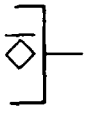
Polarity Indicator used with Inhibit Indicator—Indicates that the relatively low level signal inhibits (blocks) the active state outputs of a digital device.



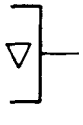
Output Delay—Binary output changes state only after the referenced input (m) returns to its inactive state (m should be replaced by appropriate dependency or function symbols).



Open Collector Output.



Open Emitter Output.



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

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Table 8–1. Schematic Diagram Notes (5 of 11)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Combinational Logic Symbols and Functions

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

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Table 8-1. *Schematic Diagram Notes (6 of 11)*

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions

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

NOTE

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

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

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Table 8-1. Schematic Diagram Notes (7 of 11)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions (Cont'd)

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

Dependency Notation

Cm	Control Dependency—Binary affecting input used where more than a simple AND relationship exists between the C input and the affected inputs and outputs (used only with D-type flip-flops).
Gm	Gate (AND) Dependency—Binary affecting input with an AND relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or letter (the identifier).
Vm	OR Dependency—Binary affecting input with an OR relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or the letter (the identifier).
mAm	Address Dependency—Binary affecting inputs of affected outputs. The m prefix is replaced with a number that differentiates between several address inputs, indicates dependency, or indicates demultiplexing of address inputs and outputs. The m suffix indicates the number of cells that can be addressed.
ENm	Enable Dependency—Binary affecting input which, when active enables all outputs. When inactive open-collector and open-emitter outputs are off, and three-state outputs are at an external high impedance state. When the enable input affects only certain inputs and outputs, they will be numbered to indicate the logic connection.
Xm	Transmission Dependency—Binary affecting input which bidirectionally connects dependent inputs and outputs.
Mm	Mode Dependency—Binary affecting input used to indicate that the effects of particular inputs and outputs of an element depend on the mode in which the element is operating. The m is replaced with a number or letter (the identifier).
Zm	Interconnection Dependency—Indicates the existence of internal logic connections between inputs, outputs, internal inputs, and/or internal outputs. The m is replaced with a number (the identifier).
,	Comma—AND Function.
/	Slant—OR Function.

NOTE

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

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Table 8–1. *Schematic Diagram Notes (8 of 11)*

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Miscellaneous



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

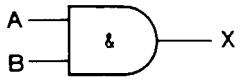
Active

Active State—A binary physical or logical state that corresponds to the true state of an input, an output, or a function. The opposite of the inactive state.

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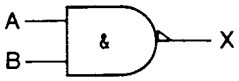
Table 8–1. *Schematic Diagram Notes (9 of 11)*

AND GATE



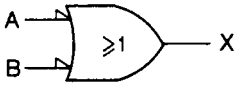
A	B	X
H	H	H
H	L	L
L	H	L
L	L	L

NAND GATE

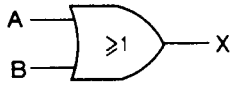


A	B	X
H	H	L
H	L	H
L	H	H
L	L	H

OR GATE WITH INVERTED INPUTS

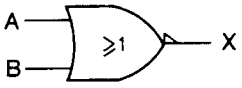


OR GATE



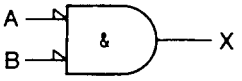
A	B	X
H	H	H
H	L	H
L	H	H
L	L	L

NOR GATE

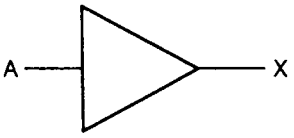


A	B	X
H	H	L
H	L	L
L	H	L
L	L	H

AND GATE WITH INVERTED INPUTS

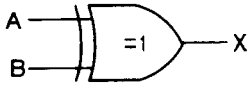


BUFFER

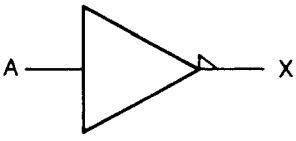


A	X
H	H
L	L

EXCLUSIVE-OR GATE



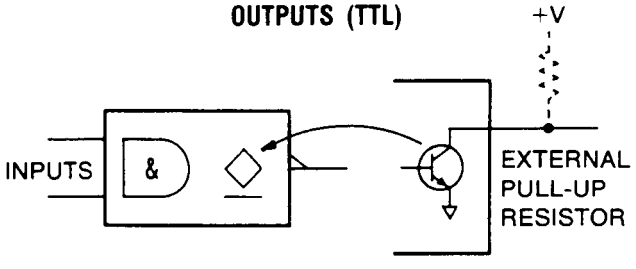
A	B	X
H	H	L
H	L	H
L	H	H
L	L	L



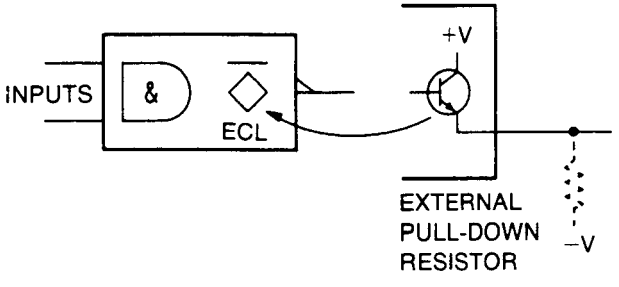
A	X
H	L
L	H

INVERTER

OPEN COLLECTOR OUTPUTS (TTL)



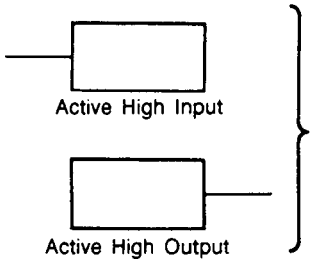
OPEN EMITTER OUTPUTS (ECL)



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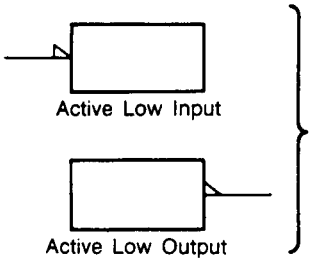
Table 8–1. *Schematic Diagram Notes (10 of 11)*

ACTIVE LEVELS





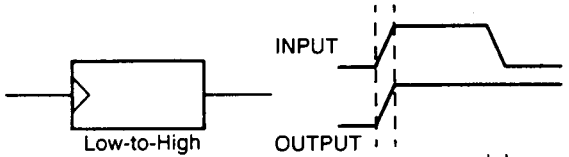
ACTIVE HIGH inputs and outputs are indicated by the absence of the polarity indicator symbol.



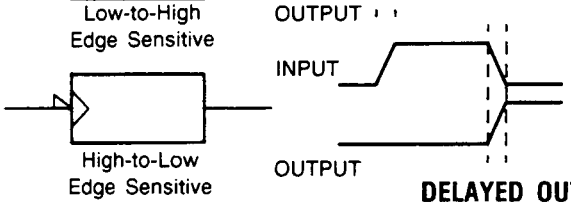


ACTIVE LOW inputs and outputs are indicated by the presence of the polarity indicator symbol (▷).

EDGE SENSITIVE INPUTS

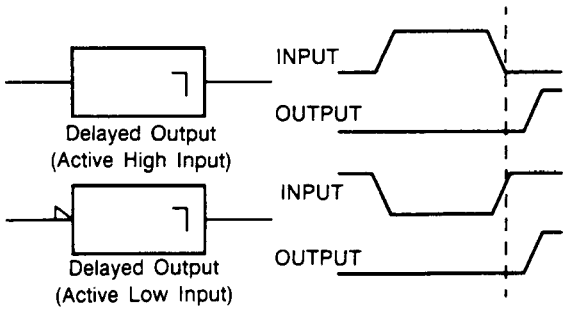


EDGE SENSITIVE (low-to-high) inputs are indicated by the presence of the dynamic indicator symbol (⊣▷).



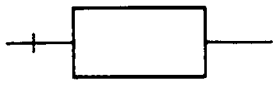
EDGE SENSITIVE (high-to-low) inputs are indicated by the presence of both the dynamic indicator and the polarity indicator symbols (⊣▷).

DELAYED OUTPUT RESPONSE



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

INHIBIT INPUTS



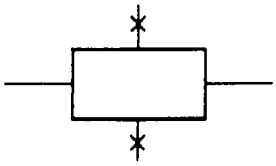
INHIBIT indicator symbol (+) indicates an input that, when active, inhibits (blocks) the output(s) from achieving their active states (the outputs remain inactive).

ANALOG LINES



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

NONLOGIC CONNECTION

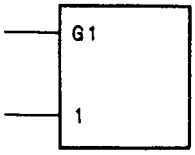


The Nonlogic Connection symbol (X) indicates a connection that does not carry any logic information.

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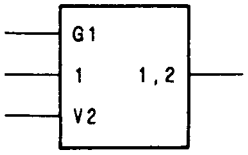
Table 8–1. *Schematic Diagram Notes (11 of 11)*

AND



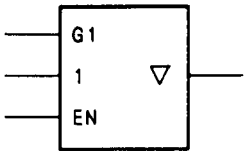
The input that controls or gates other inputs is labeled with a C or a G, followed by an identifying number.
The controlled or gated input or output is labeled with the same number. In this example, 1 is controlled by G1.

OR



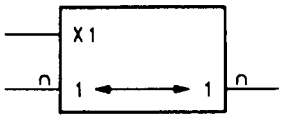
When a V input is active, the output will be in its active state. With the V input inactive, the device functions as if the V input doesn't exist.

ENABLE



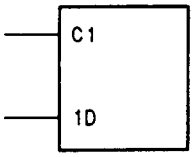
When the EN input is active, the output is enabled to function normally. When the EN input is inactive, the three-state output (▽), in this case, becomes a high impedance, effectively removing that device from the circuit.

TRANSMISSION

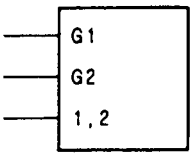


When the X1 input is active, the associated input-output pair are bi-directionally connected together. When X1 is inactive, the connection is broken.

CONTROL

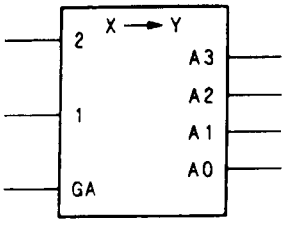


When the controlled or gated input or output already has a functional label (D is used here), that label will be prefixed by the identifying number.



If the input or output is affected by more than one gate or control input, then the identifying numbers of each gate or control input will appear separated by commas.

ADDRESS



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

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PRINCIPLES OF OPERATION

OVERALL

What the Multifunction Synthesizer Can Do

The HP 8904A Multifunction Synthesizer is a general purpose function generator which can output complex signals based on combinations of six waveforms:

- sine
- sawtooth
- triangle
- square
- noise
- dc

Control over these signals includes:

- frequency,
- amplitude, and
- phase.

Signals can (with Option 001) be combined by summation and/or modulation. The modulation formats are:

- AM
- FM
- ΦM
- DSB
- pulse

Long, complex sequences can (with Option 001) be output based on:

- tones
- DTMF (Dual Tone Multi Frequency)
- digital

Channel A can (with Option 003) be phase-continuous fast-hopped with external control of:

- timing
- frequency
- amplitude
- phase

All of the above signal combinations can (with Option 002) be output to a second port. The output ports can be single-ended or floating.

How Waveforms Are Generated

Waveforms are generated by a numerical synthesis technique. The heart of the synthesizer is a single digital waveform synthesis integrated circuit (DWSIC). For each channel, the DWSIC generates a continuous stream of numbers which represent instantaneous levels of the waveform. This "digital" waveform is then converted to an analog signal by a digital-to-analog converter or DAC (one converter for each output port). The analog signal is conditioned by high-performance (but conventional) analog circuitry and routed to the output connector. The conditioning circuits include a sample-and-hold to remove DAC switching noise, filters to remove quantization noise (that is, smooth the transitions between samples from the DAC), amplifiers to boost the maximum output, and attenuators to increase the outputs dynamic range.

Figure 8-1 is a conceptual block diagram of the simplest configuration of the instrument—one without Options 001, 002, or 003. The blocks indicate conceptually how the data is handled.

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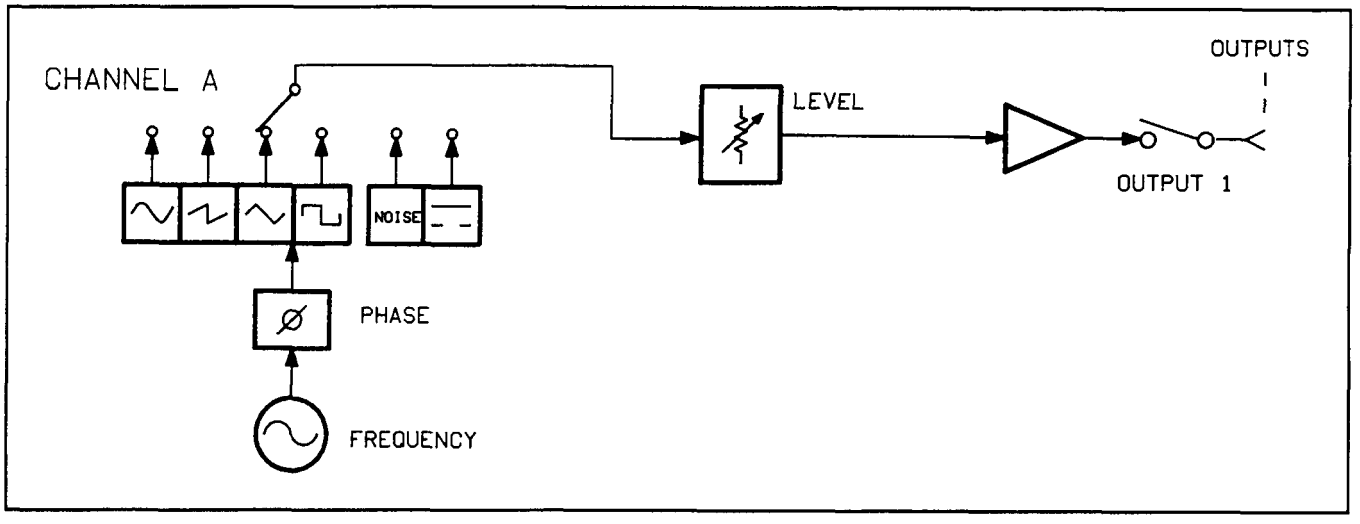


Figure 8–1. *Conceptual Block Diagram of a Standard Instrument*

The standard instrument has only one channel—Channel A. Channel A can output one of the six available waveforms. Four of the waveforms (sine, sawtooth, triangle, and square) are periodic and thus have a frequency and phase which can be controlled. The level of all waveforms can be controlled. (Level is controlled in both the DWSIC and the analog output circuits.)

The DWSIC

The DWSIC, in response to front-panel or HP-IB inputs directed to the instrument's internal computer, generates the basic waveforms (in their digital form) for each channel, modulates and combines them (still in digital form) as requested, and delivers them to the appropriate digital-to-analog converter.

Figure 8-2 shows a one-channel portion of the DWSIC. The diagram is highly simplified but detailed enough to illustrate general concepts such as

- generation of a basic sine wave
- setting and modulating its phase
- setting and modulating its frequency
- setting and modulating its amplitude

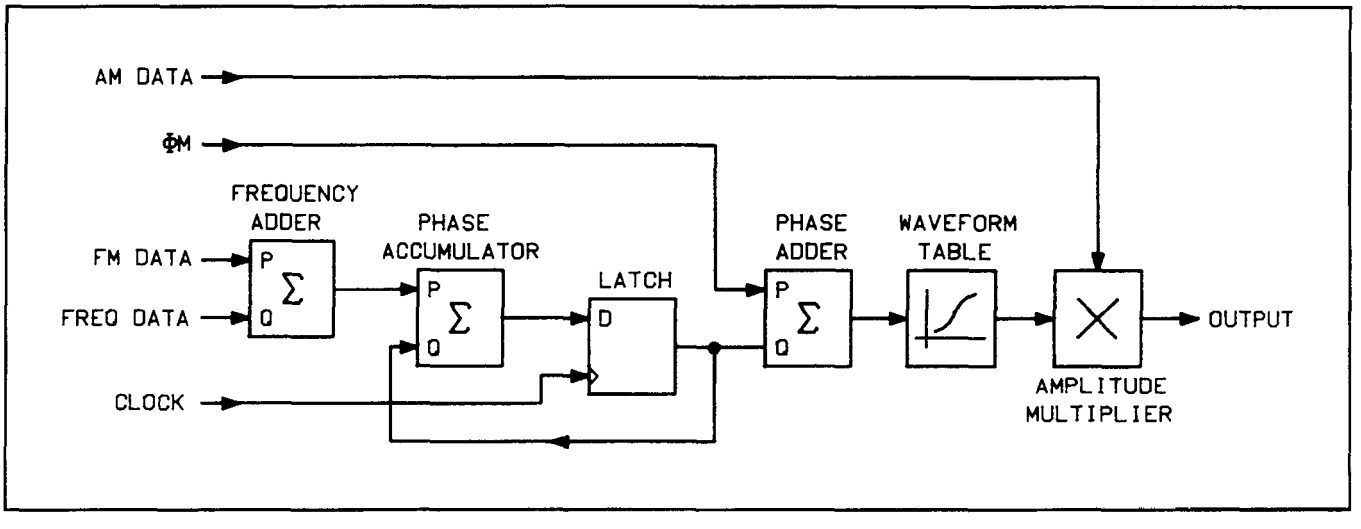


Figure 8–2. *Simplified Diagram of One Channel of the DWSIC*

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In many ways the figure resembles an analog function generator, and it may be helpful at times to visualize DWSIC operation using this analogy. (For example, the Waveform Table is analogous to an analog shaping circuit.) However, in the DWSIC all signal lines carry signal information as binary codes. Thus, the "waveforms" shown in the following figures are not really voltage-versus-time plots but are coded-value-versus-time plots. Conversion to an analog signal occurs at the output of the DWSIC and is not shown in Figure 8-2.

It should be noted in Figure 8-2 that each interconnect line in the diagram generally represents a data bus several bits wide.

Generating Staircases in the Phase Accumulator

Look first at the Phase Accumulator and Latch in Figure 8-2. The Phase Accumulator is a binary adder—its output is the sum $P+Q$. The output of the Phase Accumulator is the data (D) input of the Latch. This input is clocked through the latch once each period of the Clock input. The output of the latch feeds back to the Q input of the Phase Accumulator.

For purposes of illustration, assume all data is carried on four-bit buses. Also assume that inputs to the Frequency Adder are constants so that the P input of the Phase Accumulator is a four-bit constant P. (The Frequency Adder will be discussed later.) P can theoretically take on values between 0 and 2^4-1 or 15 (in decimal). This constant represents a fixed frequency as will be seen shortly. Each clock period the Latch outputs the sum of the input P and the output of the Phase Accumulator of the previous clock period.

For example, if $P=1$ and the Latch output for the last clock period was 6, the Phase Accumulator outputs 6+1=7 on the next clock period, 7+1=8 on the next, and so forth until the output reaches 15+1. At this time, the output goes to 0 since Phase Accumulator discards carries. From 0 the Phase Accumulator increments once each clock period. Figure 8-3 illustrates the resulting staircase and also shows what happens when $P=2$ and 3.

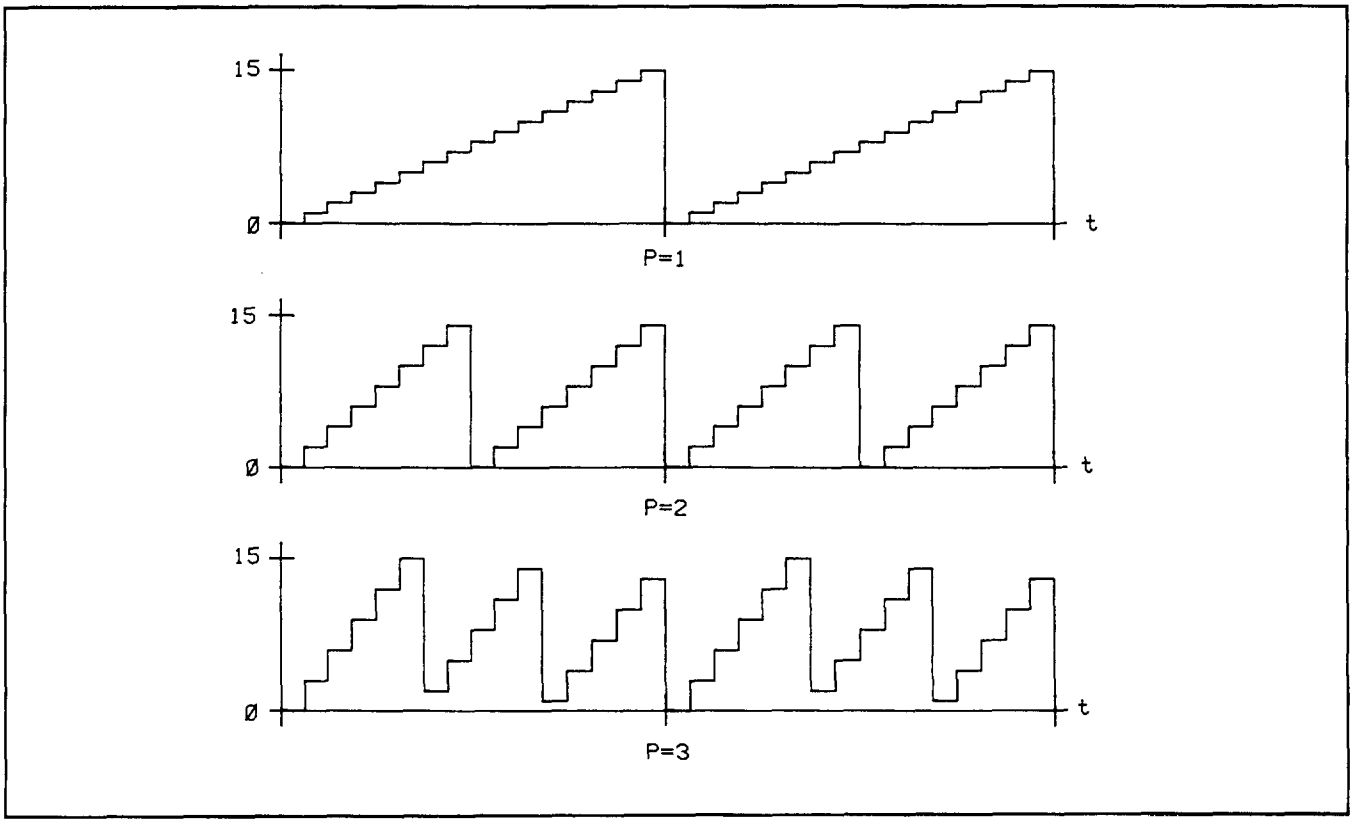


Figure 8-3. *The Output of the Phase Accumulator for P=1, 2, and 3*

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P=3 is an interesting case. The count sequence (in decimal) is 0, 3, 6, 9, 12, 15, 2, 5, 8, 11, 14, 1, 4, 7, 10, 13, 0, etc. The Latch outputs three uneven staircases that repeat every 16 clock periods. In general, if P is not 0 but is small compared to the number of possible states (16 in the current example), the Latch outputs a series of staircases (sometimes uneven) with a frequency equal to the Clock frequency $\times$ P $\div$ 16.

Adding Phase Shift

From the Latch the waveform data is added to the ΦM Data in the Phase Adder. If the ΦM Data is a constant (assumed still to be four bits), the waveform data is shifted (delayed) by the constant. Figure 8-4 illustrates the delay generated by a Phase Adder P input of P=0, 1, and 2 where P is the ΦM Data input to the Phase Adder. (The Q input to the Phase Adder is the bottom waveform of Figure 8-3.)

Generating a Sine Wave

So far the "waveform", still a numerical representation, is a staircase. The staircase itself is one of the waveforms available at the channel outputs. (After analog conversion and filtering, the waveform is a ramp.) To convert the staircase into a sine wave, the data from the Phase Adder is fed into the Waveform Table (a look-up table resident in a read-only memory (ROM)) which digitally shapes the staircase. Input the value of the staircase into the table and the ROM outputs the corresponding magnitude of a sine wave.

The process is illustrated in Figure 8-5. In the first example the frequency data into the P input of the Phase Accumulator is the constant 3, and the ΦM Data into the P input of the Phase Adder is the constant 0.

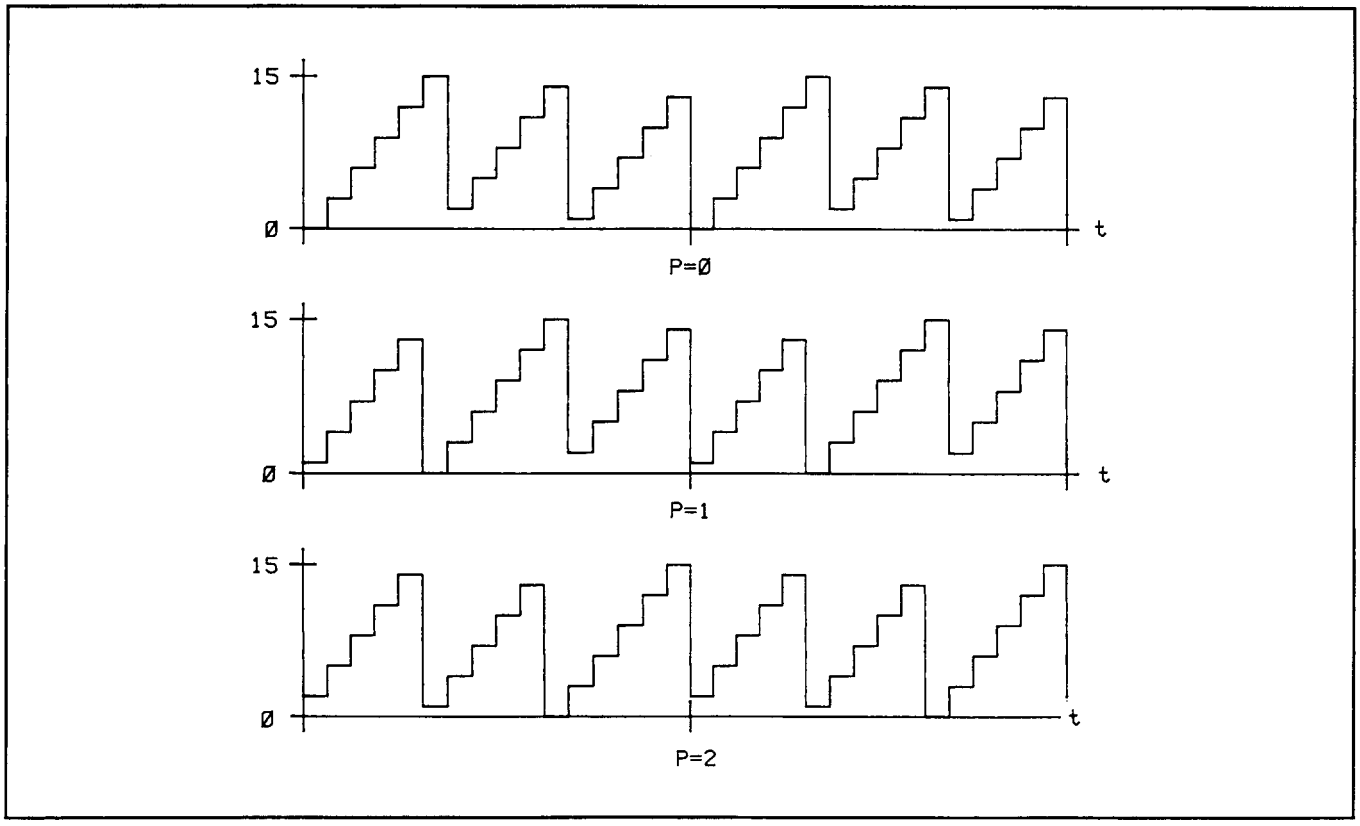


Figure 8-4. *The Output of the Phase Adder for P=0, 1, and 2*

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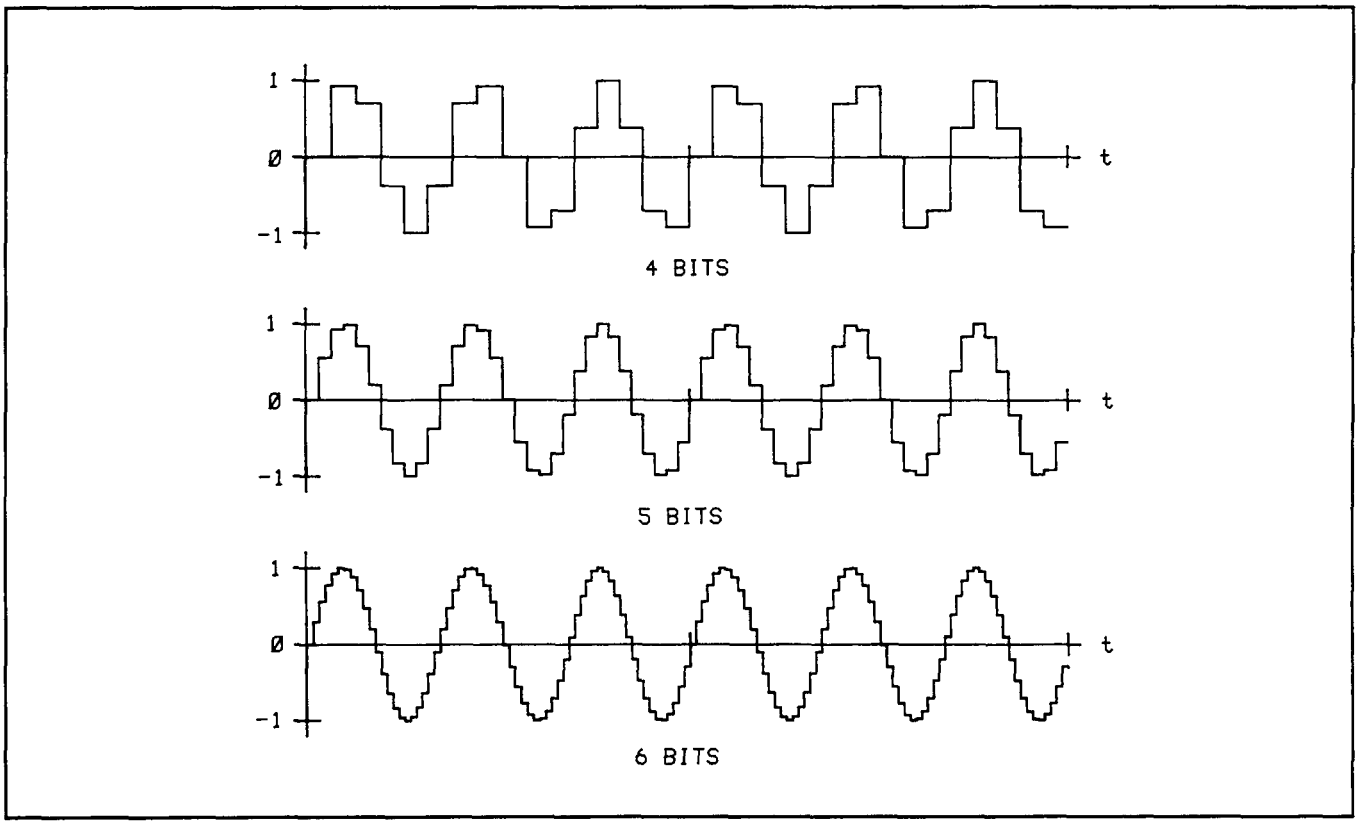


Figure 8-5. *The Output of the Waveform Table with Data Bus Widths of 4, 5, and 6 Bits*

With a four-bit data bus, the poor resemblance to a sine wave is apparent. With only four-bit quantization, the resolution is very coarse. A vast improvement is made by increasing the number of quantization states by increasing the width of the data buses. Examples of 5 and 6 bit data buses are also illustrated in Figure 8-5. In the instrument, the bus width used in the DWSIC is actually 12 bits; the total number of quantization levels is 2^{12}=4096.

Controlling Amplitude

The Amplitude Multiplier scales (by digital multiplication) the amplitude of the waveform data by the factor on the AM Data bus, thus controlling the signal level. For CW outputs the scaling covers a 2:1 range. Further level control occurs in the analog output circuitry.

Further Digital Waveform Processing with Options

Thus far, all data inputs have been assumed to be constants which control frequency, phase, and amplitude. In practice the data inputs may vary with time and thus modulate the waveforms. This feature requires Option 001. In the Frequency Adder, the Frequency Data is held constant to set the CW frequency; the FM Data can be varied to generate FM. In the Phase Adder, ΦM Data is varied to generate ΦM. In the Amplitude Multiplier, the AM Data is held constant to set the CW level or it can be varied about the level constant to generate AM.

In addition to modulation, waveforms from other channels can be summed (digitally, of course) with channel one to create waveforms of specific shapes and characteristics. Implementation of these additional capabilities is illustrated in Figure 8-6.

Figure 8-6 also shows a second output channel which is included as Option 002. If Option 002 is added without Option 001, any of the six basic waveforms can be generated at the second output independent of the first output, but neither output can be modulated or summed.

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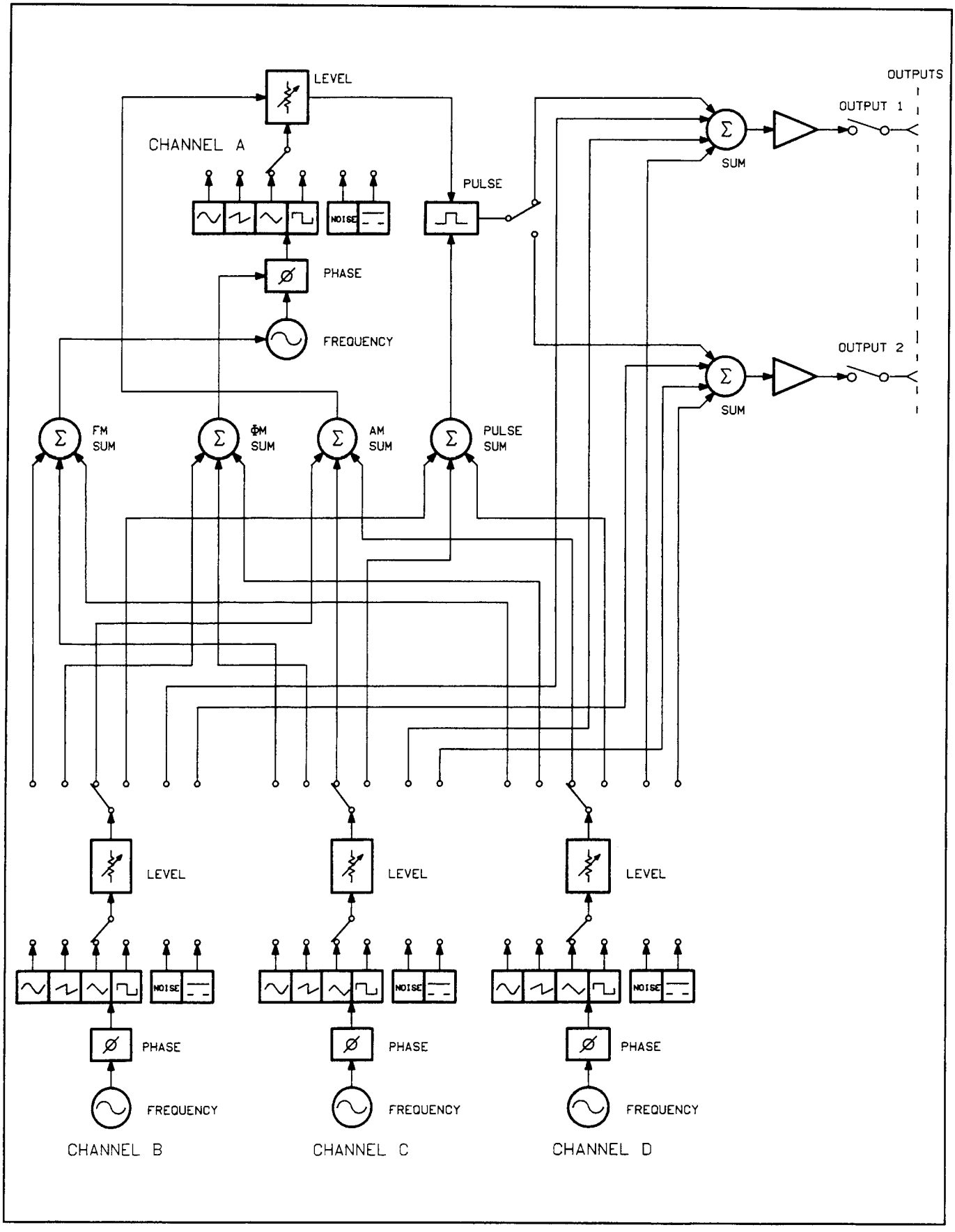


Figure 8–6. *Conceptual Block Diagram of an Instrument with Options 001 and 002*

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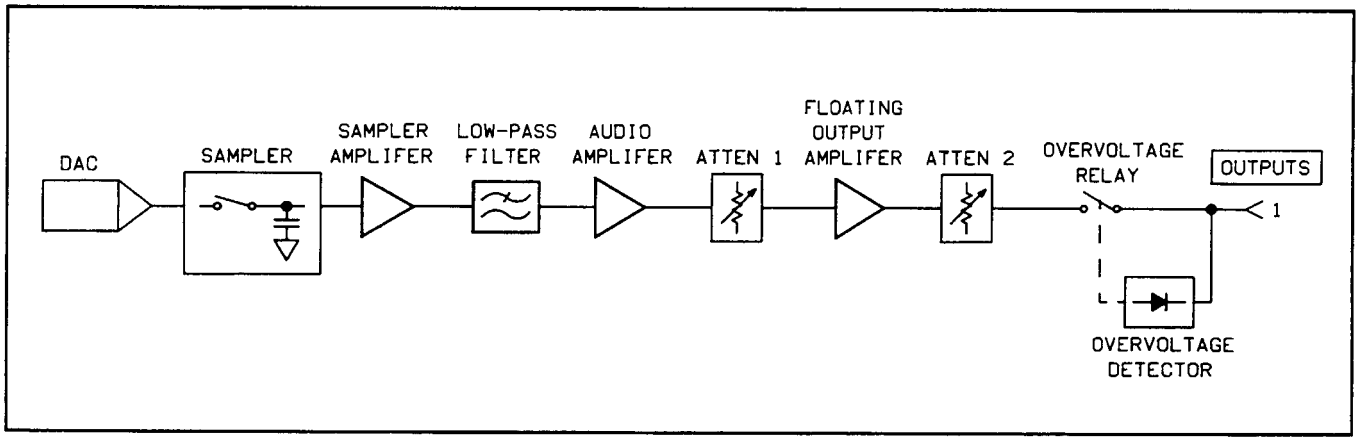


Figure 8–7. *Analog Output Block Diagram*

Analog Waveform Processing

The analog waveform processing block diagram is shown in figure 8-7. Instruments with Option 002 have a second, identical output assembly. The DAC receives digital inputs from the instrument's controller and converts them to an analog voltage. Because the DAC output has significant switching transients, each new output is sampled after settling. The Sampler Amplifier buffers the output of the Sampler.

The Low-Pass Filter is needed to accurately construct the sample-generated waveform. For smooth waveforms, such as sinewaves, a sharp-cutoff filter is selected; its 3 dB corner is approximately 670 kHz. For waveforms less smooth, such as triangle waves or tone bursts, a low-overshoot filter is selected with a 3 dB corner of 230 kHz.

The Audio Amplifier has 19 dB gain and passes signals up to 600 kHz with good flatness and low distortion. Attenuator 1 can be programmed for 0, 6, 12, or 24 dB attenuation. It reduces the need for large level range control in the DWSIC and thereby maintains waveform fidelity at low levels.

The Floating Output Amplifier is a single-ended-to-differential converter with a gain of 1.12. In its float mode, either the high or the low output (not shown in the block diagram) can be floated up to 10 V while the signal from the instrument itself appears on the other output. Output impedance is 50Ω. Attenuator 2 can be programmed for 0 or 48 dB.

Both the high and low outputs are protected from inadvertent application of a large reverse voltage by the Overvoltage Detector and Relay. When a large output voltage is sensed the Overvoltage Detector opens the relay. The relay is reset by the instrument's controller when any key is pressed if the overvoltage condition has been removed.

If the instrument has Option 006 (balanced output), Output 1 is floated by means of a balancing transformer (not shown in figure 8–7). The transformer provides a true balanced 600Ω output but limits the useable frequency range and fidelity of the various non-sinusoidal waveforms.

Interrelationship of the Circuit Assemblies

Figure 8–8 and figure 8–8.1 diagrams the assemblies by assembly number and shows their interrelationship.

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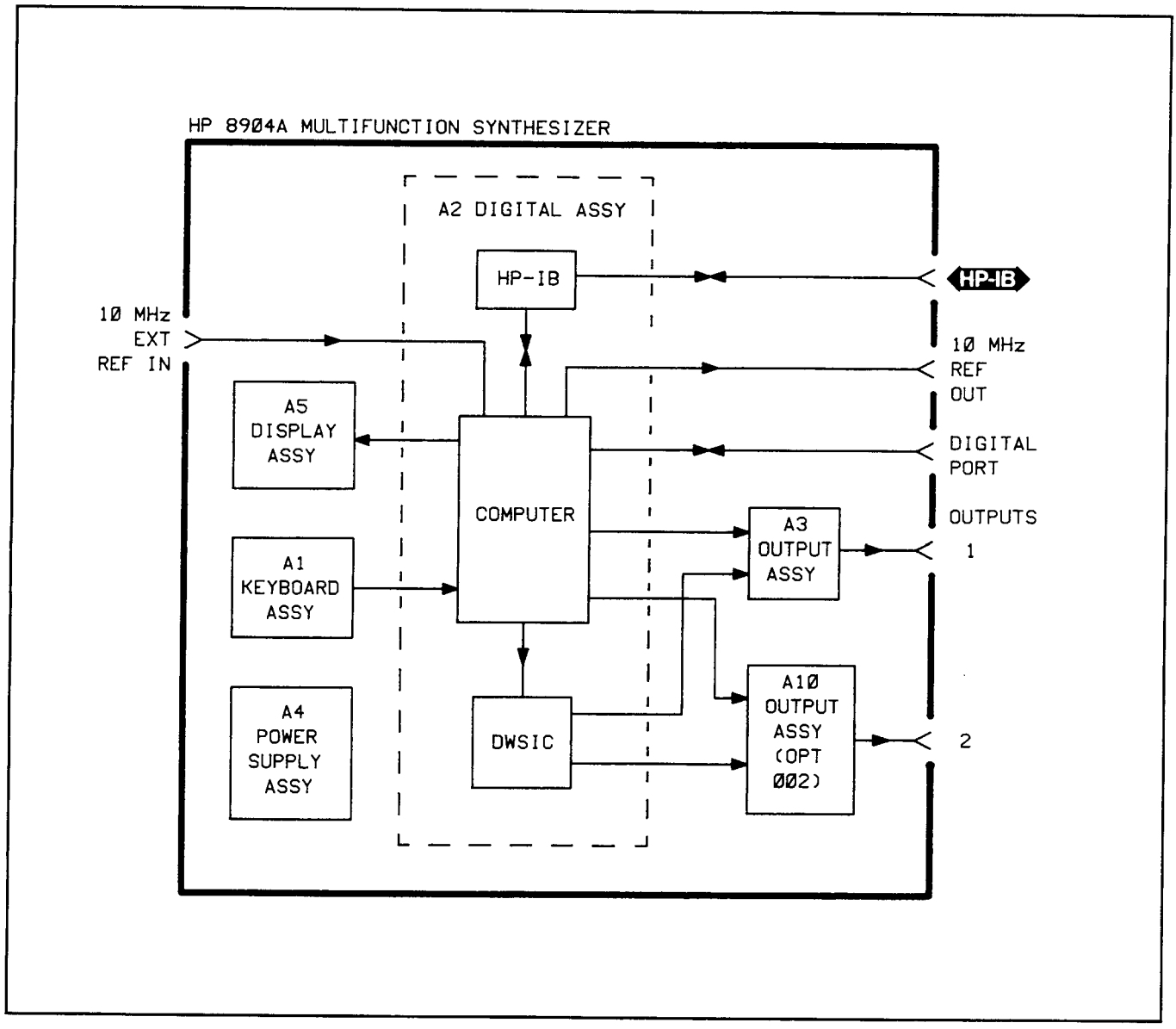


Figure 8–8. *Interrelationship of Instrument Assemblies (Serial prefix 2942A and below)*

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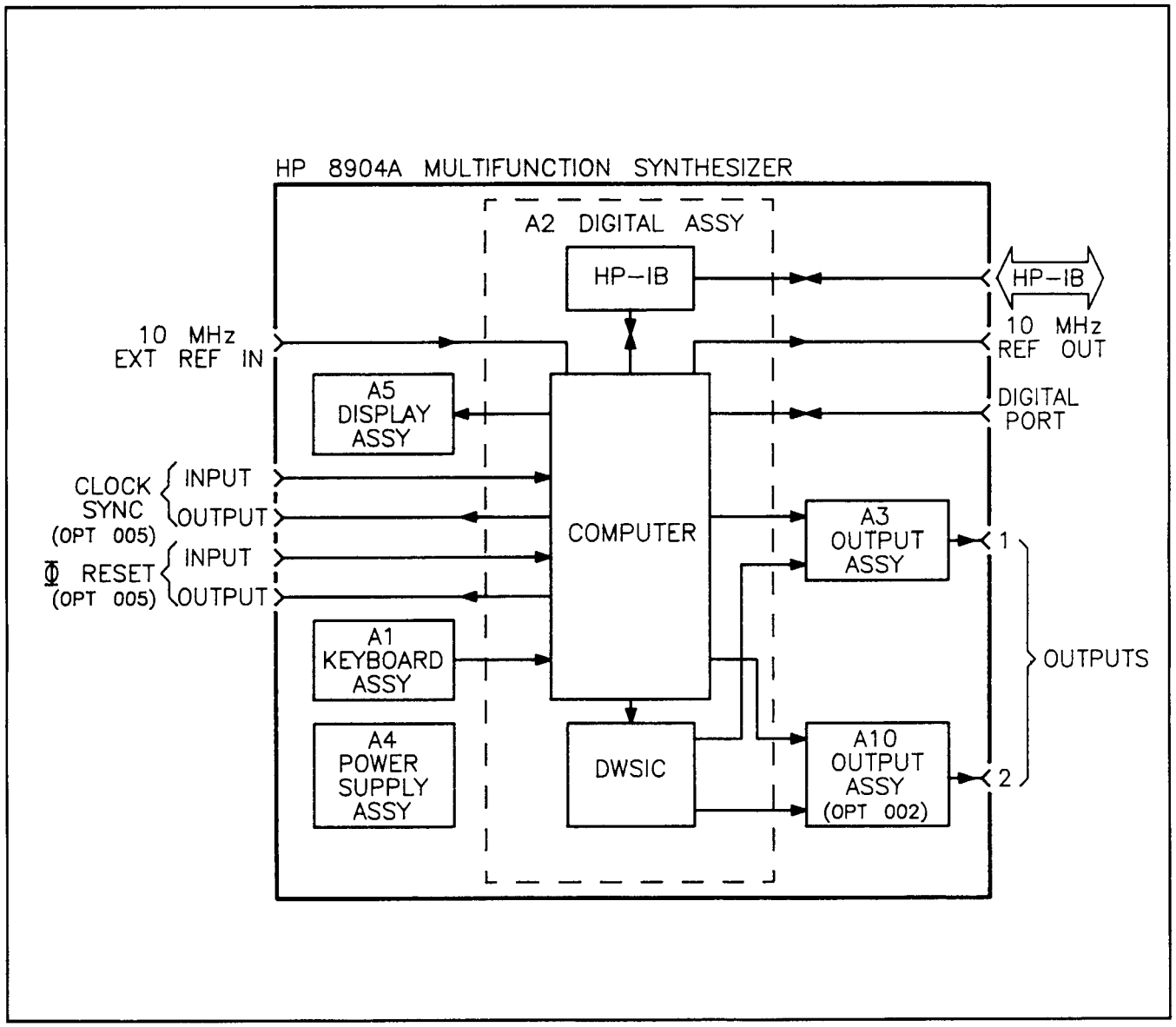


Figure 8–8.1. *Interrelationship of Instrument Assemblies (Serial prefix 2948A and above)*

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A2 DIGITAL ASSEMBLY

General

The A2 Digital Assembly creates the output waveforms as a series of digital codes (via its DWSIC) and performs the overall control and functioning of the instrument (via its microprocessor). Specific tasks include

- control the instrument's general operation
- create the digital waveforms
- distribute waveform data to the proper output
- control the programmable analog circuits (attenuators, filters, etc.)
- retain instrument settings in RAM
- backup RAM at power down
- process keyboard, HP-IB, digital port, and overvoltage interrupts
- scan the keyboard when a key press is detected
- interface with HP-IB
- generate the reference clocks
- switch between internal and external references
- control the beeper
- generate and time the display backlight
- control the front-panel displays and annunciators
- output waveform data to the digital port

Because some circuits on the assembly are proprietary and because the assembly is available as an exchange assembly, a schematic diagram with detailed theory and troubleshooting has not been provided. Troubleshooting procedures to isolate a fault to the assembly can be found in the troubleshooting section of this manual.

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A3 OUTPUT ASSEMBLY (Service Sheets 1 through 4)

General

The A3 Output Assembly converts the digitally encoded waveform from the digital waveform synthesis integrated circuit (DWSIC) on the A2 Digital Assembly to a precise and useable analog signal. Instruments with Option 002 have a second Output Assembly (designated A10) which is identical to A3. For troubleshooting purposes the two Output Assemblies can be interchanged or compared node-for-node. Specifically, the Output Assembly contains:

- the digital-to-analog converter
- a track-and-hold circuit
- clean up filters
- amplifiers and attenuators
- reverse power protection

Digital-to-Analog Converter (Service Sheet 1)

IC U6 is a 12 bit Digital-to-Analog Converter (DAC). Its function is to generate current with a magnitude proportional to the weighted 12 bit input data from DWSIC via latches U4 and U5. New data is output to the latches at a 1.6777216 MHz clock rate. The latches hold the data until it is time to clock the data to the DAC. Clocking of the latches is delayed 60 ns by U16 for optimum synchronization of the DAC and the following Track-and-Hold Circuit.

The output of the DAC is converted to a voltage by the series combination of resistors R210, R224, and R221. R224 (DAC Level) is adjusted to give the correct waveform amplitude. Connector J4 is a convenient point for testing the DAC when jumper J201 is moved to connect point 2 to point 3.

Track-and-Hold Circuit (Service Sheet 1)

After data is placed on the input of the DAC, the DAC requires 300 ns (that is, one-half clock period) settling before its output is valid. The Track-and-Hold circuit following the DAC stores (holds) the DAC's previous valid output on a capacitor (C219 at the input of the Sampler Amplifier) for 300 ns while the DAC with its new input data settles. Then the DAC's output is sampled and tracked for 300 ns.

The Track-and-Hold Circuit can be divided into three parts:

- Sampler Drive
- Sampler Switch
- Sampler Amplifier

Sampler Drive

The Sampler Drive must provide sufficient current through transformer T1 to turn on hard the sampler diodes (U201A, B, C, and F) in the Sampler Switch. When the sampler diodes are on, the voltage at the DAC output transfers to capacitor C219 at the input of the Sampler Amplifier. Operation of the Sampler Drive is most easily seen by referring to the simplified schematic of Figure 8-9.

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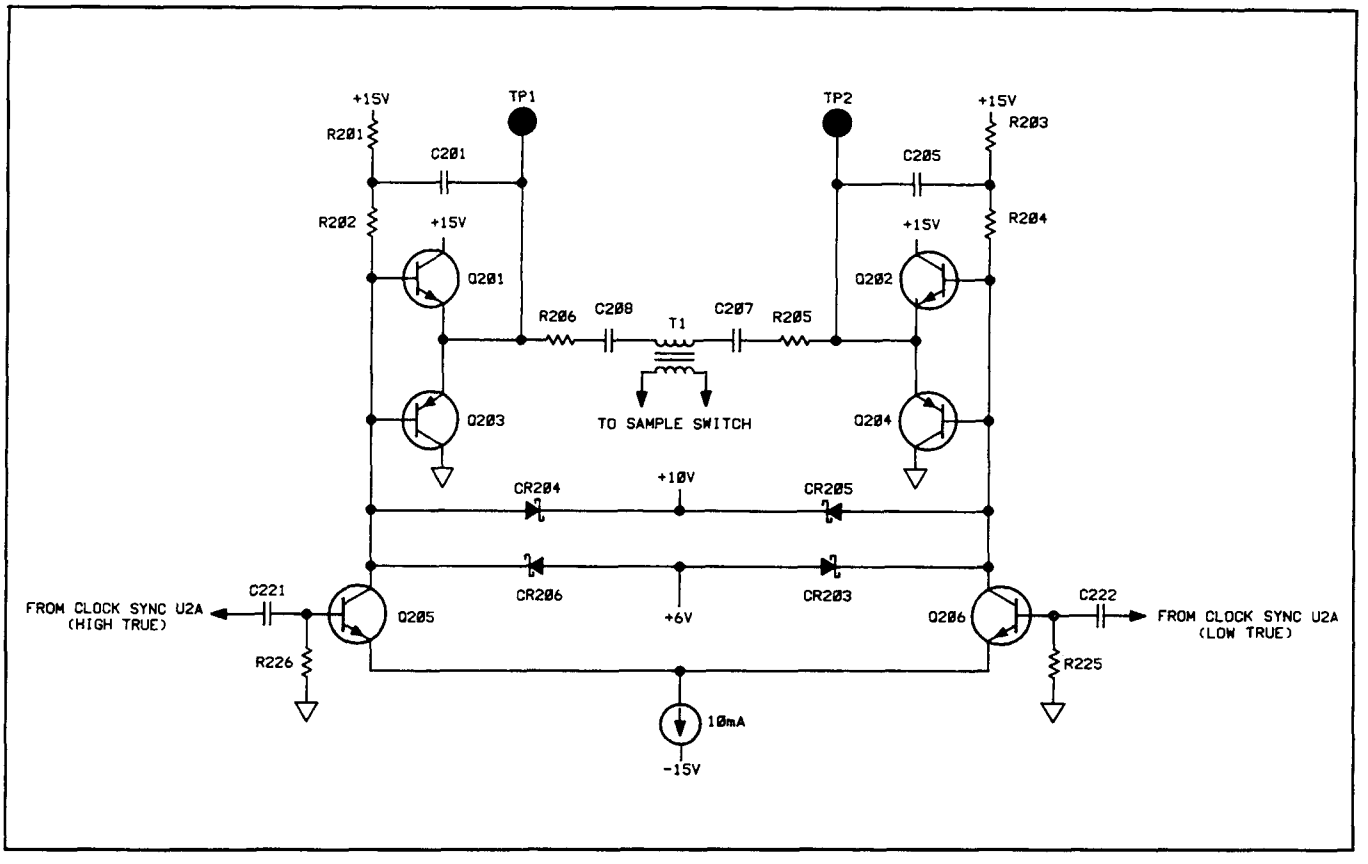


Figure 8–9. *Simplified Diagram of the Sampler Drive*

Differential input transistors (Q205 and Q206) are driven in complement by the outputs of D flip-flop U2A (the Clock Sync flip-flop). The emitter current for Q205 and Q206 is supplied by a common 10 mA current source. (The current source is Q207 and associated parts in the main schematic diagram. Diode CR207 thermally tracks the base-emitter junction of Q207 to thermally compensate the current source.) The current from the current source alternates between Q205 and Q206 each half clock period.

Diodes CR202 and CR203 clamp the collectors of Q205 and Q206 to approximately +6V; CR204 and CR205 clamp the collectors to +10V. Q204 and Q202 are emitter followers which drive one side of transformer T1; Q203 and Q201 similarly drive the opposite side of T1 but are 180° out of phase. Capacitor C201 forces the junction of R201 and R202 to follow the bases and emitters of Q201 and Q203 with a fixed dc offset. C205 performs a similar function to the other half of the circuit.

Sampler Switch

The Sampler Switch connects the DAC to the Sampler Amplifier during the "sample" half of the clock cycle; the Sampler Switch is open during "hold". The switches are diodes U201A, B, C, and F. They are switched by the Sampler Drive through T1.

When the switch diodes are off, diodes CR212 and CR208 charge capacitor C214 to approximately 2.7V. The charge on C214 has no effect when the switch diodes are on, but provides a strong initial backbias to the switch diodes as they turn off.

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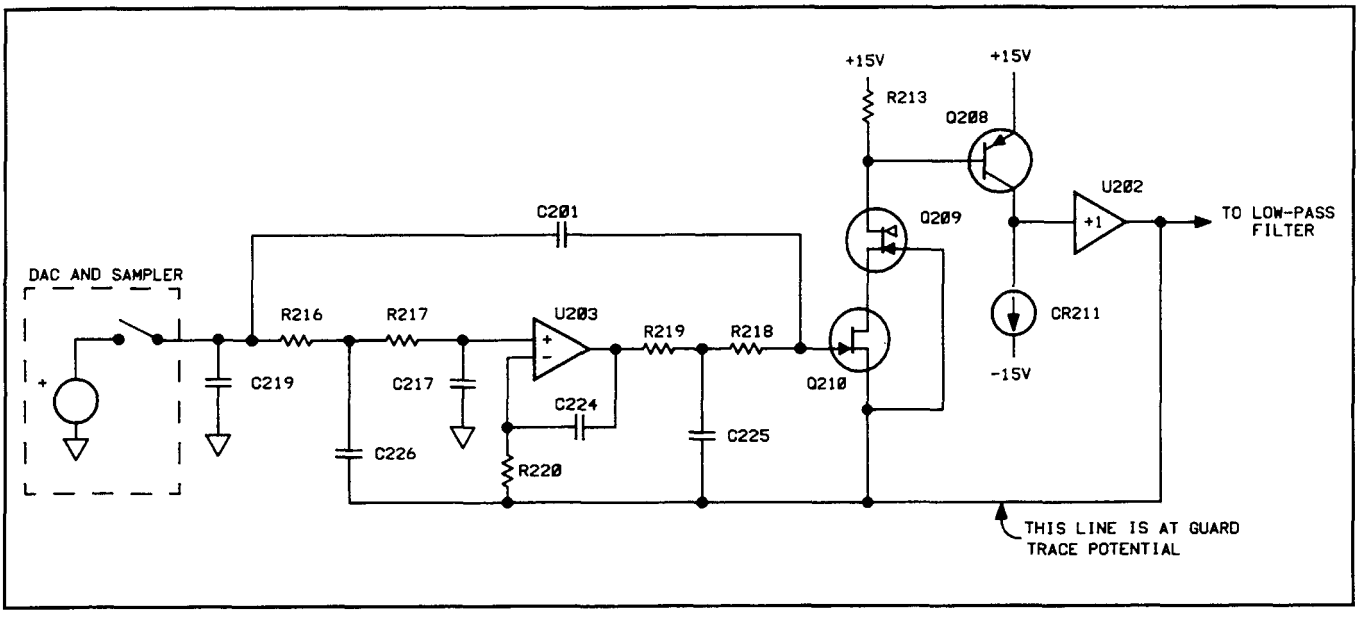


Figure 8–10. *Simplified Diagram of the Sampler Amplifier*

Sampler Amplifier

The Sampler Amplifier must accurately track the DAC output voltage when the Sampler Switch is closed and faithfully hold the sampled voltage when the switch is open. For some waveforms (for example, square and ramp) the DAC output may change abruptly several volts; these transitions must pass through the Sampler Amplifier without distortion.

Refer to the simplified schematic of Figure 8-10 which shows the Sampler Amplifier without the guard traces. The capacitor which holds the sampled voltage from the DAC is C219. It is followed by a unity-gain amplifier which presents a very high impedance to C219 (so as not to discharge it during the "hold" period), responds quickly and stably to a wide variety of inputs, has no dc offset, and can drive the load at its output.

The amplifier can be divided into two main stages: (1) a slower, high-gain input stage (U203 and associated parts) and (2) a fast, lower-gain output stage (Q210 and following). The input stage assures sufficient gain accuracy; the output stage assures quick response and output drive.

For high-frequency signal components, capacitor C201 bypasses the input stage so that the input signal appears at the gate of FET Q210. A high input impedance is maintained because capacitors C226 and C225 short resistors R216 and R218 respectively to the output of the output stage which is a unity-gain follower. Both ends of R216 and R218 move in step with the input so no current flows through them. Capacitor C217 prevents high-frequency components from entering U203. Capacitor C224 reduces the high-frequency stage gain to unity to eliminate its influence.

For low-frequency components, the input signal appears at the non-inverting (+) input of U203. The high, open-loop gain of U203 and the unity feedback force the inverting (−) input of U203 to precisely follow the non-inverting input.

Refer now to Service Sheet 1. The guard traces associated with U203 prevent any significant leakage of current from nearby circuit nodes of different potential on to highly-sensitive nodes such as C219. Leakage is most severe when the humidity is high. The guard trace is at the same potential as the input signal at all times since it is connected to the output of U202. Potentially error-producing leakage currents flow harmlessly to the guard trace.

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Low-Pass Filters (Service Sheet 2)

Precise construction of the analog waveform from the DAC requires careful filtering. Since the samples from the DAC are clocked through at approximately 1.67 MHz, sampling theory dictates that a low-pass filter of approximately 840 kHz or less is required; in practice the 3 dB corner will be less than this but it must be greater than 600 kHz, which is the upper frequency limit for a sine wave.

The output from the Track-and-Hold Circuit is filtered by the Sharp Cutoff Filter (an elliptic function filter) for sine waves, noise, and some types of complex waveforms (when automatically selected). The filter is flat within ±0.01 dB to 600 kHz and has a 3 dB corner at 670 kHz. Above 670 kHz the filter rolls off rapidly but ripples in the stopband. Adjustments to the filter are made to keep the stopband attenuation more than 68 dB beyond 1.07 MHz. For most other waveforms, the Low Overshoot Filter (a Gaussian type filter) is automatically selected. The filter prevents ringing but limits the useable frequency range to 50 kHz.

The Sharp Cutoff Filter is switched by relay K11, the Low Overshoot Filter by K10. The filters are switched in complement–one or the other is always in. The filter control signal on line FLC is inverted by peripheral driver U8A, which controls K10. The output of U8A is inverted by U8B, which controls K11. A high on FLC switches in the Low Overshoot Filter.

The filters can be isolated and tested manually by connecting a signal source to J5 and moving jumper J3 to connect point 2 to point 3, and by connecting a signal analyzer to J6 and moving jumper J7 to connect point 2 to point 3.

Audio Amplifier (Service Sheet 2)

The Audio Amplifier has a precise gain of 8.9 (19 dB). It must pass signals from dc to 600 kHz and maximum levels of 8.9 Vpk with minimum introduction of ripple, distortion, noise, or dc offset. The amplifier is a discrete design of a standard inverting operational amplifier. The gain is the ratio of the parallel combination of R48 and R231 to R47.

The Audio Amplifier has three stages: (1) an input stage (U9, Q14, and Q15), (2) an intermediate, high-gain stage (Q20 and Q21), and (3) an output driver stage (Q18 and Q19). The virtual ground of the amplifier is the junction of C40 and R49.

In the input stage the ac component of the input signal flows through C40 and R56 into the base of Q14. DC current flows through R49 and is amplified (and inverted) by U9. U9 functions as an integrator providing large gain for dc and low gain for ac. The output of U9 is fed into the emitter of Q14 through R53. Q14 differentially sums the ac and dc signals. Components C45, C46, and R57 form a lag-lead (at 1 MHz and 10 MHz) equalization critical for stabilizing the amplifier.

Q20 is a common-collector amplifier which drives common-base amplifier Q21 to form the intermediate stage. Q21 drives the collector of Q16 (through Q17) which presents a high-impedance load to Q21 and gives the intermediate stage high gain.

The output stage has unity gain. The complimentary transistor pair Q18 and Q19 provide sufficient current to drive the load. Q17 sets and thermally compensates the idle current in Q18 and Q19. Bias current for Q17 is generated by Q16. CR6 thermally compensates Q16.

Sine X/X Compensation (Service Sheet 2)

The Sine X/X Compensation filter compensates the natural roll-off of the sample-generated waveforms up to 600 kHz. L11 is adjusted for best flatness at 550 kHz. The parasitic load capacitance is accounted for in the network's design.

6, 12, and 24 dB Attenuators (Service Sheet 3)

Three pi-section attenuators provide 6, 12, and 24 dB of programmable attenuation. Each attenuator has an input impedance of 1 kΩ. C232 and C504 introduce a load capacitance that is constant for all combinations of attenuation settings.

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Floating Amplifier Driver and On/Off Switch (Service Sheet 3)

The On/Off Switch is opened for 15 ms when the Sharp Cutoff Filter is in and the frequency of the signal is changed to prevent the ringing in the filter from getting to the instrument's output.

The unity-gain, inverting buffer amplifier formed by U403 and U404 isolates the Floating Output Amplifier from the Sine X/X Compensation. The combination of resistors R412, R413, and R421 form a 1 kΩ resistance which can handle the output current from the Audio Amplifier. U404 is a current booster stage. C401 bypasses U404 at high frequencies to stabilize the buffer at high frequencies. L401 and R416 compensate the high-frequency rolloff of the Floating Output Amplifier.

Floating Output Amplifier (Service Sheet 4)

The Floating Output Amplifier is a single-ended-to-differential converter. Conversion is accomplished by a precise combination of negative feedback, positive feedback, and cross-coupling which yields a symmetrical differential output with high common-mode rejection and a well-defined output impedance of 50Ω. The complexity of the circuit makes detailed analysis difficult.

Output transistors Q401 through Q404 boost the current drive capability of differential amplifiers U401 and U402. Constant-current sources CR423 through CR426 provide bias current for diodes CR404 through CR407 and the bases of Q401 through Q404. CR423 through CR426 thermally compensate the base-emitter junctions of Q401 through Q404. Q405 through Q408 shut off Q401 through Q404 when the latter transistors start drawing too much current to protect the amplifier. Further protection is provided by CR408 through CR411 and CR419 through CR422. C425 equalizes the phase shift through the upper and lower portions of the amplifier for best high-frequency balance.

The +16 and −16V power supply regulators (Q300 and Q301) supply current to only the amplifier. This minimizes the effects of the large-current needs of the amplifier on the other circuits and minimizes distortion.

Overvoltage Protection and Output Circuits (Service Sheet 4)

Between the Floating Output Amplifier and the output connectors are several circuits.

Balun T400 improves the balance of the Floating Output Amplifier at high frequencies where the amplifier's balance has deteriorated.

The 48 dB Attenuator is a 50Ω, pi-section attenuator. C505 compensates the high-frequency effects of the parasitic capacitance of the contacts of K8.

The Overvoltage Protection Circuits open the relays on the two output lines when a large voltage is inadvertently applied to an output connector. The circuit thus protects the instrument's output circuits (especially the Floating Output Amplifier). Application of a large voltage on the output is sensed (after attenuation by voltage dividers R490 and R491 and R492 and R493) by comparators U400A through U400D which are referenced to voltages from the voltage dividers R495 and R497 and R494 and R496. Both positive and negative references are sensed on both output lines. When a comparator trips, K402A and K402B are opened via flip-flop U2B and drivers U10G, U8D and U8E. U2B also turns on Q33 which is read by the controller to generate an error message on the instrument's display. CR415 through CR418 protect the comparators. VR31 shifts the comparators' outputs to a TTL level. C440 and C441 prevent arcing of the contacts of K402 when the relay is deactivating. C64, CR17, CR18, and R122 open K402 at instrument turn-on.

Components C409 through C413 and L402 prevent high-frequency parasitic signals on the high-output line from radiating from the instrument.

Relay K404A controls the float or ground state of the low-output line.

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TROUBLESHOOTING

GENERAL

The goal of the following troubleshooting procedures is to isolate the fault to a single, replaceable assembly. The instrument assemblies are as follows:

- A1 Keyboard
- A2 Digital
- A3 Output
- A4 Power Supply
- A5 Display
- A6 High Power Output (Installed only in Option 006)
- A10 Output (Installed only in Option 002)

The exploded drawings at the end of section 6 in the manual will assist in locating, disassembling, and reassembling these assemblies.

The troubleshooting procedures assume the failure is catastrophic. For subtle or slightly-out-of-specification failures, it is best to begin diagnosis by running the performance tests and adjustments.

To isolate the fault to a printed circuit board assembly, it is usually necessary to check only the signals on the interface (interconnections) between assemblies. Specifically, this will be the interface between the A2 Digital Assembly and one of the other assemblies. The A3 (or A10) Output Assembly can be troubleshot to the component level using the troubleshooting information on the schematic diagrams.

NOTE

If the A2 Digital Assembly is replaced, it will be necessary to restore the instrument's serial number and, where applicable, Option 001 and/or 003 in non-volitile memory. The procedures to do this follow the last troubleshooting procedure.

The the troubleshooting procedures verify the signals in the:

- A2 Digital Assembly to A3 (or A10) Output Assembly Interface
- A2 Digital Assembly to A1 Keyboard Assembly Interface
- A2 Digital Assembly to A5 Display Assembly Interface
- A3 or A10 Output Assembly
- A6 High Power Output

Other procedures include:

- How to Restore the Serial Number in a Replacement A2 Digital Assembly
- How to Restore Options 001 and 003 in a Replacement A2 Digital Assembly
- How to Replace the Memory Backup Battery

NOTE

If the instrument has Option 002, a second output, and the fault appears only on one output, swap the A3 and A10 assemblies and see if the fault tracks the output assembly. If it does, then the Output Assembly is at fault; otherwise, the A2 Digital Assembly (or possibly an interconnection) is at fault.

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A2 DIGITAL ASSEMBLY TO A3 (OR A10) OUTPUT ASSEMBLY INTERFACE

Description

The following procedure will help identify whether an instrument failure is due to the analog output circuits or their control inputs. Since the layout of the instrument board assemblies breaks the circuit assemblies along digital-analog lines, this procedure will also help determine which assembly (the A2 Digital Assembly or the A3 (or A10) Output Assembly) is at fault. It does this by checking signals on the interface between the two assemblies.

If the tests pass but the output is faulty, the A3 (or A10) assembly should be replaced. If the tests fail, trace the signal to the A2 assembly. Retest the line that was faulty to determine whether the fault is in A2 or its interconnection to A3. Refer to Table 8-2, *A3 and A10 Interconnections to A2*, at the end of this procedure for a cross reference of the signal interconnections.

Equipment

Counter ..... HP 5315B
Digital Multimeter ..... HP 3478A
Oscilloscope ..... HP 1740A or Tektronix 2235

Procedure

1. Preliminary Setup

a. If the instrument has Option 002 (a second output assembly, A10) and Output 1 (the output from the A3 Output Assembly) is to be checked, move the A10 Output Assembly out of the way. (Refer to Figure 8-11, *How to Access A3 in Instruments Equipped with Option 002.*)

b. Check that switches 1 and 2 of the Service Switch, S1, on the A2 Digital Assembly are open and switches 3 through 10 are closed.

NOTE

The reference designators called out in the procedures are for the A3 or A10 Output Assembly.

2. Power Supply Checks

Connect a voltmeter to the points shown in Figure 8-12, *Power Supply Testpoints on A3 or A10.* The readings should be very close to those indicated.

3a. Clock Checks (Using an Oscilloscope)

NOTE

This procedure is adequate for most cases. Step 3b (which uses a counter), however, is more exact.

a. Connect a dc coupled, high-impedance oscilloscope to pin 3 of U2. The waveform should be a TTL squarewave with a period of approximately 150 ns (a frequency of 6.7 MHz).

b. Connect the oscilloscope to pin 2 of U2. The waveform should be a TTL squarewave with a period of approximately 600 ns (a frequency of 1.68 MHz).

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Tools:

No. 2 Pozidriv Screwdriver
Needlenose Pliers
PC Board Extractor
(included with Service Manual
or order: HP 08904-00013)

1. Turn instrument off, unplug power cord and remove bottom cover.

2. Disconnect ribbon cable, W17, from A10J1.

3. Remove hold-down screw and washer from center of A10 Ouput Assembly using Pozidriv screwdriver.

4. Pull A10 from each of its seven mounting posts. Release each mounting post by compressing the holding tang on mounting post with needlenose pliers while applying gentle upward pressure with the PC board extractor. (Extractor should exert pressure on metal shield, not on PC board, except where post does not extend through shield.)

5. Lift A10 from instrument and carefully lay A10 aside (coax cables will still be connected).

6. Replace hold-down screw (from step 3) with spacer (found under A10) into mounting hole in center of A3. This screw must be in place during adjustment procedure for A3.

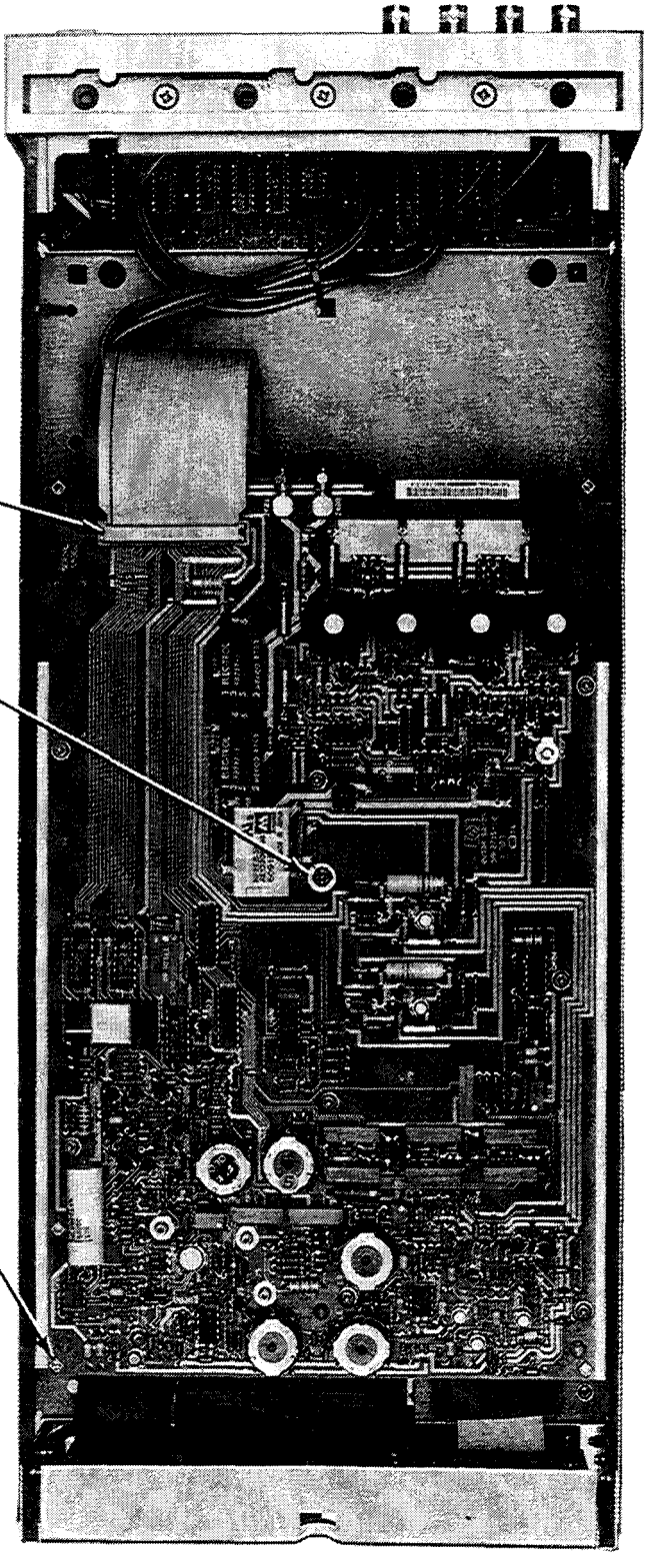


Figure 8–11. *How to Access A3 in Instruments Equipped with Option 002*

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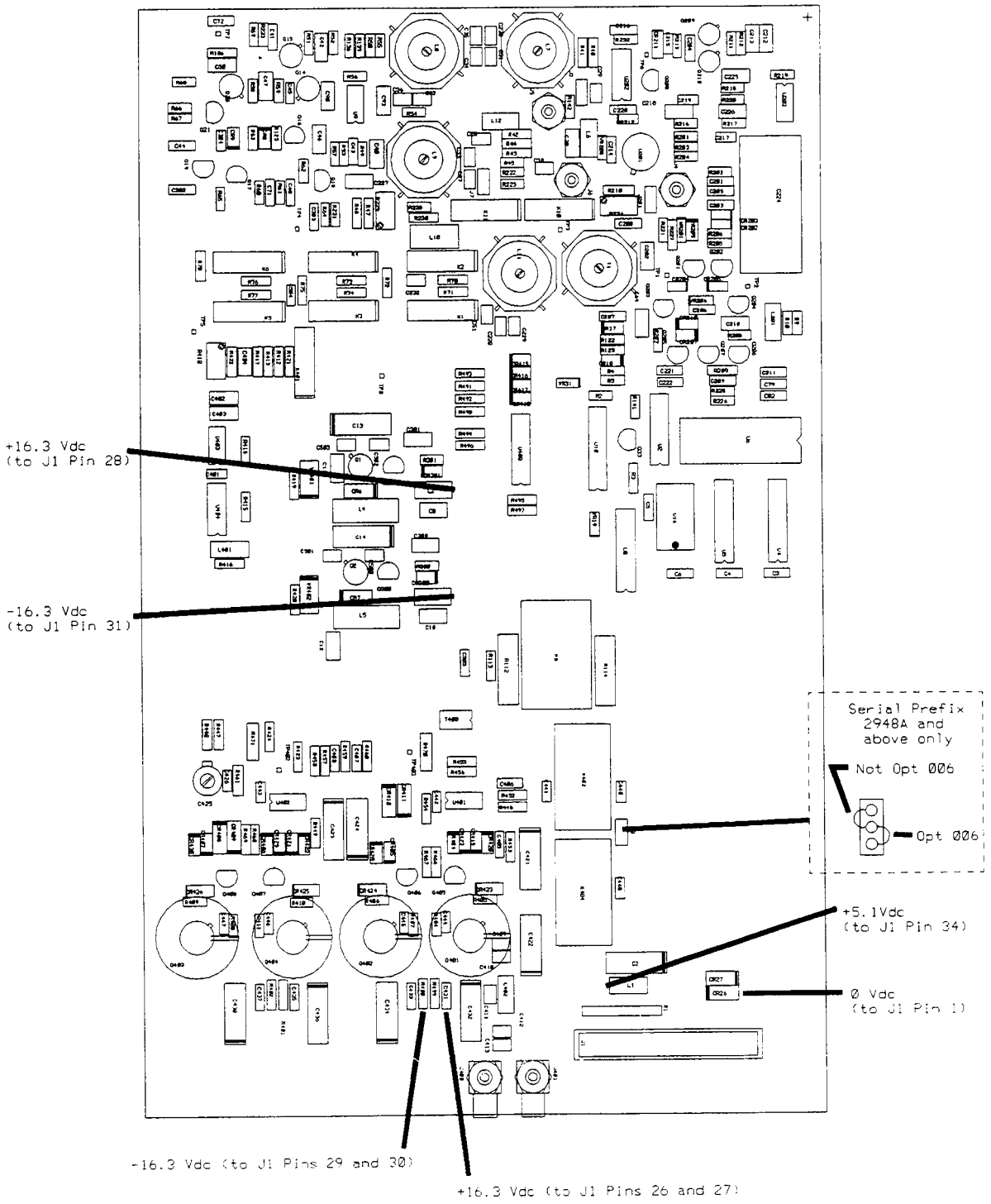


Figure 8–12. *Power Supply Testpoints on A3 or A10*

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3b. Clock Checks (Using a Counter)

a. If the counter has an external 10 MHz timebase reference input, connect it to the rear-panel 10 MHz REF OUT of the Multifunction Synthesizer.

NOTE

If the counter does not have an external reference, the readings in the following steps may be off several counts. This does not indicate a failure.

b. Connect the high-impedance counter input to pin 3 of U2. The counter should read within one count of 6.71088 MHz.

c. Connect the counter to pin 2 of U2. The counter should read within one count of 1.67772 MHz.

4a. Digital-to-Analog Converter Check (Using an Oscilloscope)

a. On the Multifunction Synthesizer, press SHIFT PRESET. After the instrument presets, key in

For A3 Output Assembly	For A10 Output Assembly
f1 (Channel Config.)	f1 (Channel Config.)
NEXT	NEXT NEXT
WAVE FORM ∿	WAVE FORM ∿
FREQ 25.6 Hz	FREQ 25.6 Hz
AMPTD 10 V	AMPTD 10 V

NOTE

Setting the frequency to exactly 25.6 Hz inputs a TTL squarewave to each input of the DAC latches. As the DAC's data input lines are probed from the most significant bit the the least significant bit, the frequency is consecutively divided by two.

b. Connect a dc coupled, high-impedance oscilloscope to the pin of the IC listed below. The waveform should be a TTL squarewave with an approximate period as indicated in the table.

IC on A3 or A10	Pin	Period
U5	14	19.1 μs
U5	13	38.1 μs
U5	11	76.3 μs
U5	6	153 μs
U5	4	305 μs
U5	3	610 μs
U4	14	1.22 ms
U4	13	2.44 ms
U4	11	4.88 ms
U4	6	9.8 ms
U4	4	19.5 ms
U4	3	39.1 ms

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4b. Digital-to-Analog Converter Check (Using a Counter)

a. If the counter has an external 10 MHz timebase reference input, connect it to the rear-panel 10 MHz REF OUT of the Multifunction Synthesizer.

NOTE

If the counter does not have an external reference, the readings in the following steps may be off several counts. This does not indicate a failure.

b. On the Multifunction Synthesizer, press SHIFT PRESET. After the instrument presets, key in

For A3 Output Assembly	For A10 Output Assembly
f1 (Channel Config.)	f1 (Channel Config.)
NEXT	NEXT NEXT
WAVE FORM ∿	WAVE FORM ∿
FREQ 25.6 Hz	FREQ 25.6 Hz
AMPTD 10 V	AMPTD 10 V

NOTE

Setting the frequency to exactly 25.6 Hz inputs a TTL squarewave to each input of the DAC latches. As the DAC's data input lines are probed from the most significant bit the the least significant bit, the frequency is consecutively divided by two.

c. Connect the high-impedance input of the counter to the pin of the IC listed below. The counter should read within one count of the frequency indicated in the table.

IC on A3 or A10	Pin	Frequency (Hz)
U5	14	52 428.8
U5	13	26 214.4
U5	11	13 107.2
U5	6	6 553.6
U5	4	3 276.8
U5	3	1 638.4
U4	14	819.2
U4	13	409.6
U4	11	204.8
U4	6	102.4
U4	4	51.2
U4	3	25.6

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5. Miscellaneous Control Checks

a. On the Multifunction Synthesizer, press SHIFT PRESET. After the instrument presets, key in

For A3 Output Assembly	For A10 Output Assembly
f1 (Channel Config.) NEXT	f1 (Channel Config.) NEXT NEXT

b. Connect a dc coupled, high-impedance oscilloscope or logic probe to the pin of the IC listed in the table below. For each connection, key in the sequences listed in the table (in the order listed) and note the logic state.

Function	A3 Key Sequence	A10 Key Sequence	A3/A10 Connection		TTL Level
			IC	Pin	
Filter	SHIFT FILTER 1 f1 f1 (Filter Select)	SHIFT FILTER 2 f1 f1 (Filter Select)	U8	1	L H
24 dB Attenuator	AMPTD 10V 625 mV	AMPTD 10V 625 mV	U10	1	H L
12 dB Attenuator	10V 2.5V	10V 2.5V	U10	3	H L
6 dB Attenuator	10V 5V	10V 5V	U10	5	H L
On/Off Switch	SHIFT OUTPUT 1 ON SHIFT OUTPUT 1 OFF	SHIFT OUTPUT 2 ON SHIFT OUTPUT 2 OFF	U8	6	L H
48 dB Attenuator	AMPTD 10V 39 mV	AMPTD 10 V 39 mV	U8	3	H L
Float/Ground Switch	SHIFT FLOAT 1 ON SHIFT FLOAT 1 OFF	SHIFT FLOAT 2 ON SHIFT FLOAT 2 OFF	U8	7	L H

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6. Overvoltage Control Checks

a. On the Multifunction Synthesizer, press SHIFT PRESET. After the instrument presets, key in

For A3 Output Assembly	For A10 Output Assembly
SHIFT SERVICE	SHIFT SERVICE
NEXT NEXT	NEXT NEXT
f3 (Memory Map Access)	f3 (Memory Map Access)
NEXT NEXT NEXT NEXT	NEXT NEXT NEXT NEXT NEXT
80	80

b. Connect a dc coupled, high-impedance oscilloscope or logic probe to pin 12 of U2. The voltage should be a TTL low.

c. Press SHIFT. The voltage should be a TTL high.

NOTE

To repeat this part of the check, key in 80 *then* SHIFT. *A beep will be heard each time 80 is keyed in.*

d. Connect the oscilloscope or logic probe to pin 11 of U2.

e. Key in 80 then SHIFT. As the shift key is pressed, the steady state TTL high should go momentarily low then back to high. (The logic probe should blink. The trace on an oscilloscope should blink perceptibly, or if the oscilloscope is in the normal trigger mode, a single sweep should be triggered.)

f. Press SHIFT PRESET. After the instrument presets, momentarily short pin 10 of U2 to ground. The instrument should beep and the display should read:

For A3:

```
Reverse Power Relay Tripped on Output 1
Press any key to reset and continue.
```

For A10:

```
Reverse Power Relay Tripped on Output 2
Press any key to reset and continue.
```


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Table 8–2. *A3 and A10 Interconnections to A2*

Clocks				
A3		J1 and J5	A2	
IC	Pin	Pin	IC	Pin
U2	3	32	U105	2
U2	2	15	U105	10

Clocks				
A10		J1 and J6	A2	
IC	Pin	Pin	IC	Pin
U2	3	32	U105	4
U2	2	15	U105	12

DAC				
A3		J1 and J5	A2	
IC	Pin	Pin	IC	Pin
U5	14	13	U37	15
U5	13	12	U37	12
U5	11	11	U37	10
U5	6	10	U37	7
U5	4	9	U37	5
U5	3	8	U37	2
U4	14	7	U33	15
U4	13	6	U33	12
U4	11	5	U33	10
U4	6	4	U33	7
U4	4	3	U33	5
U4	3	2	U33	2

DAC				
A10		J1 and J6	A2	
IC	Pin	Pin	IC	Pin
U5	14	13	U34	15
U5	13	12	U34	12
U5	11	11	U34	10
U5	6	10	U34	7
U5	4	9	U34	5
U5	3	8	U34	2
U4	14	7	U36	15
U4	13	6	U36	12
U4	11	5	U36	10
U4	6	4	U36	7
U4	4	3	U36	5
U4	3	2	U36	2

Miscellaneous Control				
A3		J1 and J5	A2	
IC	Pin	Pin	IC	Pin
U8	1	24	U38	12
U10	1	21	U38	17
U10	3	23	U38	16
U10	5	25	U38	15
U8	6	20	U38	14
U8	3	19	U38	18
U8	7	22	U38	13

Miscellaneous Control				
A10		J1 and J6	A2	
IC	Pin	Pin	IC	Pin
U8	1	24	U35	12
U10	1	21	U35	17
U10	3	23	U35	16
U10	5	25	U35	15
U8	6	20	U35	14
U8	3	19	U35	18
U8	7	22	U35	13

Overvoltage Control				
A3		J1 and J5	A2	
IC	Pin	Pin	IC	Pin
U2	12	17	U38	19
U2	11	18	U24	15

Overvoltage Control				
A10		J1 and J6	A2	
IC	Pin	Pin	IC	Pin
U2	12	17	U35	19
U2	11	18	U24	15

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A2 DIGITAL ASSEMBLY TO A1 KEYBOARD ASSEMBLY INTERFACE

Description

The following procedure will help identify whether a keyboard failure is due to the keyboard itself or the controller. It does this by checking signals on the interface between the two assemblies.

If the tests pass but the instrument does not respond to keyboard inputs, the A2 Digital Assembly should be replaced. If the tests fail, trace the signal to the A1 Keyboard Assembly. Retest the line that was faulty to determine whether the fault is in A2 or its interconnection to A1. Refer to Table 8-3, *A1 Interconnections to A2*, at the end of this procedure for a cross reference of the signal interconnections.

Equipment

Oscilloscope ..... HP 1740A or Tektronix 2235

Procedure

1a. Quick Key Check

NOTE

This check will quickly verify that the keys operate properly. If this check fails, run the following check to pinpoint the failure.

a. Check that switches 1 and 2 of the Service Switch, S1, on the A2 Digital Assembly are open and switches 3 through 10 are closed.

b. On the Multifunction Synthesizer, press SHIFT PRESET. After the instrument presets, key in

SHIFT SERVICE
f1 (Keyboard Check)

c. Press each key and check that the name of the key which appears in the lower, left hand of the display agrees with the key pressed.

NOTE

A beep will also be heard after each keypress. Press f4 *twice to exit this mode.*

1b. Key Check

a. Check that switches 1 and 2 of the Service Switch, S1, on the A2 Digital Assembly are open and switches 3 through 10 are closed.

b. On the Multifunction Synthesizer, press SHIFT PRESET. If the instrument does not preset, switch LINE to OFF and then to ON. If the instrument does not preset, the A2 Digital Assembly or A4 Power Supply is probably faulty.

c. After the instrument presets, connect a dc coupled, high-impedance oscilloscope or a logic probe to the points listed in the following table and press the keys indicated. When a key is pressed the logic level should respond as shown in the table only for the keys in that group.

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NOTE

Ignore the beeper and the display as keys are pressed. If pin 8 on A2U4 is always high, a key is probably stuck down.

IC on A2	Pin	Key Pressed	Response (TTL)
U3	17	f1, f2, SHIFT, 7, 2 All other keys	Goes Low Always High
U3	15	NEXT, LAST, LOCAL, –, 3, 9 All other keys	Goes Low Always High
U3	13	f3, f4, ⬅, kHz V, deg μV All other keys	Goes Low Always High
U3	11	FREQ, PHASE, ⇧, 5, 0 All other keys	Goes Low Always High
U3	8	⇩, AMPTD, WAVE FORM, 6, . All other keys	Goes Low Always High
U3	6	INCR SET, 1, 4, Hz mV, rad ENTER All other keys	Goes Low Always High
U1	12	f1, NEXT, f3, FREQ, AMPTD, 1 All other keys	Always Low Always High
U1	13	All keys	Blinks High
U1	14	All keys	Blinks High
U1	15	All keys	Blinks High
U1	16	All keys	Blinks High
U1	17	All keys	Blinks High

2. FLOAT and ON Annunciators Check

On the Multifunction Synthesizer, press SHIFT PRESET. After the instrument presets, key in the sequence indicated listed in the following table. The front-panel annunciators should light as indicated in the table. If the annunciators light improperly, also check the logic level at the point indicated.

NOTE

If the instrument does not have Option 002 (a second output), omit the tests for FLOAT 2 and ON 2.

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Key Sequence	Annunciator	Status	IC on A2	Pin	Level (TTL)
(None) SHIFT FLOAT 1 OFF	FLOAT 1	On Off	U38	13	L H
(None) SHIFT FLOAT 2 OFF	FLOAT 2	On Off	U35	13	L H
(None) SHIFT OUTPUT 1 OFF	ON 1	On Off	U2	16	L H
(None) SHIFT OUTPUT 2 OFF	ON 2	On Off	U2	17	L H

3. HP-IB Annunciators Check

a. On the Multifunction Synthesizer, press SHIFT PRESET. After the instrument presets, key in

SHIFT SERVICE
NEXT NEXT
f3 (Memory Map Access)
NEXT NEXT

The four front-panel, HP-IB annunciators (RMT, LSTN, TALK, and SRQ) should be on. (Pins 15, 14, 13, and 12, respectively, of U2 should all be TTL low.)

b. Key in 0 F. The HP-IB annunciators should be off. (Pins 15, 14, 13, and 12 of U2 should be high.)

Table 8–3. *A1 Interconnections to A2*

Keys			Annunciators		
IC on A2	Pin on IC	Pin on J1	IC on A2	Pin on IC	Pin on J1
U3	6	21	U2	12	7
U3	8	17	U2	13	9
U3	11	16	U2	14	8
U3	13	20	U2	15	10
U3	15	18	U2	16	4
U3	17	14	U2	17	3
U1	12	13	U38	13	6
U1	13	22			
U1	14	15	U35	13	5
U1	15	19			
U1	16	11			
U1	17	12			

Note: J1 is the 22 pin connector on the front right edge of A2. Pin 1 is nearest the center of the board. The +5V supply is on pins 1 and 2 of J1.

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A2 DIGITAL ASSEMBLY TO A5 DISPLAY ASSEMBLY INTERFACE

Description

A failure in the A5 Display Assembly can cause the entire instrument to hang up at power up. If this condition is suspected, measure pin 12 of A2U25 or pin 4 of A2U20 with a high impedance, dc coupled oscilloscope. TTL pulses should be seen with 1 μs high and 15 μs low. (The signal is normally a TTL high.)

To check the backlighting, measure the connection of the red wire at A2J8 with a high impedance, dc coupled oscilloscope. (A2J8 is located in the extreme front, right side of A2.) An ac waveform of 80 to 300 Vpp should be observed. The period should be approximately 2 ms. The amplitude will vary with brightness of the display and is adjustable. (See Adjustment 5, *Display Backlighting and Contrast* in Section 5 of the *Operation and Calibration Manual.* Display contrast is also adjustable.)

WARNING

Note that high voltages are measured.

CAUTION

A no load or short on the backlighting oscillator of A2 will damage the drive circuit.

NOTE

The display backlighting automatically turns off approximately 3 minutes after the last keystroke. Pressing any key will turn the backlighting back on.

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A3 OR A10 OUTPUT ASSEMBLY

Description

The following procedure will assist in locating a fault on the A3 or A10 Output Assembly. It is wise to perform the procedure titled *A2 Digital Assembly to A3 (or A10) Output Assembly Interface* first to confirm that the fault is indeed on the Output Assembly.

NOTE

If the instrument has Option 002, a second output, and the fault appears only on one output, swap the A3 and A10 assemblies and see if the fault tracks the output assembly. If it does, then the Output Assembly is at fault; otherwise, the A2 Digital Assembly (or possibly an interconnection) is at fault.

Equipment

Oscilloscope ..... HP 1740A or Tektronix 2235

Procedure

1. If the A3 Output Assembly is to be checked and the instrument also has an A10 Output Assembly (Option 002) present, move the A10 assembly out of the way by following the procedure of Figure 8-11, *How to Access A3 in Instruments Equipped with Option 002.*
2. To troubleshoot the Output Assembly,
   a. Turn to the schematic diagram (Service Sheets 1 through 4) of the circuit that is suspect.
   b. Set the instrument as instructed in the boxed text entitled "INITIAL INSTRUMENT SETTINGS".
   c. Connect the oscilloscope to the point to be tested.
   d. Alter the instrument settings if instructed by the troubleshooting text for that testpoint, and make the measurement.

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PHASE SYNCHRONIZATION (OPTION 005)

Description

The operation of the unit-to-unit phase synchronization circuits (Option 005 and serial prefix beginning 2948A only) is checked by monitoring the signals on the rear-panel clock synchronization and phase reset input and output lines. The checks should pinpoint the failure to either the A2 Digital Assembly or an interconnecting cable. Marginal failures may be able to be corrected by performing the *Phase Synchronization Adjustment* in Section 5; however, this is recommended only when there is strong reason to suspect that the failure is due to slight timing errors. Performance of the phase synchronization circuits can be verified by running the *Unit-to-Unit Phase Accuracy Performance Test* in Section 4.

Equipment

Digital Multimeter ..... HP 3478A
Oscilloscope ..... HP 1740A or Tektronix 2235

Procedure

1. On the Multifunction Synthesizer, connect the rear-panel CLOCK SYNC OUTPUT to the oscilloscope input. Set the oscilloscope's input to 50Ω or terminate the input in 50Ω using a tee.
2. On the Multifunction Synthesizer, press SHIFT PRESET. After the instrument presets, key in

   SHIFT SPECIAL 7 ENTER
   f2 (Status) ON
   LAST
   f2 (Status) ON

3. The oscilloscope should show a TTL waveform with a period of 74.5 ns (a frequency of 13.4 MHz). If faulty, check the cable which terminates at A2J9.
4. Connect the oscilloscope to A2TP1. (The oscilloscope input should remain at 50Ω.) Connect a short BNC cable between the rear-panel CLOCK SYNC OUTPUT and CLOCK SYNC INPUT.
5. The oscilloscope display should be the same as in step 3. If faulty, check the cable which terminates at A2J10.
6. Connect the oscilloscope input or a logic probe to the rear-panel Φ RESET OUTPUT. If an oscilloscope is used, set it to single trigger. On the Multifunction Synthesizer, press f4 (Exit).
7. Key in SHIFT Φ RESET several times and observe the oscilloscope or the logic probe. The logic probe should blink a high each time. The oscilloscope should trigger a sweep each time. (It may be necessary to adjust the oscilloscope's trigger level and the trigger may need to be armed each time.) If faulty, check the cable which terminates at A2J11.
8. Connect a short BNC cable between the rear-panel Φ RESET OUTPUT and Φ RESET INPUT. Connect the oscilloscope input or a logic probe to A2U30 pin 12.
9. Key in SHIFT Φ RESET several times, as was done in step 6, and observe the oscilloscope or the logic probe. The logic probe should blink a high each time. The oscilloscope should trigger a sweep each time. If faulty, check the cable which terminates at A2J12.

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HOW TO RESTORE THE SERIAL NUMBER IN A REPLACEMENT A2 DIGITAL ASSEMBLY

Description

If the A2 Digital Assembly has been replaced by a new or exchange assembly, the instrument's serial number suffix will need to be entered into non-volatile memory (RAM). The suffix is the last five digits of the serial number. For example, the suffix of serial number 1234A56789 is 56789.

The serial suffix can be entered from the front-panel keyboard by the following procedure. Note, however, that the procedure will only work for an assembly coming from a Hewlett-Packard sales office or service center. If the instrument has lost the contents of its non-volatile memory (for example, if the backup battery fails), the serial number cannot be entered; the A2 Digital Assembly must first be replaced, then the serial number can be entered.

The procedure is written with simple steps followed by detailed notes. Normally, it is only necessary to follow the simple steps and ignore the notes. Refer to the notes when a step doesn't work quite right.

NOTE

If the instrument has Option 001, 003, and/or 005, these options can be restored after restoring the serial number. Refer to the procedure following this one.

Procedure

1. Switch LINE to OFF and then back to ON. After the instrument powers up, the display should read:

```
*    HP 8904A  Main Selection Level    *
f1 Channel Config.
```

NOTE

After about 3 minutes if no key has been pressed, the backlighting on the display will go off. This is normal. When another key is pressed the backlighting will go back on.

2. Press SHIFT PRESET. The display will look something like the following, then after about 3 seconds it will time out. (The example shows an instrument with Option 002 installed.) Check that the serial suffix is 00000.

```
HP 8904A Opts 02
Firmware Revision 18387A Serial No 00000
```


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NOTE

a. *The* SHIFT *key is the blue key. The* PRESET *key is labeled in blue above the* ⬅ *key.*

b. *After 3 seconds the display will time out and read as in step 1. Press* SHIFT PRESET *as often as needed to view the option and serial display.*

c. *The displayed option numbers are only two digits (for example, 01) even though the official option numbers are three digits (for example, 001).*

d. *If the serial suffix is not 00000 but agrees with the suffix of the serial number on the rear panel, the instrument already has its serial suffix correctly entered.*

3. Key in SHIFT SPECIAL 8 7 ENTER SHIFT END. The display should read:

```
*****  Serial Number Installation  *****
Enter 5 digit serial number. S/N=
```

NOTE

a. *The* SPECIAL *key is labeled in blue above the* LAST *key. The* END *key is labeled in blue above the* ENTER *key.*

b. *After keying in* SHIFT SPECIAL, *the display should be:*

```
f1 Special # 0  f2 Status = Off  f4 Exit
# 0  Last state recalled on power up
```

c. *After keying in* 8 7, *the display should be:*

```
f1 Special #87  f2 Status = Off  f4 Exit
# 0  Last state recalled on power up
```

d. *After keying in* ENTER, *the instrument will beep.*

e. *After keying in* SHIFT END, *if the display is as follows, the instrument serial number cannot be entered. The A2 Digital Assembly must be replaced.*

```
*****  Serial Number Installation  *****
Serial number cannot be installed.
```


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4. Key in the serial suffix which is printed on the rear-panel serial label, then press ENTER. (For example, if the serial number on the label is 1234A56789, key in 5 6 7 8 9, then press ENTER.) The display should now read:

```
Press SHIFT f2 to install S/N = 56789.
If S/N is wrong use f3 Reenter  f4 Exit.
```

The serial suffix that you keyed in should appear at the end of the top line. (In the example shown it is 56789.)

NOTE

If a typing error occurs as the serial suffix is being entered, the backspace (⬅) key can be used to back up to the digit in error.

5. If the serial suffix is correct, press SHIFT f2. If the serial suffix is incorrect, press f3 and key in the correct number.

CAUTION

This is your last opportunity to check the serial suffix before it is entered permanently into the instrument. It cannot be changed once it has been entered.

The display should now read something like the following. (The example shows serial suffix 56789.)

```
*****  Serial Number Installation  *****
Serial Number S/N = 56789  installed.
```

After the 10 second timeout the display will read:

```
*     HP 8904A  Main Selection Level     *
f1 Channel Config.
```

6. Press SHIFT PRESET. Confirm that the serial suffix has been invoked. The display will look something like the following. (The example shows serial suffix 56789.)

```
HP 8904A Opts 02
Firmware Revision 18387A Serial No 56789
```

7. If the instrument has Options 001 and/or 003, these options can be restored after restoring the serial number. Refer to the procedure following this one.

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HOW TO RESTORE OPTIONS 001, 003, AND 005 IN A REPLACEMENT A2 DIGITAL ASSEMBLY

Description

If the A2 Digital Assembly has been replaced by a new or exchange assembly, the instrument's serial number suffix will need to be entered into non-volatile memory (RAM). (Restoration of the serial number is documented in the previous procedure.) After the serial number has been restored, Options 001, 003, and 005 can, where applicable, be restored.

The procedure requires entering of an option Codeword which is unique to the serial number and option number. The Codeword is printed on a label inside the instrument.

The procedure is written with simple steps followed by detailed notes. Normally, it is only necessary to follow the simple steps and ignore the notes. Refer to the notes when a step doesn't work quite right.

Procedure

1. Switch LINE to OFF and then back to ON. After the instrument powers up, the display should read:

```
*    HP 8904A  Main Selection Level    *
f1 Channel Config.
```

2. Press SHIFT PRESET. Check that the serial suffix matches the number on the rear panel and check that the option being restored is not already present. The display will look something like the following then after about 3 seconds it will time out. (The example shows an instrument with serial suffix 12345 with Options 002 and 001 installed.)

```
HP 8904A Opts 02/01
Firmware Revision 18387A Serial No 12345
```

NOTE

a. The SHIFT *key is the blue key. The* PRESET *key is labeled in blue above the* ⬅■ *key.*

b. After 3 seconds the display will time out and read as in step 1. Press SHIFT PRESET *as often as needed to view the option and serial display.*

c. If the serial suffix is 00000, the instrument will need its serial number entered. Refer to How to Restore the Serial Number in a Replacement A2 Assembly.

d. The displayed option numbers are only two digits (for example, 01) even though the official option numbers are three digits (for example, 001).

e. The presence of options other than the one being retrofit doesn't matter.

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3. Key in SHIFT SPECIAL 4 8 ENTER SHIFT END. The display should read:

```
****  Option Firmware Installation  ****
Enter installation code:          f4 Exit
```

NOTE

a. The SPECIAL *key is labeled in blue above the* LAST *key. The* END *key is labeled in blue above the* ENTER *key.*

b. After keying in SHIFT SPECIAL, *the display should be:*

```
f1 Special # 0  f2 Status = Off  f4 Exit
# 0  Last state recalled on power up
```

c. After keying in 4 8, *the display should be:*

```
f1 Special #48  f2 Status = Off  f4 Exit
# 0  Last state recalled on power up
```

d. After keying in ENTER, *the instrument will beep.*

e. If after keying in SHIFT END, *if the display is:*

```
****  Option Firmware Installation  ****
Option installation not performable.
```

the instrument will need its serial number entered or it is in need of repair. Refer to How to Restore the Serial Number in a Replacement A2 Assembly.

4. Locate the Codeword label for the option being restored. The Codeword label is located on the right side of the chassis toward the rear of the instrument.
5. Key in the Codeword then press ENTER. Check the options from the display. The display will look something like following then after about 10 seconds it will time out. (The example shows Option 003 now installed.)

```
The presently installed options are:
HP 8904A Opts 02/01/03
```

After the 10 second timeout, if the Codeword entry has been successful, the display will read:

```
****  Option Firmware Installation  ****
Turn off LINE power to invoke options!!
```


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NOTE

a. *If a typing error occurs as the Codeword is being entered, the backspace (⬅) key can be used to back up to the digit in error.*

b. *If the Codeword is incorrect the display will not list the desired option and after the 10 second timeout, the display will read:*

```
*    HP 8904A  Main Selection Level    *
f1 Channel Config.
```

Begin again at step 3.

6. Switch LINE to OFF and then back to ON. After the instrument powers up, the display should again read:

```
*    HP 8904A  Main Selection Level    *
f1 Channel Config.
```

7. Press SHIFT PRESET. Confirm that the option has been restored. The display will look something like following. (The example shows that Option 003 has been installed.)

```
HP 8904A Opts 02/01/03
Firmware Revision 18387A Serial No 12345
```

8. If another option is to be restored in the same instrument, start again at step 3.

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HOW TO REPLACE THE MEMORY BACKUP BATTERY

Description

The battery that backs up non-volatile memory has a limited lifetime. It should be replaced every five years or whenever it shows signs of deterioration. Replacing the battery must be done carefully so as to not interrupt the contents of the RAM. If the RAM looses its contents, the entire A2 Digital Assembly will have to be replaced because its serial number and option information will be lost.

Replacing the backup battery consists of unplugging and freeing the A2 Digital Assembly, wiring a power supply and resistor to RAM power supply pin, removing the old battery and soldering in the new one, removing the power supply backup, and re-assembling the instrument.

CAUTION

The normal precautions against electrostatic discharge must be followed but ***do not place the A2 Digital Control Assembly on a conductive metal surface,*** *which could short the battery or the RAM power supply pin.*

The substitute power supply must be floating if the solder iron has a grounded tip. (All soldering is done with the HP8904A completely disconnected from the power line.)

Do not apply too much heat to printed circuit connections when soldering. The traces on the multilayer board are easily damaged.

Do not overstress the interconnecting cables.

Tools and Supplies

Desoldering Tool
Needle Nose Pliers
Power Supply (Floating) or 3V Battery
Resistor, 10 kΩ
Solder Iron
Torx Driver

Parts

If the instrument has serial prefix 2942A and below order a 2.8V battery (HP 1420-0281) and three insulators (HP 3050-0990). If the instrument has serial prefix 2942A and above order a 2.8V battery (HP 1420-0338).

Procedure

1. Switch LINE to OFF and disconnect the power cord.
2. Remove the instrument's top cover. The cover may be tightly secured in the groove of the bottom cover. If the top cover does not pull off easily after backing out the screw on the rear edge, back out the screw on the rear edge of the bottom cover also.

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3. Partially remove the A2 Digital Assembly as follows. (figure 6-1, *Main Deck Assembly—Top*, may be helpful.)

   a. Unplug all connectors on the A2 assembly except the two soldered-in coaxial cables. (To remove the front-most keyboard ribbon cable, lift up on its retainer and push the retainer forward.)

   b. Remove the single Torx screw securing the A2 assembly.

   c. Carefully lift the A2 assembly from the seven plastic holding posts by compressing the small holding tangs with needle-nose pliers, and pulling the board up until the printed circuit board is free from the posts. Carefully rotate the board upward (hinging it from the left side as you face the front panel) until it is vertical. This should allow access to both sides of the assembly.

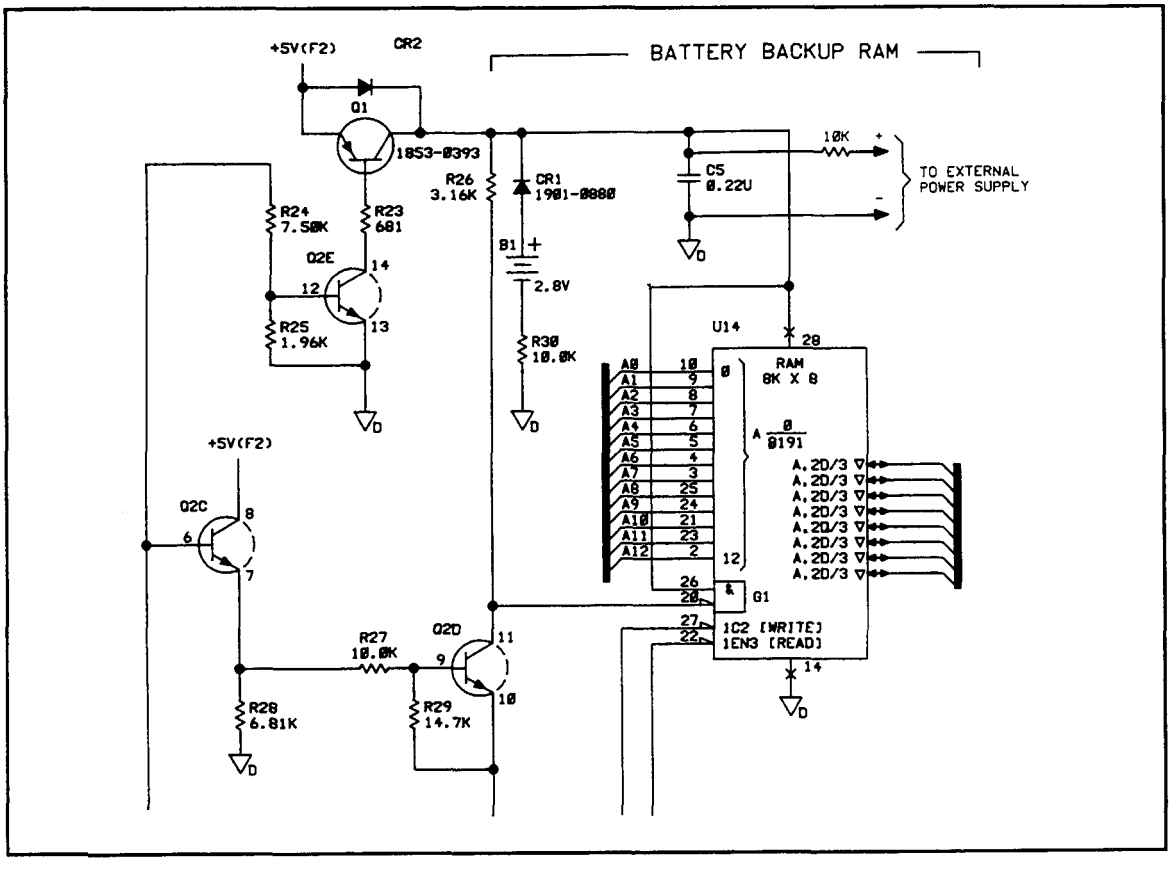


Figure 8–12.1 *Partial Schematic of A2 Digital Assembly Showing the Battery Backup*

4. Refer to Figures 8–12.1 and 8–12.3 for serial prefix 2942A and below or 8–12.4 for serial prefix 2948A and above. Rig up a temporary backup supply as follows.

   a. Temporarily solder one lead of a 10 kΩ resistor to the lead on the "+" end of capacitor A2C5. (Solder on the component side of the printed circuit board.)

   b. If a power supply is used (instead of a second battery), set it to approximately 3V then switch it completely off. Do not simply turn its voltage down to 0V, or the 10 kΩ resistor will load down the backup.

   c. Solder the other lead of the resistor to the "+" output of the power supply (or the temporary backup battery).

   d. Solder the "−" output of the power supply (or battery) to the other lead of A2C5.

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5. Desolder the three leads of the backup battery (A2B1) with a solder removal tool and remove the battery.

6a. If the instrument has serial prefix 2942A and below, put the three insulators (HP 3050-0990) on the leads of the new battery (A2B1, HP 1420-0281) and solder in the battery. The bottom of the battery case must not touch the circuit board or any solder pads.

6b. If the instrument has serial prefix 2948A and above, solder in the battery (A2B1, HP 1420-0338).

7. Remove the resistor and temporary backup connections on the A2 assembly.

8. Re-install the A2 assembly and all connectors.

9. Place the instrument in its normal operating position. Re-insert the power cord and switch LINE to ON.

10. Press SHIFT PRESET. The display should show the correct instrument serial number suffix for a few seconds.

11. Re-install the instrument's top cover.

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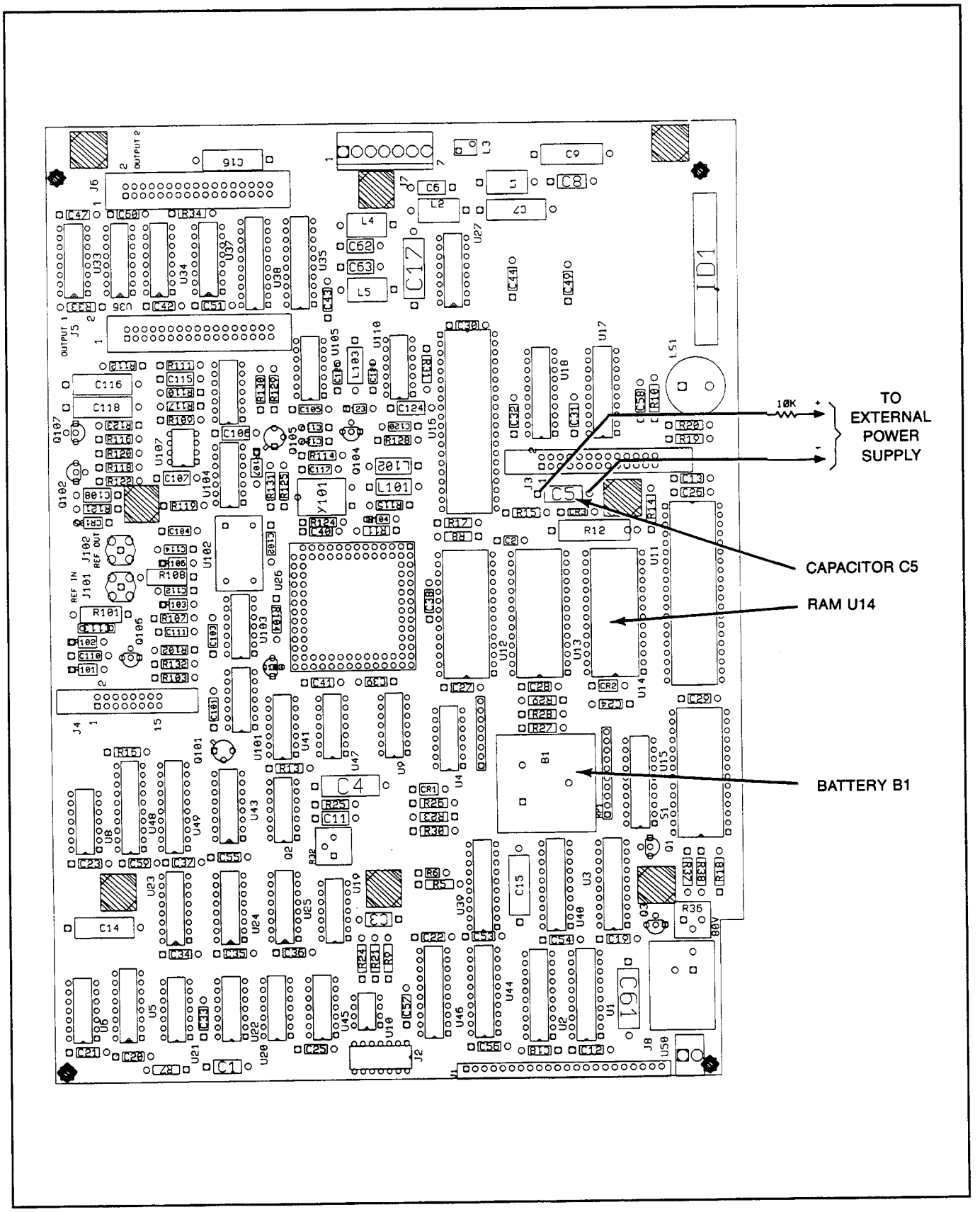


Figure 8–12.2. *Component Locator for A2 Digital Assembly Detailing the Battery Backup (Serial Prefix 2942A and Below)*

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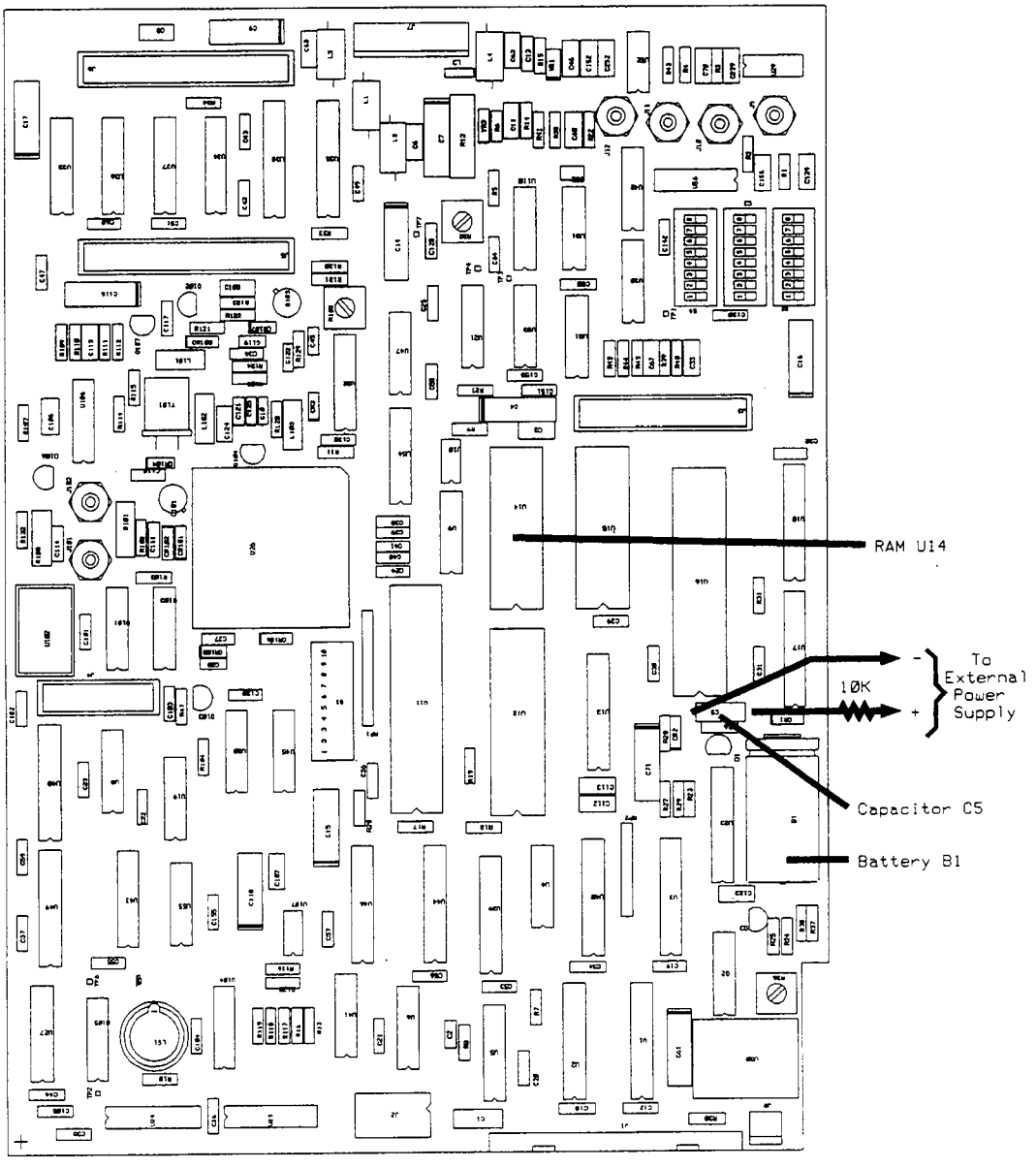


Figure 8–12.3. *Component Locator for A2 Digital Assembly Detailing the Battery Backup (Serial Prefix 2948A and Above)*

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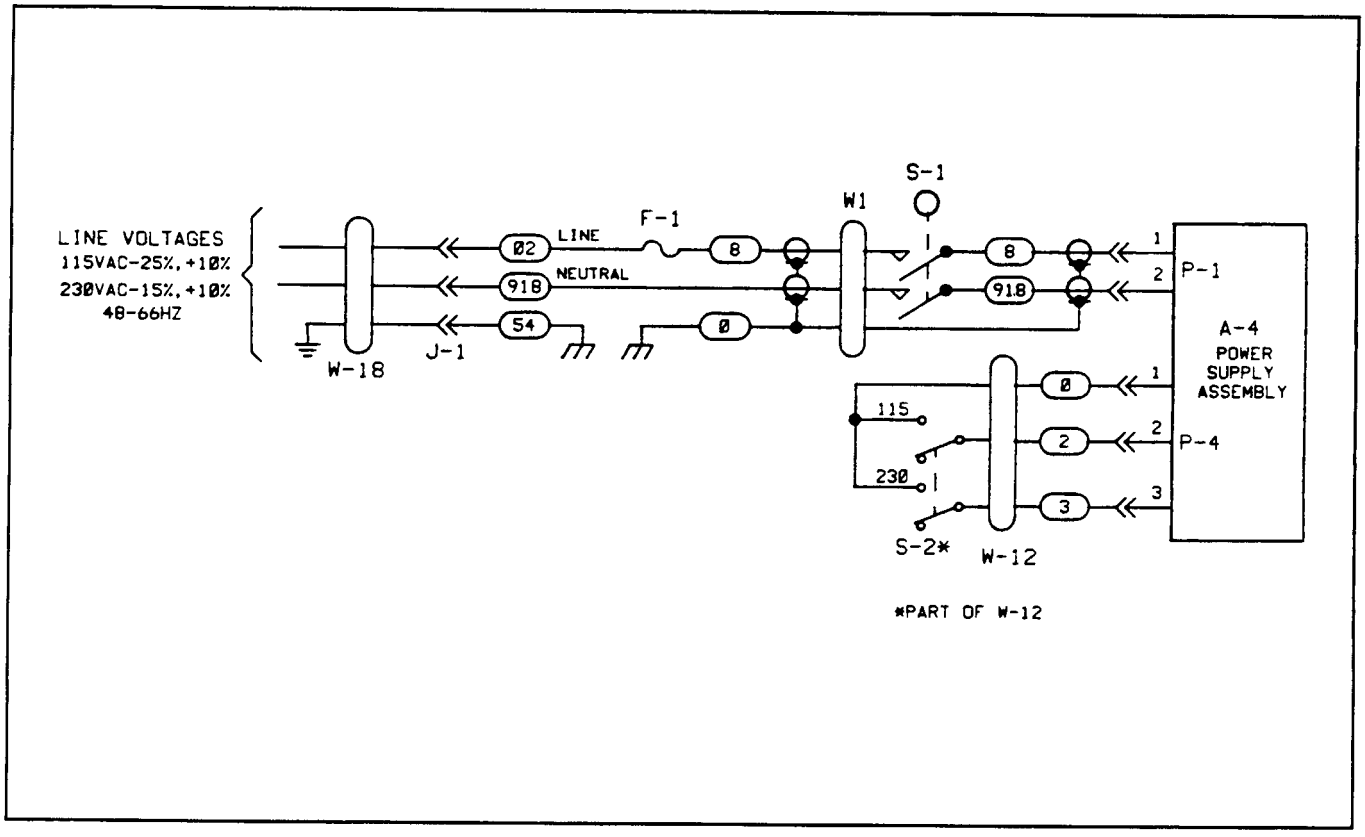


Figure 8–12.4. *Line Voltage Wiring Harness*

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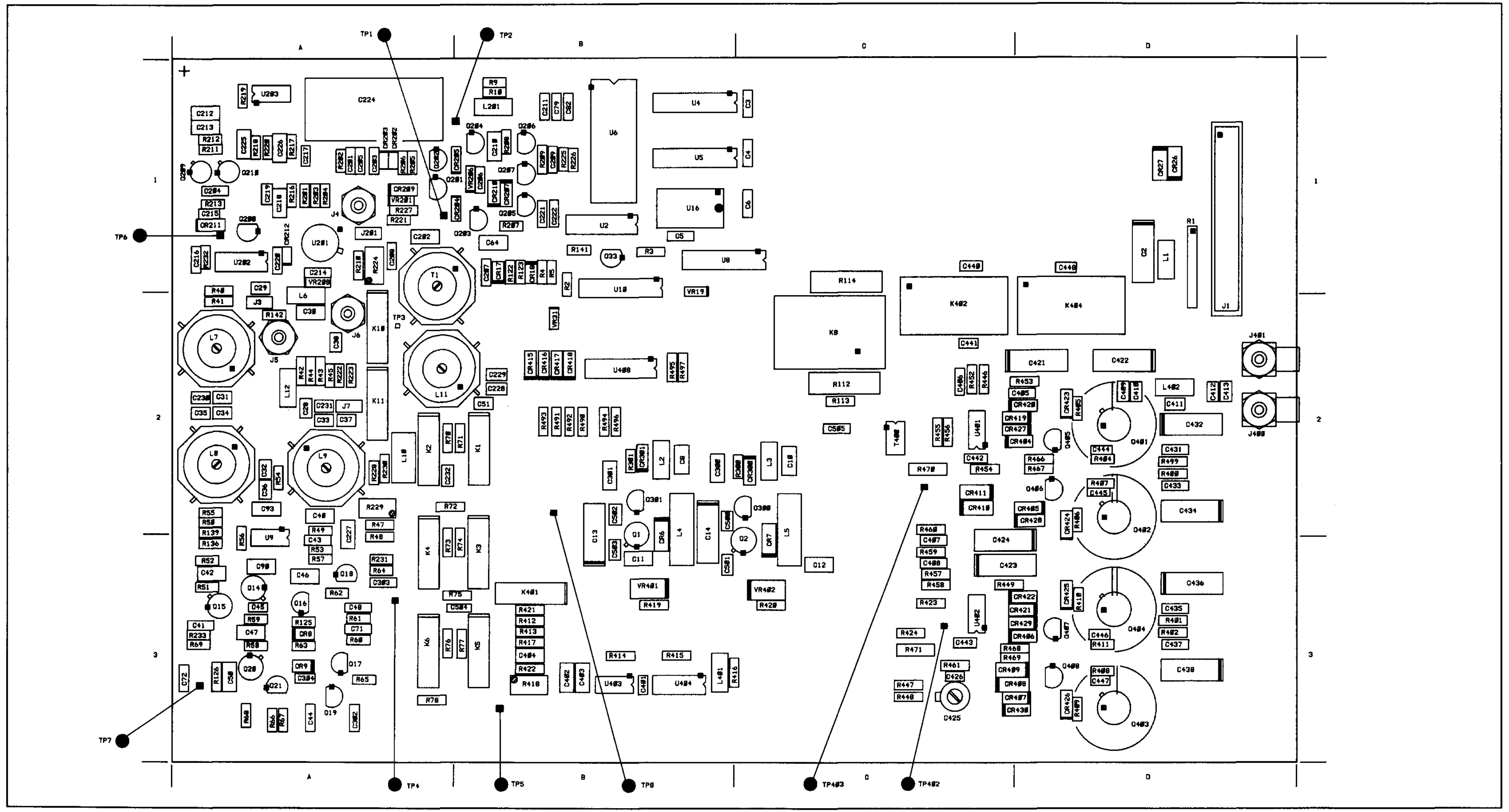


Figure 8-13. Service Sheet Information

Component Locator

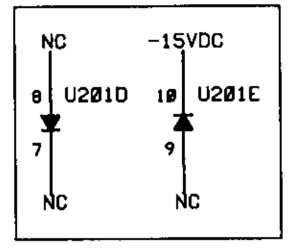
A3 Component Coordinates (1 of 2)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
C2	D,1	C206	B,1	C423	C,3	CR300	C,2	K11	A,2	Q402	D,2
C3	C,1	C207	B,1	C424	C,3	CR301	B,2	K401	B,3	Q403	D,3
C4	C,1	C208	A,1	C425	C,3	CR404	D,2	K402	C,2	Q404	D,3
C5	B,1	C209	B,1	C426	C,3	CR405	D,2	K404	D,2	Q405	D,2
C6	C,1	C210	B,1	C431	D,2	CR406	D,3			Q406	D,2
C8	B,2	C211	B,1	C432	D,2	CR407	C,3	L1	D,1	Q407	D,3
C10	C,2	C212	A,1	C433	D,2	CR408	C,3	L2	B,2	Q408	D,3
C11	B,3	C213	A,1	C434	D,2	CR409	C,3	L3	C,2		
C12	C,3	C214	A,1	C435	D,3	CR410	C,2	L4	B,3	R1	D,1
C13	B,3	C215	A,1	C436	D,3	CR411	C,2	L5	C,3	R2	B,1
C14	B,3	C216	A,1	C437	D,3	CR415	B,2	L6	A,2	R3	B,1
C28	A,2	C217	A,1	C438	D,3	CR416	B,2	L7	A,2	R4	B,1
C29	A,1	C218	A,1	C440	C,1	CR417	B,2	L8	A,2	R5	B,1
C30	A,2	C219	A,1	C441	C,2	CR418	B,2	L9	A,2	R9	B,1
C31	A,2	C220	A,1	C442	C,2	CR419	C,2	L10	A,2	R10	B,1
C32	A,2	C221	B,1	C443	C,3	CR420	D,2	L11	A,2	R40	A,1
C33	A,2	C222	B,1	C444	D,2	CR421	C,3	L12	A,2	R41	A,2
C34	A,2	C224	A,1	C445	D,2	CR422	D,3	L201	B,1	R42	A,2
C35	A,2	C225	A,1	C446	D,3	CR423	D,2	L401	B,3	R43	A,2
C36	A,2	C226	A,1	C447	D,3	CR424	D,2	L402	D,2	R44	A,2
C37	A,2	C227	A,2	C448	D,1	CR425	D,3			R45	A,2
C38	A,2	C228	B,2	C500	C,2	CR426	D,3	Q1	B,3	R47	A,2
C40	A,2	C229	B,2	C501	B,3	CR427	C,2	Q2	B,3	R48	A,3
C41	A,3	C230	A,2	C502	B,2	CR428	D,2	Q14	A,3	R49	A,3
C42	A,3	C232	B,2	C503	B,3	CR429	C,3	Q15	A,3	R50	A,2
C43	A,3	C300	B,2	C504	B,3	CR430	D,3	Q16	A,3	R51	A,3
C44	A,3	C301	B,2	C505	C,2			Q17	A,3	R52	A,3
C45	A,3	C302	A,3			J1	D,2	Q18	A,3	R53	A,3
C46	A,3	C303	A,3	CR6	B,3	J3	A,2	Q19	A,3	R54	A,2
C47	A,3	C304	A,3	CR7	C,3	J4	A,1	Q20	A,3	R55	A,2
C48	A,3	C401	B,3	CR8	A,3	J5	A,2	Q21	A,3	R56	A,3
C50	A,3	C402	B,3	CR9	A,3	J6	A,2	Q33	B,1	R57	A,3
C51	B,2	C403	B,3	CR17	B,1	J7	A,2	Q201	A,1	R58	A,3
C64	B,1	C404	B,3	CR18	B,1	J201	A,1	Q202	A,1	R59	A,3
C71	A,3	C405	D,2	CR26	D,1	J400	D,2	Q203	B,1	R60	A,3
C72	A,3	C406	C,2	CR27	D,1	J401	D,2	Q204	B,1	R61	A,3
C79	B,1	C407	C,3	CR202	A,1			Q205	B,1	R62	A,3
C82	B,1	C408	C,3	CR203	A,1	K1	B,2	Q206	B,1	R63	A,3
C90	A,3	C409	D,2	CR204	A,1	K2	A,2	Q207	B,1	R64	A,3
C93	A,2	C410	D,2	CR205	A,1	K3	B,3	Q208	A,1	R65	A,3
C201	A,1	C411	D,2	CR207	B,1	K4	A,3	Q209	A,1	R66	A,3
C202	A,1	C412	D,2	CR209	A,1	K5	B,3	Q210	A,1	R67	A,3
C203	A,1	C413	D,2	CR210	B,1	K6	A,3	Q300	C,2	R68	A,3
C204	A,1	C421	D,2	CR211	A,1	K8	C,2	Q301	B,2	R69	A,3
C205	A,1	C422	D,2	CR212	A,1	K10	A,2	Q401	D,2	R70	A,2

NOTES:

1

UNUSED CIRCUITRY



NOTE: U201 IS A DIODE ARRAY CONTAINING SIX COMPONENTS.

A3 Component Coordinates (2 of 2)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
R71	B,2	R206	A,1	R232	A,1	R421	B,3	R490	B,2	U4	B,1
R72	A,2	R207	B,1	R233	A,3	R422	B,3	R491	B,2	U5	B,1
R73	A,3	R208	B,1	R300	B,2	R423	C,3	R492	B,2	U6	B,1
R74	B,3	R209	B,1	R301	B,2	R424	C,3	R493	B,2	U8	B,1
R75	B,3	R210	A,1	R400	D,2	R446	C,2	R494	B,2	U9	A,3
R76	A,3	R211	A,1	R401	D,3	R447	C,3	R495	B,2	U10	B,1
R77	B,3	R212	A,1	R402	D,3	R448	C,3	R496	B,2	U16	B,1
R78	A,3	R213	A,1	R404	D,2	R449	C,3	R497	B,2	U201	A,1
R112	C,2	R216	A,1	R405	D,2	R452	C,2	R499	D,2	U202	A,1
R113	C,2	R217	A,1	R406	D,2	R453	D,2			U203	A,1
R114	C,1	R218	A,1	R407	D,2	R454	C,2	T1	A,1	U401	C,2
R122	B,1	R219	A,1	R408	D,3	R455	C,2	T400	C,2	U402	C,3
R123	B,1	R220	A,1	R409	D,3	R456	C,2			U403	B,3
R125	A,3	R221	A,1	R410	D,3	R457	C,3	TP1	A,1	U404	B,3
R126	A,3	R222	A,2	R411	D,3	R458	C,3	TP2	B,1	U408	B,2
R136	A,3	R223	A,2	R412	B,3	R459	C,3	TP3	A,2		
R139	A,3	R224	A,1	R413	B,3	R460	C,3	TP4	A,3	VR19	B,1
R141	B,1	R225	B,1	R414	B,3	R461	C,3	TP5	B,3	VR31	B,2
R142	A,2	R226	B,1	R415	B,3	R466	D,2	TP6	A,1	VR201	A,1
R201	A,1	R227	A,1	R416	B,3	R467	D,2	TP7	A,3	VR206	B,1
R202	A,1	R228	A,2	R417	B,3	R468	C,3	TP8	B,2	VR208	A,1
R203	A,1	R229	A,2	R418	B,3	R469	C,3	TP402	C,3	VR401	B,3
R204	A,1	R230	A,2	R419	B,3	R470	C,2	TP403	C,2	VR402	C,3
R205	A,1	R231	A,3	R420	C,3	R471	C,3	U2	B,1		

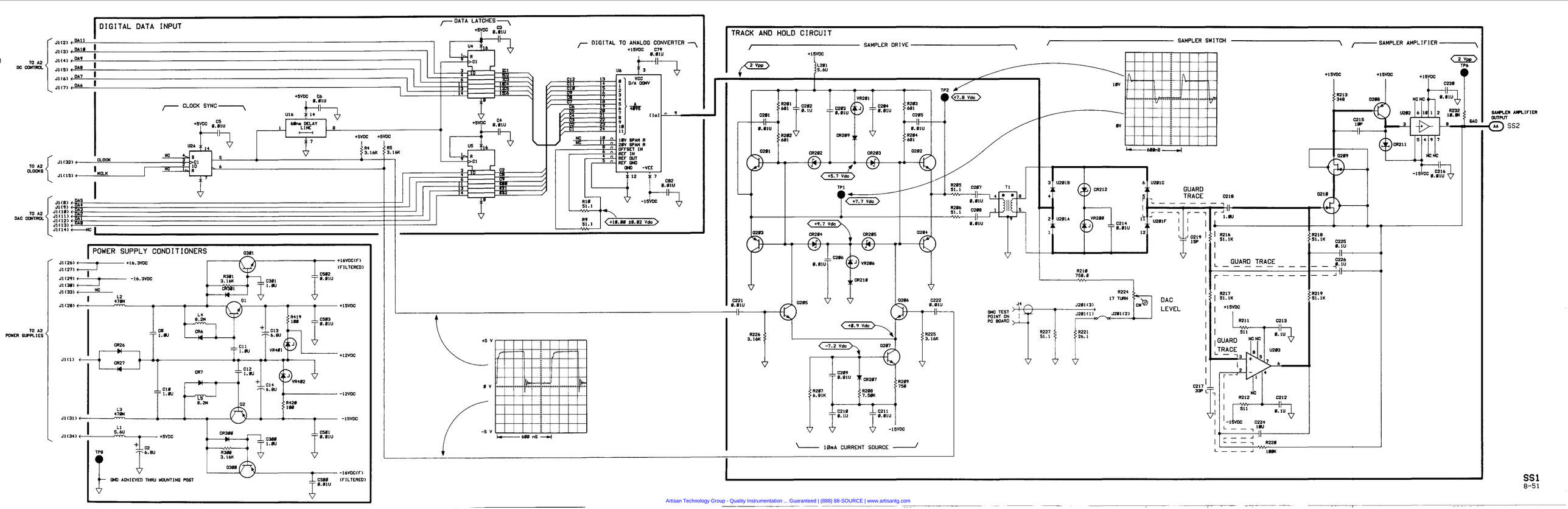
2

INITIAL INSTRUMENT SETTINGS

VOLTAGES ON THIS SCHEMATIC UNLESS OTHERWISE NOTED, SHOULD BE MEASURED AFTER KEYING IN:;

FOR A3:	FOR A10:
SHIFT PRESET	SHIFT PRESET
SHIFT FLOAT 1 OFF	SHIFT FLOAT 2 OFF
f1 (CHANNEL CONFIG.)	f1 (CHANNEL CONFIG.)
NEXT	NEXT NEXT
AMPTD 10 V	AMPTD 10 V

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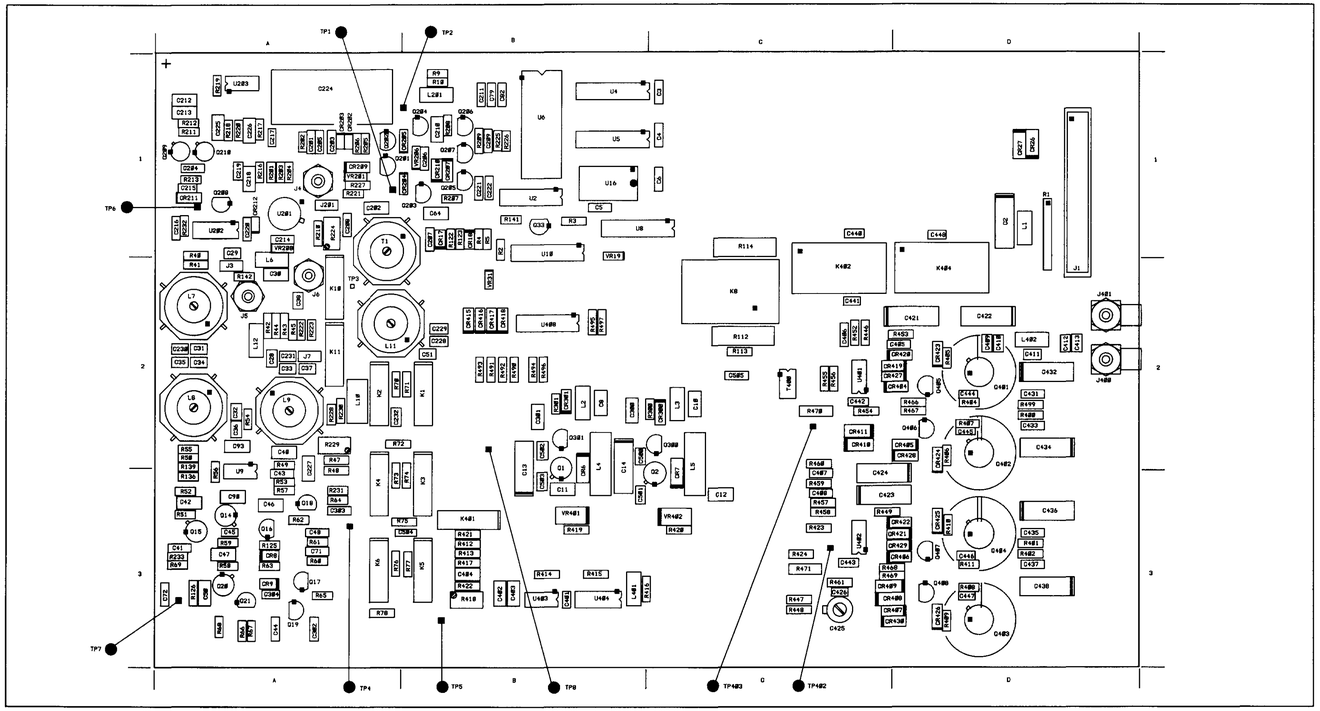


Figure 8-14. Service Sheet Information

Component Locator

A3 Component Coordinates (1 of 2)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
C2	D,1	C206	B,1	C423	C,3	CR300	C,2	K11	A,2	Q402	D,2
C3	C,1	C207	B,1	C424	C,3	CR301	B,2	K401	B,3	Q403	D,3
C4	C,1	C208	A,1	C425	C,3	CR404	D,2	K402	C,2	Q404	D,3
C5	B,1	C209	B,1	C426	C,3	CR405	D,2	K404	D,2	Q405	D,2
C6	C,1	C210	B,1	C431	D,2	CR406	D,3			Q406	D,2
C8	B,2	C211	B,1	C432	D,2	CR407	C,3	L1	D,1	Q407	D,3
C10	C,2	C212	A,1	C433	D,2	CR408	C,3	L2	B,2	Q408	D,3
C11	B,3	C213	A,1	C434	D,2	CR409	C,3	L3	C,2		
C12	C,3	C214	A,1	C435	D,3	CR410	C,2	L4	B,3	R1	D,1
C13	B,3	C215	A,1	C436	D,3	CR411	C,2	L5	C,3	R2	B,1
C14	B,3	C216	A,1	C437	D,3	CR415	B,2	L6	A,2	R3	B,1
C28	A,2	C217	A,1	C438	D,3	CR416	B,2	L7	A,2	R4	B,1
C29	A,3	C218	A,1	C440	C,1	CR417	B,2	L8	A,2	R5	B,1
C30	A,2	C219	A,1	C441	C,2	CR418	B,2	L9	A,2	R9	B,1
C31	A,2	C220	A,1	C442	C,2	CR419	C,2	L10	A,2	R10	B,1
C32	A,2	C221	B,1	C443	C,3	CR420	D,2	L11	A,2	R40	A,1
C33	A,2	C222	B,1	C444	D,2	CR421	C,3	L12	A,2	R41	A,2
C34	A,2	C224	A,1	C445	D,2	CR422	D,3	L201	B,1	R42	A,2
C35	A,2	C225	A,1	C446	D,3	CR423	D,2	L401	B,3	R43	A,2
C36	A,2	C226	A,1	C447	D,3	CR424	D,2	L402	D,2	R44	A,2
C37	A,2	C227	A,2	C448	D,1	CR425	D,3			R45	A,2
C38	A,2	C228	B,2	C500	C,2	CR426	D,3	Q1	B,3	R47	A,2
C40	A,2	C229	B,2	C501	B,3	CR427	C,2	Q2	B,3	R48	A,3
C41	A,3	C230	A,2	C502	B,2	CR428	D,2	Q14	A,3	R49	A,3
C42	A,3	C232	B,2	C503	B,3	CR429	C,3	Q15	A,3	R50	A,2
C43	A,3	C300	B,2	C504	B,3	CR430	D,3	Q16	A,3	R51	A,3
C44	A,3	C301	B,2	C505	C,2			Q17	A,3	R52	A,3
C45	A,3	C302	A,3			J1	D,2	Q18	A,3	R53	A,3
C46	A,3	C303	A,3	CR6	B,3	J3	A,2	Q19	A,3	R54	A,2
C47	A,3	C304	A,3	CR7	C,3	J4	A,1	Q20	A,3	R55	A,2
C48	A,3	C401	B,3	CR8	A,3	J5	A,2	Q21	A,3	R56	A,3
C50	A,3	C402	B,3	CR9	A,3	J6	A,2	Q33	B,1	R57	A,3
C51	B,2	C403	B,3	CR17	B,1	J7	A,2	Q201	A,1	R58	A,3
C64	B,1	C404	B,3	CR18	B,1	J201	A,1	Q202	A,1	R59	A,3
C71	A,3	C405	D,2	CR26	D,1	J400	D,2	Q203	B,1	R60	A,3
C72	A,3	C406	C,2	CR27	D,1	J401	D,2	Q204	B,1	R61	A,3
C79	B,1	C407	C,3	CR202	A,1			Q205	B,1	R62	A,3
C82	B,1	C408	C,3	CR203	A,1	K1	B,2	Q206	B,1	R63	A,3
C90	A,3	C409	D,2	CR204	A,1	K2	A,2	Q207	B,1	R64	A,3
C93	A,2	C410	D,2	CR205	A,1	K3	B,3	Q208	A,1	R65	A,3
C201	A,1	C411	D,2	CR207	B,1	K4	A,3	Q209	A,1	R66	A,3
C202	A,1	C412	D,2	CR209	A,1	K5	B,3	Q210	A,1	R67	A,3
C203	A,1	C413	D,2	CR210	B,1	K6	A,3	Q300	C,2	R68	A,3
C204	A,1	C421	D,2	CR211	A,1	K8	C,2	Q301	B,2	R69	A,3
C205	A,1	C422	D,2	CR212	A,1	K10	A,2	Q401	D,2	R70	A,2

A3 Component Coordinates (2 of 2)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
R71	B,2	R206	A,1	R232	A,1	R421	B,3	R490	B,2	U4	B,1
R72	A,2	R207	B,1	R233	A,3	R422	B,3	R491	B,2	U5	B,1
R73	A,3	R208	B,1	R300	B,2	R423	C,3	R492	B,2	U6	B,1
R74	B,3	R209	B,1	R301	B,2	R424	C,3	R493	B,2	U8	B,1
R75	B,3	R210	A,1	R400	D,2	R446	C,2	R494	B,2	U9	A,3
R76	A,3	R211	A,1	R401	D,3	R447	C,3	R495	B,2	U10	B,1
R77	B,3	R212	A,1	R402	D,3	R448	C,3	R496	B,2	U16	B,1
R78	A,3	R213	A,1	R404	D,2	R449	C,3	R497	B,2	U201	A,1
R112	C,2	R216	A,1	R405	D,2	R452	C,2	R499	D,2	U202	A,1
R113	C,2	R217	A,1	R406	D,2	R453	D,2			U203	A,1
R114	C,1	R218	A,1	R407	D,2	R454	C,2	T1	A,1	U401	C,2
R122	B,1	R219	A,1	R408	D,3	R455	C,2	T400	C,2	U402	C,3
R123	B,1	R220	A,1	R409	D,3	R456	C,2			U403	B,3
R125	A,3	R221	A,1	R410	D,3	R457	C,3	TP1	A,1	U404	B,3
R126	A,3	R222	A,2	R411	D,3	R458	C,3	TP2	B,1	U408	B,2
R136	A,3	R223	A,2	R412	B,3	R459	C,3	TP3	A,2		
R139	A,3	R224	A,1	R413	B,3	R460	C,3	TP4	A,3	VR19	B,1
R141	B,1	R225	B,1	R414	B,3	R461	C,3	TP5	B,3	VR31	B,2
R142	A,2	R226	B,1	R415	B,3	R466	D,2	TP6	A,1	VR201	A,1
R201	A,1	R227	A,1	R416	B,3	R467	D,2	TP7	A,3	VR206	B,1
R202	A,1	R228	A,2	R417	B,3	R468	C,3	TP8	B,2	VR208	A,1
R203	A,1	R229	A,2	R418	B,3	R469	C,3	TP402	C,3	VR401	B,3
R204	A,1	R230	A,2	R419	B,3	R470	C,2	TP403	C,2	VR402	C,3
R205	A,1	R231	A,3	R420	C,3	R471	C,3	U2	B,1		

NOTES:

1

INITIAL INSTRUMENT SETTINGS	
VOLTAGES ON THIS SCHEMATIC UNLESS OTHERWISE NOTED, SHOULD BE MEASURED AFTER KEYING IN:	
FOR A3:	FOR A10:
SHIFT PRESET SHIFT FLOAT 1 OFF f1 (CHANNEL CONFIG.) NEXT AMPTD 10 V	SHIFT PRESET SHIFT FLOAT 2 OFF f1 (CHANNEL CONFIG.) NEXT NEXT AMPTD 10 V

P/O A3/A10 OUTPUT ASSEMBLY SS1
SEE REVERSE SIDE

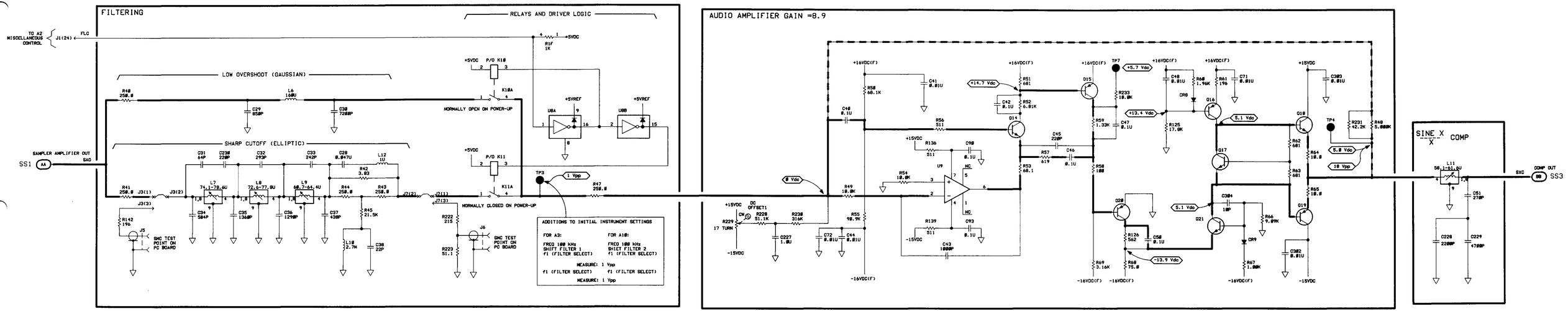
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CHANGES

All serial prefixes	**On the A3 schematic:** • **C230** - Under SHARP CUTOFF (ELLIPTIC) change the value of C230 to 1000pF.

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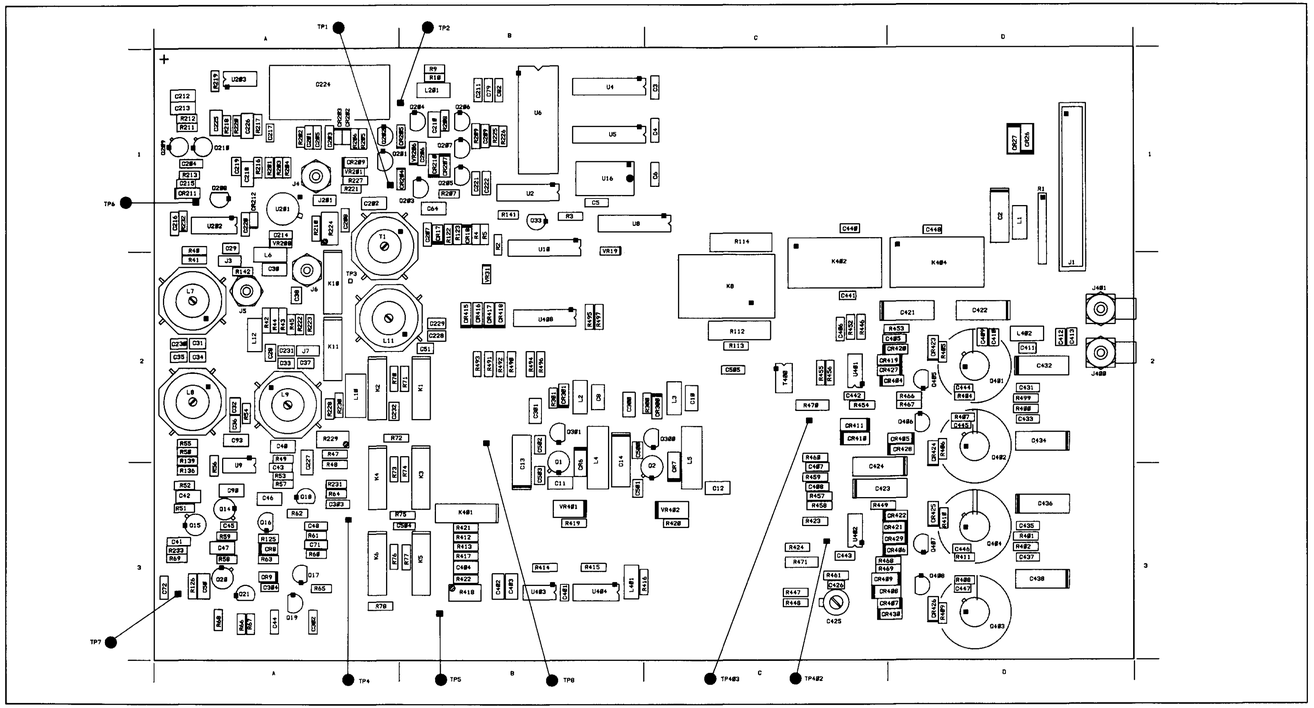


Figure 8-15. Service Sheet Information

Component Locator

A3 Component Coordinates (1 of 2)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
C2	D,1	C206	B,1	C423	C,3	CR300	C,2	K11	A,2	Q402	D,2
C3	C,1	C207	B,1	C424	C,3	CR301	B,2	K401	B,3	Q403	D,3
C4	C,1	C208	A,1	C425	C,3	CR404	D,2	K402	C,2	Q404	D,3
C5	B,1	C209	B,1	C426	C,3	CR405	D,2	K404	D,2	Q405	D,2
C6	C,1	C210	B,1	C431	D,2	CR406	D,3			Q406	D,2
C8	B,2	C211	B,1	C432	D,2	CR407	C,3	L1	D,1	Q407	D,3
C10	C,2	C212	A,1	C433	D,2	CR408	C,3	L2	B,2	Q408	D,3
C11	B,3	C213	A,1	C434	D,2	CR409	C,3	L3	C,2		
C12	C,3	C214	A,1	C435	D,3	CR410	C,2	L4	B,3	R1	D,1
C13	B,3	C215	A,1	C436	D,3	CR411	C,2	L5	C,3	R2	B,1
C14	B,3	C216	A,1	C437	D,3	CR415	B,2	L6	A,2	R3	B,1
C28	A,2	C217	A,1	C438	D,3	CR416	B,2	L7	A,2	R4	B,1
C29	A,1	C218	A,1	C440	C,1	CR417	B,2	L8	A,2	R5	B,1
C30	A,2	C219	A,1	C441	C,2	CR418	B,2	L9	A,2	R9	B,1
C31	A,2	C220	A,1	C442	C,2	CR419	C,2	L10	A,2	R10	B,1
C32	A,2	C221	B,1	C443	C,3	CR420	D,2	L11	A,2	R40	A,1
C33	A,2	C222	B,1	C444	D,2	CR421	C,3	L12	A,2	R41	A,2
C34	A,2	C224	A,1	C445	D,2	CR422	D,3	L201	B,1	R42	A,2
C35	A,2	C225	A,1	C446	D,3	CR423	D,2	L401	B,3	R43	A,2
C36	A,2	C226	A,1	C447	D,3	CR424	D,2	L402	D,2	R44	A,2
C37	A,2	C227	A,2	C448	D,1	CR425	D,3			R45	A,2
C38	A,2	C228	B,2	C500	C,2	CR426	D,3	Q1	B,3	R47	A,2
C40	A,2	C229	B,2	C501	B,3	CR427	C,2	Q2	B,3	R48	A,3
C41	A,3	C230	A,2	C502	B,2	CR428	D,2	Q14	A,3	R49	A,3
C42	A,3	C232	B,2	C503	B,3	CR429	C,3	Q15	A,3	R50	A,2
C43	A,3	C300	B,2	C504	B,3	CR430	D,3	Q16	A,3	R51	A,3
C44	A,3	C301	B,2	C505	C,2			Q17	A,3	R52	A,3
C45	A,3	C302	A,3			J1	D,2	Q18	A,3	R53	A,3
C46	A,3	C303	A,3	CR6	B,3	J3	A,2	Q19	A,3	R54	A,2
C47	A,3	C304	A,3	CR7	C,3	J4	A,1	Q20	A,3	R55	A,2
C48	A,3	C401	B,3	CR8	A,3	J5	A,2	Q21	A,3	R56	A,3
C50	A,3	C402	B,3	CR9	A,3	J6	A,2	Q33	B,1	R57	A,3
C51	B,2	C403	B,3	CR17	B,1	J7	A,2	Q201	A,1	R58	A,3
C54	B,1	C404	B,3	CR18	B,1	J201	A,1	Q202	A,1	R59	A,3
C71	A,3	C405	D,2	CR26	D,1	J400	D,2	Q203	B,1	R60	A,3
C72	A,3	C406	C,2	CR27	D,1	J401	D,2	Q204	B,1	R61	A,3
C79	B,1	C407	C,3	CR202	A,1			Q205	B,1	R62	A,3
C82	B,1	C408	C,3	CR203	A,1	K1	B,2	Q206	B,1	R63	A,3
C90	A,3	C409	D,2	CR204	A,1	K2	A,2	Q207	B,1	R64	A,3
C93	A,2	C410	D,2	CR205	A,1	K3	B,3	Q208	A,1	R65	A,3
C201	A,1	C411	D,2	CR207	B,1	K4	A,3	Q209	A,1	R66	A,3
C202	A,1	C412	D,2	CR209	A,1	K5	B,3	Q210	A,1	R67	A,3
C203	A,1	C413	D,2	CR210	B,1	K6	A,3	Q300	C,2	R68	A,3
C204	A,1	C421	D,2	CR211	A,1	K9	C,2	Q301	B,2	R69	A,3
C205	A,1	C422	D,2	CR212	A,1	K10	A,2	Q401	D,2	R70	A,2

P/O A3/A10 SEE REVERSE SIDE — OUTPUT ASSEMBLY — SS2

A3 Component Coordinates (2 of 2)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
R71	B,2	R206	A,1	R232	A,1	R421	B,3	R490	B,2	U4	B,1
R72	A,2	R207	B,1	R233	A,3	R422	B,3	R491	B,2	U5	B,1
R73	A,3	R208	B,1	R300	B,2	R423	C,3	R492	B,2	U6	B,1
R74	B,3	R209	B,1	R301	B,2	R424	C,3	R493	B,2	U8	B,1
R75	B,3	R210	A,1	R400	D,2	R446	C,2	R494	B,2	U9	A,3
R76	A,3	R211	A,1	R401	D,3	R447	C,3	R495	B,2	U10	B,1
R77	B,3	R212	A,1	R402	D,3	R448	C,3	R496	B,2	U16	B,1
R78	A,3	R213	A,1	R404	D,2	R449	C,3	R497	B,2	U201	A,1
R112	C,2	R216	A,1	R405	D,2	R452	C,2	R499	D,2	U202	A,1
R113	C,2	R217	A,1	R406	D,2	R453	D,2			U203	A,1
R114	C,1	R218	A,1	R407	D,2	R454	C,2	T1	A,1	U401	C,2
R122	B,1	R219	A,1	R408	D,3	R455	C,2	T400	C,2	U402	C,3
R123	B,1	R220	A,1	R409	D,3	R456	C,2			U403	B,3
R125	A,3	R221	A,1	R410	D,3	R457	C,3	TP1	A,1	U404	B,3
R126	A,3	R222	A,2	R411	D,3	R458	C,3	TP2	B,1	U408	B,2
R136	A,3	R223	A,2	R412	B,3	R459	C,3	TP3	A,2		
R139	A,3	R224	A,1	R413	B,3	R460	C,3	TP4	A,3	VR19	B,1
R141	B,1	R225	B,1	R414	B,3	R461	C,3	TP5	B,3	VR31	B,2
R142	A,2	R226	B,1	R415	B,3	R466	D,2	TP6	A,1	VR201	A,1
R201	A,1	R227	A,1	R416	B,3	R467	D,2	TP7	A,3	VR206	B,1
R202	A,1	R228	A,2	R417	B,3	R468	C,3	TP8	B,2	VR208	A,1
R203	A,1	R229	A,2	R418	B,3	R469	C,3	TP402	C,3	VR401	B,3
R204	A,1	R230	A,2	R419	B,3	R470	C,2	TP403	C,2	VR402	C,3
R205	A,1	R231	A,3	R420	C,3	R471	C,3	U2	B,1		

NOTES:

1

THE VOLTAGES SHOWN AT THE OUTPUTS OF A3 (OR A10) K2, K4, AND K6 ARE WITH THE RELAY CONTACTS CLOSED; THE OUTPUT OF THE FLOATING AMPLIFIER DRIVER AND ON/OFF SWITCH WITH K401 OPEN.

2

INITIAL INSTRUMENT SETTINGS

VOLTAGES ON THIS SCHEMATIC UNLESS OTHERWISE NOTED, SHOULD BE MEASURED AFTER KEYING IN:;

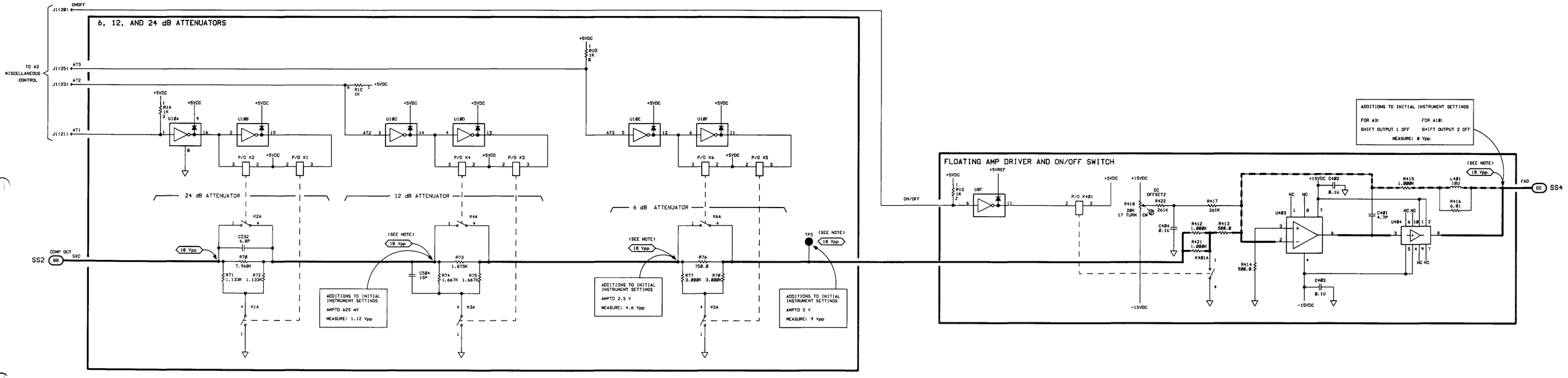
FOR A3:	FOR A10:
SHIFT PRESET	SHIFT PRESET
SHIFT FLOAT 1 OFF	SHIFT FLOAT 2 OFF
f1 (CHANNEL CONFIG.)	f1 (CHANNEL CONFIG.)
NEXT	NEXT NEXT
AMPTD 10 V	AMPTD 10 V

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CHANGES

All serial prefixes	**On the A3 schematic:** • **R417, R422** - Under FLOATING DRIVER AND ON/OFF SWITCH change the value of R417 and R422 to 75K ohms.

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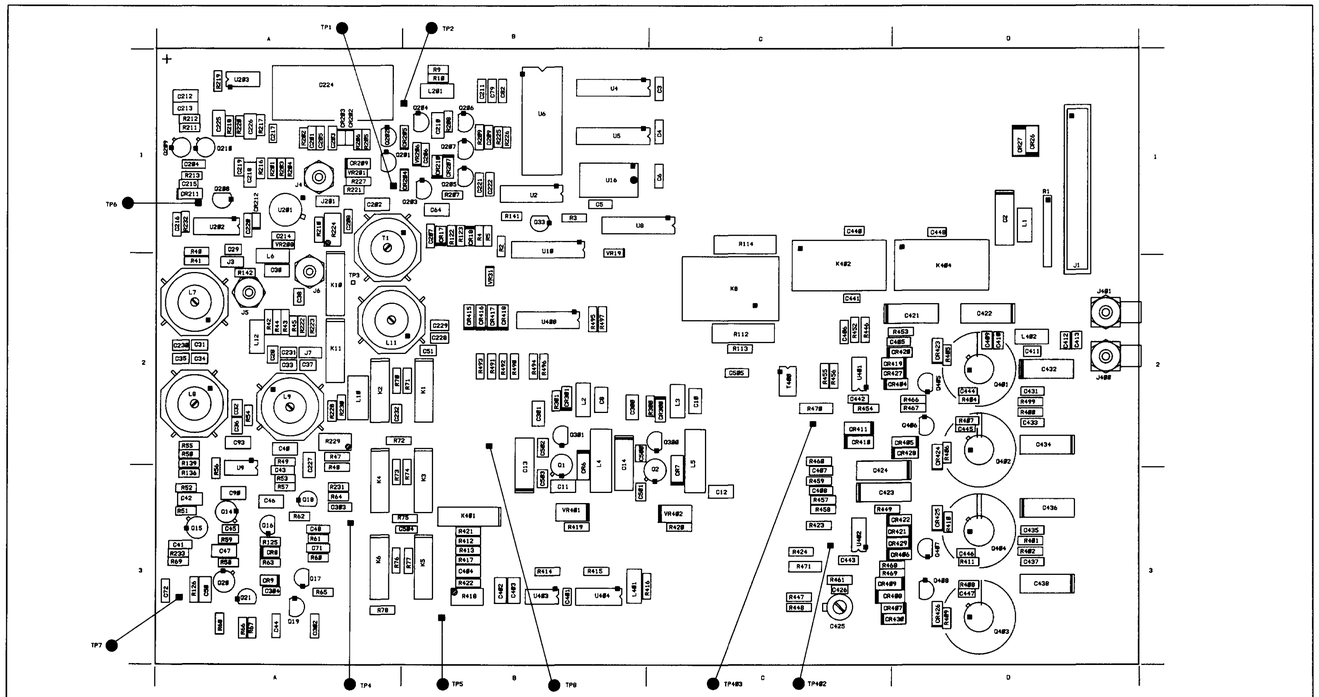


Figure 8-16. Service Sheet Information

Component Locator

A3 Component Coordinates (1 of 2)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
C2	D,1	C206	B,1	C423	C,3	CR300	C,2	K11	A,2	Q402	D,2
C3	C,1	C207	B,1	C424	C,3	CR301	B,2	K401	B,3	Q403	D,3
C4	C,1	C208	A,1	C425	C,3	CR404	D,2	K402	C,2	Q404	D,3
C5	B,1	C209	B,1	C426	C,3	CR405	D,2	K404	D,2	Q405	D,2
C6	C,1	C210	B,1	C431	D,2	CR406	D,3			Q406	D,2
C8	B,2	C211	B,1	C432	D,2	CR407	C,3	L1	D,1	Q407	D,3
C10	C,2	C212	A,1	C433	D,2	CR408	C,3	L2	B,2	Q408	D,3
C11	B,3	C213	A,1	C434	D,2	CR409	C,3	L3	C,2		
C12	C,3	C214	A,1	C435	D,3	CR410	C,2	L4	B,3	R1	D,1
C13	B,3	C215	A,1	C436	D,3	CR411	C,2	L5	C,3	R2	B,1
C14	B,3	C216	A,1	C437	D,3	CR415	B,2	L6	A,2	R3	B,1
C28	A,2	C217	A,1	C438	D,3	CR416	B,2	L7	A,2	R4	B,1
C29	A,1	C218	A,1	C440	C,1	CR417	B,2	L8	A,2	R5	B,1
C30	A,2	C219	A,1	C441	C,2	CR418	B,2	L9	A,2	R9	B,1
C31	A,2	C220	A,1	C442	C,2	CR419	C,2	L10	A,2	R10	B,1
C32	A,2	C221	B,1	C443	C,3	CR420	D,2	L11	A,2	R40	A,1
C33	A,2	C222	B,1	C444	D,2	CR421	C,3	L12	A,2	R41	A,2
C34	A,2	C224	A,1	C445	D,2	CR422	D,3	L201	B,1	R42	A,2
C35	A,2	C225	A,1	C446	D,3	CR423	D,2	L401	B,3	R43	A,2
C36	A,2	C226	A,1	C447	D,3	CR424	D,2	L402	D,2	R44	A,2
C37	A,2	C227	A,2	C448	D,1	CR425	D,3			R45	A,2
C38	A,2	C228	B,2	C500	C,2	CR426	D,3	Q1	B,3	R47	A,2
C40	A,2	C229	B,2	C501	B,3	CR427	C,2	Q2	B,3	R48	A,3
C41	A,3	C230	A,2	C502	B,2	CR428	D,2	Q14	A,3	R49	A,3
C42	A,3	C232	B,2	C503	B,3	CR429	C,3	Q15	A,3	R50	A,2
C43	A,3	C300	B,2	C504	B,3	CR430	D,3	Q16	A,3	R51	A,3
C44	A,3	C301	B,2	C505	C,2			Q17	A,3	R52	A,3
C45	A,3	C302	A,3			J1	D,2	Q18	A,3	R53	A,3
C46	A,3	C303	A,3	CR6	B,3	J3	A,2	Q19	A,3	R54	A,2
C47	A,3	C304	A,3	CR7	C,3	J4	A,1	Q20	A,3	R55	A,2
C48	A,3	C401	B,3	CR8	A,3	J5	A,2	Q21	A,3	R56	A,3
C50	A,3	C402	B,3	CR9	A,3	J6	A,2	Q33	B,1	R57	A,3
C51	B,2	C403	B,3	CR17	B,1	J7	A,2	Q201	A,1	R58	A,3
C64	B,1	C404	B,3	CR18	B,1	J201	A,1	Q202	A,1	R59	A,3
C71	A,3	C405	D,2	CR26	D,1	J400	D,2	Q203	B,1	R60	A,3
C72	A,3	C406	C,2	CR27	D,1	J401	D,2	Q204	B,1	R61	A,3
C79	B,1	C407	C,3	CR202	A,1			Q205	B,1	R62	A,3
C82	B,1	C408	C,3	CR203	A,1	K1	B,2	Q206	B,1	R63	A,3
C90	A,3	C409	D,2	CR204	A,1	K2	A,2	Q207	B,1	R64	A,3
C93	A,2	C410	D,2	CR205	A,1	K3	B,3	Q208	A,1	R65	A,3
C201	A,1	C411	D,2	CR207	B,1	K4	A,3	Q209	A,1	R66	A,3
C202	A,1	C412	D,2	CR209	A,1	K5	B,3	Q210	A,1	R67	A,3
C203	A,1	C413	D,2	CR210	B,1	K6	A,3	Q300	C,2	R68	A,3
C204	A,1	C421	D,2	CR211	A,1	K8	C,2	Q301	B,2	R69	A,3
C205	A,1	C422	D,2	CR212	A,1	K10	A,2	Q401	D,2	R70	A,2

A3 Component Coordinates (2 of 2)

COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y	COMP	X,Y
R71	B,2	R206	A,1	R232	A,1	R421	B,3	R490	B,2	U4	B,1
R72	A,2	R207	B,1	R233	A,3	R422	B,3	R491	B,2	U5	B,1
R73	A,3	R208	B,1	R300	B,2	R423	C,3	R492	B,2	U6	B,1
R74	B,3	R209	B,1	R301	B,2	R424	C,3	R493	B,2	U8	B,1
R75	B,3	R210	A,1	R400	D,2	R446	C,2	R494	B,2	U9	A,3
R76	A,3	R211	A,1	R401	D,3	R447	C,3	R495	B,2	U10	B,1
R77	B,3	R212	A,1	R402	D,3	R448	C,3	R496	B,2	U16	B,1
R78	A,3	R213	A,1	R404	D,2	R449	C,3	R497	B,2	U201	A,1
R112	C,2	R216	A,1	R405	D,2	R452	C,2	R499	D,2	U202	A,1
R113	C,2	R217	A,1	R406	D,2	R453	D,2			U203	A,1
R114	C,1	R218	A,1	R407	D,2	R454	C,2	T1	A,1	U401	C,2
R122	B,1	R219	A,1	R408	D,3	R455	C,2	T400	C,2	U402	C,3
R123	B,1	R220	A,1	R409	D,3	R456	C,2			U403	B,3
R125	A,3	R221	A,1	R410	D,3	R457	C,3	TP1	A,1	U404	B,3
R126	A,3	R222	A,2	R411	D,3	R458	C,3	TP2	B,1	U408	B,2
R136	A,3	R223	A,2	R412	B,3	R459	C,3	TP3	A,2		
R139	A,3	R224	A,1	R413	B,3	R460	C,3	TP4	A,3	VR19	B,1
R141	B,1	R225	B,1	R414	B,3	R461	C,3	TP5	B,3	VR31	B,2
R142	A,2	R226	B,1	R415	B,3	R466	D,2	TP6	A,1	VR201	A,1
R201	A,1	R227	A,1	R416	B,3	R467	D,2	TP7	A,3	VR206	B,1
R202	A,1	R228	A,2	R417	B,3	R468	C,3	TP8	B,2	VR208	A,1
R203	A,1	R229	A,2	R418	B,3	R469	C,3	TP402	C,3	VR401	B,3
R204	A,1	R230	A,2	R419	B,3	R470	C,2	TP403	C,2	VR402	C,3
R205	A,1	R231	A,3	R420	C,3	R471	C,3	U2	B,1		

NOTES:

1

OUTPUTS	1		8 (OPT 002)	
	HIGH	LOW	HIGH	LOW
FRONT PANEL	W6	W7	W8	W9
REAR PANEL (OPT 004)	W2	W3	W4	W5

2

THE VOLTAGE SHOWN AT THE FRONT OR REAR-PANEL OUTPUTS ARE WITH A3 (OR A10) K402 CONTACTS CLOSED

3

INITIAL INSTRUMENT SETTINGS

VOLTAGES ON THIS SCHEMATIC UNLESS OTHERWISE NOTED, SHOULD BE MEASURED AFTER KEYING IN:;

FOR A3:	FOR A10:
SHIFT PRESET	SHIFT PRESET
SHIFT FLOAT 1 OFF	SHIFT FLOAT 2 OFF
f1 (CHANNEL CONFIG.)	f1 (CHANNEL CONFIG.)
NEXT	NEXT NEXT
AMPTD 10 V	AMPTD 10 V

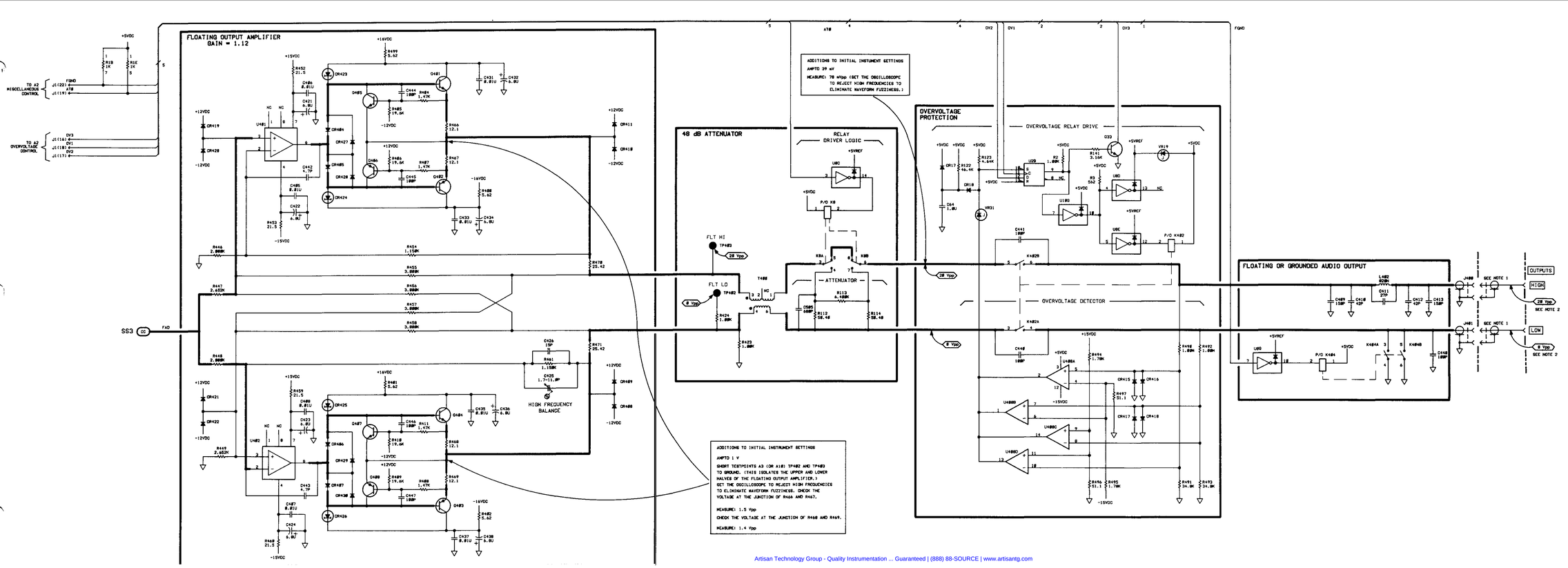
P/O A3/A10 OUTPUT ASSEMBLY SS3
SEE REVERSE SIDE

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CHANGES

2948A and above	**On the A3/A10 schematic:** • **W1, J8** - In the FLOATING OR GROUNDED AUDIO OUTPUT circuit block, open the LOW signal line (about a 0.5 inch gap) just after it passes over the +5VREF. Draw a jumper wire acrosse the opening and label it W1. Label the left end of the jumper, J8(2) and the right end of the jumper, J8(1). Draw node dot about 0.125 inch below J8(1) and label it, J8(3). Connect a common ground symbol to J8(3). Write the following note directly under the circuit block. "Jumper, J8, connects pins 1 and 2 for all instruments except when equipped with option 006. Connect J8 pins 2 and 3 for option 006 equipped instruments.

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CHANGES

2948A and above	**A6 Schematic and Component locator** • Use the component locator on page 8–60 for the A6 High Power output assembly component locations. • Use SS5 (Opt 006) on page 8–61 for the A6 High Power Oustput assembly schematic information.

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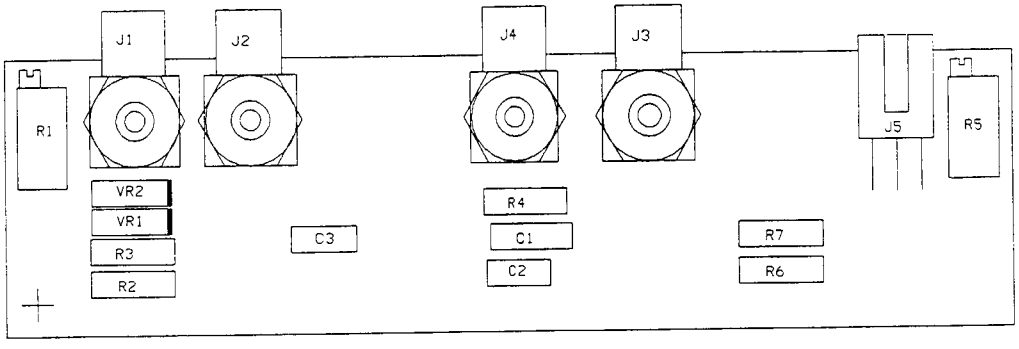
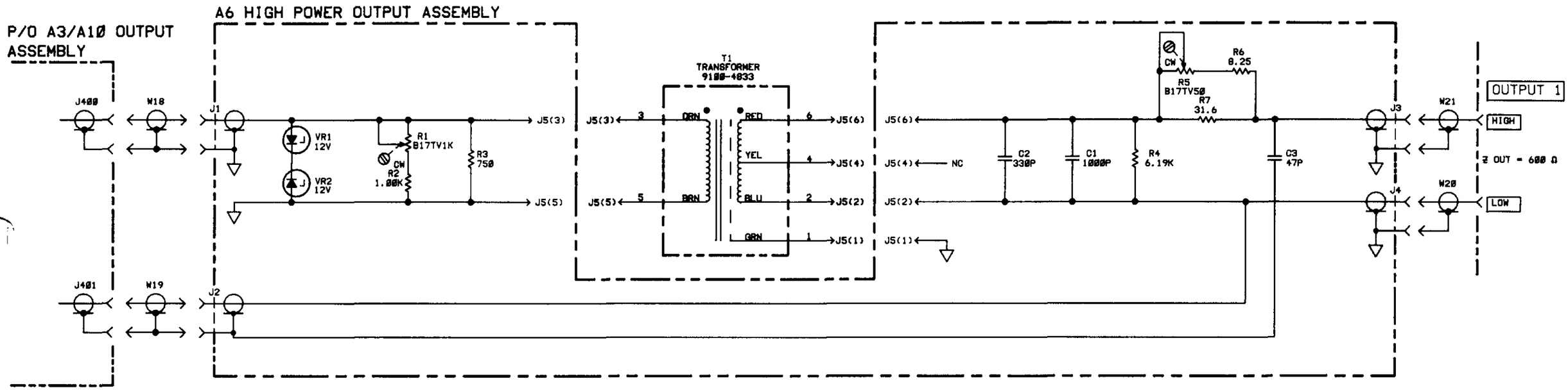


Figure 8–17. *Component Locator For S55*

SS5

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SS5
A6 HIGH POWER OUTPUT ASSEMBLY
(OPT 006)

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