Errata

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Manual Part Number: 08341-90048

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HP References in this Manual

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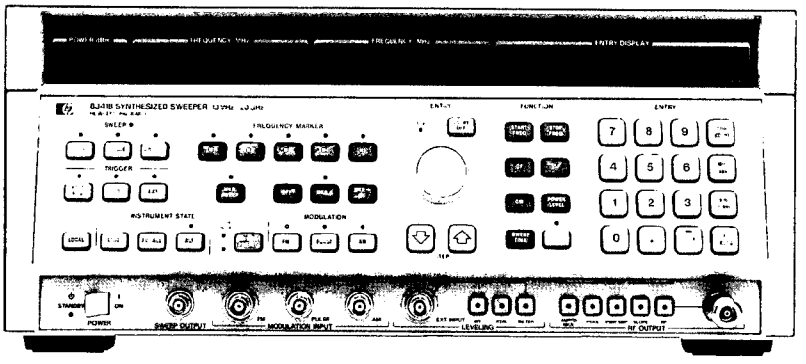
COMPONENT LEVEL SERVICE MANUAL

HP 8341B SYNTHESIZED SWEEPER

10 MHz to 20.0 GHz



HEWLETT PACKARD

HP 8341B
SYNTHESIZED SWEEPER
(Including Option 004)

Component Level Service Manual
Volume 2

SERIAL NUMBERS

This manual applies directly to the HP 8341B Synthesized Sweeper having a serial number prefix of 2650A.

This manual also applies to the following serial number prefixes with exceptions as noted.

2624A - exception, A26 Linear Modulator Assembly. Refer to Service Note 8341B-1.

2634A - exception, FM input jack configuration, static protection diodes not added.

2643A - exception, A26 Linear Modulator Assembly, part number only.

For additional information about serial numbers, refer to INSTRUMENTS COVERED BY THE MANUAL in Section I of the HP 8340B/41B Operating Manual.

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Microfiche Part Number 08341-90049

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HEWLETT PACKARD

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A20 RF Section Filter Circuit Description

ASSEMBLY PURPOSE

The A20 RF section filter provides:

- Filtered power supplies to the low band power amplifier
- Filtered power supplies to the high band power amplifier
- Low band power amplifier control switch

THE TWO PARTS OF THE FILTER

The A20 RF section filter consists of two major sections:

- The power amplifier supply filters
- The low band amplifier switch

The Power Amplifier Supply Filters

When operating at full power, the high band amplifier requires a substantial amount of current from the +5.2V and −10V power supplies. During pulsed operation, the input signal to the power amplifier is turned off and on at the input pulse rate, which causes large current surges in the supply lines. If the supply lines were unfiltered, the voltages would fluctuate at the input pulse rate. Voltage line fluctuations could affect the YO phase lock circuitry and the main YO coil driver circuitry, causing FM sidebands (at the pulse frequency) on the output carrier. The sidebands would not be noticeable in the (pulsed) RF output, but would be apparent (50 to 60 dBc) in the rear panel YO AUX output. To minimize voltage fluctuations, the +5.2V and the −10V supplies to the high band amplifier each have a two-stage LC filter, and the +20V supply to the low band amplifier is filtered through a single stage filter.

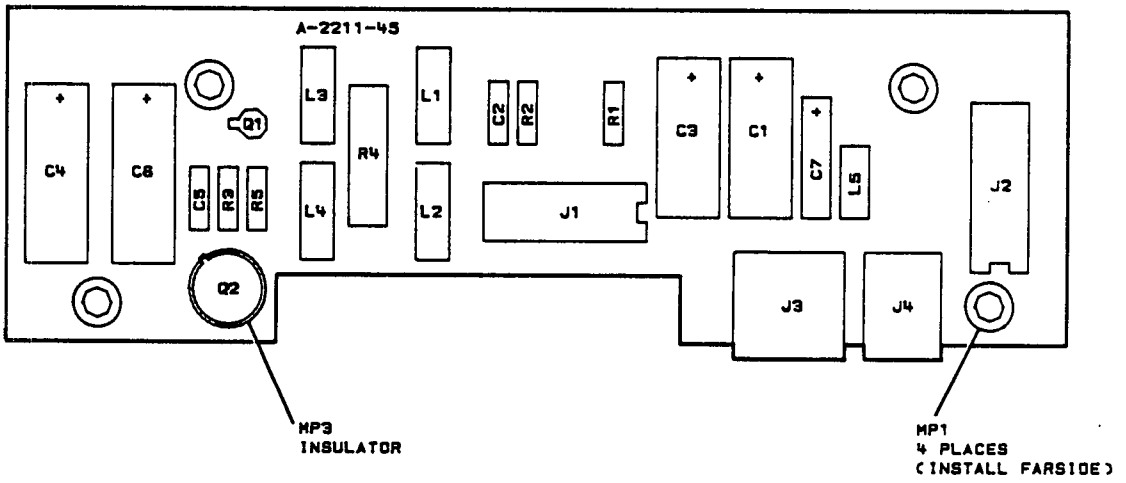
Low Band Amplifier Switch

To reduce any low band noise feedthrough at the RF output, the low band amplifier switch turns off the −10V supply to the low band amplifier when the instrument is not operating in low band. The switch is digitally controlled by the A27 level control assembly, through two common emitter control transistors.

Table A20-1. A62J19 to A20J1 Pin I/O

A62J19 Pin	Mnemonic	A62W31P2 Pin	A62W31P3 Pin	A16A1J1 Pin	A20J1 Pin	Levels
1	GND PLANE	1	1	1	1	0V
2	+20V	2	NOT USED	NOT USED	2	+20V
3	+5.2V	3	3	3	3	+5.2V
4	−5.2V	4	4	4	4	−5.2V
5	−10V	5	NOT USED	NOT USED	5	−10V
6	−40V/−40V SENSE (−)	6	NOT USED	NOT USED	6	−40V
7	LHET	7	NOT USED	NOT USED	7	TTL (LOW TRUE)
8	LHET	8	NOT USED	NOT USED	8	TTL (LOW TRUE)
9	GND PLANE	9	9	9	9	0V
10	+20V	10	NOT USED	NOT USED	10	+20V
11	+5.2V	11	11	11	11	+5.2V
12	−5.2V	12	12	12	12	−5.2V
13	−10V	13	NOT USED	NOT USED	13	−10V
14	−.25V/GHZ	NOT USED	NOT USED	NOT USED	NOT USED	
15	LHIBND	NOT USED	15	15	NOT USED	
16	HULH	16	NOT USED	NOT USED	16	TTL (HIGH TRUE)

Note: Refer to RF Section Schematic Diagram and A62 motherboard wiring list for signal source and destination information.



HP Part Number: 08340-60203

Figure A20-1. A20 RF Section Filter Component Location Diagram

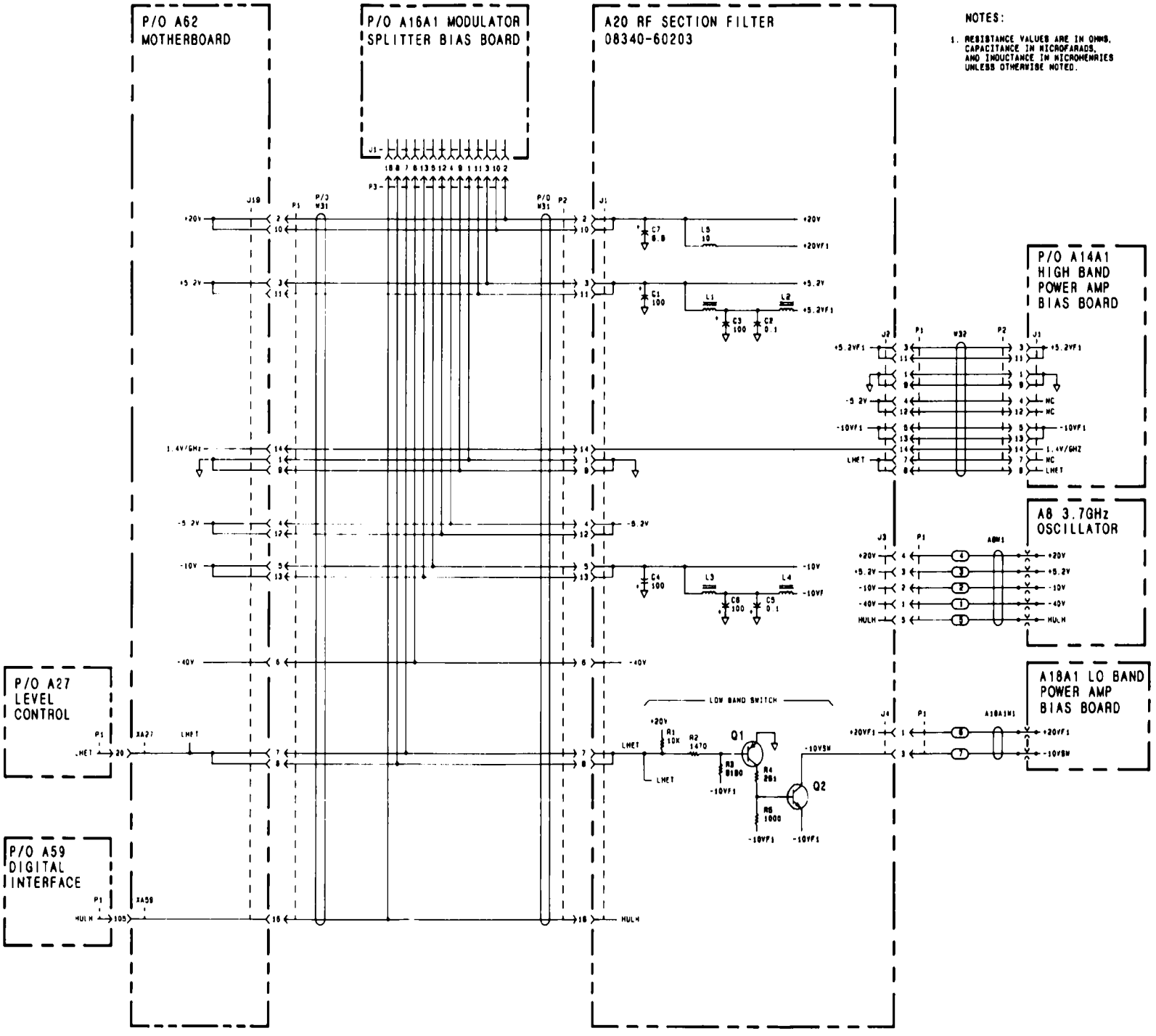


Figure A20-2. A20 RF Section Filter Schematic

Table A20-2. A20 RF Section Filter Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A20	**08340-60203**	**4**	**1**	**RF SECTION FILTER ASSEMBLY**	**28480**	**08340-60203**
A20C1	0180-2614	8	2	CAPACITOR-FXD 100UF ± 10% 30VDC TA	56289	150D107X9030S2
A20C2	0160-4835	7	2	CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A20C3	0180-2614	8		CAPACITOR-FXD 100UF ± 10% 30VDC TA	56289	150D107X9030S2
A20C4	0180-0094	4	2	CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A20C5	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A20C6	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A20C7	0180-0116	1	1	CAPACITOR-FXD 6.8UF ± 10% 35VDC TA	56289	150D685X9035B2
A20J1	1200-0482	9	2	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0482
A20J2	1200-0482	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0482
A20J3	1251-6794	5	1	CONNECTOR HEADER 5 M IR	28480	1251-6794
A20J4	1251-6795	6	1	CONNECTOR HEADER 3 M IR	28480	1251-6795
A20L1	08340-80001	2	4	COIL-TOROID	28480	08340-80001
A20L2	08340-80001	2		COIL-TOROID	28480	08340-80001
A20L3	08340-80001	2		COIL-TOROID	28480	08340-80001
A20L4	08340-80001	2		COIL-TOROID	28480	08340-80001
A20L5	9100-0539	3	1	INDUCTOR (MISC ITEM)	28480	9100-0539
A20MP1	0380-0773	0	4	SPACER-RVT-ON .5-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
A20Q1	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A20Q2	1854-0361	8	1	TRANSISTOR NPN 2N4239 SI TO-5 PD=6W	04713	2N4239
A20R1	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0 ± 100	24546	C4-1/8-T0-1002-F
A20R2	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0 ± 100	24546	C4-1/8-T0-1471-F
A20R3	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0 ± 100	19701	MF4C1/8-T0-6191-F
A20R4	0757-1090	5	1	RESISTOR 261 1% .5W F TC=0 ± 100	28480	0757-1090
A20R5	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0 ± 100	24546	C4-1/8-T0-1001-F

A21 Pulse Modulator Circuit Description

ASSEMBLY PURPOSE

The A21 pulse modulator assembly controls the synthesizer pulse modulation functions. The main control signal is the front panel BNC, PULSE MODULATION INPUT. The pulse modulator drives the PIN switch RF modulators in the A9 (low band) or A16 (high band) microcircuits.

Timing circuits send control signals to key elements of the ALC loop to coordinate the leveling function with the pulse modulation.

INPUT BUFFER AND CONTROL LOGIC (BLOCK A)

PULSE MODULATION (TTL compatible) is buffered as it enters this block. Two control lines gate the pulse input:

- HPLSEN (high pulse enable) gates the buffered pulses.
- HRFON (high RF on) overrides the pulse input, turning the RF off.

An eight-bit latch provides control lines and decoding signals for the rise time pulse driver and modulator driver circuitry. Control lines are also provided for the A25 ALC detector assembly.

Input Impedance

Input resistor R5 establishes the input impedance. If necessary, change the resistor value to 51.1Ω to provide a 50Ω impedance. If you do this, however, be aware that an open-circuit input is no longer pulled high. This means that if pulse modulation is activated with an open-circuit input, the RF turns off.

SLOW RISE TIME PULSE DRIVER (BLOCK B)

Fast rise time pulse modulation produces a broad spectrum of harmonics that can result in measurement errors. To minimize harmonics, a pulse modulation mode is available that provides pulses of approximately 2 μs rise and fall times.

When you activate the slow pulse mode (**[SHIFT] [PULSE]**), the input pulse is routed through block B to driver circuitry in the modulator driver (all pulses are routed to block C, but only slow pulse signals are routed through block B). The slow rise time driver amplifier, controls the driver circuitry. Wave shaping of the control signal provides a slow transition through the modulator turn-on region. To assure that the RF output has reached the proper level, the sample/hold timing is delayed until the pulse has risen.

Low and high band symmetry adjustments independently adjust the output for symmetrical RF pulse outputs.

MODULATOR DRIVER (BLOCK C)

The modulator driver provides the current and voltage bias for the RF pulse modulators. A differential current switch controls the bias for two transistor drivers. When the input (LPLSON) is high (RF off), the PIN diode modulator is biased on, turning the RF off. When the input is low, the PIN diode modulator is back-biased, turning the RF on.

Transistor driver output capacitors provide AC coupling for the transition current spikes from the modulators back to the A21 assembly.

Two FETs form an output multiplexer for low or high band modulator selection. Digital input signals (BAND0 and HIBAND) determine the modulator selection. Input control line LHET (block A) controls these digital lines.

INTEGRATOR TIMING (BLOCK D)

Block D controls the timing used to gate the ALC loop integrator input (A26). This ensures that the integrator responds to RF power level error signals only when the detected RF level is on and stable.

When the input (LOL) goes low (RF on), the output of the NAND gate is forced high. The low-pass filter following the NAND gate delays the transition by 1 µs. When the output goes high, the integrator is enabled. When the input goes high (RF off), the NAND gate output goes low to put the integrator circuits on hold.

When the input (LOL) goes low, it triggers timers that output low pulses to the output NAND gate. This determines the minimum time the output is high for each RF pulse. The pulse time period depends on the ALC loop bandwidth and is controlled by timing control signals from the control logic (block A). Internal leveling sample time is 1 or 10 µs, depending on the bandwidth. External leveling sample time is 0.2 µs.

ADC TIMING (BLOCK E)

The ADC timing lets the A27 assembly monitor the detected power level when either the RF is on, or up to 1.8 ms after the RF is turned off. This prevents the POWER dBm display from showing an invalid power level if the RF is turned off for over 1.8 ms (ALC sample/hold droop).

When the input is low (RF on), the output is forced high to enable the clock control circuitry on the A27 assembly. When the input goes high, the one-shot timer outputs a 1.8 ms low pulse, holding the clock control enabled. If the RF does not turn on again within 1.8 ms, the timer output goes high, forcing the output to disable the clock control.

SAMPLE/HOLD TIMING (BLOCK F)

Block F controls the timing of the sample/hold gate in detector circuits on the A25 assembly during pulse modulation. The key timing element is C19. The time delay constant is independent and adjustable for both RF on and RF off. The voltage on C19 is detected by a schmitt trigger whose square wave output is delayed by the pulse from the control logic section.

ON DELAY adjustments (for both system and internal leveling) adjust the discharge time, and OFF DELAY adjusts the charging time of C19.

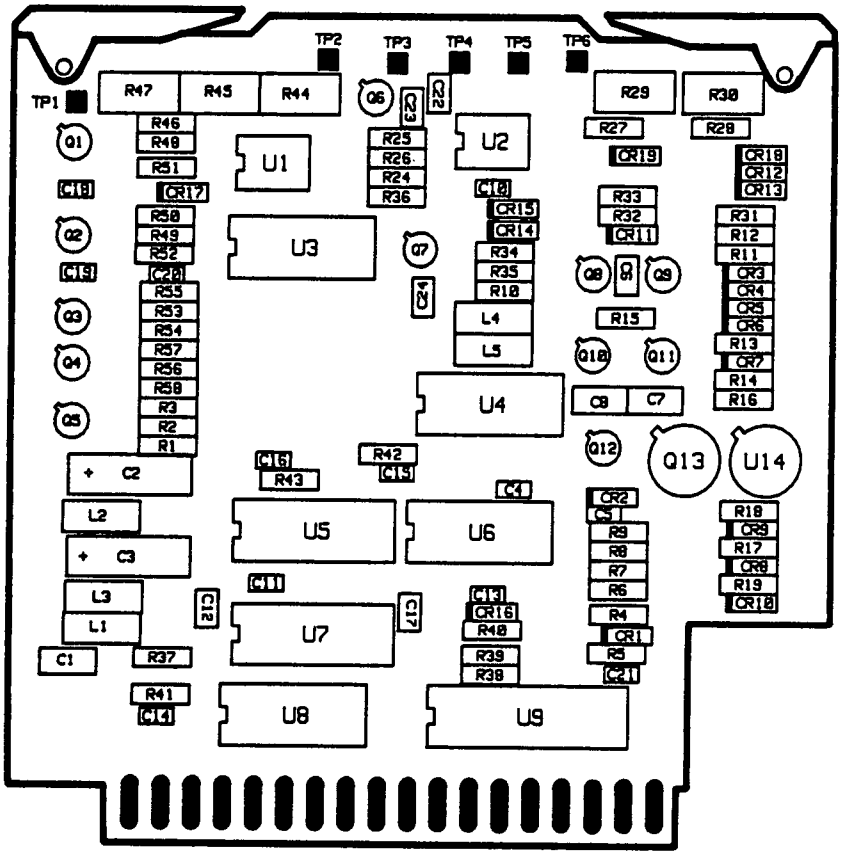
If C19 is not fully discharged before the timing input goes high, the rising edge briefly turns on a discharge transistor circuit to fully discharge C19. This ensures that the OFF DELAY is independent of the pulse width.

Table A21-1. A21 Pulse Modulator Driver P1 Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1 19	HADCEN	TTL (HIGH TRUE)	D	XA27P1-8
2 20	LMODHLD	TTL	E	XA26P1-1
3 21	DET S/H + DET S/H −	+4.5V/+3.5V +3.5V/+4.5V	F F	XA25P1-2 XA25P1-24
4 22 5 23	+20V +20V +5.2V +5.2V	+20V +20V +5.2V +5.2V	XA52P1-16, 40 XA52P1-16, 40 XA52P1-17, 18, 41, 42 XA52P1-17, 18, 41, 42	*G *G *G *G
6 24	HLBW	TTL (HIGH TRUE)	XA26P1-33	XA26P1-33
7 25	−10v −10V	−10v −10V	XA53p1-12, 13, 31, 32 XA53P1-12, 13, 31, 32	*G *G
8 26	GND GND	0V 0V	A62 STAR GND A62 STAR GND	*G *G
9 27	HPLSEN HRFON	TTL (HIGH TRUE) TTL (HIGH TRUE)	XA26P1-2 XA57P1-105	*A *A C
10 28				
11 29	LHET	TTL (LOW TRUE)	XA27P1-20	*C
12 30				
13 31				
14 32				
15 33				
16 34	LOPMOD DRV	CURRENT SOURCE	C	A62J10-SMC CENTER
17 35	PLS IN RTN PMOD RTN	0V PV	* B	*A *A
18 36	PLS IN HIPMOD DRV	TTL CURRENT TO PIN DIODE	A62J26-SMC CENTER C	A A62J25-SMC CENTER

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60265

Figure A21-1. A21 Pulse Modulator Component Location Diagram

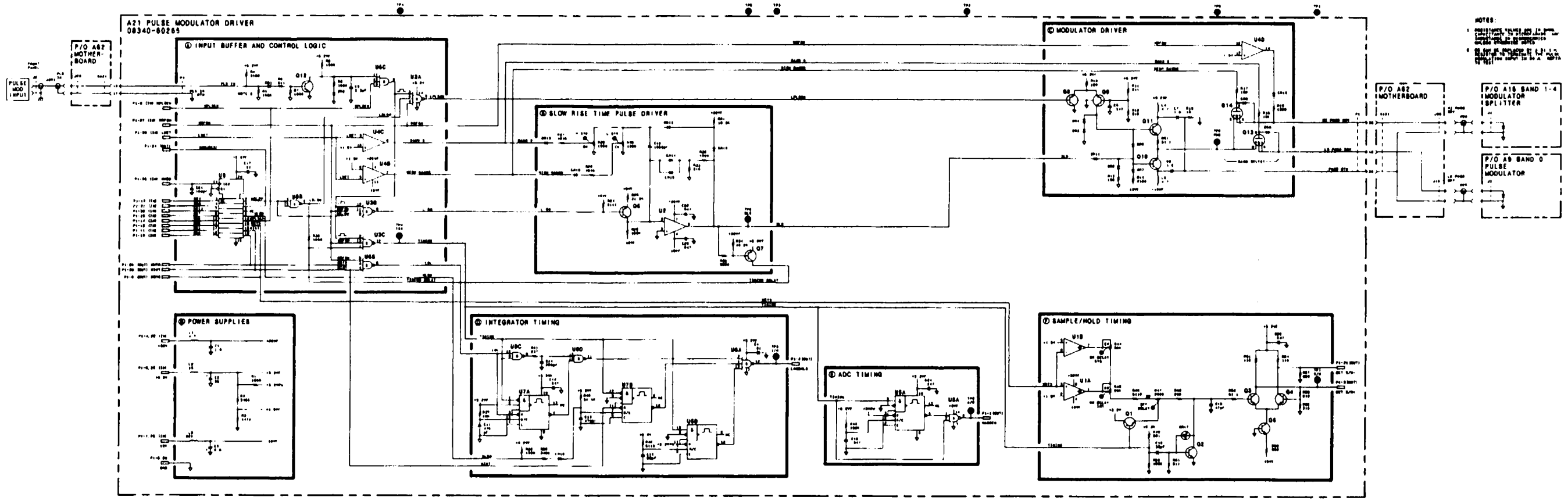


Figure A21 2 A21 Pulse Modulator Schematic

Table A21-2. A21 Pulse Modulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21	**08340-60265**	**8**	**1**	**PULSE MODULATOR DRIVER**	**28480**	**08340-60265**
A21C1	0160-4535	4	3	CAPACITOR-FXD 1UF ±5% 50VDC CER	28480	0160-4535
A21C2	0180-0229	7	1	CAPACITOR-FXD 33UF ±20% 10VDC TA	28480	0180-0229
A21C3	0180-0116	1	1	CAPACITOR-FXD 6.8UF ±20% 35VDC TA	28480	0180-0116
A21C4	0160-0575	4	9	CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21C5	0160-4797	0	1	CAPACITOR-FXD 3.3PF ±20% 100VDC CER	28480	0160-4797
A21C6	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21C7	0160-4535	4		CAPACITOR-FXD 1UF ±5% 50VDC CER	28480	0160-4535
A21C8	0160-4535	4		CAPACITOR-FXD 1UF ±5% 50VDC CER	28480	0160-4535
A21C9				NOT ASSIGNED		
A21C10	0160-4822	2	1	CAPACITOR-FXD 1000PF ±5% 100VDC CER	28480	0160-4822
A21C11	0160-4808	4	2	CAPACITOR-FXD 470PF ±5% 100VDC CER	28480	0160-4808
A21C12	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21C13	0160-4808	4		CAPACITOR-FXD 470PF ±5% 100VDC CER	28480	0160-4808
A21C14	0160-4812	0	1	CAPACITOR-FXD 220PF ±5% 100VDC CER	28480	0160-4812
A21C15	0160-4803	9	1	CAPACITOR-FXD 68PF ±5% 100VDC CER	28480	0160-4803
A21C16	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21C17	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21C18	0160-4807	3	1	CAPACITOR-FXD 33PF 5% 100V CER	28480	0160-4807
A21C19	0160-4805	1	1	CAPACITOR-FXD 47PF 5% 100V CER	28480	0160-4805
A21C20	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21C21	0160-4801	7	1	CAPACITOR-FXD .047UF 20% 50V CER	28480	0160-4801
A21C22	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21C23	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21C24	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A21CR1	1901-0050	3	9	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR13	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR14	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR15	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR16	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR17	1901-0539	3	1	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A21CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21CR19	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A21L1	9100-3562	8	3	COIL-4.7 UH 5%	28480	9100-3562
A21L2	9100-3912	2	1	INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A21L3	9140-0129	1	1	INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A21L4	9140-3562	8		COIL-4.7 UH 5%	28480	9100-3562
A21L5	9100-3562	8		COIL-4.7 UH 5%	28480	9100-3562
A21MP1	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A21MP2	4040-0749	4	1	EXTR-PC BD BRN POLYC .062-BD-THKNS	28480	4040-0749
A21MP3, 4	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A21Q1	1854-0809	9	7	TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A21Q2	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A21Q3	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A21Q4	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A21Q5	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A21Q6	1853-0405	9	3	TRANSISTOR PNP 2N4209A SI TO-18 PD=360MW	28480	1854-0405
A21Q7	1853-0405	9		TRANSISTOR PNP 2N4209A SI TO-18 PD=360MW	28480	1854-0405
A21Q8	1853-0018	0	2	TRANSISTOR PNP SI 2N4260	28480	1853-0018
A21Q9	1853-0018	0		TRANSISTOR PNP SI 2N4260	28480	1853-0018
A21Q10	1853-0405	9		TRANSISTOR PNP 2N4209A SI TO-18 PD=360MW	28480	1854-0405
A21Q11	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A21Q12	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A21Q13	1855-0251	7	2	TRANSISTOR NPN 2N6659	28480	1855-0251
A21Q14	1855-0251	7		TRANSISTOR NPN 2N6659	28480	1855-0251
A21R1	0757-0280	3	6	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A21R2	0698-3152	8	2	RESISTOR 3.48K 1% .125W F TC=0±100	24546	C4-1/8-T0-3481-F
A21R3	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A21R4	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A21R5	0757-0465	6	3	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F

Table A21-2. A21 Pulse Modulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21R6	0575-0416	7	3	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A21R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A21R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A21R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A21R10	0698-3440	7	2	RESISTOR 196 1% .125W F TC=0±100	24546	C4-1/8-T0-196R-F
A21R11	0575-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A21R12	0698-3444	4	3	RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A21R13	0698-3440	7		RESISTOR 196 1% .125W F TC=0±100	24546	C4-1/8-T0-196R-F
A21R14	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0±100	24546	C4-1/8-T0-2151-F
A21R15	0757-0394	0	2	RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A21R16	0757-0346	2	1	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A21R17	0757-0442	9	3	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A21R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A21R19	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-T0-1961-F
A21R20				NOT ASSIGNED		
A21R21				NOT ASSIGNED		
A21R22				NOT ASSIGNED		
A21R23				NOT ASSIGNED		
A21R24	0757-0438	3	3	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A21R25	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-2152-F
A21R26	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A21R27	0698-3155	5	2	RESISTOR 4.64K 1% .125W F TC=0±100	24546	C4-1/8-T0-4641-F
A21R28	0698-3155	5		RESISTOR 4.64K 1% .125W F TC=0±100	24546	C4-1/8-T0-4641-F
A21R29	2100-3352	7	2	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A21R30	2100-3352	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A21R31	0757-0447	4	2	RESISTOR 11.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-1622-F
A21R32	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A21R33	0698-3444	4		RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A21R34	0757-0447	4		RESISTOR 11.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-1622-F
A21R35	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0±100	14546	C4-1/8-TO-5621-F
A21R36	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A21R37	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A21R38	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8-T0-1331-F
A21R39	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0±100	24546	C4-1/8-T0-3481-F
A21R40	0757-0458	8	1	RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A21R41	0698-3442	7	1	RESISTOR 237 1% .125W F TC=0±100	24546	C4-1/8-T0-237R-F
A21R42	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A21R43	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A21R44	2100-3354	9	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
A21R45	2100-3353	8	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A21R46	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A21R47	2100-3273	1	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A21R48	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0±100	24546	C4-1/8-T0-215R-F
A21R49	0757-0419	0	1	RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A21R50	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-T0-1961-F
A21R51	0575-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A21R52	0757-0394	0		RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A21R53	0757-0402	1	2	RESISTOR 110 1% .125W F TC=0±100	24546	C4-1/8-T0-110R-F
A21R54	0757-0402	1		RESISTOR 110 1% .125W F TC=0±100	24546	C4-1/8-T0-110R-F
A21R55	0757-0418	9	1	RESISTOR 619 1% .125W F TC=0±100	24546	C4-1/8-T0-619R-F
A21R56	0698-3444	4		RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A21R57	0757-0422	5	2	RESISTOR 909 1% .125W F TC=0±100	24546	C4-1/8-T0-909R-F
A21R58	0757-0422	5		RESISTOR 909 1% .125W F TC=0±100	24546	C4-1/8-T0-909R-F
A21TP1	0360-0535	0	6	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A21U1	1826-1229	0	1	IC V RGLTR-FXD-POS 4.8/5.2V TO-202 PKG	27014	LM78M05CP
A21U2	1826-1049	2	1	IC OP AMP PRCN 8-DIP-C PKG	28480	1826-1049
A21U3	1820-2775	1	2	IC GATE TTL ALS NAND TPL 3-INP	01295	SN71546N
A21U4	1826-0161	7	1	IC OP AMP GP QUD 14-DIP-P PKG	04713	MLM324P
A21U5	1820-1423	4	2	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A21U6	1820-2775	1		IC GATE TTL ALS NAND TPL 3-INP	01295	SN71546N
A21U7	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A21U8	1820-2656	7	1	IC GATE TTL ALS NAND QUAD 2-INP	01295	SN71338N
A21U9	1820-1858	9	1	IC FF TTL LS D-TYPE OCTL	01295	SN58490N

A24 Attenuator Driver/Step Recovery Diode (SRD) Bias Circuit Description

ASSEMBLY PURPOSE

The A24 assembly has three functions that relate to the SYTM assembly:

- Step Recovery Diode (SRD) Bias

  The SYTM conversion efficiency in the higher multiplication bands is related to the DC bias voltage on the step recovery diode. To maintain optimum SRD bias, the bias voltage is generated as a function of both frequency and power level. The bias variation due to frequency is derived from a voltage proportional to the YO frequency on the A28 SYTM driver assembly. Power level corrections are referenced to a modulator voltage on the A26 linear modulator assembly.

- Pin Switch Control

  In low band, the RF input passes unattenuated through the SYTM. In the high bands, the low band RF input is grounded to prevent any low band feedthrough. The low band RF input is grounded through a PIN diode switch in the SYTM; the diode bias control is on the A24 assembly.

- SYTM Temperature Control

  Because the SYTM passband varies directly with temperature variations, the SYTM requires temperature control. SYTM temperature is held constant by a thermistor located inside the SYTM, and heater drive circuitry located on the A24 assembly.

FREQUENCY RAMP GENERATOR (BLOCK A)

The frequency ramp generator provides two frequency-tracking ramp voltages for the frequency-dependent element of the SRD bias circuits.

The A28 SYTM driver assembly generates a 1.4 V/GHz signal as an input to the frequency ramp generator. This ramp is inverted and amplified with an offset to produce a descending ramp. The ramp is inverted and offset again to produce an ascending ramp.

MODULATOR VOLTAGE CLAMP (BLOCK B)

The two ramps generated in the frequency ramp generator are attenuated through variable resistors, and summed to form a new ramp, a voltage dependent on frequency and RF power level.

Optimum SRD bias depends heavily on the RF power level to the SYTM (switched YIG-tuned multiplier). SRD BIAS CONT from the A26 linear modulator assembly supplies a power level voltage for the SRD bias adjustments. If the ALC (automatic leveling control) loop goes unleveled, the SRD BIAS CONT line moves abruptly positive, and no longer represents the RF power level. The ramp offsets are adjusted so that when SRD BIAS CONT jumps positive, the base-emitter junctions of the output transistors in block D are reverse-biased, breaking the connection between SRD BIAS CONT and the SRD bias output signal.

BAND DECODER (BLOCK C)

The band decoder provides control signals based on the frequency band in use. HLB0, HLB1, and HLB2, encoded with the current frequency band, are decoded by the 3-to-8 decoder into five distinct control lines:

- Three control lines to comparators for SRD bias on/off FET control.
- Two control lines for the SRD bias amplifier for proper bias level selection.

The Proper Bias for the Current Frequency Band

The comparator outputs for the SRD bias amplifier select:

- Reverse-bias in band 0.
- Forward-bias in band 1.
- The frequency and power-dependent bias in bands 2 and above.

SRD BIAS ADJUSTMENTS (BLOCK D)

In band 1 and above, adjustments provide the frequency and power-dependent bias controls for the SRD bias amplifier.

Three identical circuits, each with three adjustments, produce a synthesized control signal. Only one circuit is selected at a time, through the output on/off FETs, by the band decoding circuitry, depending on the band in use. In each section, two adjustments sum the frequency ramp generator outputs, which are proportional to frequency. The third adjustment subtracts current proportional to the RF power level from the modulator voltage clamp.

EXPONENTIAL GENERATOR (BLOCK E)

The exponential generator shapes the current generated by the SRD bias adjustments circuitry to produce an exponentially shaped voltage output.

SRD BIAS AMPLIFIER (BLOCK F)

The SRD bias amplifier converts the exponential output to a voltage that is fed to the SRD in the SYTM. The MIN adjustment determines the minimum bias voltage (approximately −0.5V) for very low power levels. The band decoding inputs control frequency band bias levels.

In band 0, the L0 line is pulled low, forcing the voltage at the output to approximately +7V, attenuating the high band output.

In band 1, the L1 line is pulled low, forward biasing the SRD, allowing the fundamental frequency to pass through the SYTM, and minimizing harmonics.

In bands 2 and above, the frequency and power level dependent inputs from exponential bias shaping are used to bias the SRD.

PIN DIODE BIAS (BLOCK G)

When low band is selected, the SYTM PIN diode is reverse-biased, allowing the low band signal to pass through the coupling loop to the SYTM output. When you select high bands, the SYTM PIN diode is turned on, grounding one side of the coupling loop attenuating the low band RF signal and preventing low band feedthrough.

READ STATUS OUTPUT BUFFER (BLOCK H)

Two status lines in the RF section can communicate information to the instrument microprocessor. The output buffer is a six-bit tri-state device.

ATTENUATOR CONTROL LATCH (BLOCK I)

Control latch data-bits 10 through 13 are latched from the instrument data bus on the rising edge of the WLEVEL strobe (10,R1:). Each latched data bit controls one of four attenuator sections. The non-inverting output of U15 activates the driver that removes the attenuator card and inserts the through card for that section. The inverting output of U15 activates the driver that removes the through card and inserts the attenuator card for that section.

ATTENUATOR COIL DRIVERS (BLOCK J)

Attenuator Cards and Through Cards

The A63 attenuator contains four attenuator cards (10, 20, 30, and 30 dB), and four through cards. In each section, latching solenoids switch-in an attenuator card or a through card, depending on the total attenuation required.

Solenoid Coil and Number of Solenoids

Once the actuator reaches full travel, the solenoid coil opens contacts internal to the attenuator. Each coil draws 300 ma for approximately 8 ms, until the internal contacts open the coil circuit. Because each attenuator card requires two solenoids, there are a total of eight separate coils that must be driven at various times, depending on the section switched and whether a through card or an attenuator card is inserted.

Coil Drivers and their Protection

The coil drivers, positive-AND drivers, drive the 5V coils of the attenuator. The diode array provides the coil drivers protection from inductive kick-back from the coils.

Filtered Power Source

Because of the large peak current required by the attenuator and drivers, a separately filtered power source is used to prevent current transients from disturbing other functions on this assembly.

SWITCHED YIG-TUNED MULTIPLIER (SYTM) HEATER CONTROL (BLOCK K)

A heater (resistor) and a thermistor inside the A13 SYTM assembly provide control functions to maintain a constant temperature. The thermistor provides a voltage that changes as the temperature changes. This voltage (SYTMTHRM) goes to the A24 assembly SYTM heater control where it is compared to a reference voltage and amplified.

As the temperature inside the A13 SYTM rises, the thermistor resistance decreases, causing the SYTMTHRM voltage to increase. When the SYTMTHRM voltage increases, the output voltage of the non-inverting op-amp increases, decreasing the current provided to the A13 SYTM heater, consequently decreasing the temperature.

When the temperature inside the SYTM decreases, the opposite happens, increasing the temperature. This maintains the SYTM temperature at approximately 85°C.

POWER SUPPLY (BLOCK L)

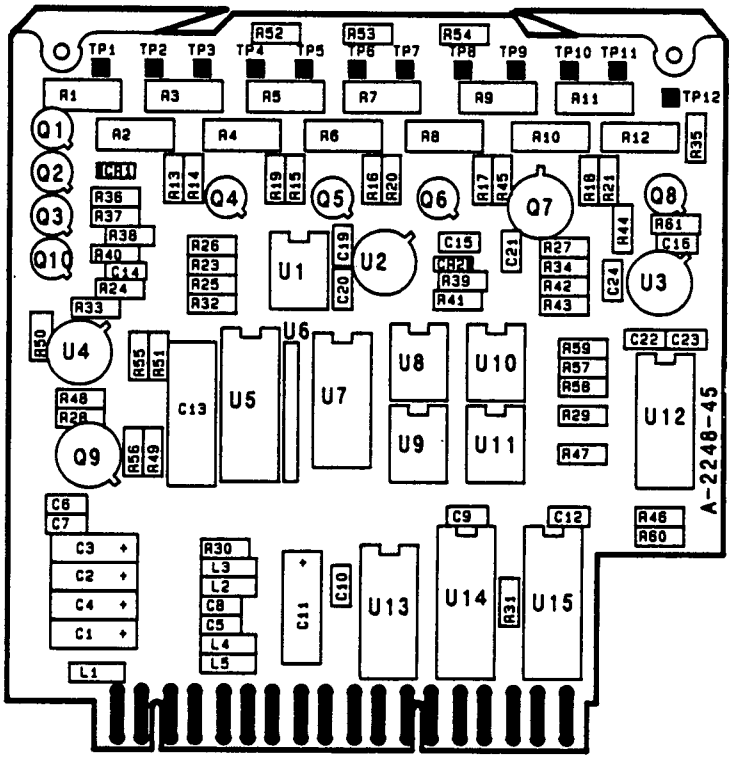
An LC filter circuit on each power supply line reduces any transients due to the attenuator coils or digital signals.

Table A24-1. A24 Attenuator Driver/SRD Bias P1 Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1 19	+20V SYTMHTR	+20V 0 TO +20V	XA52O1-16, 40 K	*L A62J18 PIN 8
2 20	SYTMTHRM HLB0	APPROX. −5V TTL (HIGH TRUE)	A62J18-9 XA27P1-46	K *C
3 21	+5.2V HLB1	+5.2V TTL (HIGH TRUE)	XA52P1-17, 18, 41, 42 XA27P1-16	*L *C
4 22	STAT10 HLB2	TTL (LOW TRUE) TTL (HIGH TRUE)	XA23P1-22 XA27P1-47	H *C
5 23	−10V RSTAT	−10V TTL (LOW TRUE)	XA53P1-12, 13, 31, 32 XA27P1-45	*L *H
6 24	1.4V/GHZ PIN BIAS	1.4V/GHZ −4V TO +12V	XA28P1-7 G	*A A62J18 PIN 10
7 25	ATN COIL + SRD BIAS	+5V −10V THRU 2K TO +5V	L F	A62J20 PIN 6 A62J18 PIN 2
8 26	GND GND PLANE	0V 0V	A62 STAR GND INSTRUMENT GND	*L *L
9 27	ATNTH4 ATNAT4	OPEN COLLECTOR OPEN COLLECTOR	J J	A62J20 PIN 4 A62J20 PIN 20
10 28	ATNTH3 ATNAT3	OPEN COLLECTOR OPEN COLLECTOR	J J	A62J20 PIN 11 A62J20 PIN 5
11 29	ATNTH2 ATNAT2	OPEN COLLECTOR OPEN COLLECTOR	J J	A62J20 PIN 3 A62J20 PIN 9
12 30	ATNTH1 ATNAT1	OPEN COLLECTOR OPEN COLLECTOR	J J	A62J20 PIN 13 A62J20 PIN 2
13 31	SRD BIAS CONT HENDKICK	0 TO −5V (LEVELED) TTL (HIGH TRUE)	XA26P1-18 XA28P1-18	B H
14 32	DB9 DB11	TTL TTL	*H *H	* *I
15 33	DB10 WLEVEL	TTL TTL (LOW TRUE)	*H XA27P1-12	*I I
16 34	DB12 DB13	TTL TTL	*H *H	*I *I
17 35	SYTM GND	0V	A62J18-13, 14, 15	*L
18 36	RGND	0V	STAR GND POINT	*L

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60158

Figure A24-1. A24 Attenuator Driver/SRD Bias Component Location Diagram

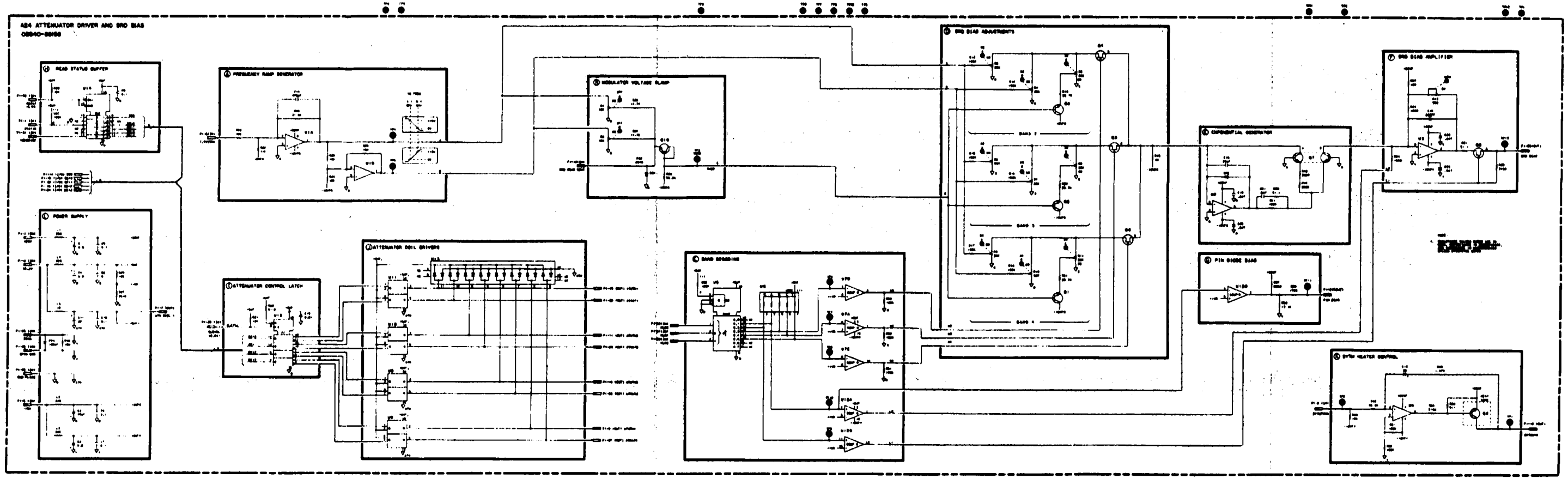


Figure A24-2. A24 Attenuator Driver/SRD Bias Schematic

Table A24-2. A24 Attenuator Driver/SRD Bias Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A24	08340-60158	8	1	ATTENUATOR DRIVER/SRD BIAS ASSEMBLY	28480	08340-60158
A24C1	0180-0116	1	4	CAPACITOR-FXD 6.8UF ±10% 35VDC TA	56289	150D685X9035B2
A24C2	0180-0116	1		CAPACITOR-FXD 6.8UF ±10% 35VDC TA	56289	150D685X9035B2
A24C3	0180-0116	1		CAPACITOR-FXD 6.8UF ±10% 35VDC TA	56289	150D685X9035B2
A24C4	0180-0116	1		CAPACITOR-FXD 6.8UF ±10% 35VDC TA	56289	150D685X9035B2
A24C5	0160-4835	7	6	CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A24C6	0160-4835	7		CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A24C7	0160-4835	7		CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A24C8	0160-4835	7		CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A24C9	0160-4835	7		CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A24C10	0160-4835	7		CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A24C11	0180-0228	6	1	CAPACITOR-FXD 22UF ±10% 15VDC TA	56289	150D226X9015B2
A24C12	0160-4832	4	1	CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A24C13	0180-0049	9	1	CAPACITOR-FXD 20UF +75-10% 50VDC AL	56289	30D206G050CC2
A24C14	0160-3335	0	1	CAPACITOR-FXD 470PF ±10% 100VDC CER	28480	0160-3335
A24C15	0160-4787	8	1	CAPACITOR-FXD 22PF ±5% 100VDC CER 0±30	28480	0160-4787
A24C16	0160-4812	0	1	CAPACITOR-FXD 220PF ±5% 100VDC CER	28480	0160-4812
A24C17, 18				NOT ASSIGNED		
A24C19	0160-0575	4	5	CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A24C20	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A24C21	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A24C22	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A24C23	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A24C24	0160-4389	6		CAPACITOR-FXD 100PF ±5PF 100VDC CER	28480	0160-4389
A24CR1	1901-0539	3	1	DIODE-SM SIG SCHOTTKY 20V	28480	1901-0539
A24CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A24L1	9140-0129	1	4	INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A24L2	9140-0129	1		INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A24L3	9140-0129	1		INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A24L4	9140-0129	1		INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A24L5	9100-0539	3	1	INDUCTOR (MISC ITEM)	28480	9100-0539
A24MP1				NOT ASSIGNED		
A24MP2	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A24MP3	4040-0752	9	1	EXTR-PC BD YEL POLYC .062-BD-THKNS	28480	4040-0752
A24MP4	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A24MP5, 6				NOT ASSIGNED		
A24MP7	1205-0033	6	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0033
A24Q1	1853-0281	9	4	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A24Q2	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A24Q3	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A24Q4	1855-0386	9	3	TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A24Q5	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A24Q6	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A24Q7	1854-0475	5	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A24Q8	1855-0420	2	1	TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A24Q9	1853-0213	4	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0213
A24Q10	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	28480	1853-0281
A24R1	2100-3274	2	2	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A24R2	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A24R3	2100-3353	8	9	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R4	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R5	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R6	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R7	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R8	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R9	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R10	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R11	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A24R12	2100-3351	6	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A24R13	0698-3453	2	6	RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A24R14	0698-3453	2		RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A24R15	0698-3453	2		RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A24R16	0698-3453	2		RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A24R17	0698-3453	2		RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A24R18	0698-3453	2		RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A24R19	0698-3449	6	3	RESISTOR 28.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-2872-F
A24R20	0698-3449	6		RESISTOR 28.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-2872-F

Table A24-2. A24 Attenuator Driver/SRD Bias Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A24R21	0698-3449	6		RESISTOR 28.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-2872-F
A24R22				NOT ASSIGNED		
A24R23	0757-0442	9	9	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R27	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R31	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A24R32	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0±100	24546	C4-1/8-T0-1102-F
A24R33	0698-3151	7	1	RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-T0-2871-F
A24R34	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A24R35	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A24R36	0698-3156	2	2	RESISTOR 14.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-1472-F
A24R37	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-1472-F
A24R38	0698-7278	7	1	RESISTOR 56.2K 1% .05W F TC=0±100	28480	0698-7278
A24R39	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A24R40	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-3162-F
A24R41	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A24R42	0698-6624	5	1	RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A24R43	0811-3575	1	1	RESISTOR-3K OHM 2% .12W	28480	0811-3575
A24R44	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A24R45	0698-8827	4	1	RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A24R46	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A24R47	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0±100	24546	C4-1/8-T0-2611-F
A24R48	0698-3162	0	1	RESISTOR 46.4K 1% .125W F TC=0±100	24546	C4-1/8-T0-4642-F
A24R49	0699-0068	1	1	RESISTOR-1.47 MEGOHM 1% .12W	28480	0699-0068
A24R50	0757-0465	6	5	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A24R51	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A24R52	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A24R53	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A24R54	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A24R55	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A24R56	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-5110-F
A24R57	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0±100	24546	C4-1/8-T0-8251-F
A24R58	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1212-F
A24R59	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0±100	24546	C4-1/8-T0-1781-F
A24R60	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A24R61	0698-7205	0	1	RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-TO-51R1-F
A24TP1	0360-0535	0	12	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP8	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP9	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP11	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24TP12	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A24U1	1826-0785	1	1	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A24U2	1826-0828	3	2	IC-15G M1 OP AMP	06665	OP-15GJ
A24U3	1826-0828	3		IC-15G M1 OP AMP	06665	OP-15GJ
A24U4	1826-1349	5	1	IC OP AMP TO-99 PKG	28480	1826-1349
A24U5	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A24U6	1810-0395	6	1	NETWORK-RES 8-SIP47.0K OHM X 7	11236	750-81-R47K
A24U7	1826-0138	8	2	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A24U8	1820-0535	7	4	IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A24U9	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A24U10	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A24U11	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A24U12	1826-0138	8		IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A24U13	1906-0074	1	1	DIODE-ARRAY 50V 400MA	28480	1906-0074
A24U14	1820-1491	6	1	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A24U15	1820-1195	7	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N

A25 ALC Detector Circuit Description

ASSEMBLY PURPOSE

The A25 ALC detector assembly processes the voltage from either internal or external detectors, producing an output voltage proportional to the RF power level. The output voltage is compared to a reference level voltage on the A26 linear modulator assembly, and the resulting error drives the RF modulators, controlling the RF leveling loop.

INTERNAL DETECTOR LOG CONVERTER (BLOCK A)

The internal dual-slope log converter receives the detected RF voltage and outputs a signal proportional to the RF power level in dBm.

Band Detector Selection

Internal low or high band crystal detector inputs are selected by the input control FETs. Comparator outputs are controlled by the LHET input, determining which detector input is selected. The low and high band offset adjustments provide the small voltage offsets required to adjust for low RF power levels due to detector non-linearities.

DC and AC Amplifiers

An operational amplifier and a transistor form a low-drift, high-gain DC amplifier that provides the DC current drive for the log amplifier. Discrete FET and bipolar transistors form a high-speed differential ac amplifier that improves the log amplifier high frequency response. The output summing amplifier sums the log amplifier current drive DC and ac components.

Log Amplifier

Two matched pair bipolar devices form the dual slope log amplifier. The dual slope amplifier tracks the detector characteristics in the square-law region and doubles the gain when the detectors operate in the linear region, providing an output voltage proportional to the RF power level over a wide range of power levels.

The logger bias circuitry provides the current source for the log amplifier. Transistors provide the adjustable bias currents, and control comparators turn on the bias for low or high band operation. Low and high band adjustments are provided for low band or high bands. A thermistor mounted internal to the A12 low band splitter/detector provides thermal compensation for the bias circuitry.

Output Clamp

Clamp transistors clamp the log amplifier negative excursions when pulse modulation turns the RF power off. The clamp voltage is approximately −0.12V, but varies with different power levels.

X5 AMPLIFIER (BLOCK B)

A discrete differential amplifier, with a gain of five, buffers the log converter's high impedance output. In addition, the LVLCOR (level correction) signal from the A27 level control assembly is summed with the detected voltage.

SAMPLE/HOLD (BLOCK C)

The sample/hold circuit stores the detected RF level when the RF power is off during pulse modulation. A FET switch, controlled by the A21 pulse modulator assembly through transistor drivers, provides the control for the sampling capacitor. During the hold stage, the small loss of charge from the sampling capacitor is compensated for by a small compensation capacitor. An adjustment provides control of the compensation level.

LEVEL METER AMPLIFIER (BLOCK D)

The level meter amplifier buffers and filters the sample/hold voltage. The voltage gain is approximately seven, with a low-pass filter cutoff frequency of 5 Hz. For thermal stability, temperature sensitive resistors track the logger gain drift. The output buffer provides an output proportional to the RF power level, and is used by the instrument microprocessor to display the output power level.

SYSTEM LEVELING RELAY DRIVER (BLOCK E)

System leveling provides calibrated external leveling compatible with the HP 83550 series millimeter-wave source modules, which have internal detectors, log amplifiers, and thermal compensation.

When in the system leveling mode, the HSYS control signal, through FET drivers, selects the external detector input for the ALC sample and hold circuitry through the system leveling relay. The external detector input allows the sample/hold circuitry to monitor an external input. The POWER dBm display shows the external input power level, **not** the instrument power output.

NOTE: For impedance matching in the system leveling mode, the external detector input is terminated in a 50Ω resistor.

Power meter leveling and external crystal leveling modes are controlled by the HMTR and HINT control lines in the function switches and external detector circuitry (block F). When either power meter or external crystal leveling is selected, the EX DET input is routed through the external detector log converter (block H).

NOTE: Because the HP 83550 series source modules have internal log amplifiers, system leveling mode diverts the EXT DET input to the sample/hold circuitry.

FUNCTION SWITCHES AND EXTERNAL DETECTOR FREQUENCY COMPENSATION (BLOCK F)

The external detector log converter output is buffered, with a DC voltage gain of approximately 10. Open collector drivers and FET switches select the internal or external detectors to be used on the A26 linear modulator assembly. See Table A25-1 for a function select truth table for the FET switches.

Table A25-1. Function Select Truth Table

Leveling Mode		Q27	Q28	Q29
Internal		ON	OFF	OFF
External	Crystal Detector	OFF	ON	OFF
	Power Meter	OFF	ON	ON
Unleveled (Shift Meter) (Shift Internal) (Shift RF)		OFF	OFF	OFF

Table A25-2. HMTR and HINT Functions

HMTR	HINT	
	Low = 0	High = 1
High = 1	External Power Leveling	"Open-Loop"
Low = 0	External Crystal Leveling	Internal Leveling

LEVEL REFERENCE TEMPERATURE COMPENSATION (BLOCK G)

The reference voltage changes with temperature to compensate for gain drift in the log converters. The temperature compensated reference voltage output (TCREF) is summed (on the A26 linear modulator assembly) with the AM and marker inputs, and compared to the output of the A25 ALC detector assembly. In the system leveling mode, the temperature sensitive network is disconnected, and resistors are connected that have a temperature coefficient of zero.

EXTERNAL LOG CONVERTER (BLOCK H)

Monitoring the RF power level externally through the external leveling input, the external detector log converter provides the logging function similar to the log converter in block A. An absolute value converter lets you use either a positive or a negative detector, with adjustments for voltage offsets to make the currents seen by the log amplifier the same.

The log amplifier is configured as a single-slope converter, with its negative output clamped at 0.3V. An adjustment provides log amplifier balancing at low output levels.

NOTE: When you use an external detector, the sample/hold is not effective during pulse modulation. Also, the front panel power dBm display continues to display the internally detected power level (instrument output power), rather than the externally detected power level.

POWER SUPPLY (BLOCK I)

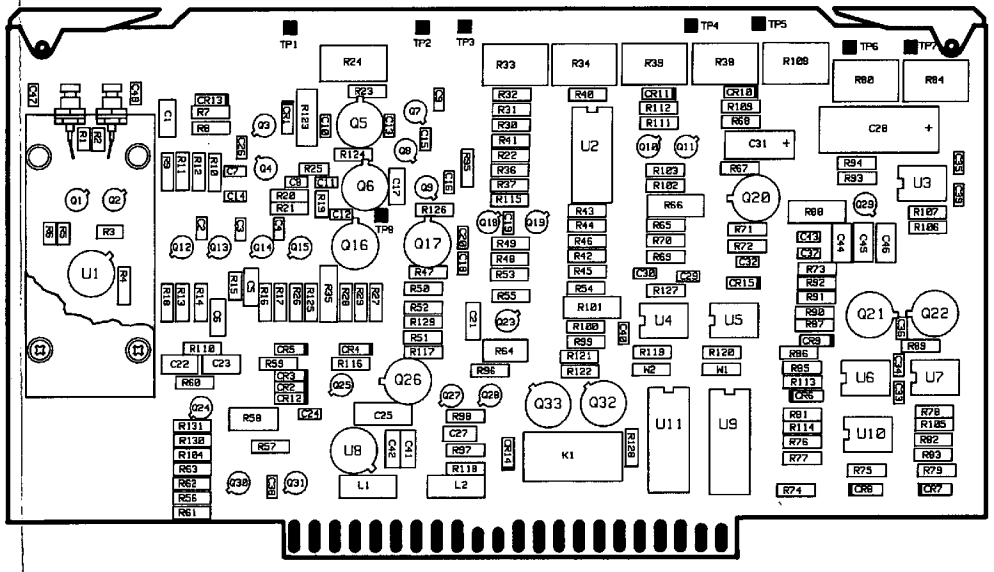
LC filtering removes noise from the +20V and −10V supply lines. Additional RC filtering keeps the +20V and −10V extra clean for use in the internal logger. The +1.5V supply is the reference voltage for the comparators.

Table A25-3. A25 ALC Detector Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1 23				
2 24	DET S/H + DET S/H −	+4.5/+3.5V +3.5/+4.5V	XA21P1-3 XA21P1-21	C C
3 25	HPLSEN	TTL (HIGH TRUE)	XA26P1-2	*NOT USED
4 26	THERM 1 THERM 2	−1V TO −8V −10V	A62J34-3 A62J34-1	A A
5 27	+20V +20V	+20V +20V	XA52P1-16, 40 XA52P1-16, 40	*H *H
6 28	+5.2V +5.2V	+5.2V +5.2V	XA52P1-17, 18, 41, 42 XA52P1-17, 18, 41, 42	*NOT USED *NOT USED
7 29	−10V −10V	−10V −10V	XA53P1-12, 13, 31, 32 XA53P1-12, 13, 31, 32	*H *H
8 30				
9 31	GND GND	0V 0V	A62 STAR GND A62 STAR GND	* *
10 32	GND DETOUT	0V −30mV/dB, 0V = 0dBm	A62 STAR GND F	* XA26P1-10
11 33	DETLVL	−200mV/dB, 0v = 0dBm	D	XA27P1-29
12 34	RGND RGND	0V 0V	STAR GND POINT STAR GND POINT	*H *H
13 35	LVLREF TCREF	0.2V/dB, 0V = 0dBm −200mV/dB, 0V = 0dBm	XA27P1-30 G	G XA26P1-12
14 36	LVLCOR HMTR	+1.25dB/VOLT, 0V = 0dB TTL (HIGH TRUE)	B XA26P1-13	XA27P1-62 A F
15 37	LHET	TTL (LOW TRUE)	XA27P1-20	*A
16 38				
17 39	LDETBW	TTL (LOW TRUE)	XA26P1-9	*NOT USED
18 40				
19 41				
20 42	HINT	TTL (HIGH TRUE)	XA26P1-42	F
21 43	EXDETR	0V	*	E
22 44	EXDET	0.5mV − 2V	A26J16 SMC CENTER	E

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60263

Figure A25-1. A25 ALC Detector Component Location Diagram

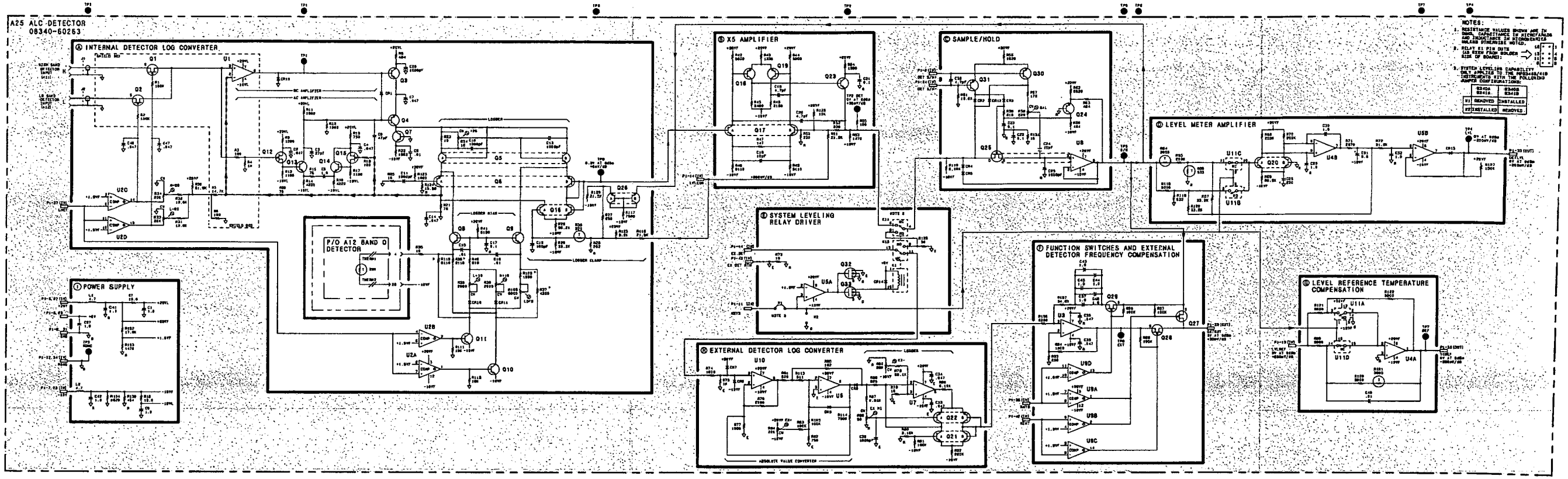


Figure A25-2. A25 ALC Detector Schematic

Table A25-4. A25 ALC Detector Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25	**08340-60263**	**6**	**1**	**ALC DETECTOR ASSEMBLY**	**28480**	**08340-60263**
A25C1	0160-4535	4	14	CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C2	0160-0575	4	10	CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C3	0160-4493	3	1	CAPACITOR-FXD 27PF ±5% 200VDC CER 0±30	28480	0160-4493
A25C4	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C5	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C6	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C7	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C8	0160-4387	4	1	CAPACITOR-FXD 47PF ±5% 200VDC CER 0±30	28480	0160-4387
A25C9	0160-3879	7	4	CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A25C10	0160-3878	6	5	CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A25C11	0160-3878	6		CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A25C12	0160-4389	6	1	CAPACITOR-FXD 100PF ±5PF 200VDC CER	28480	0160-4389
A25C13	0160-3878	6		CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A25C14	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C15	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A25C16	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A25C17	0160-4084	8	4	CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A25C18	0160-3874	2	1	CAPACITOR-FXD 10PF ±.5PF 200VDC CER	28480	0160-3874
A25C19	0160-3873	1	3	CAPACITOR-FXD 4.7PF ±.5PF 200VDC CER	28480	0160-3873
A25C20	0160-3873	1		CAPACITOR-FXD 4.7PF ±.5PF 200VDC CER	28480	0160-3873
A25C21	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A25C22	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A25C23	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A25C24	0160-4789	0	1	CAPACITOR-FXD 15PF ±5% 100VDC CER 0±30	28480	0160-4789
A25C25	0160-0153	4	1	CAPACITOR-FXD 1000PF ±10% 200VDC POLYE	28480	0160-0153
A25C26	0160-3878	6		CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A25C27	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C28	0180-2208	6	1	CAPACITOR-FXD 220UF±10% 10VDC TA	56289	150D227X9010S2
A25C29	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C30	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C31	0180-0116	1	1	CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A25C32	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C33	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C34	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C35	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C36	0160-3878	6		CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A25C37	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C38	0160-3873	1		CAPACITOR-FXD 4.7PF ±.5PF 200VDC CER	28480	0160-3873
A25C39	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C40	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A25C41	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C42	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C43	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C44	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C45	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C46	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A25C47	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25C48	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A25CR1	1901-0539	3	4	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A25CR2	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A25CR3	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A25CR4	1901-0050	3	2	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A25CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A25CR6	1901-0376	6	4	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A25CR7	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A25CR8	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A25CR9	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A25CR10	1901-0033	2	5	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A25CR11	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A25CR12	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A25CR13	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A25CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A25CR15	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A25J1	1250-0691	7	2	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A25J2	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A25K1	0490-1409	4	1	RELAY 2C 5VDC-COIL 2A 250VAC	28480	0490-1409
A25L1	9100-3562	8	2	INDUCTOR RF-CH-MLD 4.7UH 5% .166DX.385LG	28480	9100-3562
A25L2	9100-3562	8		INDUCTOR RF-CH-MLD 4.7UH 5% .166DX.385LG	28480	9100-3562

Table A25-4. A25 ALC Detector Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25MP1	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A25MP2	4040-0753	0	1	EXTR-PC BD GRN POLYC .062-BD-THKNS	28480	4040-0753
A25MP3	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A25MP4	08340-20184	6	1	COMPT FILTER	28480	08340-20184
A25MP5	08340-00054	7	1	COVER-FILTER	28480	08340-00054
A25MP6	0624-0227	7	8	SCREW-TPG 4-40 .25-IN-LG PAN-HD-POZI STL	00000	ORDER BY DESCRIPTION
A25MP7-9				NOT ASSIGNED		
A25MP10	2190-0124	4	2	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A25MP11	2950-0078	9	2	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A25Q1	1855-0276	6	2	TRANSISTOR J-FET 2N4416A N-CHAN D-MODE	01295	2N4416A
A25Q2	1855-0276	6		TRANSISTOR J-FET 2N4416A N-CHAN D-MODE	01295	2N4416A
A25Q3	1854-0477	7	3	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A25Q4	1853-0405	9	3	TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A25Q5	1854-0295	7	2	TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0295
A25Q6	1853-0075	9	1	TRANSISTOR-DUAL PNP PD=400MW	28480	1853-0075
A25Q7	1854-0345	8	4	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A25Q8	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A25Q9	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A25Q10	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A25Q11	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A25Q12	1855-0235	7	2	TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A25Q13	1854-0546	1	2	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A25Q14	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A25Q15	1855-0235	7		TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A25Q16	1854-0295	7		TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0295
A25Q17	1854-0475	5	2	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A25Q18	1853-0451	5	2	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A25Q19	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A25Q20	1854-0688	2	1	TRANSISTOR-DUAL NPN TO-71	28480	1854-0688
A25Q21	1854-0475	5		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A25Q22	1853-0269	3	1	TRANSISTOR-DUAL PNP 2N3809 PD=600MW	01295	2N3809
A25Q23	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A25Q24	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A25Q25	1855-0414	4	1	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A25Q26	1853-0316	1	1	TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
A25Q27	1855-0386	9	3	TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A25Q28	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A25Q29	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A25Q30	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A25Q31	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A25Q32	1855-0646	4	2	TRANSISTOR MOSFET N-CHAN E-MODE TO-39 SI	9M011	IRFF131
A25Q33	1855-0646	4		TRANSISTOR MOSFET N-CHAN E-MODE TO-39 SI	9M011	IRFF131
A25R1	0698-7284	5	2	RESISTOR 100K 1% .05W F TC=0±100	24546	C3-1/8-T0-1003-F
A25R2	0698-7284	5		RESISTOR 100K 1% .05W F TC=0±100	24546	C3-1/8-T0-1003-F
A25R3	0698-7212	9	3	RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-TO-100R-F
A25R4	0698-8827	4	2	RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A25R5	0698-7264	1	1	RESISTOR 14.7K 1% .05W F TC=0±100	24546	C3-1/8-T0-1472-F
A25R6	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-TO-100R-F
A25R7	0698-3429	2	2	RESISTOR 19.6 1% .125W F TC=0±100	03888	PME55-1/8-T0-19R6-F
A25R8	0698-0082	7	4	RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A25R9	0757-0280	3	4	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A25R10	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0±100	24546	C4-1/8-T0-751-F
A25R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A25R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A25R13	0757-0424	7	2	RESISTOR 1.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1101-F
A25R14	0698-3154	0	3	RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A25R15	0698-7209	4	3	RESISTOR 75 1% .05W F TC=0±100	24546	C3-1/8-TO-75R0-F
A25R16	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A25R17	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1101-F
A25R18	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0±100	03888	PME55-1/8-T0-19R6-F
A25R19	0698-7212	9		RESISTOR 100 1% .05W F TC=0±100	24546	C3-1/8-TO-100R-F
A25R20	0698-7209	4		RESISTOR 75 1% .05W F TC=0±100	24546	C3-1/8-TO-75R0-F
A25R21	0698-7209	4		RESISTOR 75 1% .05W F TC=0±100	24546	C3-1/8-TO-75R0-F
A25R22	0698-0083	8	3	RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A25R23	0757-0346	2	5	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A25R24	2100-0589	6	1	RESISTOR-TRMR 10 10% C SIDE-ADJ 1-TRN	28480	2100-0589
A25R25	0698-7188	8	1	RESISTOR 10 1% .05W F TC=0±100	24546	C3-1/8-TO-10R-F
A25R26	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-5622-F
A25R27	0698-4461	4	1	RESISTOR 698 1% .125W F TC=0±100	24546	C4-1/8-T0-698R-F
A25R28	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0±100	24546	C4-1/8-T0-3832-F
A25R29	0698-6112	6	1	RESISTOR 202 .25% .125W F TC=0±100	28480	0698-6112
A25R30	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0±100	24546	C4-1/8-T0-6192-F

Table A25-4. A25 ALC Detector Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25R31	0698-3157	3	3	RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A25R32	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A25R33	2100-1762	9	4	RESISTOR-TRMR 20K 5% WW SIDE-ADJ 1-TRN	28480	2100-1762
A25R34	2100-1762	9		RESISTOR-TRMR 20K 5% WW SIDE-ADJ 1-TRN	28480	2100-1762
A25R35	0811-3596	6	1	RESISTOR 320 2% .125W PWW TC=+5600±300	01686	R3119
A25R36	0757-0438	3	4	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A25R37	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A25R38	2100-1759	4	2	RESISTOR-TRMR 2K 5% WW SIDE-ADJ 1-TRN	28480	2100-1759
A25R39	2100-1759	4		RESISTOR-TRMR 2K 5% WW SIDE-ADJ 1-TRN	28480	2100-1759
A25R40	0757-0418	9	2	RESISTOR 619 1% .125W F TC=0±100	24546	C4-1/8-T0-619R-F
A25R41	0757-0290	5	3	RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A25R42	0698-6320	8	6	RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A25R43	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8-T0-1331-F
A25R44	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A25R45	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0±100	24546	C4-1/8-T0-3481-F
A25R46	0757-0279	0	2	RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A25R47	0698-3438	3	1	RESISTOR 147 1% .125W F TC=0±100	24546	C4-1/8-T0-147R-F
A25R48	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A25R49	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A25R50	0698-6377	5	1	RESISTOR 200 .1% .125W F TC=0±25	28480	0698-6377
A25R51	0757-0199	3	3	RESISTOR 21.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-2152-F
A25R52	0698-6366	2	1	RESISTOR 800 .1% .125W F TC=0±25	28480	0698-6366
A25R53	0757-1094	9	2	RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A25R54	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A25R55	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A25R56	0757-0428	1	2	RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A25R57	0698-3439	4	1	RESISTOR 178 1% .125W F TC=0±100	24546	C4-1/8-T0-178R-F
A25R58	2100-3351	6	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A25R59	0757-0418	9		RESISTOR 619 1% .125W F TC=0±100	24546	C4-1/8-T0-619R-F
A25R60	0698-0082	7		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A25R61	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A25R62	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-5621-F
A25R63	0698-0082	7		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A25R64	0811-3575	1	2	RESISTOR 3K 2% .125W TC=+5600±300	28480	0811-3575
A25R65	0698-6624	5	3	RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A25R66	0811-3576	2	1	RESISTOR 533 2% .125W PWW TC=+3400±300	28480	0811-3576
A25R67	0699-0793	9	2	RESISTOR 33.2K .1% .125W F TC=0±25	28480	0699-0793
A25R68	0757-0464	5	1	RESISTOR 90.9K 1% .125W F TC=0±100	24546	C4-1/8-T0-9092-F
A25R69	0698-6376	4	2	RESISTOR 200K .1% .125W F TC=0±25	19701	MF4C1/8-T9-2003-B
A25R70	0698-6376	4		RESISTOR 200K .1% .125W F TC=0±25	19701	MF4C1/8-T9-2003-B
A25R71	0698-3151	7	1	RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-T0-2871-F
A25R72	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-3162-F
A25R73	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A25R74	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A25R75	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A25R76	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A25R77	0698-6362	8	2	RESISTOR 1K .1% .125W F TC=0±25	28480	0698-6362
A25R78	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A25R79	0757-0461	2	1	RESISTOR 68.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-6812-F
A25R80	2100-1762	9		RESISTOR-TRMR 20K 5% WW SIDE-ADJ 1-TRN	28480	2100-1762
A25R81	0698-6317	3	1	RESISTOR 500 .1% .125W F TC=0±25	03888	PME55-1/8-T9-500R-B
A25R82	0757-0420	3		RESISTOR 750 1% .125W F TC=0±100	24546	C4-1/8-T0-751-F
A25R83	0757-0465	6	6	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A25R84	2100-1762	9		RESISTOR-TRMR 20K 5% WW SIDE-ADJ 1-TRN	28480	2100-1762
A25R85	0698-8332	6	1	RESISTOR 162 .1% .125W F TC=0±50	19701	MF4C1/8-T2-162R-B
A25R86	0699-1056	9	1	RESISTOR 825 .1% .125W F TC=0±25	2M627	CRB14 RO CRB25
A25R87	0757-0439	4	2	RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-T0-6811-F
A25R88	2100-0552	3	1	RESISTOR-TRMR 50 10% C SIDE-ADJ 1-TRN	28480	2100-0552
A25R89	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A25R90	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A25R91	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A25R92	0698-6621	2	1	RESISTOR 250K .1% .125W F TC=0±25	28480	0698-6621
A25R93	0698-6782	6	1	RESISTOR 250 .1% .125W F TC=0±25	28480	0698-6782
A25R94	0698-6362	8		RESISTOR 1K .1% .125W F TC=0±25	28480	0698-6362
A25R95	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A25R96	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A25R97	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A25R98	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A25R99	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A25R100	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624

Table A25-4. A25 ALC Detector Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25R101	0811-3575	1		RESISTOR 3K 2% .125W TC=+5600±300	28480	0811-3575
A25R102	0698-3136	8	1	RESISTOR 17.8K 1% .125W F TC=0±100	24546	C4-1/8-T0-1782-F
A25R103	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A25R104	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A25R105	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A25R106	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0±100	24546	C4-1/8-T0-8251-F
A25R107	0757-0123	3	1	RESISTOR 34.8K 1% .125W F TC=0±100	28480	0757-0123
A25R108	2100-1760	7	1	RESISTOR-TRMR 5K 5% WW SIDE-ADJ 1-TRN	28480	2100-1760
A25R109	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A25R110	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A25R110	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-T0-6811-F
A25R111	0757-0442	9	2	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A25R112	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A25R113	0698-5404	7	1	RESISTOR 511 .25% .125W F TC=0±100	03888	PME55-1/8-T0-511R-C
A25R114	0698-8960	6	1	RESISTOR 750K 1% .125W F TC=0±100	28480	0698-8960
A25R115	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A25R116	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-2152-F
A25R117	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-7501-F
A25R118	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A25R119	0698-8872	9	1	RESISTOR 532 .25% .125W F TC=0±100	28480	0698-8872
A25R120	0699-0793	9		RESISTOR 33.2K .1% .125W F TC=0±25	28480	0699-0793
A25R121	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A25R122	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A25R123	0698-7449	4	1	RESISTOR 1K .1% .25W F TC=0±25	19701	MF52C1/4-T9-1001-B
A25R124	0699-2053	8	1	R 15.88 .1% .10W	28480	0699-2053
A25R125	0698-6321	9	1	RESISTOR 9.9K .1% .125W F TC=0±25	03888	PME55-1/8-T9-9901-B
A25R126	0699-0642	7	1	RESISTOR 10K .1% .1W F TC=0±5	28480	0699-0642
A25R127	0698-6620	1	1	RESISTOR 150K .1% .125W F TC=0±25	28480	0698-6620
A25R128	0698-6364	0	1	RESISTOR 50 .1% .125W F TC=0±25	28480	0698-6364
A25R129	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-2152-F
A25R130	0698-0082	7		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A25R131	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A25TP1	0360-0535	0	8	TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A25TP2	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A25TP3	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A25TP4	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A25TP5	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A25TP6	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A25TP7	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A25TP8	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A25U1	1826-0845	4	1	IC OP AMP PRCN TO-99 PKG	06665	OP-07EJ
A25U2	1826-0306	2	2	IC COMPARATOR GP QUAD 14-DIP-C PKG	27014	LM339AJ
A25U3	1826-0982	0	2	IC OP AMP LOW-NOISE 8-DIP-C PKG	28480	1826-0982
A25U4	1826-0785	1	2	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A25U5	1826-0785	1		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A25U6	1826-1049	2	2	IC OP AMP PRCN 8-DIP-C PKG	28480	1826-1049
A25U7	1826-0982	0		IC OP AMP LOW-NOISE 8-DIP-C PKG	28480	1826-0982
A25U8	1826-0601	0	1	IC OP AMP PRCN TO-99 PKG	06665	OP-16FJ
A25U9	1826-0306	2		IC COMPARATOR GP QUAD 14-DIP-C PKG	27014	LM339AJ
A25U10	1826-1135	7		IC OP AMP PRCN 8-DIP-C PKG	28480	1826-1135
A25U11	1826-1186	8	1	ANALOG SWITCH 4 SPST 16 -CERDIP	06665	SW-06GQ
A25W1	8159-0005	0	2	RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A25W2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005

A26 Linear Modulator Circuit Description

ASSEMBLY PURPOSE

The A26 linear modulator assembly compares the detected RF power level against the level reference voltage, and drives the RF modulators to correct any errors, closing the ALC loop and leveling the RF power. The amplitude modulation (AM) input is logged and added to the level reference on this assembly.

AM LOG CONVERTER (BLOCK A)

In this block, the front panel AM modulation input is buffered and sent to a log converter where the output is logarithmically related to the input voltage. The logger output is buffered and amplified and sent to the ALC loop integrator.

ALC LOOP INTEGRATOR (BLOCK B)

Summing Node

At the ALC loop summing node, DETOUT (the detected RF power level voltage) is summed with TCREF (the reference power level voltage). When the loop is closed and leveled, these signals are equal and opposite, canceling each other. If they do not cancel, the error current is integrated and changes the RF modulation level to correct the power level. HMRKR (the marker pulses) and the logged external AM (if enabled) are also added to the summing node.

ALC Loop Band Width

The main ALC amplifier forms an integrator with two integrating capacitors that affect the loop bandwidth. Internal leveling has a loop bandwidth of 100 kHz, with one integrating capacitor connected. Selecting external leveling connects another capacitor in parallel resulting in a loop bandwidth of 80 kHz. Other operational conditions may require additional capacitance, which further lowers the loop bandwidths (see Figure A26-1).

Maximum Voltage Levels

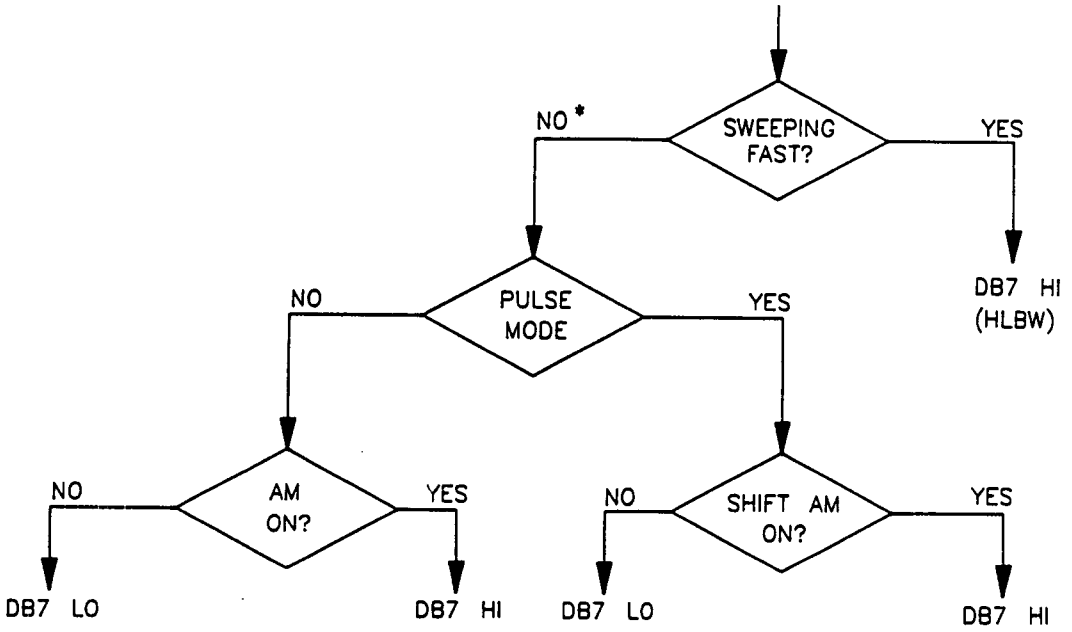
The negative voltage from the ALC amplifier is clamped at about −3.9V when the loop goes unleveled; the positive voltage is clamped at about +0.5V.

Power Meter Leveling

When using power meter leveling, to avoid ALC overshoot due to slow power meter response times, a capacitor is placed across the clamp transistor control line to make the turn-on time at bandswitches or at the beginning of sweep very slow. Leveled ALC loop bandwidth is not affected.

Open-Loop Mode

For the open-loop mode, U8 is an inverting amplifier instead of an integrator, and the reference sensitivity is doubled to get a wide control range.



FAST SWEEP: <5 SEC

*INCLUDES MANUAL & CW

SHIFT AM ACTIVATES AM
TURNING AM OFF DE-ACTIVATES SHIFT AM

Figure A26-1. HLBW Algorithm

OVERMODULATION/UNLEVELED DETECTORS (BLOCK C)

The MODLVL (modulation level) voltage stays within certain bounds when the RF power is leveled. If MODLVL exceeds these bounds, comparators detect the condition and send the information to the microprocessor. The overmodulation/unleveled circuitry is disabled at end-of-sweep by HSP.

ALC MODULATOR SWITCH (BLOCK D)

In this block, the low band or high band RF modulators are selected to be driven by the modulator driver. Control line LB0 from the band switch driver controls FET switches that select the proper modulator.

ALC LOOP FUNCTION SWITCH DRIVERS (BLOCK E)

Digital information is latched from the microprocessor to control the major ALC functions. HMTR (high power meter) and HINT (high internal) determine the primary leveling mode. These two lines, with two decoders, drive comparators to control the main ALC amplifier. The other outputs from the latch (and the comparators) control functions for loop bandwidth, enable amplitude modulation, and enable the overmodulation/unleveled comparators.

BAND SWITCH DRIVERS (BLOCK F)

In this block, band information is decoded from control lines HLB0, HLB1, and HLB2. Each output goes low for the selected band, causing the output of the appropriate comparator to go high. The band switch drivers output control signals for the modulator switch and the modulator driver circuitry.

ALC MODULATOR DRIVER (BLOCK G)

The ALC loop gain is separately adjustable for each band (HET, X1, X2, X3, X4). Input FET switches, selected by the band switch drivers allow the MODLVL signal to pass through the proper band adjustment.

Exponential Current Source

An exponential current source drives current through the RF modulators. The exponential function linearizes the modulators' attenuation characteristics (see Figure A26-2), which is a non-linear function of drive current. RF attenuation (in dB) is proportional to the MODLVL (modulation level) voltage. In the high bands, non-linearities in the A13 SYTM power transfer characteristics require additional modulator drive shaping.

Modulator Offset

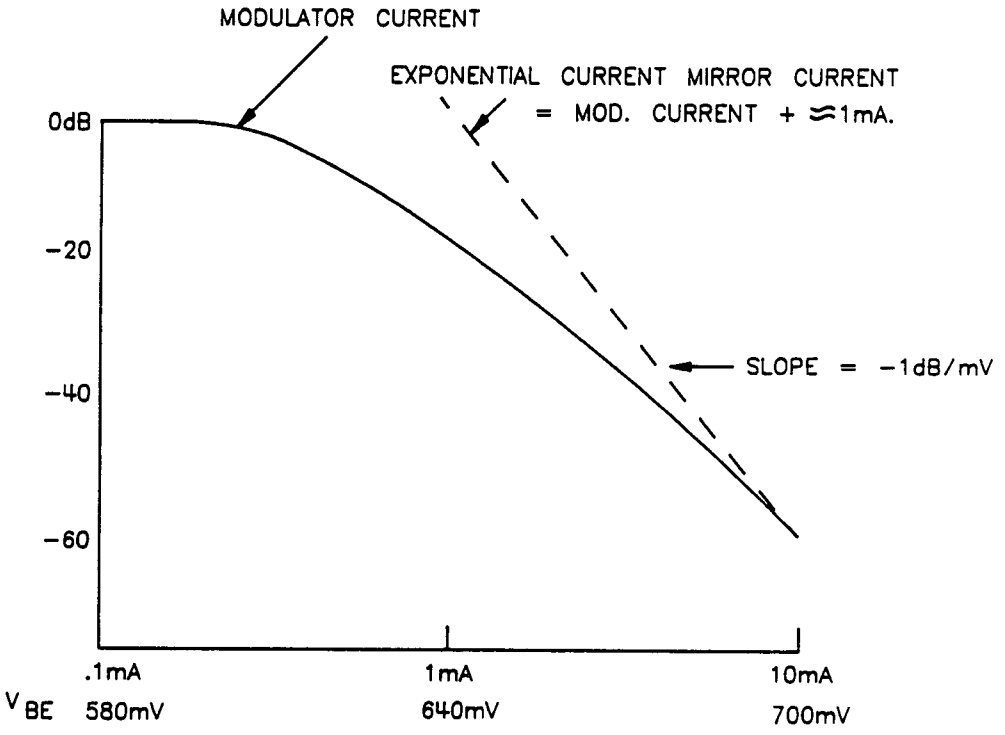
The modulator offset circuitry (MO) provides a bias current to the exponential current source input so that when MODLVL is at 0V, the exponentiator outputs a current that equals the current shunted from the modulators.

Output Buffer

An output buffer provides a high band output to the A24 SRD bias assembly for use in biasing the step recovery diode internal to the SYTM.

POWER SUPPLY (BLOCK H)

Power supply filtering consists of LC filters. The 1.5 VF is a reference voltage for comparators.



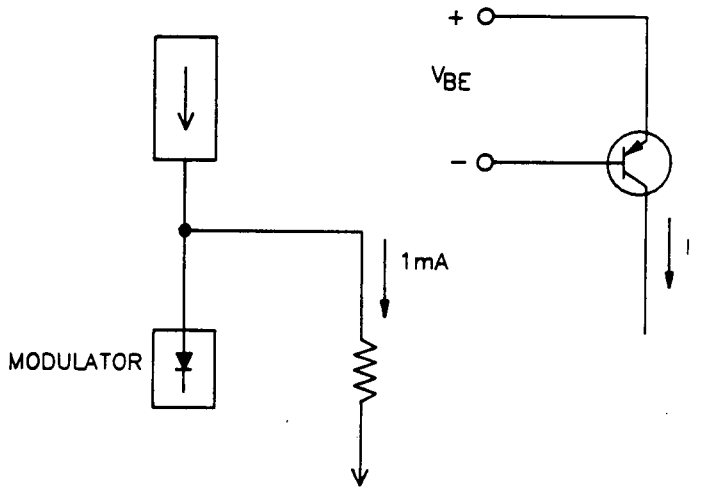


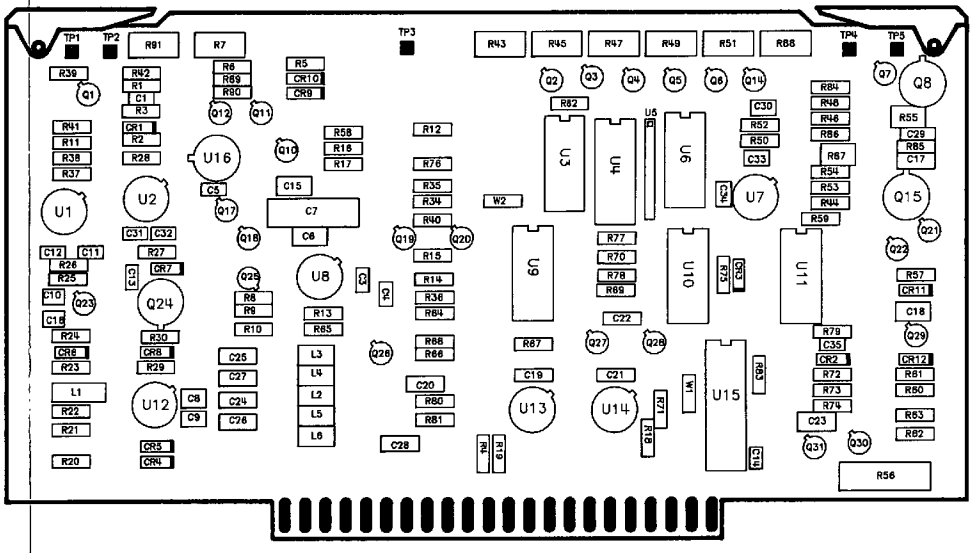
Figure A26-2. Modulator Attenuation Characteristic

Table A26-1. A26 Linear Modulator Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1 23	LMODHLD LHIBND	TTL TTL (LOW TRUE)	XA21P1-2 D	B A62J19 PIN 15
2 24	HPLSEN HRFON	TTL (HIGH TRUE) TTL (HIGH TRUE)	E XA57P1-105	* *B
3 25	+20V +20V	+20V +20V	XA52P1-16, 40 XA52P1-16, 40	*H *H
4 26	+5.2V +5.2V	XA52P1-17, 18, 41, 42 +5.2V	*H XA52P1-17, 18, 41, 42	 *H
5 27	−10V −10V	−10V −10V	XA53P1-12, 13, 31, 32 XA53P1-12, 13, 31, 32	*H *H
6 28	GND GND	0V 0V	A62 STAR GND A62 STAR GND	*H *H
7 29	HSP HLB0	TTL (HIGH TRUE) TTL (HIGH TRUE)	XA57P1-13 XA27P1-46	* *F
8 30	LOMD HLB1	TTL (LOW TRUE) TTL (HIGH TRUE)	C XA27P1-16	XA27P1-48 *F
9 31	LDETBW HLB2	TTL (LOW TRUE) TTL (HIGH TRUE)	E XA27P1-47	*XA25P1-39 *F
10 32	DETOUT MODLVL	−30mV/dB, 0V = 0dBm 0V TO −3V (LEVELED)	XA25P1-32 B	B XA27P1-61
11 33	RGND HLBW	0V TTL (HIGH TRUE)	STAR GND POINT E	*H XA21P1-6
12 34	TCREF RGND	−200mV/dB, 0V= 0dBm 0V	XA25P1-35 STAR GND POINT	B *H
13 35	HMTR DB11	TTL (HIGH TRUE) TTL	E *	XA25P1-36 *E
14 36	LHET LUNLVL	TTL (LOW TRUE) TTL (LOW TRUE)	XA27P1-20 C	*NOT USED XA27P1-52
15 37	DB0 DB1	TTL TTL	XA60P1-20 XA60P1-76	*E *E
16 38	DB2 DB3	TTL TTL	XA60P1-21 XA60P1-77	*E *E
17 39	DB4 DB6	TTL TTL	XA60P1-22 XA60P1-78	*E *E
18 40	SRD BIAS CONT DB7	0 TO −5V (LEVELED) TTL	G XA60P1-79	XA24P1-13 *E
19 41	AM IN AM RTN	±1V MAXIMUM 0V	A62J15-SMC CENTER *	A A
20 42	MODHI HINT	CURRENT SOURCE TTL (HIGH TRUE)	D E	A62J13-SMC CENTER XA25P1-42
21 43	MOD RTN HMRKR	0V TTL (HIGH TRUE)	D XA57P1-2, 12	A62J13-SMC SHIELD B
22 44	MODLO WMOD	CURRENT SOURCE TTL (LOW TRUE)	D XA27P1-59	A62J14-SMC CENTER *E

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring List for a complete representation of signal sources and destinations.



HP Part Number: 08340-60284

Figure A26-3. A26 Linear Modulator Component Location Diagram

Figure A26-4. A26 Linear Modulator Schematic

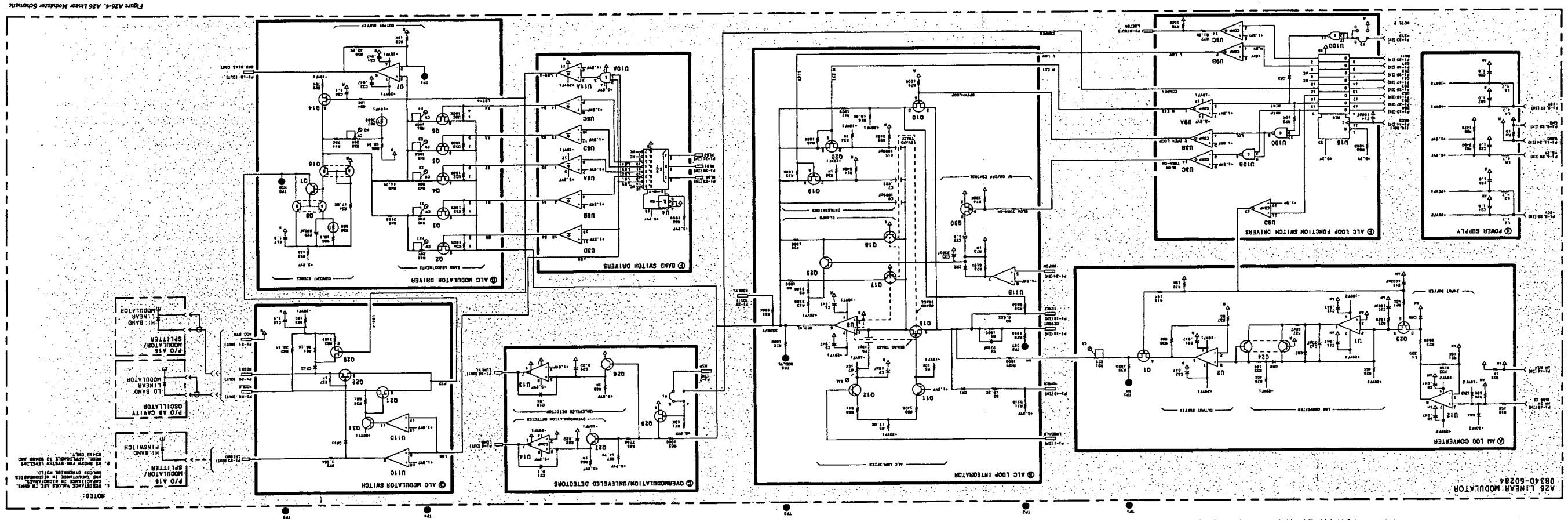


Table A26-2. A26 Linear Modulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A26	**08340-60284**	1	1	**LINEAR MODULATOR ASSEMBLY**	**28480**	**08340-60284**
A26C1	0160-4811	9	1	CAPACITOR-FXD 270PF ±5% 100VDC CER	28480	0160-4811
A26C2	0160-4385	2	1	CAPACITOR-FXD 15PF ±5% 200VDC CER 0±30	28480	0160-4385
A26C3	0160-0575	4	10	CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C4	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C5	0160-4793	6	1	CAPACITOR-FXD 6.8PF ±.5PF 100VDC CER	28480	0160-4793
A26C6	0160-0153	4	2	CAPACITOR-FXD 1000PF ±10% 200VDC POLYE	28480	0160-0153
A26C7	0160-0162	5	1	CAPACITOR-FXD .022UF ±10% 200VDC POLYE	28480	0160-0162
A26C8	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C9	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C10	0160-4389	6	2	CAPACITOR-FXD 100PF ±5PF 200VDC CER	28480	0160-4389
A26C11	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C12	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C13	0160-4386	3	1	CAPACITOR-FXD 33PF ±5% 200VDC CER 0±30	28480	0160-4386
A26C14	0160-4389	6		CAPACITOR-FXD 100PF ±5PF 200VDC CER	28480	0160-4389
A26C15	0160-0153	4		CAPACITOR-FXD 1000PF ±10% 200VDC POLYE	28480	0160-0153
A26C16	0160-3878	6	1	CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A26C17	0160-4535	4	8	CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A26C18	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A26C19	0160-4835	7	2	CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A26C20	0160-5098	6	2	CAPACITOR-FXD .22UF ±10% 50VDC CER	16299	CAC05X7R224J050A
A26C21	0160-4835	7		CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A26C22	0160-5098	6		CAPACITOR-FXD .22UF ±10% 50VDC CER	16299	CAC05X7R224J050A
A26C23	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A26C24	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A26C25	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A26C26	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A26C27	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A26C28	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A26C29	0160-4825	5	1	CAPACITOR-FXD 560PF ±5% 100VDC CER	28480	0160-4825
A26C30	0160-3879	7	1	CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A26C31	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C32	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C33	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C34	0160-0575	4		CAPACITOR-FXD .047UF ±20% 50VDC CER	28480	0160-0575
A26C35	0160-4810	8	1	CAPACITOR-FXD 330PF ±5% 100VDC CER	28480	0160-4810
A26C36				NOT ASSIGNED		
A26CR1	1901-0033	2	7	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A26CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A26CR3	1901-0539	3	5	DIOED-SM SIG SCHOTTKY	28480	1901-0539
A26CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A26CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A26CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A26CR7	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A26CR8	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A26CR9	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A26CR10	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A26CR11	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A26CR12	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A26L1	9100-1643	2	1	INDUCTOR RF-CH-MLD 300UH 5% .2DX.45LG	28480	9100-1643
A26L2	9140-0112	2	5	INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A26L3	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A26L4	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A26L5	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A26L6	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A26MP1	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A26MP2	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A26MP3	4040-0754	1	1	EXTR-PC BD BLU POLYC .062-BD-THKNS	28480	4040-0754
A26Q1	1855-0420	2	1	TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A26Q2	1855-0414	4	9	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A26Q3	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A26Q4	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A26Q5	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A26Q6	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A26Q7	1853-0451	5	2	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A26Q8	1853-0388	7	1	TRANSISTOR-DUAL PNP PD=600MW	28480	1853-0388
A26Q9				NOT ASSIGNED		
A26Q10	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393

Table A26-2. A26 Linear Modulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A26Q11	1853-0018	0	2	TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A26Q12	1853-0018	0		TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A26Q13				NOT ASSIGNED		
A26Q14	1855-0421	3	4	TRANSISTOR J-FET 2N5114 P-CHAN D-MODE	17856	2N5114
A26Q15	1854-0475	5	2	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A26Q16	1855-0232	4	1	TRANSISTOR-JFET DUAL 2N5565 N-CHAN	04713	2N5565
A26Q17	1854-0477	7	3	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A26Q18	1853-0281	9	2	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A26Q19	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A26Q20	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A26Q21	1855-0421	3		TRANSISTOR J-FET 2N5114 P-CHAN D-MODE	17856	2N5114
A26Q22	1855-0421	3		TRANSISTOR J-FET 2N5114 P-CHAN D-MODE	17856	2N5114
A26Q23	1855-0386	9	1	TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A26Q24	1854-0475	5		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A26Q25	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A26Q26	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A26Q27	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A26Q28	1855-0278	8	1	TRANSISTOR J-FET 2N5116 P-CHAN D-MODE	17856	2N5116
A26Q29	1855-0421	3		TRANSISTOR J-FET 2N5114 P-CHAN D-MODE	17856	2N5114
A26Q30	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A26Q31	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A26R1	0698-6362	8	2	RESISTOR 1K .1% .125W F TC=0±25	28480	0698-6362
A26R2	0698-3450	9	2	RESISTOR 42.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-4222-F
A26R3	0698-8861	6	2	RESISTOR 6.66K .1% .125W F TC=0±25	28480	0698-8861
A26R4	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A26R5	0698-3151	7	2	RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-T0-2871-F
A26R6	0698-0084	9	2	RESISTOR 2.15K 1% .125W F TC=0±100	24546	C4-1/8-T0-2151-F
A26R7	2100-3273	1	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A26R8	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-T0-2871-F
A26R9	0757-0280	3	9	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R11	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A26R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R13	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A26R14	0698-3458	7	2	RESISTOR 348K 1% .125W F TC=0±100	28480	0698-3458
A26R15	0757-0465	6	5	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A26R16	0698-3157	3	2	RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A26R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R18	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A26R19	0698-6323	1	1	RESISTOR 100 .1% .125W F TC=0±25	28480	0698-6323
A26R20	0698-6317	3	2	RESISTOR 500 .1% .125W F TC=0±25	03888	PME55-1/8-T9-500R-B
A26R21	0698-6360	6	1	RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A26R22	0698-4433	0	1	RESISTOR 2.26K 1% .125W F TC=0±100	24546	C4-1/8-T0-2261-F
A26R23	0698-6624	5	1	RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A26R24	0757-0442	9	7	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A26R25	0757-0428	1	2	RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A26R26	0698-6363	9	2	RESISTOR 40K .1% .125W F TC=0±25	28480	0698-6363
A26R27	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A26R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R29	0698-6363	9		RESISTOR 40K .1% .125W F TC=0±25	28480	0698-6363
A26R30	0757-0401	0	4	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A26R31				NOT ASSIGNED		
A26R32				NOT ASSIGNED		
A26R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A26R34	0698-8827	4	6	RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A26R35	0698-3458	7		RESISTOR 348K 1% .125W F TC=0±100	28480	0698-3458
A26R36	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A26R37	0698-6364	0	1	RESISTOR 50 .1% .125W F TC=0±25	28480	0698-6364
A26R38	0698-6317	3		RESISTOR 500 .1% .125W F TC=0±25	03888	PME55-1/8-T9-500R-B
A26R39				NOT ASSIGNED		
A26R40	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A26R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A26R42	0698-6362	8		RESISTOR 1K .1% .125W F TC=0±25	28480	0698-6362
A26R43	2100-3353	8	3	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A26R44	0757-0462	3	2	RESISTOR 75K 1% .125W F TC=0±100	24546	C4-1/8-T0-7502-F
A26R45	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A26R46	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0±100	24546	C4-1/8-T0-2151-F
A26R47	2100-3354	9	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
A26R48	0698-3156	2	2	RESISTOR 14.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-1472-F
A26R49	2100-3355	0	2	RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	28480	2100-3355
A26R50	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-4222-F

Table A26-2. A26 Linear Modulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A26R51	2100-3355	0		RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	28480	2100-3355
A26R52	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A26R53	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A26R54	0698-3136	8	1	RESISTOR 17.8K 1% .125W F TC=0±100	24546	C4-1/8-T0-1782-F
A26R55	0811-3619	4	1	RESISTOR 260 2% .125W PWW TC=+3400±300	01686	R3129
A26R56	0757-0816	1	1	RESISTOR 681 1% .5W F TC=0±100	28480	0757-0816
A26R57	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A26R58	0698-8861	6		RESISTOR 6.66K .1% .125W F TC=0±25	28480	0698-8861
A26R59	0757-0462	3		RESISTOR 75K 1% .125W F TC=0±100	24546	C4-1/8-T0-7502-F
A26R60	0698-3152	8	2	RESISTOR 3.48K 1% .125W F TC=0±100	24546	C4-1/8-T0-3481-F
A26R61	0698-3159	5	2	RESISTOR 26.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-2612-F
A26R62	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-2612-F
A26R63	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A26R64	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R65	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R66	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-7501-F
A26R67	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-1472-F
A26R68	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A26R69	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A26R70	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A26R71	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A26R72	0698-8959	3	1	RESISTOR 619K 1% .125W F TC=0±100	28480	0698-8959
A26R73	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	28480	0698-8827
A26R74	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A26R75	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A26R76	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A26R77	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0±100	24546	C4-1/8-T0-6192-F
A26R78	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A26R79	0698-0083	8	1	RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A26R80	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A26R81	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0±100	24546	C4-1/8-T0-3481-F
A26R82	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R83	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A26R84	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A26R85	0698-3429	2	1	RESISTOR 19.6 1% .125W F TC=0±100	03888	PME55-1/8-T0-19R6-F
A26R86	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A26R87	0811-3575	1	1	RESISTOR 3K 2% .125W TC=+5600±300	28480	0811-3575
A26R88	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A26R89	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A26R90	0757-0402	1	1	RESISTOR 110 1% .125W F TC=0±100	24546	C4-1/8-T0-111-F
A26R91	2100-3350	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A26TP1	0360-0535	0	5	TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A26TP2	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A26TP3	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A26TP4	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A26TP5	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A26U1	1826-0601	0	3	IC OP AMP PRCN TO-99 PKG	06665	OP-16FJ
A26U2	1826-1007	2	1	IC OP AMP PRCN 8-TO-99 PKG	28480	1826-1007
A26U3	1826-0306	2	3	IC COMPARATOR GP QUAD 14-DIP-C PKG	27014	LM339AJ
A26U4	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A26U5	1810-0371	8	1	NETWORK-RES 8-SIP100.0K OHM X 7	01121	208A104
A26U6	1826-0306	2		IC COMPARATOR GP QUAD 14-DIP-C PKG	27014	LM339AJ
A26U7	1826-0828	3	1	IC OP AMP PRCN TO-99 PKG	06665	OP-15GJ
A26U8	1826-0601	0		IC OP AMP PRCN TO-99 PKG	06665	OP-16FJ
A26U9	1826-0306	2		IC COMPARATOR GP QUAD 14-DIP-C PKG	27014	LM339AJ
A26U10	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A26U11	1826-0161	7	1	IC OP AMP GP QUAD 14-DIP-P PKG	04713	MLM324P
A26U12	1826-0601	0		IC OP AMP PRCN TO-99 PKG	06665	OP-16FJ
A26U13	1826-0026	3	2	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A26U14	1826-0026	3		IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A26U15	1820-1730	6	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A26W1	8159-0005	0	2	RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A26W2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005

Controller
Component-Level Service F

CONTENTS

A57 MARKER/BANDCROSS

A59 DIGITAL INTERFACE

CONTENTS (Cont'd)

A60 PROCESSOR

A57 Marker/Bandcross Circuit Description

ASSEMBLY PURPOSE

The A57 marker/bandcross assembly generates the z-axis signal required to place intensity markers on an external CRT. If enabled, amplitude markers are generated by sending a marker signal to the leveling circuits. The same circuits that detect markers are used to detect band crossings or the end of sweep. These circuits both cause the sweep to stop and activate the microprocessor. Other circuits interface with the rear panel connections. During self test, hardware on this assembly verifies that the 16-bit microprocessor data bus is operating.

The sweep-event memory stores numbers that correspond to voltages on the 0-10V sweep signal. Each number stored in the memory represents a single sweep event. Sweep events are detected by the sweep comparator, which compares them against the 0-10V sweep ramp. Sweep events include:

- Turning markers on and off
- Stopping the sweep for a bandcrossing
- Stopping the sweep for the end-of-sweep and retrace

The sweep comparator DAC also finds the current sweep position when you make changes in frequency parameters during an analog sweep longer than 300 ms.

The manual sweep DAC offsets the sweep-out signal when the instrument is in CW or manual mode.

The sweep control block allows the sweep to be stopped either from the rear panel, or by the sweep comparator. With the CRT Z-axis control circuits, the sweep can be blanked on a display for bandcrossing or retrace, and markers can be intensified.

The A57 marker/bandcross assembly uses the LBX (low bandcross) signal to stop the analog sweep at positions previously loaded in the sweep event memory by the microprocessor. When LBX is low, the A59 digital interface causes the microprocessor to run, allowing the microprocessor to perform the tasks necessary for the sweep to proceed. This happens either at a bandcrossing, or at retrace at the end of a sweep.

SWEEP EVENT DETECTION (BLOCKS A, B, C, D, E, and F)

A Sweep Event and How it's Loaded

A sweep event is a marker, a band crossing, or the end of sweep. Prior to the beginning of a sweep, the microprocessor stores (in the sweep event memory, block B) a series of numbers that correspond to all the sweep events to take place during that sweep. The numbers load as follows:

1. The microprocessor sets the address register (block A) to 0 (i.e. sets data bits zero through six to 0, and outputs address 12,R3:).
2. The microprocessor writes a series of numbers into the sweep event memory (block B) that correspond to the upcoming sweep events. The address register (block A) automatically increments after each write to memory.
3. The microprocessor sets the address register (block A) back to 0.

How the Number and Position of Sweep Events are Determined

Before a sweep begins, the microprocessor determines the number of sweep events. For example, for a sweep having one bandcrossing and one marker, there are four sweep events:

1. Beginning of marker
2. End of marker
3. Bandcrossing
4. End of sweep

After determining the number of sweep events, the microprocessor computes the point in the sweep that each event occurs, and converts this information to a number from 0 to 999 that corresponds to the 0 to 10V sweep.

How Sweep Events are Executed

The series of numbers that defines the location of sweep events is written into the sweep event memory (block B) via data lines B0 through B9. When the address register (block A) is set to location 0, the first number stored in memory appears at the input of the sweep comparator DAC (block D). The DAC converts this number to a voltage between 0 and 10V. This voltage does not appear at the DAC output, but is compared internally to the marker ramp (MKR RMP) 0 to 10V signal. When the MKR RMP rises to the voltage to which the DAC is set, the DAC fires a comparator and the first sweep event occurs.

When the first sweep event occurs, the marker and bandcross flip flops (block F) are clocked, and their data (taken from data bits 10 and 11 of the RAM) determine the type of sweep event. Two sweep events create a marker; the first event turns the marker on, and the second turns it off. Markers are 2/1000 of the display width.

What Happens when You Change Sweep Parameters

If you change a frequency parameter in the middle of a slow sweep (300 ms or longer), the sweep event detection circuitry (blocks A through F) determines the position of the sweep, and allows the instrument to phase-lock to a frequency appropriate to that sweep position. For faster sweep times, the instrument waits until the beginning of the next sweep to make frequency changes.

ADDRESS REGISTER (BLOCK A)

Counter Register

A 6-bit counter register presets when the microprocessor writes to I/O address 12,R3:.

Address Register

The address register is counted or incremented in one of two ways:

- The microprocessor writes to I/O address 12,R0:
- RAM data timer (block E)

The timer signals that a sweep event has occurred and tells the sweep event detection circuitry (blocks A through F) to get ready for the next sweep event.

The address register outputs (A0 through A6) are used to address the sweep event memory (block B).

SWEEP EVENT MEMORY (BLOCK B)

Each RAM contains 128 8-bit bytes, which are combined to provide 128 16-bit words of memory. Sweep events are stored in RAM when the microprocessor writes to I/O address 12,R0:. In normal operation, approximately 15 words of memory are used for a full-band sweep with all five markers on, each location corresponding to the position and type of a single sweep event.

READ/WRITE RAM BUFFER (BLOCK C)

Bidirectional Buffer

A 16-bit bidirectional buffer connects the microprocessor with the sweep event memory (block B). When the microprocessor sends I/O address 12,R0:, the buffer transfers data from the instrument data bus (DB0 through DB15) to B0 through B15.

When the microprocessor sends I/O address 12,R2: data is transferred in the opposite direction, i.e. from the sweep event memory to the microprocessor.

SWEEP COMPARATOR (BLOCK D)

Digital-to-Analog Converter (DAC)

The output of a 10-bit DAC is compared to the 0-to-10V MKR RMP (marker ramp). At the beginning of a sweep, the DAC output is below 0V. When the voltage applied by the MKR RMP equals the digital number at the DAC input, the output goes above 0V.

Comparator

A comparator trips when the DAC output rises above 0V. Two feedback resistors provide a 2 mV offset to the positive input of the comparator to ensure that it does not change states due to noise on the MKR RMP.

10V End of Sweep Adjust

Use the 10V END of SWP ADJ (R32) to set the end of sweep voltage to 10.000V.

RAM DATA UNSTABLE TIMER (BLOCK E)

This circuit debounces the sweep comparator output (block D) and increments the address register (block A) after each sweep event is detected.

MARKER/BANDCROSS FLIP-FLOPS (BLOCK F)

Control signals from the sweep event memory (block B) indicate the type of sweep event. At a bandcrossing, the sweep stops so that the microprocessor can initiate phase-lock for that bandcrossing (with the low bandcross signal, LBX). At a marker, however, the sweep does not stop; the marker is generated as the sweep continues.

MANUAL SWEEP DAC (BLOCK G)

The manual sweep DAC is used only in the MANUAL SWEEP mode. In this mode, MKR RAMP is 0V. SWEEP OUT results from either the manual sweep DAC (when MANUAL SWEEP is selected), or the MKR RAMP (when MANUAL SWEEP is not selected).

Manual Gain (MAN GAIN)

In MANUAL SWEEP, with the frequency set to the maximum possible value for a given sweep (the STOP frequency), the manual gain adjustment (R33) is used to set 10:000V at the sweep output.

SWEEP OUTPUTS (BLOCK H)

SWEEP OUT is buffered by two operational amplifiers that are connected to the front and rear panel sweep output connectors. These operational amplifiers sense and remove unwanted low frequency noise on the output connectors.

READ STATUS BUFFER (BLOCK I)

Reading from I/O address 12,R1:, the microprocessor can (using the READ STATUS BUFFER) monitor the state of the following signals:

- The sweep comparator (CMP)
- The marker flip-flop (MKR)
- The high sweep (HSP) line

CONTROL REGISTER (BLOCK J)

The control register enables the microprocessor to directly control the state of the various interface lines connected to the register by writing data to I/O address 13.R3:.

Marker Generation

An AND gate controls the RF marker signal (HMRKR). When this signal is high, the RF power control circuits slightly decrease the RF power to create a marker.

MICROPROCESSOR READ and WRITE STROBES (BLOCK K)

The instrument microprocessor outputs I/O address information on the I/O address bus (ADR0 through ADR4, and SIOA). The decoder decodes the address information and generates the appropriate strobe.

Strobes

The strobes generated by the decoder are used throughout this assembly either to clock registers (causing them to store data found on the I/O data bus), or to enable buffers to place data on the I/O data bus for the microprocessor to read.

SWEEP TRIGGER (BLOCK L)

Multiplexer

A multiplexer selects either LINE or EXT trigger when the microprocessor outputs the appropriate bits to the instrument data bus (DB10 through DB13).

Shift Register

The shift register enables the appropriate multiplexer input (pin 7 high selects line trigger; pin 5 high selects external trigger). The register also disables the RAM Data Unstable Timer (block E).

The shift register also controls the ZON (Z-axis on) line. When this signal is high, the Z-AXIS output (block N) is forced to +5V.

3-to-8 Decoder

The 3-to-8 decoder generates 500 ns pulses each time the microprocessor writes to I/O address 13,R1:. By writing the appropriate numbers to this register, one of the following happens:

- The sweep starts
- The sweep stops
- Trigger enable
- The marker bandcross flip-flop clears

Stop Sweep

The output flip-flop controls the end of sweep. When the output is low, the sweep stops. If the sweep is already stopped, the STOP SWEEP signal inhibits new sweeps.

STOP SWEEP CONTROL (BLOCK M)

Stopping the Sweep

The sweep is stopped when:

- The bandcross signal (LBX) is applied from:
  a. Sweep Event Detection (block F)
  b. The sweep generator assembly. This **only** happens if the marker/bandcross assembly fails to stop the sweep before it reaches 12V.
- The microprocessor tells the Sweep Trigger (block L) to stop.
- The LSSP (low stop sweep) rear panel BNC is held low.

Low Stop Sweep (LSSP)

LSSP is an IN/OUT signal. As an input signal, it prevents HSP (high sweep) from going high when LSSP is low. HSP goes to all devices in the instrument that need to respond to the sweep starting and stopping. As an output signal, LSSP is active high.

CRT Z-AXIS CONTROL (BLOCK N)

The Z-AXIS signal is used to drive the Z-axis input of a CRT display.

Beam Intensity

When this signal is 0V, the display turns its beam on with normal brightness.
When this signal is +5V, the display turns the beam off (blanks).
When this signal is −5V, the display intensifies the beam.

The Z-AXIS signal can be used to turn the display off for bandcrossings, when the sweep is reset (sweep retrace), or at other times when the instrument is waiting for a sweep to start. Z-AXIS can also be used to show markers by brightening the display at that point on the trace.

INTERFACE SIGNALS

When the synthesizer is connected to the following equipment, the signals listed below are required from this assembly:

HP 8410B Interface

- 0-to-10V SWEEP (drives display X-axis)
- STOP SWP (allows the HP 8410B to stop the sweep)
- NEG BLANK (for display blanking)
- Z-AXIS (to generate markers on the display)
- HP 8410 EXT TRIG (to initiate HP 8410 phase lock when the synthesizer phase locks)

HP 8755C Interface

- 0 to 10V SWEEP (drives display X-axis)
- Z-AXIS (controls blanking and marker generation)
- L ALTEN (low indicates alternate mode enabled)
- L ALTSEL (low indicates alternate state active)
- L RETRACE (low indicates retrace used to synchronize with the start of sweep).

Plotter Interface

- MUTE (to freeze the servo for bandcrossings)
- PEN LIFT (to raise the pen for retrace and, optionally, for bandcrossings)
- 0 to 10V SWEEP (to drive the X-axis)

HOW TO CHECK THE MICROPROCESSOR I/O ADDRESS STROBES

U28 (block K) is connected to the I/O address bus, and generates all the I/O strobes used on this assembly. You can check the strobes on the output of U28 using the front panel to write directly to U28's I/O address while monitoring its outputs:

1. Press **[INSTR PRESET] [MANUAL]**
2. Connect a logic probe to the output you wish to check.
3. At the front panel, enter the corresponding I/O address (from the schematic).

   Example: Address 12,R0: (WRITE RAM) is entered:

   [SHIFT] [GHz] [1] [2] [Hz] (the channel)
   [SHIFT] [MHz] [0] [Hz] (the subchannel)
   [SHIFT] [Khz] (makes the entry)
4. Make entries by pressing the step keys, using the front panel knob, or using the data pad. Each entry generates an active low signal, approximately 500 ns wide, that you can monitor with the logic probe, or see on a storage oscilloscope. Refer to COMPONENT LEVEL SERVICE, in volume 1 for more information on direct I/O addressing.

HOW TO CHECK THE MICROPROCESSOR OUTPUT DEVICES

The following are microprocessor output devices:

U1 (block A)
U8 (block C)
U9 (block G)
U10 (block A)
U16 (block C)
U17 (block G)
U18 (block L)
U23 (block J)
U25 (block L)

These can be checked using direct I/O addressing, as described above.

HOW TO CHECK THE MICROPROCESSOR INPUT DEVICES

The following are microprocessor input devices:

U8 (block C)
U16 (block C)
U24 (block I)

These can be checked using direct I/O addressing. After setting the address, press **[SHIFT] [Hz]**. Each time you press **[Hz]**, the instrument reads from the addressed device and displays the results in the entry display, in both decimal and octal formats. To check each input, monitor the outputs and short DB0 to DB15 to +5V or ground.

HOW TO CHECK THE SWEEP DETECTION CIRCUITS (BLOCKS A THROUGH F)

Verify the Problem is in Blocks A through F

1. Press **[INSTR PRESET] [SWEEP TIME] [2] [0] [SEC] [SHIFT] [M2]**.
2. Check the front panel POWER dBm display. It should indicate the band number as the instrument goes from band to band.

   If the number is not changing, LBX (low bandcross; block F) is not being generated.

   If the numbers count rapidly from 1 through 5, LBX is not being pulled low, as it should be when the sweep progresses.
3. Check that the front panel green SWEEP LED goes out at band crossings.

How to Check the Sweep Event Detection Circuitry

1. Press **[INSTR PRESET]**
   [START] [3] [GHz]
   [STOP] [6] [GHz]
   [M1] [4] [GHz]
   [M2] [5] [GHz]
   [MKR Δ] [1]
2. Using an oscilloscope, monitor the sweep output and the Z-axis signal. The sweep output should stop at 10V before it is reset for the next sweep. If the sweep goes to 12V, there is a problem in block F.
3. Check the Z-axis signal to see if the delta marker is on for the middle portion of the sweep. Turn off the delta marker and see if two markers are indicated by the Z-axis signal.
4. U6 pin 7 should have a pulse for each sweep event. If not, slow the sweep to 200s and turn all markers off. Measure the inputs of U3 to see if the binary number input is correct [decimal = 1000; binary = (bit 10) 1 1 1 1 1 0 1 0 0 0 (bit 0)]. this number represents a 10V set point for the comparator.
5. Check the RAM Data Unstable Timer (block E) for the 5.7 μs and 200 ns pulse widths:

   Press **[INSTR PRESET].**
   Clock an oscilloscope on the CMP signal (block D, U6 pin 7).
6. If you suspect U2 and U15, check A0 through A6 using digital signature analysis (refer to I/O data test in the A60 processor assembly troubleshooting). If the signatures are incorrect, make sure that the RAM Data Unstable Timer (block E) is not clocking the address register. Disable this by placing the instrument in MANUAL mode while performing the test.

How to Troubleshoot Blocks A through F

Block D:

1. Press **[INSTR PRESET] [VF] [1] [Mz] [SWEEP TIME] [1] [0] [SEC]**.
2. Check that U3 pin 16 has a 10s, 0 to 10V ramp.
3. Check that the B9 through B0 inputs of DAC U3 read:

   (B9) 1 1 1 1 1 0 1 0 0 0 (B0)

NOTE: 1 = TTL high

4. Check U3 pin15. It should be below 0V until the sweep gets to 10V. As the sweep rises above 10V, the voltage at pin 15 should rise above 0V, and comparator U6 should fire, forcing CMP (U6 pin 7) high for approximately 50 ms.

Block E:

1. Press **[INSTR PRESET] [VF] [1] [MHz]**.
2. Using an oscilloscope, trigger on the rising edge of CMP (U6 pin 7). Check that U5B has a 700 ns positive pulse at pin 5, and an inverted, identical pulse at pin 12.
3. Check that each time U5B fires, U5A also fires, creating a 5.7 µs positive pulse at U5A pin 13.
4. Check that U5B pin 11 is not stuck low. It should go low only when the synthesizer is not sweeping.

Block F:

1. Press **[INSTR PRESET]**
   [START] [1] [GHz]
   [STOP] [1] [3] [GHz]
   [SWEEP TIME] [1] [0] [0] [msec]
   [M1] [8] [GHz]
   [M2] [1] [1] [GHz]
   [MKR Δ]
2. U11B pin 9 (MKR) should repetitively be high for 30 ms, then low for approximately 100 ms.
3. U11A pin 5 should go high for approximately 50 ms when TP5 (SWEEP OUT) reaches approximately 4V. When TP5 reaches 10V, there should be another 50 ms pulse.
4. U11A pin 1 should have a single 500 ns pulse applied by U25 block L) at the end of each sweep. If not, check U25 using direct I/O addressing.

Block C:

Bidirectional buffers U8 and U16 are thoroughly verified by the instrument preset/ power on tests. If the instrument front panel check LED II is off, the buffers are good. Use direct I/O addressing to verify that data can be sent from DB0-DB15 to B0-B15. To verify the other direction (B0-B15 to DB0-DB15):

1. Press **[INSTR PRESET] [SINGLE]** sweep.
2. Do a read from address 12,R2: (reads sweep event from RAM):
   a. Press **[SHIFT] [GHz]**.
   b. Enter address **[1] [2]** and press any terminator (**[GHz]**, **[MHz]**, **[kHz]**, or **[Hz]**).
   c. Press **[SHIFT] [MHz]**.
   d. Enter subchannel **[2]** and press any terminator.
   e. Read (press **[SHIFT] [Hz]**.

NOTE: You can control the synthesizer bandcross selection as follows:

Enable: **[SHIFT] [MHz] [2] [3] [Hz] [SHIFT] [kHz] [0] [Hz]**
Advance: **[SHIFT] [MHz] [2] [2] [Hz] [SHIFT] [kHz] [0] [Hz]**
Disable: **[SHIFT] [MHz] [2] [4][Hz] [SHIFT] [kHz] [0] [Hz]**

3. The entry display should show an octal number and its decimal equivalent. Convert the octal number to a binary number. This is the number that should be on B0 through B15.

   For B0 through B15 to be correct, the SWEEP EVENT MEMORY must have been properly loaded with this number. This is done through U8 and U16. First check that U8 and U16 can transfer data from the instrument data bus to the marker bandcross bus.

   Before replacing U8 or U16, verify that the two I/O strobes 12,R2: and 12,R0: are generated by U29 (block K). If the problem only involves a few bits, the self test LEDs on the A60 processor assembly can be used to indicate which bits are incorrect. If all LEDs are on, the problem may have to do with blocks A, B, E, or K.

Block A:

1. Press **[INSTR PRESET] [SINGLE]** sweep
   [SHIFT] [MHz] [2] [3] [Hz] [SHIFT] [kHz] [0] [Hz]
   [SHIFT] [GHz]
   [1] [2] [Hz]
   [SHIFT] [MHz]
   [3] [Hz]
   [SHIFT] [kHz] (write)
   [0] [Hz]

   This should clear U1 and U10. Verify that lines A0 through A6 are low.

2. Using the front panel, enter:

   [1], [2], [4], [8], [1] [6], [3] [2], [6] [4]

   These entries should latch into U1 and U10, and appear on the A0 through A6 lines.

   Example: When you enter 16, the A bus should read:

   (A6) 0 0 1 0 0 0 0 (A0)

3. Press **[0] [Hz]**
   [MHz] [0] [Hz]

   The A bus lines should be all low. Note that each time you press a **[STEP]** key, the number on the A bus increments by 1.

   0 = (A6) 0 0 0 0 0 0 0 (A0)
   32 = (A6) 0 1 0 0 0 0 0 (A0)
   15 = (A6) 0 0 0 1 1 1 1 (A0)

   U29B pin 5 should be high throughout this entire test. U29B pin 6 should follow U29B pin 4.

Block B:

Use direct I/O addressing to check that the READ/WRITE RAM BUFFER (block C) can place data on the B-BUS (B0 through B15). Check that U8 and U16 can read the B-BUS:

1. Press **[INSTR PRESET] [SINGLE]** sweep
   [SHIFT] [GHz]
   [1] [2] [Hz]
   [SHIFT] [MHz]
   [2] [Hz]
   [SHIFT] [Hz] to read
   [SHIFT] [MHz] [2]
   [SHIFT] [Hz]

2. Alternately short each B-BUS line to +5V and ground. After each short, press **[SHIFT] [Hz]**, and note that the octal number in the entry display indicates the appropriate bit forced high for shorts to +5V and low for shorts to ground.

3. If all lines pass step 2, you can store and read back numbers in the SWEEP EVENT RAM as follows:

   Press **[INSTR PRESET]**
   [SHIFT] [MHz] [2] [3] [Hz] [SHIFT] [kHz] [0] [Hz]
   [SHIFT] [SINGLE]
   [SHIFT] [GHz]
   [1] [2] [Hz]

4. Write to locations in RAM:

   Press **[SHIFT] [MHz]**
   [3] [Hz]
   [SHIFT] [kHz]
   [a] [a] [a] [Hz] (aaa = RAM address from 0 through 127)

   Press **[SHIFT] [MHz]**
   [0] [Hz]
   [SHIFT] [kHz]
   [d] [d] [d] [Hz] (ddd = data to be written to RAM)

   It is only necessary to check through address 15. Verify that the numbers are properly stored in RAM:

   Press **[SHIFT] [MHz]**
   [3] [Hz]
   [SHIFT] [kHz]
   [a] [a] [a] [Hz]
   [SHIFT] [MHz]
   [2] [Hz]
   [SHIFT] [Hz]

NOTE: aaa is the RAM address. The read data from the RAM is displayed in decimal and octal in the entry display. Verify that it matches the sequence of numbers entered.

HOW TO TROUBLESHOOT BLOCKS G THROUGH N

To check the Manual Sweep DAC (block G) and the Sweep Outputs (block H)

1. Put the instrument in MANUAL mode.
2. While monitoring the sweep outputs on the front or rear panel, turn the front panel knob and check that the voltage is 10V when the frequency is as high as possible, and 0V when the frequency is adjusted as low as possible. The voltage should be continuously variable between 10 and 0V.

To check the Sweep Trigger (block L) and the Control Register (block J)

1. Press **[INSTR PRESET] [TIME] [2] [0] [sec]**. Note that the sweep stops.
2. Provide an external trigger and verify that the green SWEEP LED is on during the sweep, and out momentarily for each bandcrossing and for the end of sweep.
3. Press the **[EXT]** trigger.
4. Verify that the instrument makes a complete sweep but does not continue to sweep.
5. Check the line trigger:

   Press **[ΔF] [1] [MHz]**. Check that the sweep repetition rate is slower when in LINE trigger.

Table A57-1. A57 Marker/Bandcross P1 Pin I/O (1 of 3)

Pin	Mnemonic	Levels	Source	Destination
1 56	GND PLANE 0V GND PLANE	INSTRUMENT GROUND 0V	*0 INSTRUMENT GROUND	*0
2 57	HMRKR LINE TRIG	TTL (HIGH TRUE) LINE FREQ 7 TO 10V	J A62-CR1 CATHODE/A62R1	XA26P1-43 L
3 58	LRETRACE	TTL (LOW TRUE)	J	F A62J31-11, 25
4 59	LALTSEL	TTL (LOW TRUE)	J	A62J31-10, 24
5 60	LALTEN	TTL (LOW TRUE)	J	A62J31-9, 23
6 61	MUTE	TTL (HIGH TRUE)	J	A62J31-8, 22
7 62	8410 TRIG	TTL	J	A62J31-7
8 63				
9 64				
10 65				
11 66				
12 67	HMRKR	TTL (HIGH TRUE)	J	XA26P1-43
13 68	HSP LINE TRIG	TTL (HIGH TRUE) LINE FREQ 7 TO 10V	M A62-CR1 CATHODE/A62R1	*I N L
14 69	LIPS LBX	TTL (LOW TRUE) TTL (LOW TRUE)	XA52P1-36/A62J1-19 *F	*NOT USED M XA59-69
15 70	SIOA GND PLANE	TTL (LOW TRUE) 0V	XA60P1-15 INSTRUMENT GROUND	*K *0
16 71	SIOB GND PLANE	TTL (LOW TRUE) 0V	XA60P1-16 INSTRUMENT GROUND	*NOT USED *0
17 72	ADR0 GND PLANE	TTL 0V	XA60P1-17 INSTRUMENT GROUND	*K *0
18 73	ADR2 ADR1	TTL TTL	XA60P1-18 XA60P1-73	*K *K
19 74	ADR4 ADR3	TTL TTL	XA60P1-19 XA60P1-74	*K *K

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A57-1. A57 Marker/Bandcross P1 Pin I/O (2 of 3)

Pin	Mnemonic	Levels	Source	Destination
20 75	DB0 GND PLANE	TTL 0V	*C XA60P1-20 INSTRUMENT GROUND	*A C G J *O
21 76	DB2 DB1	TTL TTL	*C XA60P1-21 *C XA60P1-76	*A C G J *A C G J
22 77	DB4 DB3	TTL TTL	*C XA60P1-22 *C XA60P1-77	*A C G J *A C G J
23 78	DB6 DB5	TTL TTL	*C XA60P1-23 *C XA60P1-78	*A C G J *A C G J
24 79	DB8 DB7	TTL TTL	*C XA60P1-24 *C XA60P1-79	*C G *C G J
25 80	DB10 DB9	TTL TTL	*C I XA60P1-25 *C XA60 1-80	*C L *C G
26 81	DB12 DB11	TTL TTL	*C I XA60P1-26 *C I XA60P1-81	*C L *C L
27 82	DB14 DB13	TTL TTL	*C I XA60P1-27 *C I XA60P1-82	*C L *C L
28 83	DB15	TTL	*C I XA60P1-83	*C L
29 84	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*O *O
30 85	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*O *O
31 86	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*O *O
32 87				
33 88				
34 89	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*O *O
35 90	+20V +20V	+20V +20V	XA52P1-16, 40 XA52P1-16, 40	*O *O
36 91	+5.2V +12V	+5.2V +12V	XA52P1-17, 18, 41, 42 XA52P1-9, 33	*O *NOT USED
37 92	+5.2V +5.2V	+5.2V +5.2V	XA52P1-17, 18, 41, 42 XA52P1-17, 18, 41, 42	*O *O

A single letter in the source or destination column refers to a function block on this assembly schematic.

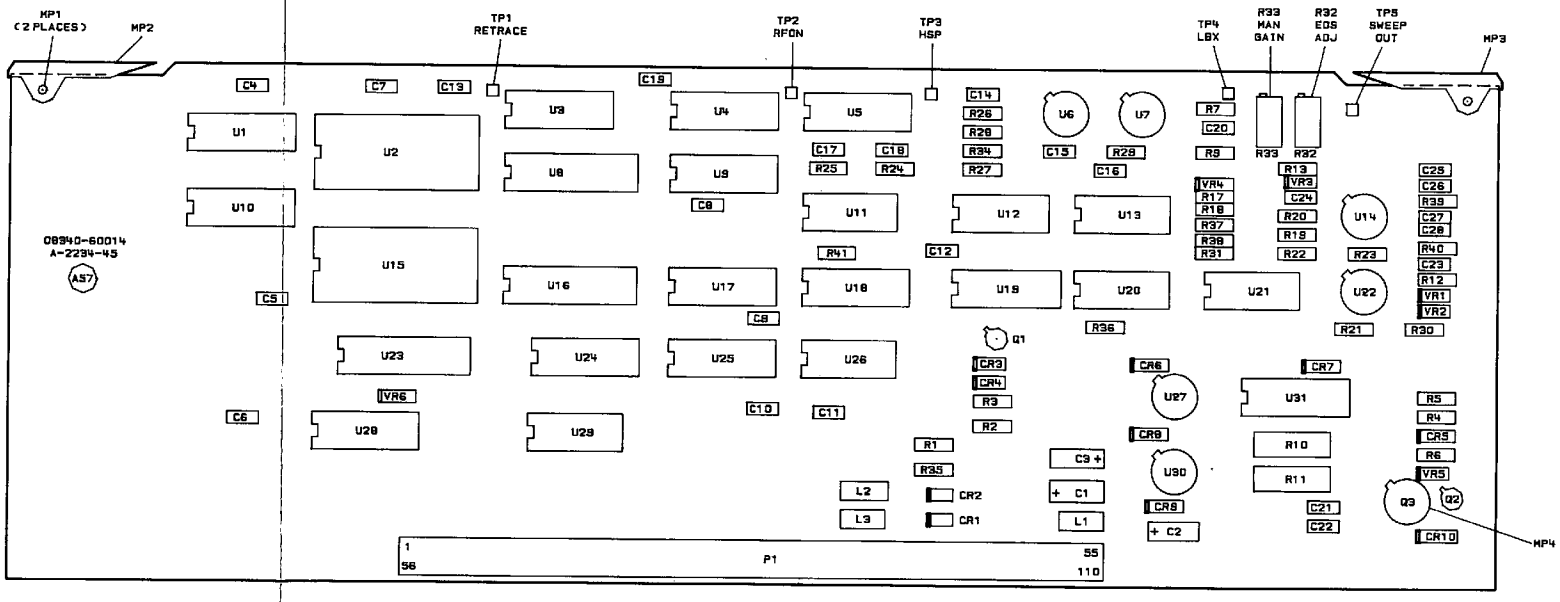
An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A57-1. A57 Marker/Bandcross P1 Pin I/O (3 of 3)

Pin	Mnemonic	Levels	Source	Destination
38 93	−15V −5.2V	−15V −5.2V	XA56P1-15, 30 XA53P1-18, 36	*O *O
39 94	−10V −10V	−10V −10V	XA53P1-12, 13, 31, 32 XA53P1-12, 13, 31, 32	*NOT USED *NOT USED
40 95	GND PLANE	0V	INSTRUMENT GROUND	*O
41 96	NEG BLANK MKR RMP	0, +5V 0 TO 10V SWEEP	N XA58P1-96	A62J31-1, 15 D G
42 97	RFSWP Z-AXIS BLANK	10V/SWEEP +5V/−5V	H N	XA27P1-17 A62J31-2, 16
43 98	FPNLSWP	10V/SWEEP	H	A62J9-SMC CENTER
44 99	RPNLSWP FPNLSWP RTN	10V/SWEEP 0V	H H	A62J8-SMC CENTER
45 100	RGND RPNLSWP RTN	0V 0V	STAR GND POINT H	*O *
46 101	RGND RGND	0V 0V	STAR GND POINT STAR GND POINT	*O *O
47 102				
48 103				
49 104	HULH	TTL (HIGH TRUE)	A62J19-16	*NOT USED
50 105	HRFON	TTL (HIGH TRUE)	J	*
51 106	EXT TRIG	EXTERNAL SOURCE LEVEL	A62J31-4, 18	L A62J31-4, 18
52 107	LSSP	TTL (LOW TRUE)	M	A62J31-5, 19
53 108	PEN LIFT	CLAMP AT 56V	J	A62J31-6, 20
54 109	LSRQ PEN LIFT RTN	TTL (LOW TRUE) 0V	* J	*NOT USED A62J31-21
55 110	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*O *O

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60014

Figure A57-1. A57 Marker/Bandcross, Component Location Diagram

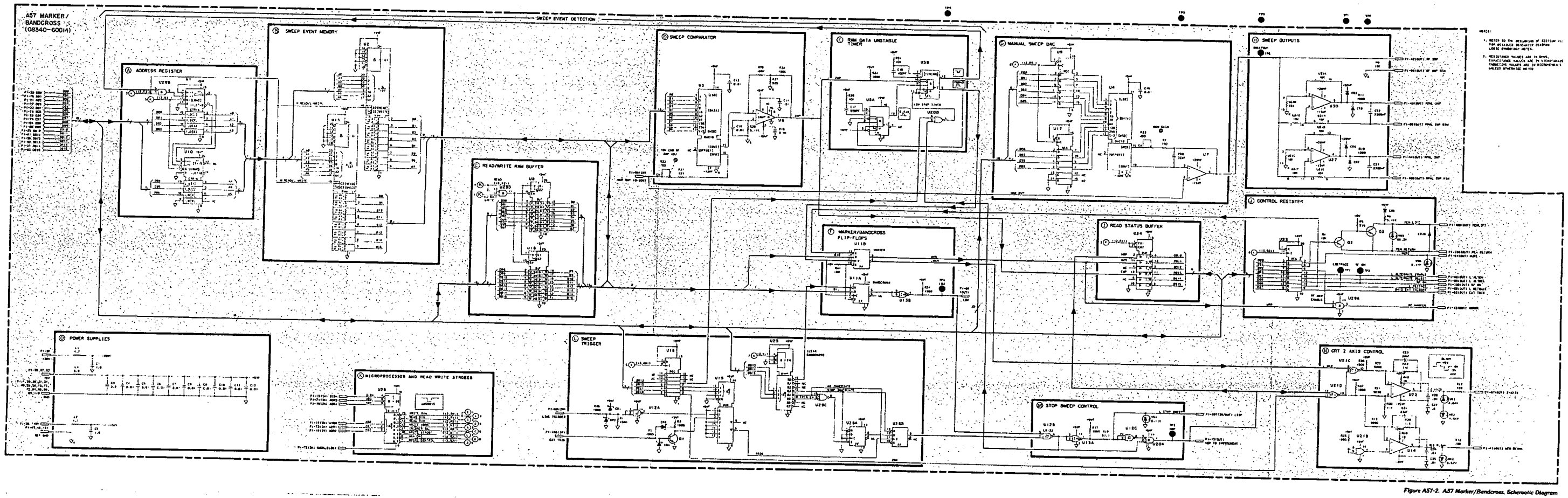


Figure A57-2. A57 Marker/Bandcross, Schematic Diagram

Table A57-2. A57 Marker/Bandcross Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A57	**08340-60014**	**5**	**1**	**MARKER/BANDCROSS ASSEMBLY**	**28480**	**08340-60014**
A57C1	0180-0291	3	2	CAPACITOR-FXD 1UF ±10% 35VDC TA	56289	150D105X9035A2
A57C2	0180-0291	3		CAPACITOR-FXD 1UF ±10% 35VDC TA	56289	150D105X9035A2
A57C3	0180-0197	8	1	CAPACITOR-FXD 2.2UF ±10% 20VDC TA	56289	150D225X9020A2
A57C4	0160-4832	4	18	CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C5	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C6	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C7	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C8	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C9	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C10	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C11	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C12	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C13	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C14	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C15	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C16	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C17	0160-4823	3	1	CAPACITOR-FXD 820PF ±5% 100VDC CER	28480	0160-4823
A57C18	0160-4801	7	1	CAPACITOR-FXD 100PF ±5% 100VDC CER	28480	0160-4801
A57C19	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C20	0160-4807	3	3	CAPACITOR-FXD 33PF ±5% 100VDC CER 0±30	28480	0160-4807
A57C21	0160-4819	7	2	CAPACITOR-FXD 2200PF ±5% 100VDC CER	28480	0160-4819
A57C22	0160-4819	7		CAPACITOR-FXD 2200PF ±5% 100VDC CER	28480	0160-4819
A57C23	0160-4807	3		CAPACITOR-FXD 33PF ±5% 100VDC CER 0±30	28480	0160-4807
A57C24	0160-4807	3		CAPACITOR-FXD 33PF ±5% 100VDC CER 0±30	28480	0160-4807
A57C25	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C26	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C27	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57C28	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A57CR1	1901-0535	9	4	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A57CR2	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A57CR3	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A57CR4	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A57CR5	1901-0033	2	6	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A57CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A57CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A57CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A57CR9	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A57CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A57L1	9100-3562	8	2	INDUCTOR RF-CH-MLD 4.7UH 5% .166DX.385LG	28480	9100-3562
A57L2	9100-3562	8		INDUCTOR RF-CH-MLD 4.7UH 5% .166DX.385LG	28480	9100-3562
A57L3	9100-1788	6	1	CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A57MP1, 2	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A57MP3	4040-0753	0	1	EXTR-PC BD GRN POLYC .062-BD-THKNS	28480	4040-0753
A57MP4	4040-0755	2	1	EXTR-PC BD VIO POLYC .062-BD-THKNS	28480	4040-0755
A57P1	1251-7469	3	1	CONN – POST TYPE	28480	1251-7469
A57Q1	1854-0404	0	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A57Q2	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A57Q3	1854-0361	8	1	TRANSISTOR NPN 2N4239 SI TO-5 PD=6W	04713	2N4239
A57R1	0757-0280	3	8	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A57R2	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A57R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A57R4	0757-0442	9	4	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A57R5	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0±100	24546	C4-1/8-T0-215R-F
A57R6	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A57R7	0757-0402	1	1	RESISTOR 110 1% .125W F TC=0±100 (RECOMMENDED REPLACEMENT)	24546	C4-1/8-T0-110R-F
A57R8				NOT ASSIGNED		
A57R9	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0±100	24546	C4-1/8-T0-121R-F
A57R10	0690-1021	0	2	RESISTOR 1K 10% 1W CC TC=0+647	01121	GB1021
A57R11	0690-1021	0		RESISTOR 1K 10% 1W CC TC=0+647	01121	GB1021
A57R12	0757-0401	0	2	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A57R13	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A57R14-16				NOT ASSIGNED		
A57R17	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A57R18	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A57R19	0757-0288	1	3	RESISTOR 9.09K 1% .125W F TC=0±100	19701	MF4C1/8-T0-9091-F
A57R20	0757-0443	0	3	RESISTOR 11K 1% .125W F TC=0±100	24546	C4-1/8-T0-1102-F
A57R21	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0±100	19701	MF4C1/8-T0-9091-F
A57R22	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0±100	19701	MF4C1/8-T0-9091-F

Table A57-2. A57 Marker/Bandcross Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A57R23	0757-0443	0		RESISTOR 11K 1% .125W F TC=0±100	24546	C4-1/8-T0-1102-F
A57R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A57R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A57R26	0757-0465	6	2	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A57R27	0757-0421	4	1	RESISTOR 825 1% .125W F TC=0±100	24546	C4-1/8-T0-825R-F
A57R28	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A57R29	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A57R30	0757-0443	0		RESISTOR 11K 1% .125W F TC=0±100	24546	C4-1/8-T0-1102-F
A57R31	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A57R32	2100-3757	6	1	RESISTOR-TRMR 100 10% C SIDE-ADJ 17-TRN	28480	2100-3757
A57R33	2100-3757	6	1	RESISTOR-TRMR 100 10% C SIDE-ADJ 17-TRN (RECOMMENDED REPLACEMENT)	28480	2100-3757
A57R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A57R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A57R36	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A57R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A57R38	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A57R39	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A57R40	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A57R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A57TP1	0360-2050	8	5	TEST POINT	28480	0360-2050
A57TP2	0360-2050	8		TEST POINT	28480	0360-2050
A57TP3	0360-2050	8		TEST POINT	28480	0360-2050
A57TP4	0360-2050	8		TEST POINT	28480	0360-2050
A57TP5	0360-2050	8		TEST POINT	28480	0360-2050
A57U1	1820-1194	6	2	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A57U2	1818-0135	8	2	IC NMOS 1024 (1K) STAT RAM 360-NS 3-S	04713	MCM68A10L
A57U3	1820-1984	2	2	IC CONV 10-B-D/A 16-DIP-C PKG	24355	AD561KD
A57U4	1820-1984	2		IC CONV 10-B-D/A 16-DIP-C PKG	24355	AD561KD
A57U5	1820-1437	0	1	IC MV TTL LS MONOSTBL DUAL	01295	SN74LS221N
A57U6	1826-0098	9	1	IC COMPARATOR PRCN TO-99 PKG	27014	LM211H
A57U7	1826-0471	2	3	IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A57U8	1820-2075	4	2	IC MISC TTL LS	01295	SN74LS245N
A57U9	1820-1196	8	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A57U10	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A57U11	1820-1112	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A57U12	1820-1425	6	1	IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74LS132N
A57U13	1820-1272	1	1	IC BFR TTL LS NOR QUAD 2-INP	01295	SN74LS33N
A57U14	1826-0081	0	2	IC OP AMP WB TO-99 PKG	27014	LM318H
A57U15	1818-0135	8		IC NMOS 1024 (1K) STAT RAM 360-NS 3-S	04713	MCM68A10L
A57U16	1820-2075	4		IC MISC TTL LS	01295	SN74LS245N
A57U17	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A57U18	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A57U19	1820-1298	1	1	IC MUXR/DATA-SEL TTL LS 8-TO-1-LINE	01295	SN74LS251N
A57U20	1820-1144	6	2	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A57U21	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A57U22	1826-0081	0		IC OP AMP WB TO-99 PKG	27014	LM318H
A57U23	1820-1730	6	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A57U24	1820-1491	6	1	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A57U25	1820-1216	3	2	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A57U26	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A57U27	1826-0471	2		IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A57U28	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A57U29	1820-1201	6	1	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A57U30	1826-0471	2		IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A57U31	1810-0583	4	1	NETWORK-RES 16-DIP10.0K OHM X 8	28480	1810-0583
A57VR1	1902-3104	6	3	DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A57VR2	1902-3104	6		DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A57VR3	1902-3104	6		DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A57VR4	1902-0579	3	2	DIODE-ZNR 5.1V 5% PD=1W IR=10UA	28480	1902-0579
A57VR5	1902-3357	1	1	DIODE-ZNR 56.2V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3357
A57VR6	1902-0579	3		DIODE-ZNR 5.1V 5% PD=1W IR=10UA	28480	1902-0579

A59 Digital Interface Circuit Description

ASSEMBLY PURPOSE

The digital interface links the microprocessor to the sweep generator, the reference M/N oscillator, and the 20-30 synthesizer. The microprocessor read/write strobes enable buffers that either send data to the microprocessor, or clock registers that store data sent from the microprocessor. Several strobes also operate registers on other assemblies.

The digital interface assembly connects to the 16-bit data bus (DB0 to DB15). Using the LSTP (low stop) signal, this assembly can stop all microprocessor operations when all current tasks are completed. When the microprocessor stops, the RUN LED on the processor assembly turns off. LSTP stops the microprocessor when it is not needed, or when it is necessary to eliminate all potential sources of digital noise (e.g. during forward sweeps).

When the LSTP signal releases the microprocessor to perform a task, the microprocessor defers processing until it determines that the LSRQ (low service request) signal is low. LSRQ can be sent low by the digital interface, by the front panel processor, or by LBX (low bandcross). Once LSRQ is sensed low, it can go high again; the microprocessor finishes all pending tasks before checking this signal again.

Using the change detectors and the processor service request block, the microprocessor responds to the following:

- Changes in the UNLOCK or OVEN indicators
- Changes in OVERMOD or UNLEVELED conditions
- Changes in the EXTERNAL REFERENCE switch position
- Sweep events as indicated by the marker/bandcross assembly

The microprocessor also distinguishes between power on and instrument preset.

MICROPROCESSOR READ/WRITE STROBE (BLOCK A)

3-to-8 Decoders

Three decoders decode address lines ADR0 through ADR4 and SIOB. The outputs of these 3-to-8 decoders are used by circuits both on and off the A59 assembly either to clock latches connected to the I/O bus or to enable buffers connected to the bus (for output operations).

I/O Strobe B (SIOB)

SIOB is a 500 ns pulse that enables the three 3-to-8 decoders. While they are enabled, the logic signals on ADR0 through ADR4 select specific I/O addresses. For example, I/O address 0,R0: (channel 0, subchannel 0) causes a 500 ns strobe at pin 15 of the first decoder (LCK2).

PHASE LOCK INDICATORS AND CONTROL (BLOCK B)

Phase Lock Indicators

You can monitor the six phase lock loops in the instrument and determine if they are locked by writing a mask to the input buffer that selects individual lock indicator signals and allows the processor to test them via the Processor Service Request circuits (block H).

During instrument operation, the processor sends data to the input buffer that sets up the output flip-flops to monitor the phase lock indicators, which indicate either a locked or unlocked condition for a particular instrument function.

Lock and Roll

U22A and U22B are RS flip-flops whose inverted signals set flip-flops U22C and U22D. The outputs of U22C and U22D control the LOCK/ROLL signals for the 20-30 loop and the YO loop. Once U22C and U22D are set, the corresponding phase-lock loop tries to lock. This condition persists until the set signals are removed and the high sweep signal (HSP) goes high, indicating the start of sweep. This causes the appropriate oscillator to switch from LOCK to ROLL mode.

When the instrument sweeps, either the YO or the 20-30 oscillator is allowed to sweep by having its LOCK/ROLL control line (HLEY or HLEZ) set to ROLL. The 20-30 is swept when the YO Delta F is <5 MHz.

NOTE: The YO DELTA F is the overall sweep width divided by the harmonic number (1 through 4).

The remaining outputs of the input buffer are ANDed with the corresponding oscillator LOCKED signals and ORed together by the output flip-flops to generate the UNLOCKED signal.

CHANGE DETECTOR (BLOCK C)

The instrument microprocessor responds to several conditions when they change state. Because the microprocessor stops running when it completes its tasks, the change detector circuit detects changes in instrument conditions and starts the microprocessor again so that it can interrogate the service request buffers and respond to the changes.

Types of Change

Detected changes:

- The oven either becomes cold, or comes up to temperature (HOVC)
- A change occurs in the enabled phase LOCK indicators (UNLOCKED)
- The rear panel frequency reference switch is set to EXT (HXREF)
- The LCHNG (low change) line is driven low due to a:
  1. change in the OVERMODULATION indicator,
  2. change in UNLEVELED indicator, or
  3. service request from the ADC.

Changes in the Oven (HOVC)

When the control signal from the oven (HOVC) falls below 3.5V, the output of the comparator goes HIGH. This signal is buffered by U7A, which drives U6B. In response to the positive change at pin 6, U6B immediately produces a low at pin 4 (LCHNG). Approximately 100 μs later, when C2 is charged, pin 5 of U6B goes high, and the resulting negative going pulse from U6B causes flip-flop U4C to set. The output of U4C goes to block H, causing an instrument processor service request.

When the oven control signal changes in the opposite direction (i.e. rises above 3.5V), comparator changes states again, causing U6B to create a low-going pulse approximately 100 μs wide.

The Low Change Line (LCHNG)

The LCHNG line, on the A62 motherboard, allows other circuits in the instrument to request service from the microprocessor.

Changes in the UNLOCKED and external reference signals also cause low-going pulses on the LCHNG line due to the wire-OR configuration. As with the HOVC control signal processing, an exclusive OR gate generates the low pulses on LCHNG.

M/N CONTROL (BLOCK E)

When the microprocessor writes to I/O address 3,R3;, it uses two registers to latch the control signals necessary to program the M/N oscillator.

MISCELLANEOUS INPUTS (BLOCK F)

A buffer allows the microprocessor to determine if an option is set. The input of I/O bit 4 (DB4) is tied low, and can be used by the microprocessor to determine that the digital interface is present.

MISCELLANEOUS CONTROL (BLOCK G)

When the microprocessor writes to I/O address 1,R3:, it uses a register to latch eight bits of information that are sent to the motherboard to control various functions.

Control Signals

The control signals are:

- **HSTD** (high standard). Turns on the +20V to the frequency standard (see A52). If the microprocessor sees that HXREF is low (as set by the rear panel switch), it sets HSTD high.
- **HFILYO** (high filtered YO). A high places a large filter capacitor across the YO coil. This happens in the CW or MANUAL mode.

- **LRSP** (low reset sweep). A low at the end of every sweep causes the sweep generator to reset the sweep. The reset signal is removed before the sweep starts.
- **LYSP** (low YO sweep). A TTL signal that goes to the A55 YO driver assembly. LYSP is low for YO sweep widths greater than 5 MHz, and switches out a filtering capacitor on the A55 assembly to remove any swept frequency delay.
- **HCEN** (high compensation enable). A TTL signal that goes to the A55 YO driver assembly. When high, HCEN allows the ramp voltage VCOMP to be added to PRETUNE on the driver assembly to compensate for the YO swept frequency delay.

PROCESSOR SERVICE REQUESTS (BLOCK H)

Buffer/Register

The microprocessor uses a buffer/register to determine which tasks need to be performed. All conditions needing the processor's attention (except for the front panel, which generates its own service request) are communicated through this register.

Service Request Line (LSRQ)

All possible reasons for service are ORed, and the result is sent to the microprocessor on the LSRQ line, indicating that service is requested. LSRQ can be driven low by instrument preset, by bandcross signals, or by the front panel (indicating a key has been pushed or the front panel knob has been turned).

Stop Line (LSTP)

The LSTP line stops the microprocessor after all pending tasks are completed.

Conditions that Can be Monitored

When the microprocessor reads I/O address 4,R3:, the following conditions can be monitored:

- **BANDCROSS**. This line is driven by the LBX from the A57 marker/bandcross assembly. After being inverted on the A59 assembly, BANDCROSS goes high when a sweep event (except for a marker) occurs. The sweep generator can also drive the LBX line if the sweep exceeds 12V.
- **UNLOCKED**. An oscillator is unlocked.
- **EXT REF**. External reference is selected by the rear panel frequency standard INT/EXT switch.
- **OVEN**. The oven is up to temperature.
- **POWER FAIL**. This indicates that a power on has just occurred. This is used by the microprocessor to distinguish between power on (restore the last state) and instrument preset.
- **CHANGE FF**. One of the change detector inputs has changed.

CHECKING THE MICROPROCESSOR I/O ADDRESS STROBES (BLOCK A)

U12, U19, and U26 are connected to the I/O address bus and generate 24 I/O strobes that are either used on this assembly or sent to other assemblies. These strobes can be checked using the front panel to write directly to the I/O addresses while monitoring the 3-to-8 decoders outputs.

Procedure

1. Press **[INSTR PRESET] [MANUAL]**.
2. Connect a logic probe to the output you wish to check.
3. Enter the desired I/O address (shown on the schematic above the outputs of U12, U19, and U26).

   For example, enter address 3,R3: as follows:

   a. Set the I/O channel
      Press **[SHIFT] [GHz] [3] [Hz]**
   b. Set the I/O subchannel
      Press **[SHIFT] [MHz] [3] [Hz]**
   c. Activate the selected I/O address
      Press **[SHIFT] [kHz]**

   d. Make entries using the step keys, the front panel knob, or the data pad. Each entry generates the M/N oscillator control strobe, an active low signal approximately 500 ns wide that can be monitored with the logic probe, or seen on a storage scope.

For more direct I/O addressing information, refer to COMPONENT-LEVEL SERVICE INTRODUCTION in volume 1 of this manual set.

CHECKING MICROPROCESSOR OUTPUT DEVICES (BLOCKS B, E, and G)

The following are microprocessor output devices:

- U24 (block B)
- U10 and U17 (block E)
- U23 (block G)

Microprocessor output devices can be checked using direct I/O addressing, as described for block A. Monitor the outputs as you enter the numbers that effect the signals you are interested in. For example, if the signal of interest is taken from DB2, enter the number 0 and observe the register output; it should go low. Enter the number 4; DB2 goes high.

CHECKING MICROPROCESSOR INPUT DEVICES (BLOCKS F and H)

You can check input devices (U7 and U18) the same way you check output devices:

1. Use the front panel to set up the I/O channel and subchannel.
2. After you press **[SHIFT] [Hz]**, each time you press **[Hz]** the instrument reads from the addressed I/O device and displays the results in the entry display in both decimal and octal formats.
3. To check each input device, short each input to +5V or ground (through a current limiting resistor), as applicable. Note that U18 is an inverting buffer; a low at its input should produce a high at the output.

CHANGE DETECTORS (BLOCK C)

To Check INT/EXT:

1. Connect a logic probe or storage scope to test point 8 (CHGFF).
2. Check that an active low pulse is generated each time you switch the rear panel frequency standard INT/EXT switch (in either direction).
3. Check that the front panel EXT REF LED is on when the frequency standard switch is in the EXT position, and is off when the switch is in the INT position.

To Check the UNLOCKED Input:

1. Select CW.
2. Disconnect one of the snap-on cables in the phase locked loop.
3. Check for a pulse at test point 8 and that the front panel UNLOCKED LED lights.
4. Reconnect the cable; check that the UNLOCKED LED goes out.

To Check the Oven Line (HOVC):

1. Unplug the instrument.
2. After 5 minutes, plug in the instrument and turn it on.
3. Check that the OVEN LED lights and, after a few minutes, goes off.

PROCESSOR SERVICE REQUEST (BLOCK H)

To Check U18:

1. Check U18 as you would any other input device (see block F and H troubleshooting)

2. Use direct I/O addressing to check that U18 bit 14 is high:

   Press **[INSTR PRESET]**
   [SHIFT] [GHz]
   [4] [Hz]
   [SHIFT] [MHz]
   [3] [Hz]
   [SHIFT] [Hz]

   Two numbers appear in the ENTRY display. The number on the right is an octal (base 8) number. For bit 14 to be high, the second digit from the left in this number must be a four, a six, or a seven.

To Check the Rest of Block H:

1. Press **[INSTR PRESET] [CW]**.
2. Check that the RUN LED on the processor assembly is off. If the LED is lit, either the LSRQ (low service request) line is pulled low, or U4D has not been set by the microprocessor.

   LSTP (low stop sweep) must be low for the processor run LED to go out.

   NOTE: If the instrument is UNLOCKED because of a hardware problem, the processor runs continuously; in this case, LSTP remains high.
3. Ground the LBX test point on the marker/bandcross assembly.
4. Check that test point 6 goes high, LSRQ goes low, and LSTP goes high.

Table A59-1. A59 Digital Interface P1 Pin I/O (1 of 3)

Pin	Mnemonic	Levels	Source	Destination
1 56	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*J *J
2 57				
3 58				
4 59				
5 60				
6 61				
7 62				
8 63				
9 64				
10 65	HOVC LSTP	+3 VOLTS - OVEN WARM TTL (LOW TRUE)	A62J3-3 I	C XA6101-85 *
11 66	LYSP HSTD	TTL (LOW TRUE) TTL (HIGH TRUE)	G G	XA55P1-7 XA52P1-21
12 67	HCEN	TTL (HIGH TRUE)	G	XA55P1-14
13 68	HSP WPDAC	TTL (HIGH TRUE) TTL (LOW TRUE)	XA57P1-13 A	*B XA54P1-36
14 69	LIPS LBX	TTL (LOW TRUE) TTL (LOW TRUE)	XA52P1-36/A62J7-19 *	*I I
15 70	SIOA	TTL (LOW TRUE)	XA60P1-15	*NOT USED
16 71	SIOB	TTL (LOW TRUE)	XA60P1-16	*A
17 72	ADR0 HFILYO	TTL TTL	XA60P1-17 G	*A *XA58P1-47, 72
18 73	ADR2 ADR1	TTL TTL	XA60P1-18 XA60P1-73	*A *A
19 74	ADR4 ADR3	TTL TTL	XA60P1-19 XA60P1-74	*A *A

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A59-1. A59 Digital Interface P1 Pin I/O (2 of 3)

Pin	Mnemonic	Levels	Source	Destination
20 75	DB0 GND PLANE	TTL 0V	*D XA60P1-20 INSTRUMENT GROUND	*D E G *J
21 76	DB2 DB1	TTL TTL	*D XA60P1-21 *D XA60P1-76	*D E G *D E G
22 77	DB4 DB3	TTL TTL	*D F XA60P1-22 *D XA60P1-77	*D E G *D E G
23 78	DB6 DB5	TTL TTL	*D F XA60P1-23 *D F XA60P1-78	*D G *D E G
24 79	DB8 DB7	TTL TTL	*XA60P1-24 *D F XA60P1-79	*B D I *D G
25 80	DB10 DB9	TTL TTL	*XA60P1-25 *XA60P1-80	*B E I *B I
26 81	DB12 DB11	TTL TTL	*XA60P1-26 *XA60P1-81	*B E I *B E I
27 82	DB14 DB13	TTL TTL	*XA60P1-27 *XA60P1-82	*B E I *B E I
28 83	WSPTM DB15	TTL (LOW TRUE) TTL	A *XA60P1-83	XA58P1-28 *B E I
29 84	WRDAC WSPAT	TTL (LOW TRUE) TTL (LOW TRUE)	A A	XA58P1-29 XA58P1-84
30 85	WCDAC LRSP	TTL (LOW TRUE) TTL (LOW TRUE)	A G	XA54P1-28 XA58P1-85
31 86	M5 LMNE	TTL (HIGH TRUE) TTL (LOW TRUE)	E E	XA34P1-1 XA34P1-2
32 87	M3 M4	TTL (HIGH TRUE) TTL (HIGH TRUE)	E E	XAE4P1-3 XA34P1-4
33 88	M1 M2	TTL (HIGH TRUE) TTL (HIGH TRUE)	E E	XA34P1-5 XA34P1-6
34 89	5 MHZ CLK LSRQ	TTL TTL (LOW TRUE)	XA60P1-34 *I	D *
35 90	+20V +20V	+20V +20V	XA52P1-16, 40 XA52P1-16, 40	*NOT USED *NOT USED
36 91	+5.2V +12V	+5.2V +12V	XA52P1-17, 18, 41, 42 XA52P1-9, 33	*J *NOT USED
37 92	+5.2V +5.2V	+5.2V +5.2V	XA52P1-17, 18, 41, 42 XA52P1-17, 18, 41, 42	*J *J

A single letter in the source or destination column refers to a function block on this assembly schematic.

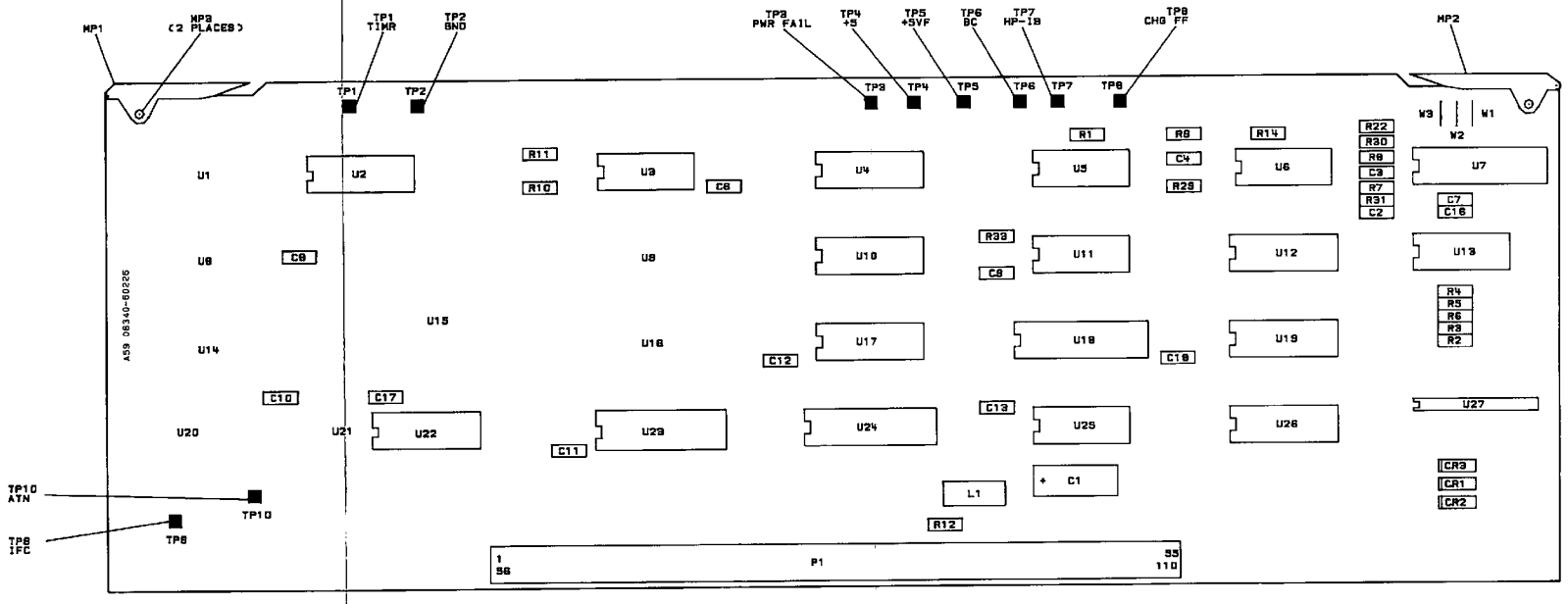
An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A59-1. A59 Digital Interface P1 Pin I/O (3 of 3)

Pin	Mnemonic	Levels	Source	Destination
38 93	−15V −5.2V	−15V −5.2V	XA56P1-15, 30 XA53P1-18, 36	*NOT USED *NOT USED
39 94	−10V −10V	−10V −10V	XA53P1-12, 13, 31, 32 XA53P1-12, 13, 31, 32	*NOT USED *NOT USED
40 95	GND PLANE HPUP	0V TTL (HIGH TRUE)	INSTRUMENT GROUND XA52P1-46	*J *D I
41 96	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*J *J
42 97	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*J *J
43 98	GND PLANE HXREF	0V TTL (HIGH TRUE)	INSTRUMENT GROUND A62J31-17	*J *C
44 99	GND PLANE WYOKW	0V TTL (LOW TRUE)	INSTRUMENT GROUND A	*J XA54P1-6
45 100	LCHNG TYOKP	TTL (LOW TRUE) TTL (LOW TRUE)	* A	C *
46 101	N5 N6	TTL TTL	E E	XA34P1-11 XA34P1-10
47 102	N3 N4	TTL TTL	E E	XA34P1-13 XA34P1-12
48 103	N1 N2	TTL TTL	E E	XA34P1-15 XA34P1-14
49 104	HULR HULM	TTL (HIGH TRUE) TTL (HIGH TRUE)	XA34P2-14 XA34P1-8	B B
50 105	HULY HULH	TTL (HIGH TRUE) TTL (HIGH TRUE)	A62J2-16 A62J19-16	B *B
51 106	HLEY HUL1	TTL (HIGH TRUE) TTL (HIGH TRUE)	B XA37P1-26; XA39P1-1, 16	A62J2-3 B
52 107	LCK4 HUL2	TTL (LOW TRUE) TTL (HIGH TRUE)	A XA41P1-4	* B
53 108	HLE2 LCK3	TTL (HIGH TRUE) TTL (LOW TRUE)	B A	* XA43P1-19
54 109	LCK1 LCK2	TTL (LOW TRUE) TTL (LOW TRUE)	A A	XA42P1-19 XA42P1-1
55 110	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*J *J

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60226

Figure A59-1. A59 Digital Interface, Component Location Diagram

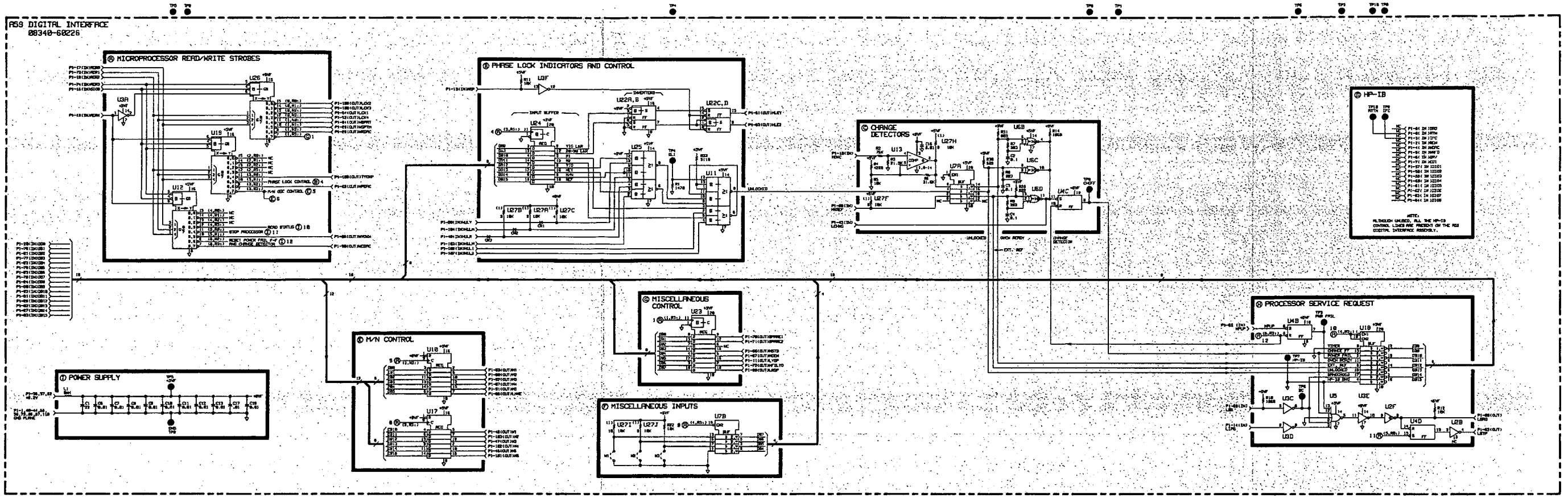


Figure A59-2. A59 Digital Interface, Schematic Diagram

Controller A59-13/A59-14

Table A59-2. A59 Digital Interface Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A59	**08340-60226**	**1**	**1**	**DIGITAL INTERFACE ASSEMBLY**	**28480**	**08340-60226**
A59C1	0180-2228	6	1	CAPACITOR-FXD 22UF ±10% 15VDC TA	56289	150D226X9015B2
A59C2	0160-4557	0	3	CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X7R104M050A
A59C3	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X7R104M050A
A59C4	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X7R104M050A
A59C5				NOT ASSIGNED		
A59C6	0160-4832	4	11	CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C7	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C8	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C9	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C10	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C11	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C12	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C13	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C14				NOT ASSIGNED		
A59C15				NOT ASSIGNED		
A59C16	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C17	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59C18	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A59CR1	1901-0033	2	3	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A59CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A59CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A59L1	9011-1788	6	1	CHOKE-WIDE BAND ZMAX=680Ω @ 180 MHZ	02114	VK200 20/48
A59MP1	4040-0756	3	1	EXTR-PC BD WHT POLY .062-BD-THKNS	28480	4040-0756
A59MP2,3	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A59MP4	4040-0753	0	1	EXTR-PC BD GRN POLY .062-BD-THKNS	28480	4040-0753
A59P1	1251-7469	3	1	CONN-POST TYPE .100-PIN-SPCG 110-CONT	28480	1251-7469
A59R1	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A59R2	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0±100	24546	C3-1/8-T0-7502-F
A59R3	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-2152-F
A59R4	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-TO-4221-F
A59R5	0757-0442	9	5	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A59R6	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0±100	24546	C4-1/8-TO-3162-F
A59R7	0698-3446	3	3	RESISTOR 383 1% .125W F TC=0±100	03292	C4-1/8-TO-383R-F
A59R8	0698-3446	3		RESISTOR 383 1% .125W F TC=0±100	03292	C4-1/8-TO-383R-F
A59R9	0698-3446	3		RESISTOR 383 1% .125W F TC=0±100	03292	C4-1/8-TO-383R-F
A59R10	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-T0-1961-F
A59R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A59R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A59R13				NOT ASSIGNED		
A59R14	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-T0-1961-F
A59R15-21				NOT ASSIGNED		
A59R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A59R23-24				NOT ASSIGNED		
A59R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A59R26-28				NOT ASSIGNED		
A59R29	0757-0422	5	3	RESISTOR 909 1% .125W F TC=0=-100	03292	CT4-1/8-TO-909R-F
A59R30	0757-0422	5		RESISTOR 909 1% .125W F TC=0=-100	03292	CT4-1/8-TO-909R-F
A59R31	0757-0422	5		RESISTOR 909 1% .125W F TC=0=-100	03292	CT4-1/8-TO-909R-F
A59R32				NOT ASSIGNED		
A59R33	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0=-100	03292	CT4-1/8-TO-5111-F
A59TP1	0360-0535	0	10	TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP2	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP3	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP4	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP5	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP6	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP7	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP8	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP9	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59TP10	0360-0535	0		TERMINAL TEST POINT, PCB	00000	ORDER BY DESCRIPTION
A59U1				NOT ASSIGNED		
A59U2	1820-0577	7	2	IC INV TTL HEX 1-INP	01295	SN7416N
A59U3	1820-1416	5	1	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A59U4	1820-1440	5	2	IC LCH TTL LS QUAD	01295	SN74LS279N
A59U5	1820-1905	7	1	IC GATE TTL LS NOR DUAL 5-INP	07263	74LS260PC

Table A59-2. A59 Digital Interface Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A59U6	1820-1297	0	1	IC GATE TTL LS EXCL-NOT QUAD 2-INP	01295	SN74LS266N
A59U7	1820-2024	3	1	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A59U8				NOT ASSIGNED		
A59U9	1820-1196	8	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174
A59U10	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A59U11	1820-1210	7	2	IC GATE TTL LS AND-OR-INV DUAL 2-INP	01295	SN74LS51N
A59U12	1820-1216	3	3	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A59U13	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A59U14-16				NOT ASSIGNED		
A59U17	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A59U18	1820-1917	1	1	IC BFR TTL LS LINE DRVR OCTL	01295	SN74LS240N
A59U19	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A59U20				NOT ASSIGNED		
A59U21				NOT ASSIGNED		
A59U22	1820-1440	5		IC LCH TTL LS QUAD	01295	SN74LS279N
A59U23	1820-1858	9	2	IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A59U24	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A59U25	1820-1210	7		IC GATE TTL LS AND-OR-INV DUAL 2-INP	01295	SN74LS51N
A59U26	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A59U27	1810-0280	8	1	NETWORK-RES 10-SIP 10.0KΩ X 9	01121	210A103
A59W1	1460-1489	8	3	WIREFORM BE CU AG	28480	1460-1489
A59W2	1460-1489	8		WIREFORM BE CU AG	28480	1460-1489
A59W3	1460-1489	8		WIREFORM BE CU AG	28480	1460-1489

A60 Processor Circuit Description

ASSEMBLY PURPOSE

The A60 processor assembly performs all instrument data processing. This assembly consist of:

- A microprocessor
- Memory
- An HP-IB interface
- The necessary circuitry for:
  Clock generation
  Address and memory decoding
  Buffering
  Interrupt handling

The microprocessor interfaces directly with memory, which consists of:

- 32K words of Ultra Violet Erasable Programmable Read Only Memory (UVEPROM)

  The instrument software program (firmware) is stored in this section of memory, with the default calibration data.

- 2K words of Electrically Erasable Programmable Read Only Memory (EEPROM)

  Protected calibration data is stored here.

- 8K words of Random Access Memory (RAM)

  Working calibration data and SAVE/RECALL register values are stored here. Battery backup provides power to RAM when AC power is disconnected. If the backup power fails, working calibration data and SAVE/RECALL information is lost. When AC power is restored, the EEPROM calibration data is loaded in RAM, and the front panel displays CALIBRATION RESTORED.

NOTE: 1 word = 2 bytes; 1 byte = 8 bits.

The microprocessor is controlled by the firmware stored in memory. With this program, the microprocessor can transfer data (I/O addressing) and internally process data it has accessed. All data transfers go through the microprocessor.

The A60 processor assembly communicates with the rest of the instrument by means of the internal address and data busses. External communication is through the HP-IB connection on the rear panel. The HP-IB interface circuitry provides the link between the internal instrument bus and the external HP-IB interface.

MEMORY (BLOCKS A, B, and C)

UVEPROM (block A) has 32K words of programmed firmware that contains the complete instrument operating program.

EEPROM (block B) has 2K words of electrically alterable memory that contains protected calibration data (calibration constants).

RAM (block C) has 8K words of volatile memory that is used for working calibration data and SAVE/RECALL registers. Block G provides battery backup for RAM if line power is disconnected.

TIMER/SELF TEST INDICATOR/DSA (BLOCK D)

This block contains a counter-timer and a parallel interface adapter for:

- RUN/STOP indication for the instrument microprocessor.
- Test output signals for the test LEDs.
- Interrupts with timer countdown.
- Control points for testing and for DSA:

TP1	Non-destructive RAM testing
TP2 – 5	DSA controls
TP6	Status line control for RAM testing

I/O DECODING AND CONTROL (BLOCK E)

The I/O decoder consists of two PLA (programmable logic array) devices that form a state machine for I/O bus control. Address and control lines develop the output control signal state equations (AND/OR/INVERSION).

The I/O decoder outputs provide control for the I/O data bus buffers (block N), the I/O address bus buffer (block P), and the HP-IB interface (block M).

SELF TEST (BLOCK F)

The self test registers interface the instrument data and address busses to the I/O data and address busses. Both the address and data lines are check as follows:

- **Address.** An I/O bus transfer is initiated with the I/O address latched onto the address register. Using control lines, the instrument microprocessor monitors the address under test.
- **Data.** I/O data is latched into the buffers and checked by the microprocessor.

POWER SUPPLIES (BLOCK G)

The main instrument power supplies provide the inputs to the A60 assembly. The +22 VDC supply is the standby supply when the instrument is plugged in, and provides RAM voltage during standby and normal operation.

When the instrument is unplugged, the battery (BT1) provides power to maintain calibration constant information in RAM.

The +1.2 VDC supply provides comparator reference voltage for the A60 assembly POWER UP/ STOP circuitry.

Supply power from capacitors C3 and C5 allow the microprocessor to complete operations and set registers and memory if main instrument power is disconnected or lost.

MEMORY DECODING (BLOCK H)

The memory decoder is a PLA (programmable logic array) that uses address and control lines to create the PLA equations for proper memory address locations.

Output control lines are derived from the AND/OR/INVERSION combinations of the input lines. The memory decoding controls the UVEPROM, EEPROM, RAM, and I/O addressing, according to the memory map in Figure A60-1.

CLOCK (BLOCK I)

The crystal output (approximately 14.75 MHz) is shaped by an RC series circuit for waveshaping and RFI elimination, and divided-by-two by a flip-flop to provide the main output clock signals (LCLK and CLK).

The 7.4 MHz clock signals are again divided-by-two for the HP-IB clock signal (approximately 3.6 MHz).

INTERRUPT ENCODER (BLOCK J)

An 8-to-3 encoder provides three level-interrupt signals to the microprocessor. The least significant input is connected to ground, which maintains the encoder outputs high when no interrupts are pending.

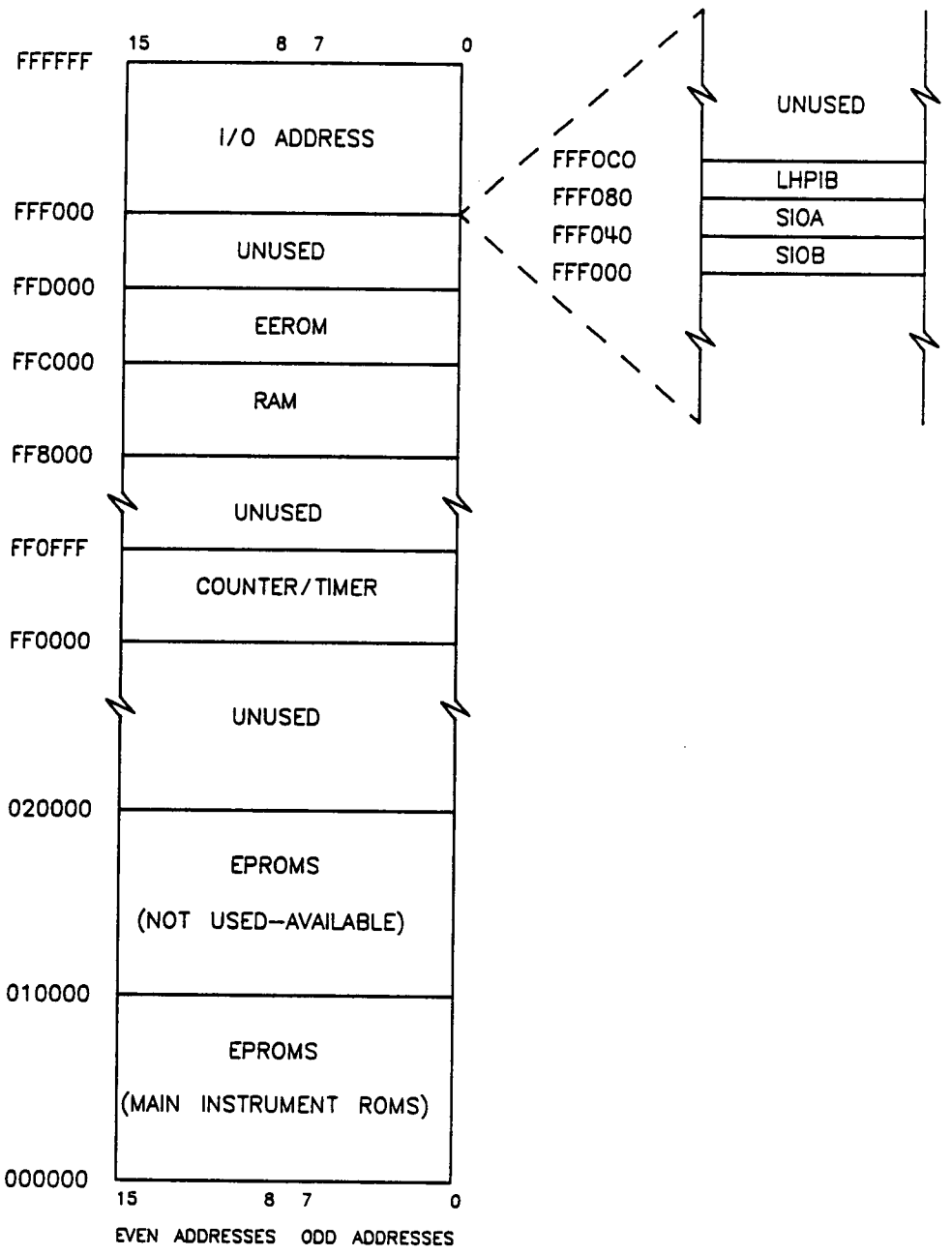


Figure A60-1. Microprocessor Memory Map

PROCESSOR (BLOCK K)

The microprocessor is a 16-bit Motorola 68000, with a 16-bit data bus and a 23-bit address bus. Instrument control is provided by the following lines:

- Interrupt control
- Bus control and arbitration
- Peripheral control
- Microprocessor status

The microprocessor data bus, pulled up to +5 VDC, is the main instrument bus for the transfer of data throughout the instrument.

The address bus uses only 17 of the available 23 lines. AD0 is internal to the microprocessor for byte (upper/lower) determination. The unused address lines are sign extended so as not to slow microprocessor operation. A18 is a control line for DSA troubleshooting.

The microprocessor status line outputs indicate the microprocessor state (user or supervisor), and the type of cycle. The lines are gated to the VPA input, and must be correct for the processor to function.

The microprocessor uses an automatic vectored interrupt system, with encoded interrupt requests from the interrupt encoder (block J). When an interrupt is active, the microprocessor jumps to the proper memory address for the service routine.

FREE RUN DSA (BLOCK L)

Free run DSA is a routine where the microprocessor completes a "no op" instruction and increments through its complete address sequence. This mode of operation is required for address bus troubleshooting.

HP-IB INTERFACE (BLOCK M)

The interface circuitry contains a VLSI HP-IB chip, and two bidirectional bus drivers to interface the main instrument to external devices and controllers.

The VLSI chip contains the necessary circuitry for all control signals and handshaking required for HP-IB control. The HP-IB clock signal is used for bus transfer timing, with the VLSI chip controlling the actual data transfer through the bidirectional latches.

HP-IB operations are interrupt driven, with the main instrument microprocessor servicing the request after it is received.

I/O DATA BUS BUFFERS (BLOCK N)

The I/O data bus buffers provide a bidirectional interface between the instrument data bus and the I/O data bus. Internal latches hold the data until it is needed by the microprocessor or by I/O devices.

When there is no activity on the I/O data bus, all lines are held low, to minimize noise.

Four control lines (shown in Table A60-1) control the I/O data bus buffer control logic.

Table A60-1. I/O Buffers Truth Table

Control Lines				Operation
DISDB	DB DAT CLK	SE LAB	DIR AB	
High	Low → High	X	X	Store data in A latches
Low	X	High	High	Store A data to B bus
Low	X	Low	Low	I/O bus read
Low	X	Low	High	I/O bus write

Figure A60-2 shows I/O bus write cycle and read cycle timing diagrams.

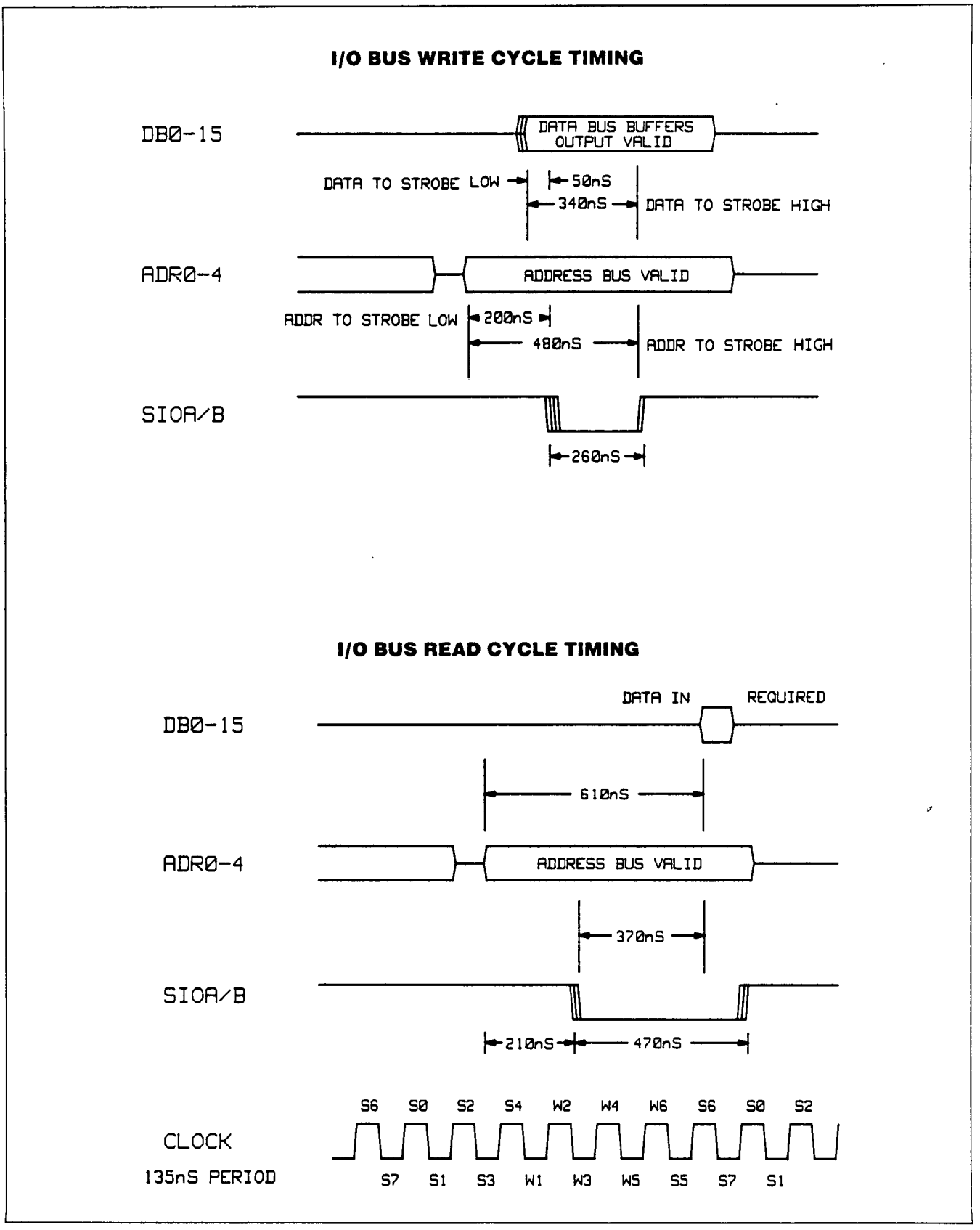


Figure A60-2. I/O Bus Write Cycle and Read Cycle Timing Diagrams

POWER UP/STOP (BLOCK O)

At power on, the HPUP control signal is high, which triggers the input comparator to output an active high. The comparator output biases a transistor and capacitor, providing the slight delay required by the microprocessor.

Output comparators provide the microprocessor and HP-IB reset signals (LRESET and LSTP), after the required delay.

Transistors Q2 and Q3 protect the RAM devices if instrument AC power or DC supply is lost.

I/O ADDRESS BUS (BLOCK P)

An address latch interfaces the instrument address bus with the I/O address bus. Five I/O address lines and two main control signals (SIOA and SIOB) form the I/O address bus.

A60 Processor Component-Level Troubleshooting

TYPES OF TROUBLESHOOTING

There are several types of troubleshooting for the A60 processor assembly:

- **Input Signal Verification.** This test checks several processor assembly input signals and should be performed prior to doing any in-depth troubleshooting.
- **Self Test.** Self test runs when you turn the instrument on or when you press **[INSTR PRESET]**. Two front panel LEDs (INSTR CHECK I and INSTR CHECK II) provide a visual indication of the self check results.
- **SHIFT M4.** When you initiate this diagnostic, you can check the operation of specific circuitry on the A60 processor assembly.
- **Destructive RAM Test.** This test exhaustively tests RAM and completely verifies EEPROM operation.
- **Signature Analysis** (SA). Use signature analysis when the self test fails to run, or to verify a portion of the self test results. SA allows component level troubleshooting of the processor assembly.
- **HP-IB Verification.** The A60 assembly HP-IB circuitry is contained in one block of circuitry on the schematic, to facilitate troubleshooting.

INPUT SIGNAL VERIFICATION

When to Use Input Signal Verification

Use input signal verification prior to in-depth troubleshooting of the A60 assembly. Verification consists of measuring all input signals to the A60 assembly, in addition to a few key signals that are required to run self test.

Equipment Required

A DVM and/or an oscilloscope.

Procedure

NOTE: The A60 processor is a static sensitive assembly. Work only at an anti-static work station.

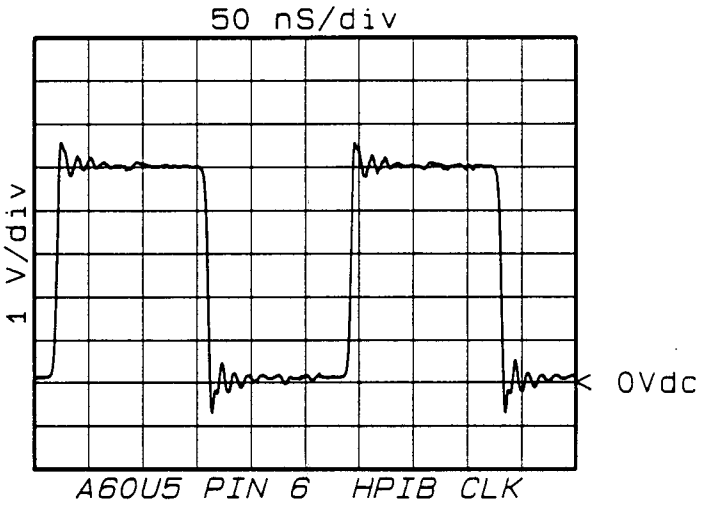
1. Turn line power off. Place the A60 processor assembly on an extender.
2. Turn line power on.
3. Using A60TP7 or A60TP17 as ground, verify the voltages in Table A60-2.

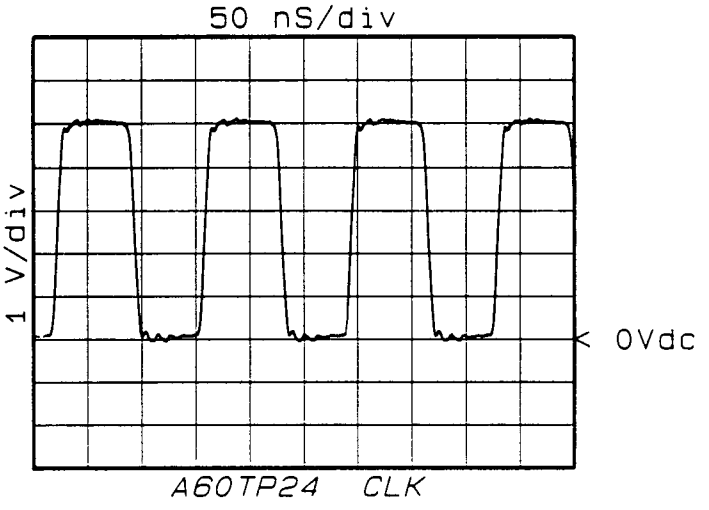
Table A60-2. Input Signal Voltages

Measurement Point	Voltage
A60TP11 (LSTP)	+5V*
A60TP21 (+5V)	+5V
A60TP22 (HRAMPUP)	+5V
A60TP23 (LRESET)	+5V
A60P1-33 (Vpp)	+4.5V
A60U38 Pin 23 (VRAM)	+5V
A60U1 Pin 8 (VREF)	+1.2V
+5PF (anode of A60CR1 or A60CR4)	+5V

* A microprocessor failure can cause LSTP to be low.

4. Verify the following waveforms:





SELF TESTS

What are Self Tests

At power on and at instrument preset, self test performs diagnostic checks on some of the instrument circuitry. The tests performed are the SHIFT M4 tests 0 through 8, and 10 through 13 (described under **SHIFT M4**). If the destructive RAM test is activated, self test also performs SHIFT M4 tests number 7 and 8 (see **DESTRUCTIVE RAM TEST**).

Figure A60-3 shows the instrument self test flow chart.

How to Check the Results of Self Test

You can check the results of instrument self test in 3 ways:

- On the INSTR CHECK LEDs I and II
- Using the A60 Processor Self Test LEDs
- Using the diagnostic SHIFT M4

NOTE: The most accurate failure indication is given by the A60 processor self test LEDs. A failure can occur that invalidates the indication of the INSTR CHECK LEDs and SHIFT M4.

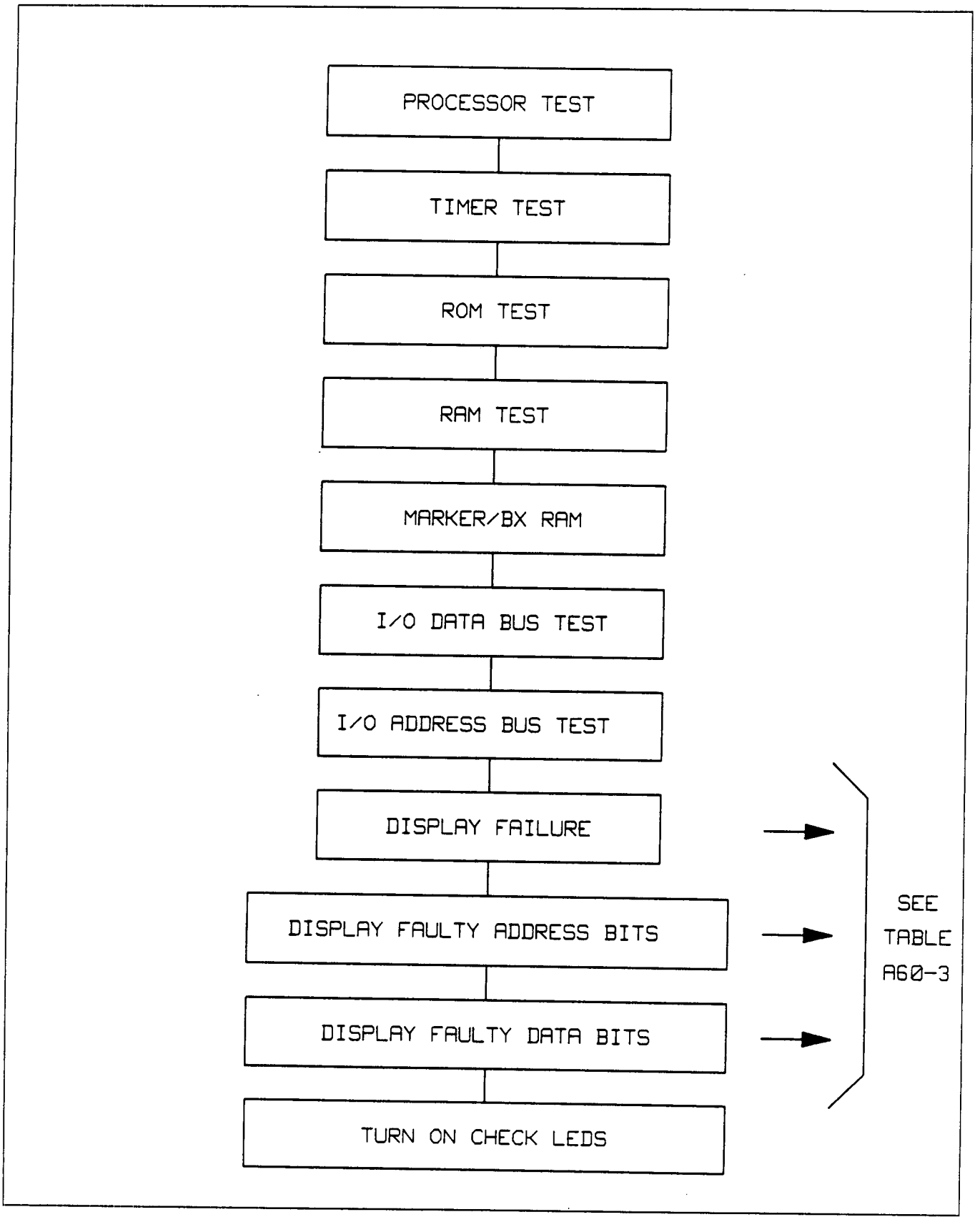


Figure A60-3. Self Test Flow Chart

Instrument Check LEDs I and II

The INSTR CHECK LEDs I and II are the easiest failure indicators to check because they are located on the front panel, adjacent to the **[INSTR PRESET]** key.

1. Switch on power or press **[INSTR PRESET]**.

   Both INSTR CHECK LEDs turn on.

   LED I turns off when the processor, memory, and peripheral interface timer (on the A60 assembly) pass self test (SHIFT M4 tests 0 through 6, 10, and 11).

   LED II turns off when the I/O address bus, I/O data bus, and marker RAM pass self test (SHIFT M4 tests 9, 12, and 13).

If no failure occurs, both LEDs are off after approximately 1 second. If either LED remains on, check the 16 LEDs on the A60 assembly. Remember that it is possible for a failure to occur that causes both INSTR CHECK LEDs to go off when they shouldn't.

A60 PROCESSOR SELF TEST LEDs

There are 16 self test LEDs at the top of the A60 assembly that turn on when you switch the power on or press **[INSTR PRESET]**. If there is no failure, all 16 LEDs light and approximately 1 second later, turn off.

1. If self test fails, cycle the line power or press **[INSTR PRESET]** and observe the processor self test LEDs.

   All 16 LEDs turn on.

   If all sixteen LEDs stay on, refer to **SIGNATURE ANALYSIS**.

After 2 seconds:

A60DS15 and A60DS16 (the LEDs closest to the front panel) turn off.

A60DS1 through A60DS14 indicate the failure (see Table A60-3).

After 4 seconds:

A60DS9 through A60DS15 turn off and A60DS16 turns on.

A60DS1 through A60DS8 then indicate which I/O address bus line failed (see Table A60-2).

After 6 seconds:

A60DS1 through A60DS16 indicate which I/O data bus line failed (see Table A60-3).

Table A60-3. A60 Self test LEDs - Failure Indications

A60 Processor Self Test LEDs (Time After Power On or [INSTR PRESET])				
A60 Processor LED	First 2 Seconds		Second 2 Seconds	Afterward
	SHIFT M4 Test #	Test Name	I/O Address Bus Test	I/O Data Bus Test
DS1	0	PROCESSOR	ADR0	DB0
DS2	1	ROM U37	ADR1	DB1
DS3	2	ROM U36	ADR2	DB2
DS4	3	ROM U35	ADR3	DB3
DS5	4	ROM U34	ADR4	DB4
DS6	5	RAM U39	SIOA	DB5
DS7	6	RAM U38	SIOB	DB6
DS8	7	EEPROM U33	SIOA	DB7
DS9	8	EEPROM U32	OFF	DB8
DS10	9	MKR BX RAM	OFF	DB9
DS11	10	TMR LEDS U4	OFF	DB10
DS12	11	TMR U4	OFF	DB11
DS13	12	I/O ADRS	OFF	DB12
DS14	13	I/O DATA	OFF	DB13
DS15		OFF	OFF	DB14
DS16		OFF	ON	DB15

SHIFT M4

When to Use SHIFT M4

After you have determined the failure mode (using the processor self test LEDs and Table A60-3), you can use the SHIFT M4 diagnostic to further isolate the failure. This service diagnostic tests DACs and control circuitry in the instrument, and allows the results of the self test to be displayed in the front panel ENTRY DISPLAY.

What SHIFT M4 Does

SHIFT M4 does not perform exhaustive DAC tests, but provides an indication to direct your troubleshooting to a specific device or circuit path.

Table A60-4 lists all the tests performed when you press **[SHIFT] [M4]**. As you can see, this service diagnostic tests more than just the A60 assembly. All of the tests are listed because only one test (0) is not dependent on the test results of one or more of the other tests.

NOTE: SHIFT M4 does not automatically run tests 7 and 8 (EEPROM 1 RD/WR and EEPROM 2 RD/WR) see **DESTRUCTIVE RAM TEST** for details.

The Interdependency of the SHIFT M4 Tests

Table A60-5 illustrates the interdependency of the SHIFT M4 tests. The vertical axis (Test Number) lists the tests, 0 through 31. The horizontal axis (Dependent On) lists the test numbers and indicates which test(s) must pass for a given test result to be valid. An **X** in a Dependent On column indicates that a given test is valid only if the test in that column also passes.

Example:

Test 11 is only valid if tests 0, 5, and 6 pass. If test 11 fails, verify that tests 0, 5, and 6 have passed **before** troubleshooting the circuitry exercised in test 11.

SHIFT M4 Test Procedure

1. Press **[SHIFT] [M4]**.

   While the tests are running, the ENTRY DISPLAY shows **DIAGNOSTIC TESTS IN PROGRESS**.

   When the tests are through, the instrument displays **TEST:?FULL DIAGNOSTIC** and then displays **PASS** or **FAIL**. PASS indicates that all of the tests related to this diagnostic have passed. FAIL indicates that one or more of the tests failed.

2. If the display indicates FAIL, use the RPG or the step keys to move through the test results and determine which test(s) failed.

Table A60-4. Diagnostic SHIFT M4 Tests (1 of 2)

Number	Name	Description
0	PROCESSOR TST	Verifies the operation of the Processor (A60 Block E), the Free Run DSA (A60 Block F), A60U25A, A60U25D, the processor's data and address bus, and a portion of the UV-EROM (A60 Block A) and A60U29.
1	ROM 1 CKSUM	Verifies the operation (checksum) of A60U37.
2	ROM 2 CKSUM	Verifies the operation (checksum) of A60U36.
3	ROM 3 CKSUM	Verifies the operation (checksum) of A60U35.
4	ROM 4 CKSUM	Verifies the operation (checksum) of A60U34.
5	RAM 1 RD/WR	Verifies the operation (read/write) of A60U39 and a portion of A60U29.
6	RAM 2 RD/WR	Verifies the operation (read/write) of A60U38 and a portion of A60U29.
7	EEROM 1 RD/WR	Verifies the operation (read/write) of A60U33 and a portion of A69U29. Note that this test is only performed if A60TP1 RAM is grounded (initiates the Destructive RAM test).
8	EEROM 2 RD/WR	Verifies the operation (read/write) of A60U32 and a portion of A60U29. Note that this test is only performed if A60TP1 RAM is grounded (initiates the Destructive RAM test).
9	MKR RAM RD/WR	Verifies the operation (read/write) of the Address Register (A57 Block A), the Sweep Event Memory (A57 Block B), the Read/Write RAM Buffer (A57 Block C), and the Microprocessor Read/Write Strobes (A57 Block K).
10	PIT (LED Registers)	Verifies the operation of A60U4 and a portion of A60U29.
11	PIT RESPONDS	Verifies the operation of A60U4 and a portion of A60U29.
12	I/O ADDR BUS	Verifies the operation of the I/O address Bus (A60 Block K), A60U22, the I/O Address bus, and a portion of the I/O Decoding and Control (A60 Block J) and A60U29.
13	I/O DATA BUS	Verifies the operation of the I/O Data Bus Buffers (A60 Block P), A60U14, A60U16, the I/O Data Bus, and a portion of the I/O Decoding and Control (A60 Block J) and A60U29.
14	A-D CONVERTER	Verifies the operation of the ADC Control Latch (A27 Block L), the ADC Clock/Control (A27 Block M), the ADC Input Multiplexer (A27 Block N), the Test ADC (A27 Block O), the ADC Window Comparator (A27 Block P), the Conversion Complete Timer/SRQ Latch (A27 Block Q), and the Status Buffer (A27 Block R). The Address Decoding (A27 Block B) is partially verified.
15	LEVEL REF DAC	Verifies the operation of the ALC Reference Generator (A27 Block H) and a portion of the Address Decoding (A27 Block B). Monitors LVL (A27 Block H output) to determine the test results.
16	MAN SWP DAC	Verifies the operation of the Manual Sweep Dac (A57 Block G) and a portion of the Microprocessor And Read Write Strobes (A57 Block K). Monitors LVL SWP (A27 Block I output) to determine the test results.

Table A60-4. Diagnostic SHIFT M4 Tests (2 of 2)

Number	Name	Description
17	MARKER RAMP	Verifies the operation of the A58 Sweep Generator assembly. Monitors BVSWP (A58 Block O Output) to determine the test results.
18	RESET DAC	Verifies the operation of the A58 Sweep Generator assembly. This test specifically exercises the Reset DAC (A57 Block C) and monitors BVSWP (A58 Block O output) to determine the test results.
19	LEVEL SWP DAC	Verifies the operation of the Power Sweep Generator (A27 Block I) and a portion of the Address Decoding (A27 Block B). Monitors LVL SWP (A27 Block I output) to determine the test results.
20	BND CROSS DAC	Verifies the operation of the Sweep Comparator (A57 Block D) and a portion of A57U24 and A57U28. Monitors CMP (A57 Block I input) to determine the test results.
21	SWP WIDTH DAC	Verifies the operation of the A58 Sweep Generator assembly. This test specifically exercises the Sweep Width DAC (A58 Block M) and monitors BVSWP (A58 Block O output) to determine the test results.
22	SWP RANGE ATN	Verifies the operation of the A58 Sweep Generator assembly. This test specifically exercises the Sweep Width Register (A58 Block E) and monitors BVSWP (A58 Block O output) to determine the test results.
23	V/GHz CIRCUIT	Verifies the operation of the −0.25 V/GHz circuitry (A28 Block E) and a portion of the Programmable Scalar (A28 Block D) and the Digital Control (A28 Block I). Monitors −.25 V/GHz (A28 Block E output) to determine the test results.
24	V/GHz BND ATN	Verifies the operation of the Programmable Scalar (A28 Block D), A28U19 and a portion of A28U16. Monitors −.25 V/GHz (A28 Block E output) to determine the test results.
25	BRK PNT 1 DAC	Verifies the operation of the 9 GHz Breakpoint Slope Compensation (A27 Block D), the Compensation Summing Amplifier (A27 Block G), and a portion of the Address Decoding (A27 Block B). Monitors LVL COR (A27 Block G output) to determine the test results.
26	BRK PNT 2 DAC	Verifies the operation of the 20 GHz Breakpoint Slope Compensation (A27 Block C), the Compensation Summing Amplifier (A27 Block G), and a portion of the Address Decoding (A27 Block B). Monitors LVL COR (A27 Block G output) to determine the test results).
27	ATN SLOPE DAC	Verifies the operation of the Attenuator Slope Compensation (A27 Block E), the Compensation Summing Amplifier (A27 Block G), and a portion of the Address Decoding (A27 Block B). Monitors LVL COR (A27 Block G output) to determine the test results.
28	YO PRETUN DAC	Verifies the operation of the Pretune Register (A54 Block A), the Pretune DAC (A54 Block B), and the Summing Amplifier (A54 Block C). Monitors −.25 V/GHz (A28 Block E output) to determine the test results.
29	SWEEPTIME DAC	Verifies the operation of the A58 Sweep Generator assembly. This test specifically exercises the Sweep Time DAC (A58 Block G) and uses the A57 Marker Bandcross assembly and the PIT (A60U4) to determine the test results.
30	NOT USED	
31	A27 INSTALLED	Verifies that the A27 Level Control Assembly is installed.

Table A60-5. SHIFT M4 Test Interdependence

Test Number	Dependent On Test Number											
	0	5	6	9	11	12	13	14	15	17	20	31
0												
1	X											
2	X											
3	X											
4	X											
5	X											
6	X											
7	X	X	X									
8	X	X	X									
9	X	X	X			X	X					
10	X	X	X									
11	X	X	X									
12	X	X	X									
13	X	X	X									
14	X	X	X			X	X	X				
15	X	X	X			X	X	X				X
16	X	X	X			X	X	X	X			X
17	X	X	X			X	X	X	X			X
18	X	X	X			X	X	X	X			X
19	X	X	X			X	X	X	X			X
20	X	X	X			X	X	X				X
21	X	X	X			X	X	X	X			X
22	X	X	X			X	X	X	X			X
23	X	X	X			X	X	X	X			X
24	X	X	X			X	X	X	X			X
25	X	X	X			X	X	X	X			X
26	X	X	X			X	X	X	X			X
27	X	X	X			X	X	X	X			X
28	X	X	X			X	X	X	X			X
29	X	X	X	X	X	X	X	X		X	X	X
30												
31	X											

DESTRUCTIVE RAM TEST

CAUTION

This test totally erases the instrument state Save registers in random access memory (RAM). Use this test only if a failure occurs with the instrument state Save/Recall registers or if the calibration data is defaulted (CAL FAULT) or continually exhibits incorrect values.

Functions of the Destructive RAM Test

This test has two functions:

1. To exhaustively test RAM.
2. To completely verify EEPROM operation.

Because of the limited write lifetime of EEPROM, and because of the loss of information in RAM, this test is not automatically part of either the self test performed at power on (or instrument PRESET), or the diagnostics run using SHIFT M4 (tests 7 and 8).

Procedure

1. Connect a jumper between A60TP1 (RAM) and A60TP7 (GND).
2. Cycle the line power, or press **[INSTR PRESET]**.
3. Wait for the entire test to complete (4 to 5 minutes).
3. Remove the jumper between A60TP1 (RAM) and A60TP7 (GND).
4. Check the A60 processor self test LEDs for failure indications. Note that if a failure occurs in RAM, the EEPROMs are not tested. The EEPROM tests (7 and 8) require that the RAM tests (5 and 6) pass first.

How Calibration Data Can be Restored

RAM holds the working calibration data and the SAVE/RECALL register values. If calibration data and the register values are lost, protected calibration data stored in EEPROM loads into RAM and the instrument displays **CALIBRATION RESTORED**, when you turn the instrument on. The register values, however, can not be recovered.

SIGNATURE ANALYSIS

When to Use Signature Analysis

Use signature analysis if self test fails to run (the self test LEDs turn on and stay on), and you have verified the inputs to the A60 assembly.

What Signature Analysis Does and Does Not Do

The signatures given in Figure A60-4 test the address decoding circuitry required to run self test, but do not verify the operation of the microprocessor's data bus, the UVEPROMs, or the microprocessor itself. If the signatures are correct, the self test failure is due to one of the untested items.

Equipment Required To Perform Signature Analysis

Signature Multimeter

Procedure

1. Switch the instrument to STANDBY.
2. Remove the A60 processor assembly from the instrument and remove A60U40.
3. Place the A60 assembly on an extender board.
4. Attach a jumper from A60TP15 (LSA) to A60TP17 (GND).
5. Turn the instrument on and connect the signature multimeter as follows:

   START: A60TP16 (RS)
   STOP: A60TP16 (RS)
   CLOCK: A60TP24 (CLK)
   GND: A60TP7 (GND)

6. Set the START for falling edge triggering and both the STOP and CLOCK for rising edge triggering. Set the THRESHOLD for TTL.

7. Verify the signatures in Figure A60-4.

NOTE: After troubleshooting, do not forget to **replace** A60U40.

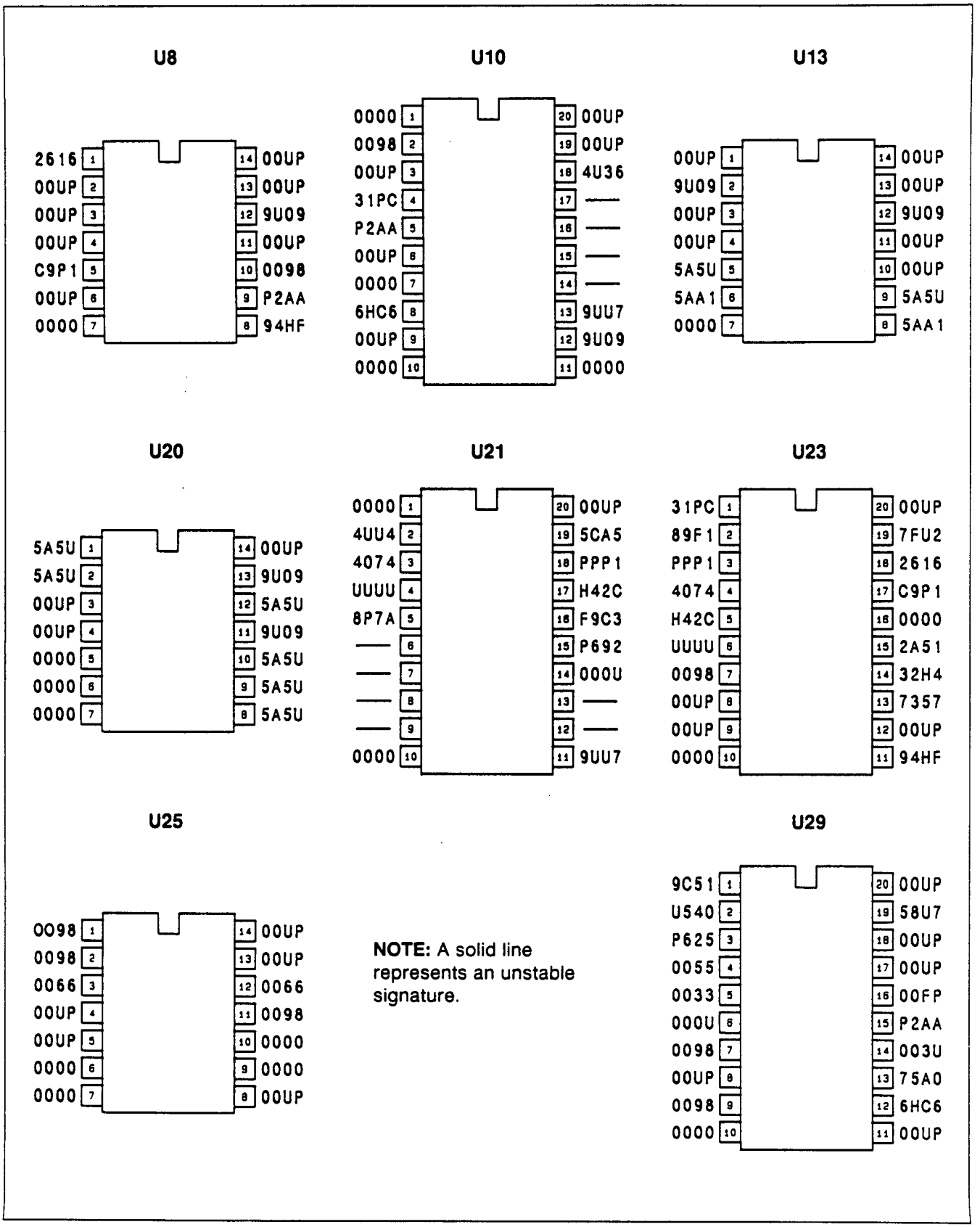


Figure A60-4. A60 Processor Signatures (1 of 2)

Note: A solid line represents an unstable signature.

U27

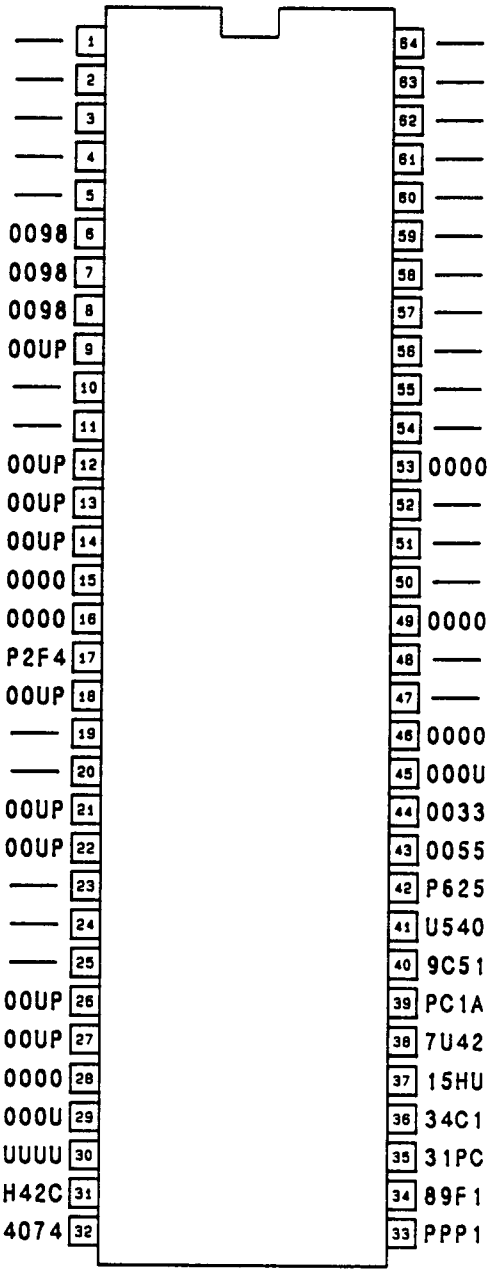


Figure A60-4. A60 Processor Signatures (2 of 2)

HP-IB VERIFICATION

Block G contains the HB-IB circuitry on the A60 assembly. If the instrument fails the HP-IB verification procedure due to an A60 problem, troubleshoot this block.

BATTERY REPLACEMENT

What the Battery Does

The processor assembly battery (A60B1) provides backup power to RAM, which holds the working calibration data and the SAVE/RECALL register values.

How Calibration Data is Restored

If the battery is defective, or is replaced, the calibration data and the register values are lost. If RAM does lose its information, the next time you turn the instrument on, protected calibration data stored in EEPROM loads into RAM and the instrument displays **CALIBRATION RESTORED**. Note, however, that register values are not restored.

How Long Should the Battery Last

The battery provides at least two years of back up power, and has a shelf life exceeding 10 years. It is not rechargeable.

WARNING

Although the battery has a strong outer case, do not abuse it mechanically, electrically, or thermally. This battery contains lithium and thionyl chloride ($SOCL_2$) and can be a fire, explosion, and severe burn hazard if abused.

Lithium can burn or explode on contact with moisture.

Thionyl chloride is highly toxic. On contact with air, it partially breaks down into hydrochloric acid and sulfur dioxide fumes, which are toxic, extremely repulsive, strongly irritating, and corrosive to eyes, skin, lungs, and mucous membranes. If a person comes in contact with or breathes this material, CONTACT A POISON CONTROL CENTER OR DOCTOR IMMEDIATELY.

Do not try to charge this battery; it may rupture.

Do not attempt to open the battery, heat it above 212° F (100° C), expose its contents to water, or incinerate it.

Your local laws may require the disposal of thionyl chloride or lithium in a chemical waste disposal site. You can return the battery to: Hewlett-Packard, 1400 Fountaingrove Parkway, Santa Rosa, California 95401, Attention: Environmental Engineering Department.

Dead batteries have converted most of the lithium and thionyl chloride into not-toxic chemicals.

How to Replace the Battery

CAUTION

This assembly contains static sensitive components. Work at a bench equipped with an anti-static surface, and wear a grounding strap that provides a path to earth ground of between 1 and 2.5 MΩ. Always handle a printed circuit board by the edges; never touch the finger contacts.

Do not set the A60 assembly on bare metal; this can short out and cause damage to a good battery.

1. Turn the line switch off and disconnect the instrument power cord. Wait 3 minutes.
2. Remove the A60 processor assembly.
3. Remove the battery and dispose of it properly (see WARNING, above).
4. Check the new battery before installing it; place a 10K ohm resistor across the battery and measure the voltage across the resistor. The voltage should be at least 3.4V (typically 3.6V).
5. If the voltage is correct, install the new battery in the processor assembly.
6. Reinstall the processor assembly in the instrument. Reconnect the power cord, and turn the instrument on. The front panel ENTRY display reads **CALIBRATION RESTORED**.
7. Verify that TP26 (IBATT) is less than 3 mV. A larger voltage indicates excessive battery drain.
8. Replace the top cover.

Table A60-6. A60 Processor P1 Pin I/O (1 of 3)

Pin	Mnemonic	Levels	Source	Destination
1 56	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*L *L
2 57	REN DIO1	TTL (LOW TRUE) TTL	A62J7-10 D	D A62J7-1
3 58	IFC DIO2	TTL (LOW TRUE) TTL	A62J7-17 D	D A62J7-3
4 59	NDAC DIO3	TTL TTL	D D	A62J7-15 A62J7-5
5 60	NRFD DIO4	TTL TTL	D D	A62J7-13 A62J7-7
6 61	DAV DIO5	TTL TTL	D D	A62J7-11 A62J7-2
7 62	EOI DIO6	TTL TTL	D D	A62J7-9 A62J7-4
8 63	ATN DIO7	TTL TTL	D D	A62J7-21 A62J7-6
9 64	SRQ DIO8	TTL TTL	A62J7-19 D	D A62J7-8
10 65	LSTP	TTL (LOW TRUE)	XA59P1-65	D A62J1-43
11 66				
12 67				
13 68				
14 69	LIPS	TTL (LOW TRUE)	XA52P1-36/A62J1-19	*E
15 70	SIOA GND PLANE	TTL (LOW TRUE) 0V	*G INSTRUMENT GROUND	*J *L
16 71	SIOB GND PLANE	TTL (LOW TRUE) 0V	*G INSTRUMENT GROUND	*J *L
17 72	ADR0 GND PLANE	TTL 0V	*G INSTRUMENT GROUND	*J *L
18 73	ADR2 ADR1	TTL TTL	*G *G	*J *J
19 74	ADR4 ADR3	TTL TTL	*G *G	*J *J

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A60-6. A60 Processor P1 Pin I/O (2 of 3)

Pin	Mnemonic	Levels	Source	Destination
20 75	DB0 GND PLANE	TTL 0V	*J K I INSTRUMENT GROUND	*I K *L
21 76	DB2 DB1	TTL TTL	*I K *I K	*I K *I K
22 77	DB4 DB3	TTL TTL	*I K *I K	*I K *I K
23 78	DB6 DB5	TTL TTL	*I K *I K	*I K *I K
24 79	DB8 DB7	TTL TTL	*J K I *I K	*I K *I K
25 80	DB10 DB9	TTL TTL	*J K I *J K L	*I K *I K
26 81	DB12 DB11	TTL TTL	*J K I *J K I	*I K *I K
27 82	DB14 DB13	TTL TTL	*J K L *J K I	*I K *I K
28 83	DB15	TTL	*J K I	*I K
29 84				
39 85				
31 86				
32 87				
33 88				
34 89	5 MHZ CLK LSRQ	TTL TTL (LOW TRUE)	B *	C F XA59P1-34 *I
35 90	+20V +20V	+20V +20V	XA52P1-16, 40 XA52P1-16, 40	*NOT USED *NOT USED
36 91	+5.2V +12V	+5.2V +12V	XA52P1-17, 18, 41, 42 XA52P1-9, 33	*L *L
37 92	+5.2V +5.2V	+5.2V +5.2V	XA52P1-17, 18, 41, 42 XA52P1-17, 18, 41, 42	*L *L

A single letter in the source or destination column refers to a function block on this assembly schematic.

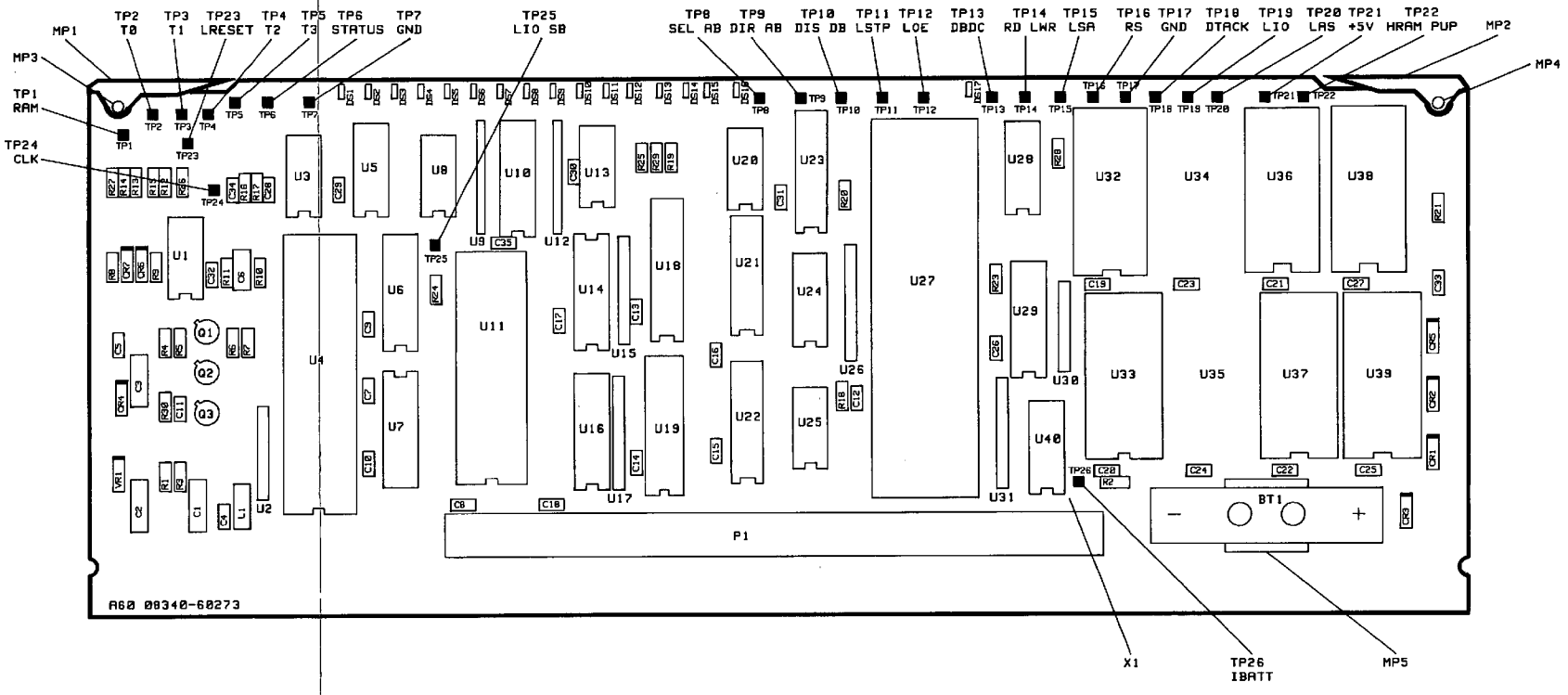
An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A60-6. A60 Processor P1 Pin I/O (3 of 3)

Pin	Mnemonic	Levels	Source	Destination
38	−15V	−15V	XA56P1-15, 30	*NOT USED
93	−5.2V	−5.2V	XA53P1-18, 36	*L
39	−10V	−10V	XA53P1-12, 13, 31, 32	*NOT USED
94	−10V	−10V	XA53P1-12, 13, 31, 32	*NOT USED
40	GND PLANE	0V	INSTRUMENT GROUND	*L
95	HPUP	TTL (HIGH TRUE)	XA52P1-46	*NOT USED
41	GND PLANE	0V	INSTRUMENT GROUND	*L
96	GND PLANE	0V	INSTRUMENT GROUND	*L
42	GND PLANE	0V	INSTRUMENT GROUND	*L
97	GND PLANE	0V	INSTRUMENT GROUND	*L
43	GND PLANE	0V	INSTRUMENT GROUND	*L
98	GND PLANE	0V	INSTRUMENT GROUND	*L
44	GND PLANE	0V	INSTRUMENT GROUND	*L
99	GND PLANE	0V	INSTRUMENT GROUND	*L
45	HSTM	TTL (HIGH TRUE)	H	XA61P1-45
100	GND PLANE	0V	INSTRUMENT GROUND	*L
46	LSOB	TTL (LOW TRUE)	H	XA61P1-46
101	LWRT	TTL (LOW TRUE)	H	XA61P1-101
47	LIDA14	TTL (LOW TRUE)	I	XA61P1-47
102	LIDA15	TTL (LOW TRUE)	I	XA61P1-102
48	LIDA12	TTL (LOW TRUE)	I	XA61P1-48
103	LIDA13	TTL (LOW TRUE)	I	XA61P1-103
49	LIDA10	TTL (LOW TRUE)	I	XA61P1-49
104	LIDA11	TTL (LOW TRUE)	I	XA61P1-104
50	LIDA8	TTL (LOW TRUE)	I	XA6P1-50
105	LIDA9	TTL (LOW TRUE)	I	XA61P1-105
51	LIDA6	TTL (LOW TRUE)	I	XA61P1-51
106	LIDA7	TTL (LOW TRUE)	I	XA61P1-106
52	LIDA4	TTL (LOW TRUE)	I	XA61P1-52
107	LIDA5	TTL (LOW TRUE)	I	XA61P1-107
53	LIDA2	TTL (LOW TRUE)	I	XA61P1-53
108	LIDA3	TTL (LOW TRUE)	I	XA6P1-108
54	LIDA0	TTL (LOW TRUE)	I	XA61P1-54
109	LIDA1	TTL (LOW TRUE)	I	XA61P1-109
55	GND PLANE	0V	INSTRUMENT GROUND	*L
110	GND PLANE	0V	INSTRUMENT GROUND	*L

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60273

Figure A60-5. A60 Processor, Component Location Diagram

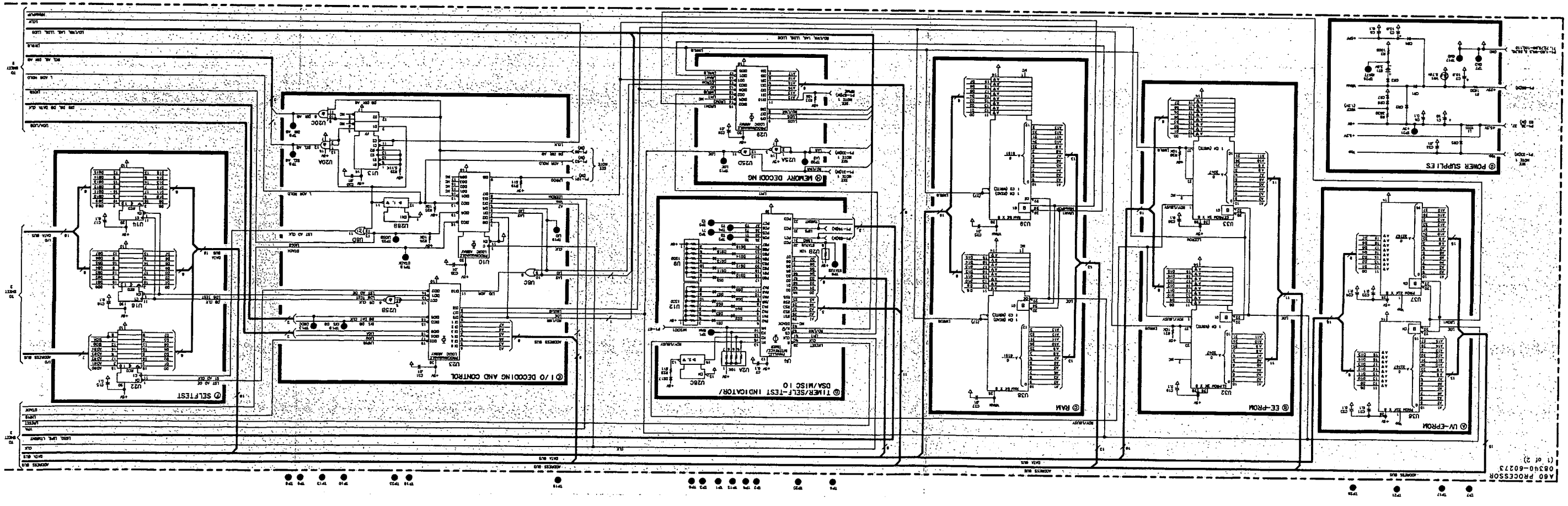


Figure A50-4. A60 Processor Schematic Diagram (1 of 2)

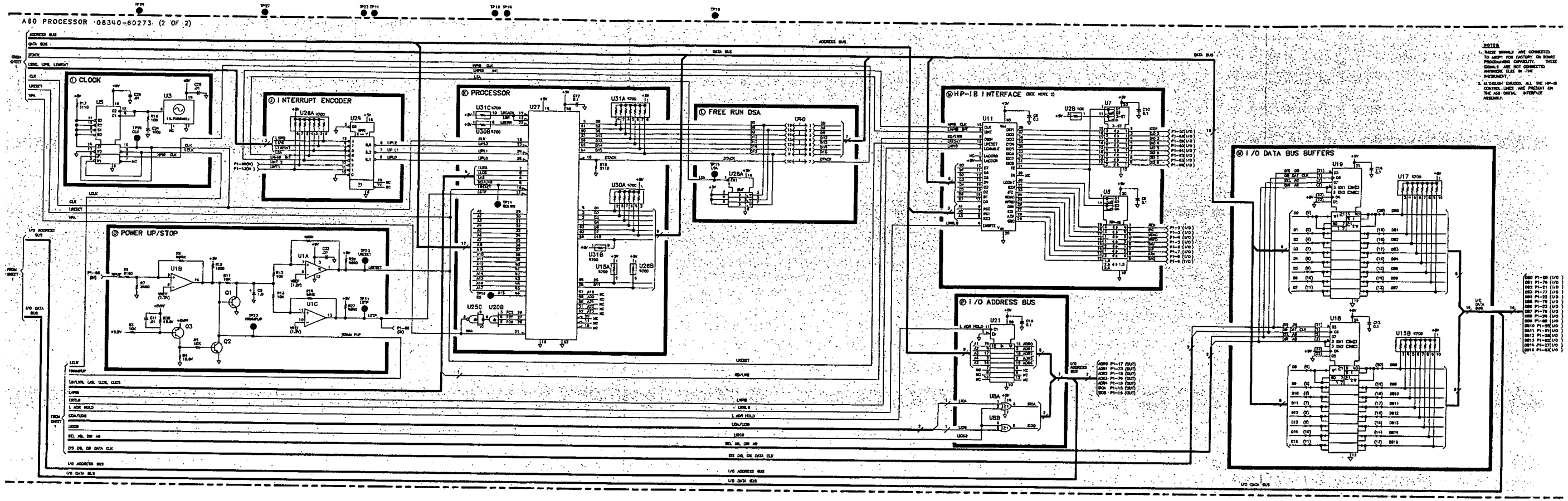


Figure A60-6. A60 Processor Schematic Diagram (2 of 2)

Table A60-7. A60 Processor Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A60	**08340-60273**	**8**	**1**	**PROCESSOR ASSEMBLY**	**28480**	**08340-60273**
A60BT1	1420-0331	3	1	BATTERY 3.4V 1.75A-HR LITHIUM THIONYL	28480	1420-0331
A60C1	0180-0374	3	3	CAPACITOR-FXD 10UF ± 10% 20VDC TA	56289	150D106X9020B2
A60C2	0180-0374	3		CAPACITOR-FXD 10UF ± 10% 20VDC TA	56289	150D106X9020B2
A60C3	0180-0374	3		CAPACITOR-FXD 10UF ± 10% 20VDC TA	56289	150D106X9020B2
A60C4	0160-4835	7	19	CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C5	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C6	0180-0291	3	1	CAPACITOR-FXD 1UF ± 10% 35VDC TA	56289	150D105X9035A2
A60C7	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C8	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C9	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C10	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C11	0160-4832	4	11	CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C12	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C13	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C14	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C15	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C16	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C17	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C18	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C19	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C20	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C21	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C22	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C23	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C24	0160-4835	7		CAPACITOR-FXD .1UF ± 10% 50VDC CER	28480	0160-4835
A60C25	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C26	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C27	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C28	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C29	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C30	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C31	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C32	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C33	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60C34	0160-4801	7	1	CAPACITOR-FXD 100PF ± 5% 100VDC CER	28480	0160-4801
A60C35	0160-4832	4		CAPACITOR-FXD .01UF ± 10% 100VDC CER	28480	0160-4832
A60CR1	1901-0376	6	2	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A60CR2	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A60CR3	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A60CR4	1901-0050	3	2	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A60CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A60CR6	1901-1098	1	2	DIODE-SWITCHING 50V 200MA 4NS	02682	1N4150
A60CR7	1901-1098	1		DIODE-SWITCHING 50V 200MA 4NS	02682	1N4150
A60DS1	1990-1149	0	16	LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS2	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS3	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS4	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS5	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS6	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS0	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS8	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS9	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS10	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS11	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS12	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS13	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS14	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS15	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS16	1990-1149	0		LED-LAMP IF = 7MA-MAX BVR = 5V	28480	1990-1149
A60DS17	1990-1148	9	1	LED-LAMP LUM-INT = 1MCD IF = 20MA-MAX BVR = 5V	28480	1990-1148
A60L1	9100-1788	6	1	CHOKE-WIDE BAND ZMAX = 680 OHM@ 180 MHZ	02114	VK200 20/48
A60MP1	4040-0754	1	1	EXTR PC BD BLU	28480	4040-0754
A60MP2	4040-0748	3	1	EXTR PC BD BLK	28480	4040-0748
A60MP3,4	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A60MP5	1400-1267	4	1	CLIP BTRY AA	28480	1400-1267
A60P1	1251-7469	3	1	CONN-POST TYPE .100-PIN-SPCG 110-CONT	28480	1251-7469
A60Q1	1853-0281	9	2	TRANSISTOR PNP 2N2907A SI TO-18 PD = 400MW	04713	2N2907A
A60Q2	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD = 500MW	04713	2N2222A
A60Q3	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD = 400MW	04713	2N2907A

Table A60-7. A60 Processor Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A60R1	0757-0873	0	1	RESISTOR 1.62K 1% .5W F TC=0±100	28480	0757-0873
A60R2	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A60R3	0757-0442	9	10	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R4	0698-3157	3	2	RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A60R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R6	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A60R7	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0±100	24546	C4-1/8-T0-3481-F
A60R8	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0±100	24546	C4-1/8-T0-3831-F
A60R9	0698-3260	9	3	RESISTOR 464K 1% .125W F TC=0±100	28480	0698-3260
A60R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A60R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R14	0698-3260	9		RESISTOR 464K 1% .125W F TC=0±100	28480	0698-3260
A60R15	0698-3260	9		RESISTOR 464K 1% .125W F TC=0±100	28480	0698-3260
A60R16	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A60R17	0757-0438	3	3	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A60R18	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A60R19	0757-0416	7	2	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A60R20	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R22				NOT ASSIGNED		
A60R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A60R26	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0±100	24546	C4-1/8-T0-4641-F
A60R27	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0±100	24546	C4-1/8-T0-4641-F
A60R28	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A60R29	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A60R30	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A60TP1-TP26	0360-0535	0	26	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A60U1	1826-0759	9	1	IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A60U2	1810-0206	8	1	NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
A60U3	1813-0196	1	1	XTAL-CLOCK-OSCILLATOR 14.7456-MHZ	28480	1813-0196
A60U4	1820-3449	8	1	IC-PARALLEL INTERFACE/TIMER/8MHZ/MC68000	28480	1820-3449
A60U5	1820-3172	4	1	IC FF CMOS/74HC J-K BAR POS-EDGE-TRIG	28480	1820-3172
A60U6	1820-3513	7	1	IC TRANSCEIVER TTL S INSTR-BUS IEEE-488	27014	BS75161AN
A60U7	1820-3431	8	1	IC TRANSCEIVER TTL S INSTR-BUS IEEE-488	27014	BS75160AN
A60U8	1820-3401	2	1	IC BFR TTL ALS OR QUAD 2-INP	28480	1820-3401
A60U9	1810-0276	2	2	NETWORK-RES 10-SIP1.5K OHM X 9	01121	210A152
A60U10	08340-80005	6	1	IO DECODER	28480	08340-80005
A60U11	1820-2548	6	1	IC GENERAL PURPOSE INTERFACE BUS ADAPTER	28480	1820-2548
A60U12	1810-0276	2		NETWORK-RES 10-SIP1.5K OHM X 9	01121	210A152
A60U13	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A60U14	1820-1997	7	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A60U15	1810-0279	5	4	NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A60U16	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A60U17	1810-0279	5		NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A60U18	1820-2675	0	2	IC RCVR TTL LS BUS OCTL	01295	SN74LS646N
A60U19	1820-2675	0		IC RCVR TTL LS BUS OCTL	01295	SN74LS646N
A60U20	1820-1203	8	1	IC GATE TTL LS AND TPL 3-INP	01295	SN74LS11N
A60U21	1820-2102	8	1	IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A60U22	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A60U23	08340-80007	8	1	DECODER	28480	08340-80007
A60U24	1820-1851	2	1	IC ENCDR TTL LS	01295	SN74LS148N
A60U25	1820-2656	7	1	IC GATE TTL ALS NAND QUAD 2-INP	01295	SN74ALS00N
A60U26	1810-0279	5		NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A60U27	1820-2505	5	1	IC – MPU: CLK FREQ=8MHZ, INSTRUCTION	28480	1820-2505
A60U28	1820-1492	7	1	IC BFR TTL LS INV HEX 1-INP	01698	SN74LS368AN
A60U29	08340-80006	7	1	MEMORY DECODER	28480	08340-80006
A60U30	1810-0205	7	1	NETWORK-RES 8-SIP4.7K OHM X 7	01121	208A472
A60U31	1810-0279	5		NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A60U32	1818-3464	2	2	IC EPROM 2KX8	28480	1818-3464
A60U33	1818-3464	2		IC EPROM 2KX8	28480	1818-3464
A60U34				NOT ASSIGNED		
A60U35				NOT ASSIGNED		

Table A60-7. A60 Processor Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A60U36/37	08340-60249	8	2	PROGRAMMED 256K UVEPROM SET NOT SEPARATELY REPLACEABLE	28480	08340-60249
A60U38	1818-3183	2	2	IC CMOS 65536 (64K) STAT RAM 150-NS 3-S	28480	1818-3183
A60U39	1818-3183	2		IC CMOS 65536 (64K) STAT RAM 150-NS 3-S	28480	1818-3183
A60U40	1251-4787	2	1	SHUNT-DIP 8-POSITION	28480	1251-4787
A60VR1	1902-3107	9	1	DIODE-ZNR 5.76V 2% DO-35 PD=.4W	28480	1902-3107
A60X1	1200-0607	0	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607

Front Panel/Rear Panel Component-Level Service G

CONTENTS

CONTENTS (Cont'd)

CONTENTS (Cont'd)

A1 Alpha Display Circuit Description

ASSEMBLY PURPOSE

The A1 alpha display assembly provides the physical mounting for the seven 4-character dot matrix display elements. The assembly is mounted on the front panel bezel, and interfaces to the A2 display driver assembly via a multi-pin connector.

DOT MATRIX DISPLAY

An integrated 5X7 dot matrix display, consisting of seven, 4-character devices (for a total of 28 characters), displays alphanumeric information.

How the 4-Character Devices Work

Figure A1-1 illustrates one 4-character device. Each character is made up of 35 LEDs (5 columns, 7 rows each). For each character, the 5 LEDs in each row are common to a single row driver. For all 28 characters, the 7 LEDs in each column (1 through 5) are common to a single column driver (i.e. column 1 in all 28 characters is driven by the same column driver).

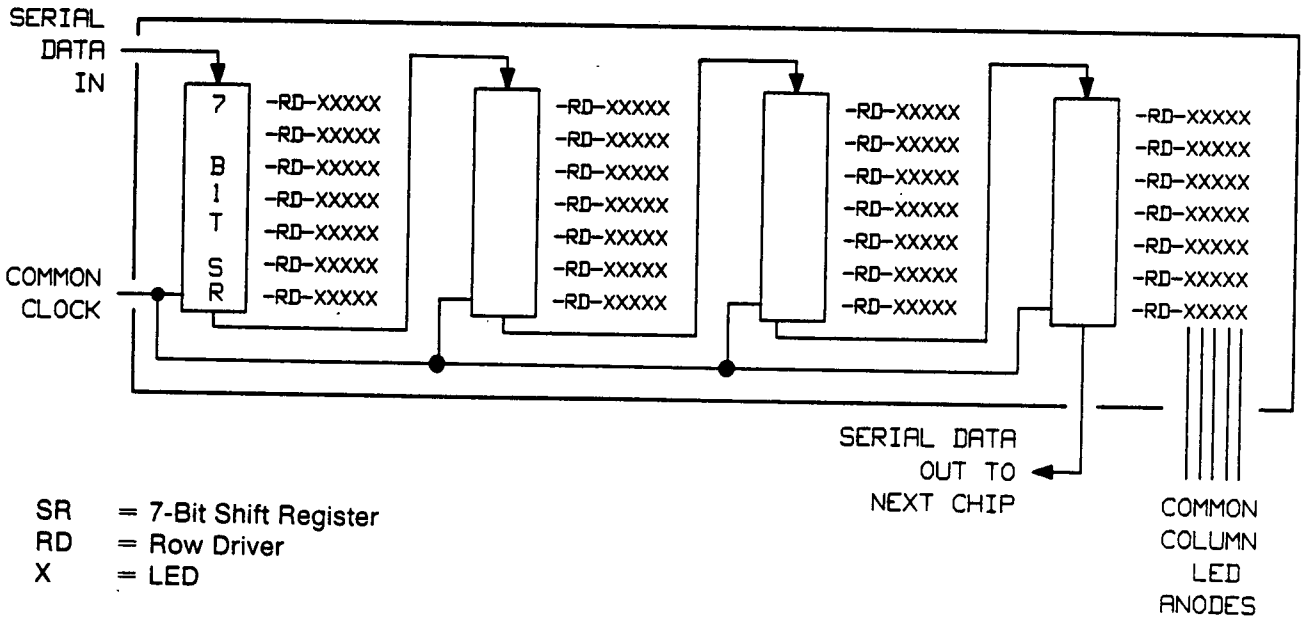


Figure A1-1. Alpha Display 4-Character Device

How the Microprocessor Displays Information

When something is to be displayed, the display processor reads the last character position from RAM and determines which column is required. It then looks up the bit pattern for the 7 LEDs in that column and outputs the 7 bits to the appropriate shift register. The shift register outputs the 7 bits to the displays and the LEDs light. Because the 5 LEDs in each row have a common row driver, if a bit for that particular row is a 1, the LED cathodes in that row are pulled low. The appropriate LED turns on, however, because that column line is pulled high. Then the display processor reads the next-to-last character and repeats the above sequence until all 196 bits (7 rows by 28 characters) are shifted into the displays. The sequence is repeated for each of the five columns at a rate of approximately 80 times per second (the LEDs light for approximately 2.5 ms), providing a flicker-free display.

Where the Alpha Display Shift Clock Comes From

The alpha display shift clock is generated and controlled on the A3 display processor assembly.

How the Alpha Display Dissipates Heat

Because the alpha displays dissipate considerable power, they require a substantial heat sink. For this reason, the display devices are soldered into the printed circuit board, and the board is attached directly to the anodized aluminum front panel bezel assembly with screws. On the printed circuit board, all pins to the devices have as much copper connected to them as possible to conduct the heat into the copper of the board and then into the bezel. Use heat sink compound between the alpha display printed circuit board and the bezel to ensure a low thermal resistance.

CAUTION

DO NOT use silicone based thermal compound. Silicone based oil migrates passed element sockets, switch contacts, or printed circuit board edge connectors, raising contact resistance, or electrically isolating the contacts. Silicone based thermal compounds disperse into the air, depositing themselves anywhere in the instrument. Heat increases the rate of dispersion.

A1 Alpha Display Component-Level Troubleshooting

HOW TO TROUBLESHOOT THE ALPHA DISPLAY

1. Turn the instrument off and remove the A1, A2 and A3 assemblies from the display casting.
2. Plug the A1 assembly directly into the A2 assembly, and connect the ribbon cable from the motherboard. Do not let the A1 alpha display short out against the A2 Display Driver. Turn the instrument on.
3. If the alpha display works correctly when removed from the casting, suspect a shorted anodized insulator. If so, clean the casting and the printed circuit board, checking for sharp protrusions or foreign particles. Install a new insulator using a non-silicone base thermal compound.
4. If some of the characters are working and some are not, either a signal trace is open or one of the integrated displays is faulty. On the display device that is not working, probe CS1 through CS5, ALPHA CLK, and DATA IN. If the signals appear at the device pins, replace the display. If the DATA IN signal does not appear at the display (pin 12), either the display you are checking or the previous display is at fault.

A2 Display Driver Circuit Description

ASSEMBLY PURPOSE

The A2 display driver assembly contains the 7-segment displays and the instrument annunciators, and it provides an interface with the A1 alpha display assembly.

NUMERIC SEGMENT DRIVERS (BLOCK A)

How the Segments are Arranged

Each numeric digit is a combination of seven segments and a decimal point. There are eight segment drivers common to all digits plus one digit driver for each of the 31 digits. The anodes of the same segment in each numeric digit are connected in parallel to a segment driver; the cathodes of all eight segments within a digit are connected in parallel to a digit driver.

How the Display Processor Displays Numbers

To display numbers in all display digits, the display processor starts at the first digit, clearing the segment driver latch and turning on the digit driver for that digit (block G). The display processor then determines the character to be displayed in the digit and sets the appropriate bits on the segment driver latch.

Once the latch bits are set, the appropriate segment drivers supply current through the segment and out the digit driver. The segment drivers are on for a few tenths of milliseconds, and are turned off at the end of this display time when the shift register/digit driver shifts to drive the second digit. The second digit LED segments do not turn on until the processor determines the character to be displayed and turns on the appropriate segment drivers.

This process is repeated for all 31 digits, and then the processor starts with the first digit again, at a rate of about 80 times per second (the displays light for approximately 2.5 ms).

The Segment Current Source

Two transistors and two resistors form a segment current source . When the segment driver latch input goes high, the base bias resistor provides base current to the first transistor, which turns on and conducts current from the display supply, through its emitter resistor. The current increases until the voltage drop across the resistor equals the Vbe drop of the second transistor, which begins to conduct, removing some of the base drive current from the first transistor.

An equilibrium is reached, with the second transistor conducting just enough current to remove the excess base current supplied to the first transistor. This type of current source is fairly immune to display supply voltage variations.

When the segment driver latch output goes low, it sinks all the current provided by the base bias resistor away from the base of the first transistor, turning off the current source.

Each of the eight segment current sources provides approximately 37 mA to each particular segment.

NUMERIC DISPLAYS (BLOCKS B, C, D)

The numeric displays consist of two 15 digit and one 5 digit monolithic 7-segment displays (A matched set provides equal illumination). In the instrument, only 13 of the 15 digits are used in each of the larger displays.

LIGHT EMITTING DIODE (LED) ANNUNCIATORS (BLOCK E)

Each annunciator is connected in series with a current limiting resistor to +12 volts. The resistor values are selected to make the apparent brightness to the eye the same on all annunciators.

LEVEL SHIFTERS (BLOCK F)

To meet the input voltage requirements of the power shift registers, level shifters must be used to translate the TTL levels to that required by these ICs.

When the input to the clock level shifter (CLK) is high, current is supplied to the base of the transistor through biasing components, turning the device on. When the transistor turns on, it pulls one end of the collector resistor down to approximately −5V. When the input to the clock level shifter is low, the base of the transistor is allowed to be pulled down to −5.2V, turning the device off and allowing the internal pull ups of the power shift register to pull the output high.

SHIFT REGISTER/NUMERIC DIGIT DRIVER (BLOCK G)

The numeric digit drivers are power shift registers whose outputs are capable of sinking 250 mA. When the start line (LVL STRT, etc) is pulsed high, all outputs of the shift register go high. After the start pulse, the first low going clock pulse applied to the clock line causes the first output of the register to go low. Each successive pulse on the clock line shifts this low output to the next output line and the previous line goes high. The low output shifts through each output line and finally is shifted out of the shift register at which time all outputs are again high. The outputs of the power shift registers are each connected to all segment cathodes of one digit thus when the output goes low it turns on all of the segments in that digit whose segment drivers are activated. The power shift registers have non-standard logic levels for the clock and start inputs. The clock input low level is −2.2V and has a pull up inside the device so it can be driven from an open collector transistor. The start input has a high level of +0.5V and a low level of −0.8V.

CONTROL DATA LATCH (BLOCK H)

The control data latch is an open collector addressable latch. The address inputs and the data input are connected to the display processor I/O port P10 through P13. The clock line is connected to the LE signal so each LE cycle the latch will be updated with the current information contained on the I/O port lines. Outputs go to the numeric display start pulse level translators and to the alpha display column drivers.

ALPHA COLUMN DRIVERS (BLOCK I)

The alpha column drivers are formed by column driver transistors and biasing resistors. When it is time for the processor to turn on one of the alpha columns, the processor pulls one of the column control lines in the control data latch low, which pulls the base of one of the column driver transistors low. This turns on the transistor, which pulls the column line up to the display supply voltage level, controlling the A1 alpha display indicators.

A2 Display Driver Component-Level Troubleshooting

ALL NUMERIC DISPLAYS ARE OFF

NOTE: If you press **[SHIFT] [CONT]**, the displays turn off.

If all of the segments of all numeric displays are off, first check the display supply. Troubleshoot the shift register/numeric digit driver (block G), level shifters (block F), and numeric segment drivers (block A).

How to Check the U9 Control Signals

1. Press **[SHIFT] [FREE RUN]** to run the front panel display diagnostics. Set up the oscilloscope for 50 µs/Div.
2. Probe CLR (U9 pin 15) with the oscilloscope. You should find low-going TTL pulses which are 10 to 50 µs wide. If this signal is low all the time then all numeric displays remain off. If CLR is not correct, troubleshoot the display processor (A3 block D) or replace A2U9.
3. Probe LE (U9 pin 14) with the oscilloscope. Set the oscilloscope to 1 us/Div. You should find low going TTL pulses which are 0.36 µs wide with a period of 1.36 µs. If this signal does not appear, troubleshoot the display processor (A3 block D).
4. Probe the remaining inputs to U9 (pins 1, 2, 3, and 13). If any of these lines do not have TTL activity, or have incorrect voltage levels, troubleshoot the display processor (A3 block D).

ONE OR MORE NUMERIC DISPLAY SEGMENTS IS ALWAYS OR NEVER ON

If one or more of the numeric display's segments is always on or is never on, the problem most likely lies with the segment current source, or a bad shift register.

How to Check a Segment's Current Source

1. With an oscilloscope, probe the appropriate U9 output for the affected segment. Set the oscilloscope to 0.5 ms/Div. You should find various patterns of 0.3 ms wide, high-going pulses that are limited in amplitude to approximately 3 to 3.5V.
2. If the signal at the output of U9 is approximately correct, and the segment is always **on**, either the transistor connected to the display supply is shorted, or a trace from the current sources to the numeric displays is open or shorted.
3. If the signal at the output of U9 is approximately correct, and the segment is always **off**, the transistor connected to the display supply is open, the current limiting transistor is shorted, or a trace from the current sources to the numeric displays is open or shorted.

NEITHER THE SEGMENT DRIVERS NOR THE DIGIT DRIVERS ARE FAULTY

If you have determined that neither the segment drivers (block A) nor the digit drivers (block G) are faulty, replace the numeric display set. Because this display set is matched for intensity, either replace the entire set or use a segment driver of the same intensity.

LED ANNUNCIATORS (BLOCK E)

One or More Annunciators is Incorrectly On or Off

1. If one or more annunciator is incorrectly on or off, verify that the appropriate input (J11 or J13) is approximately 0.2V if the associated annunciator should be on, and 6.5 to 9V if the annunciator should be off.
2. If one or several annunciators are off when they should be on, and the input(s) from J11 and/or J13 is/are correct, check the +12V at the annunciator(s)
3. If +12V is not at the annunciator, look for an open trace along the top edge of the board or troubleshoot the A3 assembly. If +12V is present, replace the annunciator.

Annunciators are All Off When They Should Be On

1. If all of the annunciators are off, check the +12V supply or troubleshoot the annunciator latch on the A3 assembly.

LEVEL SHIFTERS (BLOCK F)

1. With the oscilloscope, check TP3 (NUM CLK). Set the oscilloscope to 1 µs/Div. You should see 3 µs wide, high-going, 3V pulses. If not, troubleshoot the display processor (A3 block D).
2. If the NUM CLK signal is greater than 3.5V, check the signal at the base of Q6. You should find 3 µs wide pulses that are 0.6 to 0.8 volts high. If there are no pulses at the base of Q6, VR4 is open. If the pulses at the base of Q6 are higher than 0.8V, the base of Q6 is open.
3. Probe CLK with the oscilloscope. You should find 3 µs wide, low-going pulses that go between −3 volts and at least +1.8V. If CLK stays at −3V, Q6 is shorted. If CLK stays near 5V, Q6 is open, or R7 is open.
4. To check the STRT level shifter circuits, probe the appropriate signal (LVL START, F1 START, or F2 START) at the cathode of VR1, VR2 or VR3. You should find 3 µs wide, high-going pulses with levels from 0.7V to approximately 4 volts. If no signal appears, troubleshoot the control data latch (block H).
5. If one of these signals is greater than 4 volts, probe the associated test point (TP4, TP5, or TP7). You should find approximately ± 1.5V levels. If the signal at the test point stays at −1.5 V, the zener diode is probably open. If this signal never goes negative, the zener may be shorted. Also, an input to one of the numeric digit drivers may be shorted.

HOW TO CHECK THE SHIFT REGISTER/NUMERIC DIGIT DRIVER (BLOCK G)

1. Check for +5.2V at U4, U5, and U8 pin 9.
2. Check for approximately 4.4 to 4.6 volts at U4 or U5 pin 10 and U8 pin 10. If this voltage is not present, replace CR1 or CR2 as appropriate.
3. Check the CLK signal at pin 9 of U4, U5, or U8. You should find 3 µs wide, low-going pulses that go between −3V and at least +1.8V. If these pulses are not present, troubleshoot the level shifters (block F).

4. Check the STRT signal of the suspected driver at pin 8 of U4, U5, or U8. You should find 3 μs wide, high-going pulses that go between approximately +1.5V and −1.5V. If these pulses are not present, troubleshoot the level shifters (block F).

5. Using small clip leads, connect a 1 kΩ resistor between the scope probe and +5V. Set the oscilloscope to 0.1 ms/Div and check the digit driver outputs (U4, U5 or U8). You should see 400 μs wide, low-going pulses that go between +5V and approximately +0.5V. If these pulses do not appear, or if the low level is above +0.8V, replace the driver.

HOW TO CHECK THE CONTROL DATA LATCH (BLOCK H)

1. With an oscilloscope, check the P10 through P13 signals (U3 pins 1, 2, 3, and 13). Set the oscilloscope 0.5 ms/Div. If you find TTL activity, proceed with step 3.

2. Check LE (U3 pin 14). Set the oscilloscope to 1 us/Div. You should find 0.4 μs wide, low-going pulses, with a period of 1.4 μs.

3. On the three STRT lines you should find 3 μs wide, high-going pulses. If any of these signals are not present, replace U3.

4. Check the COL1 through COL5 signals (U3 pins 4, 5, 6, 7, and 11). Set the oscilloscope to 0.5 ms/Div. You should find signals that go between 0.5V and 4V. If not, replace U3.

HOW TO CHECK THE ALPHA COLUMN DRIVERS (BLOCK I)

1. With an oscilloscope, check CS1 through CS5 at the collector of Q1 through Q5. Set the oscilloscope to 0.5 ms/Div. You should find approximately 1 ms wide, high-going pulses of varying amplitudes (at least 2V). If these signals are present, but one or more alpha display column is not lighting, check for opens to the A1 assembly, or troubleshoot the A1 alpha display.

2. If CS1, CS2, CS3, CS4, or CS5 remain high, connect a 1 kΩ resistor between your probe and ground using small clip leads and check that signal again. If the signal now appears, there is probably an open trace between the transistor and the alpha display devices.

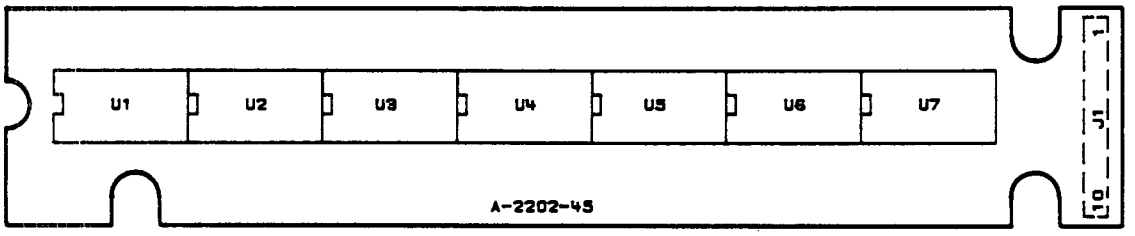
3. If the signal remains high after performing step 2, either the associated transistor is shorted, or the input to this block is low all the time. Check the appropriate COL1 through COL5 signal at U3. If the signal appears at this point, the drive transistor may be shorted. If no signal appears at U3, troubleshoot the control data latch (block H).

4. If CS1, CS2, CS3, CS4, or CS5 remain low, check the appropriate COL1 through COL5 signal at U3. If a signal appears at the output of U3 but the output of the associated driver transistor (Q1 through Q5) remains low, a trace is open, one of the resistors in U2 is open, or the drive transistor is open. If no signal appears at U3, troubleshoot the control data latch (block H).

Table A2-1. A62J1 Pin I/O

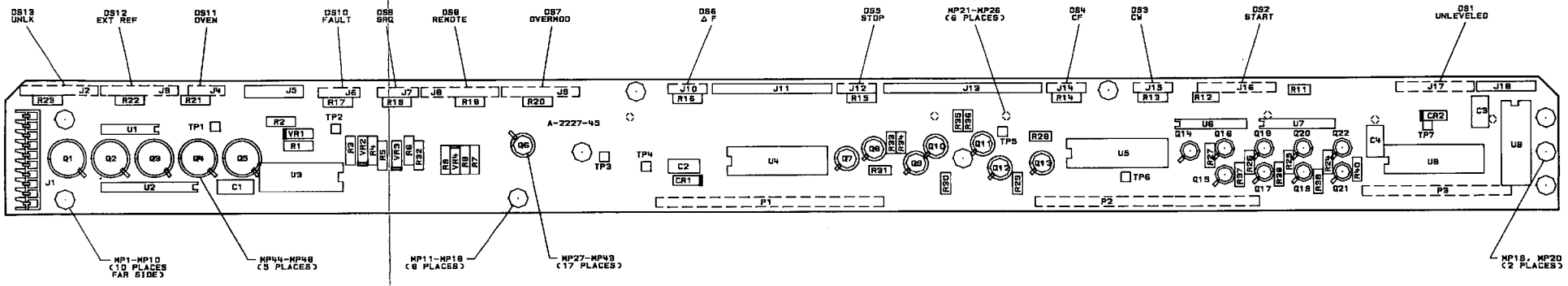
A62J1 Pin	Mnemonic	A62W1P1	A62W1P2	Levels
1	GND PLANE	PIN 1	PIN 1	0V
2	+12V	PIN 2	PIN 2	+12V
3	DB0	PIN 3	PIN 3	TTL
4	DB1	PIN 4	PIN 4	TTL
5	DB2	PIN 5	PIN 5	TTL
6	DB3	PIN 6	PIN 6	TTL
7	DB4	PIN 7	PIN 7	TTL
8	DB5	PIN 8	PIN 8	TTL
9	DB6	PIN 9	PIN 9	TTL
10	DB7	PIN 10	PIN 10	TTL
11	DB8	PIN 11	PIN 11	TTL
12	DB9	PIN 12	TTL	
13	DB10	PIN 13	PIN 13	TTL
14	DB11	PIN 14	PIN 14	TTL
15	DB12	PIN 15	PIN 15	TTL
16	DB13	PIN 16	PIN 16	TTL
17	DB14	PIN 17	PIN 17	TTL
18	DB15	PIN 18	PIN 18	TTL
19	LIPS	PIN 19	PIN 19	TTL (LOW TRUE)
20	LSBY	NOT USED	PIN 20	0V TO +22V
21	GND PLANE	NOT USED	PIN 21	0V
22	HPUP	NOT USED	NOT USED	TTL (HIGH TRUE)
23	ADR0	PIN 23	PIN 23	TTL
24	ADR1	PIN 24	PIN 24	TTL
25	ADR2	PIN 25	PIN 25	TTL
26	ADR3	PIN 26	PIN 26	TTL
27	ADR4	PIN 27	PIN 27	TTL
28	LSTEPUP	NOT USED	PIN 28	TTL (LOW TRUE)
29	GND PLANE	PIN 29	PIN 29	0V
30	+22V	NOT USED	PIN 30	+22V
31	+5.2V	PIN 31	PIN 31	+5.2V
32	+5.2V	PIN 32	PIN 32	+5.2V
33	+5.2V	PIN 33	PIN 33	+5.2V
34	+5.2V	PIN 34	PIN 34	+5.2V
35	+5.2V	PIN 35	PIN 35	+5.2V
36	+5.2V	PIN 36	PIN 36	+5.2V
37	+5.2V	NOT USED	PIN 37	+5.2V
38	GND PLANE	NOT USED	PLIN 38	0V
39	GND PLANE	PIN 39	PIN 39	0V
40	GND PLANE	NOT USED	PIN 40	0V
41	GND PLANE	NOT USED	PIN 41	0V
42	−5.2V	PIN 42	PIN 42	−5.2V
43	LSTP	NOT USED	NOT USED	TTL (LOW TRUE)
44	LSPLD	NOT USED	PIN 44	TTL
45	LSRQ	NOT USED	PIN 45	TTL (LOW TRUE)
46	GND PLANE	NOT USED	PIN 46	0V
47	SIOB	NOT USED	PIN 47	TTL (LOW TRUE)
48	GND PLANE	PIN 48	PIN 48	0V
49	ISOA	PIN 49	NOT USED	TTL (LOW TRUE)
50	GND PLANE	PIN 50	PIN 50	0V

Note: Refer to A62 motherboard wiring list for signal source and destination information.



HP Part Number: 08340-60007

Figure A2-1. A1 Alpha Display Component Location Diagram



HP Part Number: 08340-60182

Figure A2-2. A2 Display Driver, Component Location Diagram

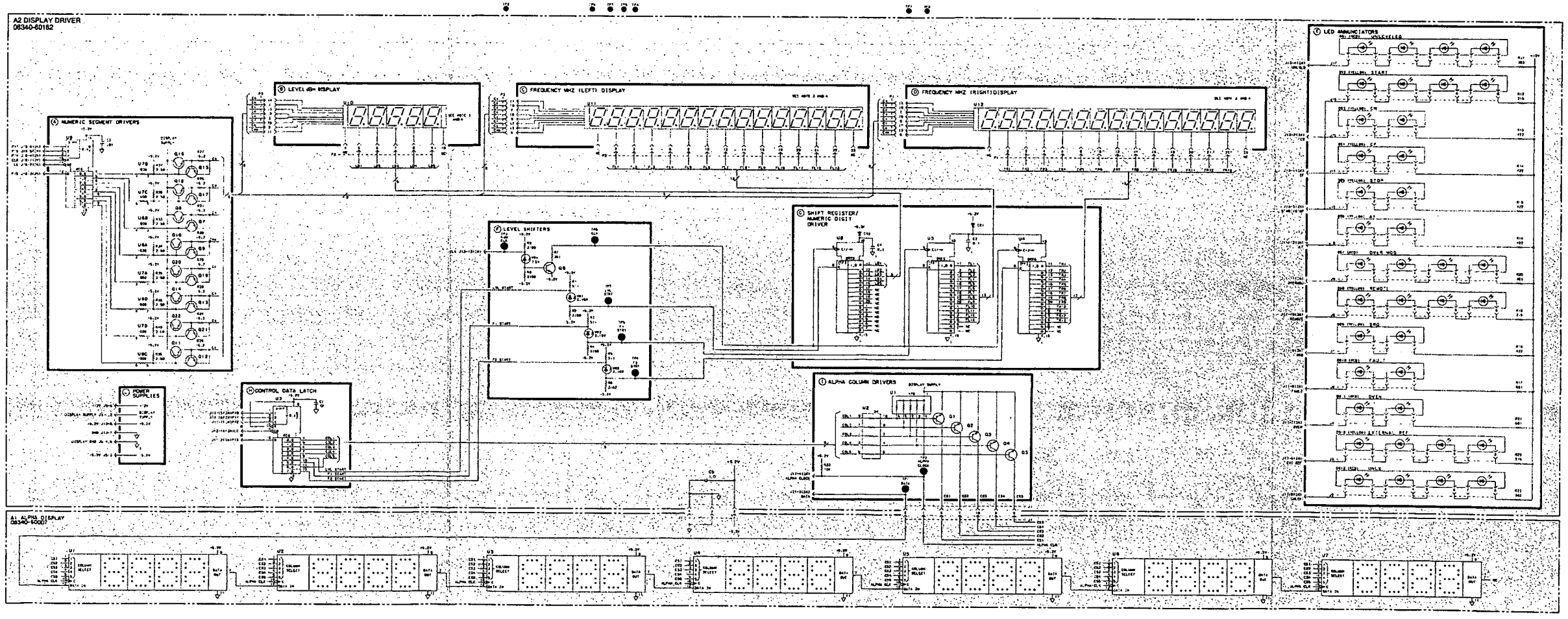


Figure A2-3. A1 Alpha Display and A2 Display Driver, Schematic Diagram

Table A2-2. A1/A2 Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	**08340-60007**	**6**	**1**	**ALPHA DISPLAY ASSEMBLY**	**28480**	**08340-60007**
				NOTE: A1J1 must be cut to length before replacement.		
A1J1	1251-6798	9	1	CONNECTOR PC 36-CONT M	03206	65647-136
A1U1-7	1990-0919	0		DISPLAY ANNUNCIATOR SET MATCHED FOR LUMINOUS INTENSITY	28480	1990-0919
A1U1-7	1990-0553	8	7	DISPLAY ANNUNCIATOR .15-IN-HIGH	01542	QDSP-2049, CAT C
A2	**08340-60182**	**8**	**1**	**DISPLAY DRIVER ASSEMBLY**	**28480**	**08340-60182**
A2C1	0160-2055	9	2	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C2	0160-4084	8	2	CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A2C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C4	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A2C5	0160-4535	4	1	CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A2CR1	1901-0033	2	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2DS1	1990-0699	3	3	L.E.D. (RED) 7 MCD	01542	1LM1-2350
A2DS2-6/8/9/12	1990-0887	1		L.E.D. SET MATCHED FOR LUMINOUS INTENSITY	28480	1990-0887
A2DS2	1990-0700	7	3	L.E.D. (YELLOW) 5 MCD	01542	1LM1-2450
A2DS3	1990-0697	1	5	L.E.D. (YELLOW) 2 MCD	01542	1LM1-2400
A2DS4	1990-0697	1		L.E.D. (YELLOW) 2 MCD	01542	1LM1-2400
A2DS5	1990-0697	1		L.E.D. (YELLOW) 2 MCD	01542	1LM1-2400
A2DS6	1990-0697	1		L.E.D. (YELLOW) 2 MCD	01542	1LM1-2400
A2DS7	1990-0699	3		L.E.D. (RED) 7 MCD	01542	1LM1-2350
A2DS8	1990-0700	7		L.E.D. (YELLOW) 5 MCD	01542	1LM1-2450
A2DS9	1990-0697	1		L.E.D. (YELLOW) 2 MCD	01542	1LM1-2400
A2DS10	1990-0696	0	2	LED-LIGHT BAR MODULE LUM-INT=3MCD	01542	1LM1-2300
A2DS11	1990-0696	0		LED-LIGHT BAR MODULE LUM-INT=3MCD	01542	1LM1-2300
A2DS12	1990-0700	7		L.E.D. (YELLOW) 5 MCD	01542	1LM1-2450
A2DS13	1990-0699	3		L.E.D. (RED) 7 MCD	01542	1LM1-2350
A2J1	1251-6063	1	1	CONNECTOR-PC 10 FEMALE IR	28480	1251-6063
A2J2	1200-0940	4	6	SOCKET-STRP 8-CONT DIP-SLDR	28480	1200-0940
A2J3	1200-0940	4		SOCKET-STRP 8-CONT DIP-SLDR	28480	1200-0940
A2J4	1200-0575	1	7	SOCKET-STRP 4-CONT DIP-SLDR	28480	1200-0575
A2J5	1251-6787	6	3	SOCKET-STRIP 6 CONTACT	28480	1251-6787
A2J6	1200-0575	1		SOCKET-STRP 4-CONT DIP-SLDR	28480	1200-0575
A2J7	1200-0575	1		SOCKET-STRP 4-CONT DIP-SLDR	28480	1200-0575
A2J8	1200-0940	4		SOCKET-STRP 8-CONT DIP-SLDR	28480	1200-0940
A2J9	1200-0940	4		SOCKET-STRP 8-CONT DIP-SLDR	28480	1200-0940
A2J10	1200-0575	1		SOCKET-STRP 4-CONT DIP-SLDR	28480	1200-0575
A2J11	1251-6787	6		SOCKET-STRIP 6 CONTACT	28480	1251-6787
A2J12	1200-0575	1		SOCKET-STRP 4-CONT DIP-SLDR	28480	1200-0575
A2J13	1251-6788	7	1	SOCKET-STRIP 16 CONTACT	28480	1251-6788
A2J14	1200-0575	1		SOCKET-STRP 4-CONT DIP-SLDR	28480	1200-0575
A2J15	1200-0575	1		SOCKET-STRP 4-CONT DIP-SLDR	28480	1200-0575
A2J16	1200-0940	4		SOCKET-STRP 8-CONT DIP-SLDR	28480	1200-0940
A2J17	1200-0940	4		SOCKET-STRP 8-CONT DIP-SLDR	28480	1200-0940
A2J18	1251-6787	6		SOCKET-STRIP 6 CONTACT	28480	1251-6787
A2MP1	08340-20060	7	10	STANDOFF PRIM	28480	08340-20060
A2MP2	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP3	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP4	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP5	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP6	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP7	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP8	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP9	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP10	08340-20060	7		STANDOFF PRIM	28480	08340-20060
A2MP11	08340-20061	8	8	STANDOFF-SEC	28480	08340-20061
A2MP12	08340-20061	8		STANDOFF-SEC	28480	08340-20061
A2MP13	08340-20061	8		STANDOFF-SEC	28480	08340-20061
A2MP14	08340-20061	8		STANDOFF-SEC	28480	08340-20061
A2MP15	08340-20061	8		STANDOFF-SEC	28480	08340-20061
A2MP16	08340-20061	8		STANDOFF-SEC	28480	08340-20061
A2MP17	08340-20061	8		STANDOFF-SEC	28480	08340-20061
A2MP18	08340-20061	8		STANDOFF-SEC	28480	08340-20061
A2MP19	08340-20063	0	2	STANDOFF-SHORT	28480	08340-20063
A2MP20	08340-20063	0		STANDOFF-SHORT	28480	08340-20063

Table A2-2. A1/A2 Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2MP21	08340-20066	3	6	SPACER POST	28480	08340-20066
A2MP22	08340-20066	3		SPACER POST	28480	08340-20066
A2MP23	08340-20066	3		SPACER POST	28480	08340-20066
A2MP24	08340-20066	3		SPACER POST	28480	08340-20066
A2MP25	08340-20066	3		SPACER POST	28480	08340-20066
A2MP26	08340-20066	3		SPACER POST	28480	08340-20066
A2MP27-43	1200-0172	4	17	INSULATOR-XSTR DAP-GL	28480	1200-0172
A2MP44	1200-0173	5	5	INSULATOR-XSTR DAP-GL	28480	1200-0173
A2MP45	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A2MP46	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A2MP47	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A2MP48	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
				NOTE: A2P1 and 2 must be cut to length before replacement.		
A2P1	1200-0681	0		SOCKET-STRP 20-CONT DIP-SLDR	28480	1200-0681
A2P2	1200-0681	0		SOCKET-STRP 20-CONT DIP-SLDR	28480	1200-0681
A2P3	1251-6786	5	1	CONNECTOR-SINGLE CONTACT .02	28480	1251-6786
A2Q1	1853-0442	4	5	TRANSISTOR PNP 2N3867 SI TO-5 PD=1W	04713	2N3867
A2Q2	1853-0442	4		TRANSISTOR PNP 2N3867 SI TO-5 PD=1W	04713	2N3867
A2Q3	1853-0442	4		TRANSISTOR PNP 2N3867 SI TO-5 PD=1W	04713	2N3867
A2Q4	1853-0442	4		TRANSISTOR PNP 2N3867 SI TO-5 PD=1W	04713	2N3867
A2Q5	1853-0442	4		TRANSISTOR PNP 2N3867 SI TO-5 PD=1W	04713	2N3867
A2Q6	1854-0477	7	17	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q7	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q8	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q9	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q10	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q11	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q12	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q13	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q14	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q15	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q16	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q17	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q18	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q19	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q20	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q21	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2Q22	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2R1	0757-0416	7	3	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A2R2	0757-0279	0	4	RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A2R3	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A2R4	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A2R5	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A2R6	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A2R7	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0±100	24546	C4-1/8-T0-2610-F
A2R8	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0±100	24546	C4-1/8-T0-2151-F
A2R9	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A2R10				NOT ASSIGNED		
A2R11	0698-3446	3	3	RESISTOR 383 1% .125W F TC=0±100	24546	C4-1/8-T0-383R-F
A2R12	0698-3441	8	3	RESISTOR 215 1% .125W F TC=0±100	24546	C4-1/8-T0-215R-F
A2R13	0698-3447	4	5	RESISTOR 422 1% .125W F TC=0±100	24546	C4-1/8-T0-422R-F
A2R14	0698-3447	4		RESISTOR 422 1% .125W F TC=0±100	24546	C4-1/8-T0-422R-F
A2R15	0698-3447	4		RESISTOR 422 1% .125W F TC=0±100	24546	C4-1/8-T0-422R-F
A2R16	0698-3447	4		RESISTOR 422 1% .125W F TC=0±100	24546	C4-1/8-T0-422R-F
A2R17	0757-0419	0	2	RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A2R18	0698-3441	8		RESISTOR 215 1% .125W F TC=0±100	24546	C4-1/8-T0-215R-F
A2R19	0698-3447	4		RESISTOR 422 1% .125W F TC=0±100	24546	C4-1/8-T0-422R-F
A2R20	0698-3446	3		RESISTOR 383 1% .125W F TC=0±100	24546	C4-1/8-T0-383R-F
A2R21	0757-0419	0		RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A2R22	0698-3441	8		RESISTOR 215 1% .125W F TC=0±100	24546	C4-1/8-T0-215R-F
A2R23	0698-3446	3		RESISTOR 383 1% .125W F TC=0±100	24546	C4-1/8-T0-383R-F
A2R24	0698-7193	5	8	RESISTOR 16.2 1% .05W F TC=0±100	24546	C3-1/8-TO-16R2-F
A2R25	0698-7193	5		RESISTOR 16.2 1% .05W F TC=0±100	24546	C3-1/8-TO-16R2-F
A2R26	0698-7193	5		RESISTOR 16.2 1% .05W F TC=0±100	24546	C3-1/8-TO-16R2-F
A2R27	0698-7193	5		RESISTOR 16.2 1% .05W F TC=0±100	24546	C3-1/8-TO-16R2-F
A2R28	0698-7193	5		RESISTOR 16.2 1% .05W F TC=0±100	24546	C3-1/8-TO-16R2-F
A2R29	0698-7193	5		RESISTOR 16.2 1% .05W F TC=0±100	24546	C3-1/8-TO-16R2-F
A2R30	0698-7193	5		RESISTOR 16.2 1% .05W F TC=0±100	24546	C3-1/8-TO-16R2-F

Table A2-2. A1/A2 Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R31	0698-7193	5		RESISTOR 16.2 1% .05W F TC=0±100	24546	C3-1/8-TO-16R2-F
A2R32	0698-3274	5	1	RESISTOR 10K 1% .125W F TC=0±25	28480	0698-3274
A2R33	0698-7244	7	8	RESISTOR 2.15K 1% .05W F TC=0±100	24546	C3-1/8-T0-2151-F
A2R34	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0±100	24546	C3-1/8-T0-2151-F
A2R35	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0±100	24546	C3-1/8-T0-2151-F
A2R36	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0±100	24546	C3-1/8-T0-2151-F
A2R37	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0±100	24546	C3-1/8-T0-2151-F
A2R38	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0±100	24546	C3-1/8-T0-2151-F
A2R39	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0±100	24546	C3-1/8-T0-2151-F
A2R40	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0±100	24546	C3-1/8-T0-2151-F
A2TP1	0360-2050	8	7	TERMINAL TEST POINT PCB	28480	0360-2050
A2TP2	0360-2050	8		TERMINAL TEST POINT PCB	28480	0360-2050
A2TP3	0360-2050	8		TERMINAL TEST POINT PCB	28480	0360-2050
A2TP4	0360-2050	8		TERMINAL TEST POINT PCB	28480	0360-2050
A2TP5	0360-2050	8		TERMINAL TEST POINT PCB	28480	0360-2050
A2TP6	0360-2050	8		TERMINAL TEST POINT PCB	28480	0360-2050
A2TP7	0360-2050	8		TERMINAL TEST POINT PCB	28480	0360-2050
A2U1	1810-0364	9	1	NETWORK-RES 6-SIP470.0 OHM X	5	01121206A471
A2U2	1810-0340	1	1	NETWORK-RES 10-SIP24.0 OHM X	5	01121210B240
A2U3	1820-2266	5	1	IC DRVR TTL 18324 NE590F		
A2U4	1820-1226	5	3	IC SHF-RGTR TTL ASYNCHRO SERIAL-IN	28480	1820-1226
A2U5	1820-1226	5		IC SHF-RGTR TTL ASYNCHRO SERIAL-IN	28480	1820-1226
A2U6	1810-0374	1	2	NETWORK-RES 8-SIP1.0K OHM X	4	01121208B102
A2U7	1810-0374	1		NETWORK-RES 8-SIP1.0K OHM X	4	01121208B102
A2U8	1820-1226	5		IC SHF-RGTR TTL ASYNCHRO SERIAL-IN	28480	1820-1226
A2U9	1820-1729	3	1	IC LCH TTL LS COM CLEAR 8-BIT	01295	SN74LS259N
A2U10/11/12	08340-60017	3	3	DISPLAY SET MATCHED FOR LUMINOUS INTENSITY	28480	08340-60017
A2VR1	1902-3036	3	3	DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A2VR2	1902-3036	3		DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A2VR3	1902-3036	3		DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A2VR4	1902-0064	1	1	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064

A3 Display Processor Circuit Description

ASSEMBLY PURPOSE

The A3 display processor assembly provides the communication link for interfacing the main instrument microprocessor to the instrument displays. The instrument microprocessor sends display data to the A3 display processor via the instrument data and address busses. The A3 display processor stores the data in internal RAM (random access memory), and processes the data into the necessary control signals to display the information. The display processor has 2K of internal ROM (read only memory) that contains the program for display control.

The A3 display processor assembly outputs control signals to the A2 display driver assembly for the power/frequency 7-segment displays, the entry display 5X7 dot matrix displays, and the instrument LED annunciators.

PRESET CIRCUITRY (BLOCK A)

The preset circuitry:

- Allows the instrument preset signal to clear the annunciator LEDs (all on) and to reset the display processor.
- Allows either the instrument preset signal or the display processor to clear the numeric display segment driver data latch (all off).

Low Instrument Preset Signal (LIPS) and Clear (CLR)

The LIPS signal comes into a schmitt trigger buffer, is inverted twice and appears at the output of the second schmitt trigger buffer with its polarity unchanged. This buffered LIPS signal directly resets the annunciator latches (block E), and the display processor (block D). This active low signal is combined with an active low signal from the display processor I/O port P25 (block D), and the result is inverted to produce the active low clear that is sent to the numeric segment drivers (A2, block A).

INSTRUMENT BUS INTERFACE (BLOCK B)

The instrument bus interface consists of a 3-to-8 line decoder, an eight-bit latch, and an RS flip-flop.

3-to-8 Decoder

The 3-to-8 decoder decodes the address information from the instrument address bus and the SIOA signal, and generates I/O strobe LEN 5 or LEN 7. LEN 5 latches annunciator control bits (block E) off the instrument data bus. LEN 7 is both the interrupt strobe to the display processor, and the clock to the eight-bit D-latch, which latches the data sent to the display processor via the instrument data bus.

Eight-Bit Latch

The eight-bit latch connects the two asynchronous buses. The outputs of this latch are connected to the display assembly's internal data/address bus. When the display processor is ready to accept the data stored in the input latch, the processor read line goes low, enabling the latch, which outputs onto the display data bus.

Service Request Latch

The service request latch consists of two NAND gates connected as a set/reset flip-flop. One input is connected to the input decoder. The other input is connected to the display processor read line, which is high until data from the input latch is read. In this state, the set/reset flip-flop output is high until an input changes.

When the instrument microprocessor sends an interrupt to the display, the interrupt line (LEN7) first goes low, and then goes high. When this line goes low, it forces one input of the request latch to go low, and its output to go low. The flip-flop is then stable in this state. Because the flip-flop output is connected to the display processor interrupt line, when it goes low, the processor starts an interrupt sequence.

During the interrupt service routine, the display processor sets the read line low, which is connected to an input of the request flip-flop, and to the eight-bit data bus latch. When this happens, the request flip-flop output goes high.

DISPLAY SUPPLY (BLOCK C)

The entry and numeric displays can require as much as 2 amps of current, but the average current required is much less. Current peaks or transients caused by strobing the displays can cause spurs on the instrument's RF output.

Constant Current Source

A constant current source connected to the instrument +5.2V supply provides a constant load for the instrument supplies. The output of this current source, along with a large amount of stored energy (output capacitors), is connected to the LED current source circuits. The current source provides slightly more than the average amount of current required by the LEDs, and the capacitors provide the additional current required during peak demands.

How the Current Source is Adjusted

The average current demand of the displays changes as more or less segments or characters are turned on. To keep the current source in regulation during both high and low average current demands, the current source is adjustable. The voltage is sensed at the energy storage capacitors through sense resistor R11, and as this voltage goes down, the voltage at the integrator output goes up. This causes an increase in the current to the display supply. The current source does not track the output voltage or respond to variations caused by strobing segments and columns, but responds only to slow variations in the average voltage at the display supply.

When the current source is supplying a large amount of current and the requirement goes down, it tries to continue supplying the large current. The voltage at the output rises until it cannot go any higher, and then the current source goes out of regulation. This causes a current transient on the main supply to the display. VR1 and R6 sink this excess current until the integrating feedback has time to reduce the average output current.

DISPLAY PROCESSOR (BLOCK D)

The display processor is an 8049 microprocessor that contains 128 bytes of random access memory (RAM), and and 2K bytes of read only memory (ROM). The ROM contains all of the microcoded program that controls the display processor. This microcomputer contains an eight-bit down counter that uses a prescaled address latch enable (ALE) signal for its input clock. I/O consists of two 8-bit parallel ports that can be either input or output ports, and an 8-bit bi-directional processor bus.

The display uses the 128 bytes of RAM for internal registers, storage (characters displayed in the numeric and alpha displays), and a first-in-first-out register (FIFO).

How the Instrument Microprocessor Sends Information to the Display Processor

The instrument processor sends information to the display processor via the bidirectional instrument data bus, but the display processor cannot send data back to the instrument processor. The instrument processor outputs command or data information to the display interface latch. The display processor immediately takes the information in the interface latch and places it on the bottom of the FIFO. Commands and data contained on the FIFO are executed sequentially when the display processor is not refreshing the numeric and entry displays. This provides the minimum response time to interrupts from the instrument processor, and a flicker free display.

Clock Circuit

The oscillator circuit consists of a 10.92 MHz crystal connected to the display processor internal oscillator circuit. The internal oscillator circuitry provides a latch enable signal (LE) for the two control latches on the A2 assembly.

ANNUNCIATOR LATCH/DRIVER (BLOCK E)

When the annunciator strobe (LEN5) goes low and then high, the information on the instrument data bus is latched into the annunciator data latches, whose outputs drive the annunciator LEDs.

DSA CONNECTOR (BLOCK F)

Start, Stop, Clock and Ground are arranged in the same order as they appear on the HP 5005A signature analyzer pod. To enable the DSA function, short the ground (TP6) and DSA enable line (TP5) on the connector together, and **momentarily** force the LIPS line low by pressing instrument preset or by shorting LIPS to ground on the display.

ALPHA DISPLAY SHIFT REGISTER (BLOCK G)

How Information is Sent to the Alphanumeric Displays

The alpha displays (on the A1 assembly) require row information in serial form. The alpha display shift register parallel inputs are connected to the display data/address bus. When the display processor writes, the write line (block D) goes low and forces the parallel load line (LWRITE) low. At that time, the data on the data bus is loaded into the shift register. This information is then shifted serially to the alphanumeric integrated displays.

Alpha Display Clock Control

The alpha display clock synchronizes the transfer of serial data from the alpha display shift register into the serial shift registers contained within the alpha display integrated circuits.

POWER SUPPLIES (BLOCK H)

This circuitry filters out conducted transients caused by the display processor, TTL circuitry, and other display circuitry.

A3 Display Processor Component-Level Troubleshooting

HOW TO CHECK THE PRESET CIRCUITRY (BLOCK A)

1. Check LRESET (TP12) voltage. This should be a TTL high. Now press **[INSTR PRESET]** on the front panel; LRESET should go low. If LRESET is correct, proceed to step 3.
2. Probe LIPS at A3U9B pin 5. LIPS should also be high normally and should go low when you press **[INSTR PRESET]**.
3. Probe CLR at A3U9C pin 8 or A3P1-1. Set the oscilloscope to 0.2 ms/div and 1 V/Div. The CLR signal should be a continuous series of low pulses approximately 1 ms wide and 4 ms apart. Press **[INSTR PRESET]** and CLR should go low and remain low until you release the key. If both LRESET and CLR are correct, the preset circuitry is performing correctly.
4. Disconnect the display processor assembly (A3) from the display driver assembly (A2) and repeat step 3. If CLR is now correct, suspect a shorted trace or a shorted input to A2U9 on the A2 display driver assembly.
5. Check U9D pin 13 for pulses from the display processor (these are the same pulses as in step 3).

IF ALL THE ANNUNCIATORS STAY ON AFTER [INSTR PRESET]

If all annunciators remain lit at power up (similar to holding **[INSTR PRESET]** in), the instrument processor may not be running.

Check the Load Strobe

1. If the annunciators all stay on after **[INSTR PRESET]**, the load strobe (LEN5) from A3U10 may be bad (block B). Use direct I/O addressing to manually generate the strobe:

   Press **[SHIFT] [GHz] [15] [Hz]**
   [SHIFT] [MHz] [0] [Hz]
   [SHIFT] [kHz]

2. With an oscilloscope, check LEN5 (A3U10 pin 10) while rotating the front panel knob. Set the oscilloscope to 0.2 us/div and 2V/div. Rotate the front panel knob to cause a series of writes to the annunciator's address. The oscilloscope should display low going pulses, approximately 300 ns wide. You can also use a logic probe to detect these pulses. If the pulses are present, troubleshoot the annunciator latch/driver (block E).
3. Probe SIOA (A3U10 pin 4) while rotating the front panel knob. You should again find 300 to 400 ns wide, low going pulses. If SIOA is pulsing, go to step 5.
4. Probe SIOA on the motherboard end of the ribbon cable. If SIOA is pulsing, replace the ribbon cable. If SIOA isn't pulsing; troubleshoot the A60 processor assembly.
5. Check each of the address bits (A0 through A4 A3U10 pins 5, 2, 3, 6, and 1) for bus activity while the instrument sweeps. The lack of activity on any one of these address bits indicates that a wire is probably open in the front panel ribbon cable.

IF THE FRONT PANEL ENTERS DISPLAY SELF TEST MODE AT POWER ON

1. If the Front Panel enters the display self test mode when power is turned on, and the main instrument processor is working, the display processor is probably not receiving interrupts. The interrupt strobe (LEN7) from A3U10 (block B) may be bad. To check this, use direct I/O addressing to manually generate the strobe:

   Press **[SHIFT] [GHz] [15] [Hz]**
   [SHIFT] [MHz] [2] [Hz]
   [SHIFT] [kHz]

2. With an oscilloscope, check A3U10 pin 7 (LEN 7) while rotating the front panel knob. Set the oscilloscope to 0.2 us/div and 2V/div. Rotate the front panel knob to cause a series of writes to the display's address. The oscilloscope should display low going pulses, approximately 300 ns wide. You can also use a logic probe to detect pulses at this location. If the pulses are present, proceed to step 6.

3. Probe SIOA (A3U10 pin 4) while rotating the front panel knob. Again, you should find 300 to 400 ns wide, low going pulses. If SIOA is pulsing, proceed to step 5.

4. Probe SIOA on the Motherboard end of the ribbon cable. If SIOA is pulsing, replace the ribbon cable. If SIOA isn't pulsing, troubleshoot the A60 processor assembly.

5. Check each of the address bits (A0 through A4 A3U10 pins 5, 2, 3, 6, and 1) for bus activity while the instrument sweeps. The lack of activity on any one of these address bits indicates that a wire is probably open in the front panel ribbon cable.

6. Probe LIRQ (A3U3 pin 6). You should see low going pulses, between 10 and 25 us wide each time the display is addressed (LEN7 pulsed). This time varies due to differences in the response time of the display processor to interrupts from the instrument processor. If pulses are present at LIRQ, the service request latch is operating properly.

7. If LIRQ never goes low, check for low going pulses at A3U3 pin 4 each time you write to the display. If there are no pulses, replace A3U3.

8. Check the level of LREAD signal (A3U3 pin 5). LREAD is high normally, and goes low for 700 ns each time the display processor accepts an interrupt request.

9. If LREAD stays low, it prevents LIRQ from going low. check along the READ signal trace for a short.

IF THE DISPLAY REMAINS BLANK OR HAS INCORRECT MESSAGES

If the display remains BLANK or has garbled messages and numbers, one or more of the data bits may not be getting to the display processor. To check this, you can use digital signature analysis (DSA), or you can use the following manual procedure:

1. Set up the instrument to write to the display using direct I/O addressing:

Press **[SHIFT] [GHz] [15] [Hz]**
[SHIFT] [MHz] [2] [Hz].

2. Turn the instrument power switch to the STANDBY position.

3. Connect the following:

LRESET (TP12)	to	GROUND (TP10)
EA (TP8)	to	+12V (TP14)
READ (TP9)	to	GROUND (TP6)

4. Turn the instrument power switch to the ON position.

5. Write a 0 to the display interface latch:

   Press **[SHIFT] [kHz] [0] [Hz]**.

6. Check that the interface latch outputs are low.

7. Write all 1's to the display interface latch:

   Press **[2] [5] [5] [Hz]**.

8. Check each output for a high level.

9. If any of the outputs are not high or low when they should be, check the ribbon cable for opens. If there are no shorts in the cable, replace A3U6.

HOW TO TROUBLESHOOT THE DISPLAY SUPPLY (BLOCK C)

If the +5.2V power supply is correct, but the display supply is not, troubleshoot the display supply as follows:

If the Display Supply Voltage is <3V

If the display supply voltage is below approximately 3V, neither the numeric displays nor the entry display will light up with the proper intensity. If the display supply is below approximately 2V, all of the LEDs will be off.

1. Measure U11 pin 3. The voltage should be 4V. Measure U11 pin 5 (block C). The voltage should be 4.3V. If the voltage at these pins is incorrect, troubleshoot the 5V supply.

2. Measure the output of U11B (pin 7). Normally, this voltage is approximately 3.3V. If this output is approximately 0.1 to 0.2V, either Q1 or Q2 is probably open. Check the Q1 and Q2 base-emitter voltage to help determine which is at fault. If this output is near 5V, either CR2 is shorted, or U11 is bad.

3. Measure the voltage at U11B pin 5. This voltage should be approximately 4.3 volts (one diode drop below the supply). If it is greater than 4.3V, CR1 is shorted, R8 is open, or the input to the U11A (pin 5) is damaged.

4. Measure the voltage at U11A pin 3. It should be approximately 4V. If it is not, measure the voltage between U11A pin 2 and pin 3. If this voltage is not 0V, either R11 is open or U11 is bad. If this voltage is 0V, R12 or R13 is bad, causing the current source operating point to be incorrect.

If the Display Supply Voltage is >4.2V

- If the Display supply average voltage is greater than approximately 4.2V, the current source is not regulating.
- If the display supply voltage is above about 4.4V, VR1 is probably open.

Either of the above conditions causes excessive current fluctuations on the +5.2V supply that are conducted and radiated to sensitive circuits inside the instrument.

1. Measure U11 pin 3. The voltage should be 4V. Measure U11 pin 5 (block C). The voltage should be 4.3V. If the voltage at these pins is incorrect, troubleshoot the 5V supply.
2. Check the collector to emitter voltage of Q1. If this voltage is less than about 0.15V, Q1 is probably shorted or overdriven.
3. Check the collector to emitter voltage of Q2. This voltage should be approximately 3.6V. If it is less than about 0.08V, Q2 is probably shorted. If Vce is 0.1 to 3.5V, Q2 is over-driven by U11B.
4. To determine if U11A is operating correctly measure the voltage at U11A pin 3 and pin 1. These voltages should be approximately the same, and should be 3.9 to 4.0V. If the voltage at pin 3 is not near 4.0V, either R12, R13, or U11 is bad. If the voltage at pin 3 is about 4.0V but the output (pin 1) is not, a trace is shorted, U11A is bad, or the feedback path is open.
5. If the output of U11A is correct, measure the voltage at U11B pin 5. This voltage should be 4.2 to 4.3 volts. If it is near ground, CR1 is probably open.
6. If all measurements up to this point are correct, but the display supply is still saturated, replace U11.

HOW TO TROUBLESHOOT THE DISPLAY PROCESSOR SECTION (BLOCK D)

If you suspect the display processor is bad, first determine if all inputs to the processor are correct.

1. On an oscilloscope, verify the following voltages:

U1 pin 40	+5V
LRESET (U1 pin 4)	High
LIRQ (U1 pin 6)	High
EA (U1 pin 7)	Low
U1 pins 5 and 25	High

2. Check both sides of the crystal (Y1) with the oscilloscope set to 50 ns/Div. You should find a 10.92 MHz, 4V signal on both sides. If the signal is present, go to step 6.
3. Check both C1 and C2 to see if either is shorted.
4. If C1 and C2 are not shorted, replace Y1.
5. With an oscilloscope, check U1 pin 11 (LTE). Set the oscilloscope to 1 us/Div. This signal should have a period of approximately 1.4 us, and be low for 1 µs. If LTE is present, go to step 7.

6. If LTE is not present, verify that the trace for LTE is not shorted. If LTE is not shorted, replace U1.
7. Check U3C pin 8 (LE) with the oscilloscope set to 1 us/div. You should find an inverted version of LTE. Press **[INSTR PRESET]**; LE should go high.

How to Check the Remaining Processor Outputs

If all other signals are correct, the remaining outputs from the processor are best checked using digital signal analysis (see SIGNATURE ANALYSIS, following HOW TO TROUBLESHOOT THE ANNUNCIATOR LATCH/DRIVER). You can also use the internal DSA routine below to exercise all of the processor outputs in a predictable manner and look at the outputs with an oscilloscope.

NOTE: If any of the following signals are not present, or are not the correct amplitude (at least 4V except for CLK), troubleshoot the block that the signal is connected to, or replace A3U1, as appropriate.

1. Connect TP5 (DSA EN) to TP4 (GND).
2. To start the DSA mode, turn the power switch to STANDBY and then to ON.
3. Set the oscilloscope to 1 us/Div and trigger off of the appropriate edge of the signal.
4. Check U1 pins 12 through 19 (D0 through D7). You should find low going TTL Level pulses that are 1 to 2 µs wide.
5. Check U1 pins 27 through 34 (P10 through P17). You should find high going TTL pulses that are 3 to 4 µs wide.
6. Check U1 pins 36 and 38 (P25 and P27). You should find high going TTL pulses that are 3 to 5 µs wide.
7. Check U1 pin 37 (CLK). You should find high (1.6V) going pulses that are 3 to 4 µs wide. This signal is clamped to 1.6V by the A2 assembly level shifters.
8. Check U1 pin 35 (START). Set the oscilloscope to 10 ms/Div. You should find a signal that is high for approximately 12 ms, and low for approximately 21 ms.

HOW TO TROUBLESHOOT THE ANNUNCIATOR LATCH/DRIVER (BLOCK E)

NOTE: If all the annunciators stay on after instrument preset but the rest of the display and the keyboard are correct, first troubleshoot the PRESET CIRCUITRY (block A) and then the INSTRUMENT BUS INTERFACE (block B).

NOTE: You can partially troubleshoot the annunciator latch/driver using DSA (see SIGNATURE ANALYSIS, following this procedure).

If One or More Annunciators is Incorrectly On or Off

1. If one or more annunciator is incorrectly on or off, verify that the appropriate outputs of U5 and U7 are low if the associated annunciator is on, and high if the annunciator is off.

2. Verify that the associated output of U4 or U8 is in the correct state (see NOTE below). The output of U4 or U8 should be approximately 0.2V if the annunciator is on, and 6.5 to 9V if the annunciator is off. If the outputs are correct, the annunciator latch/driver is operating correctly.

NOTE: Because the outputs of U4 and U8 are open collector outputs, an open trace, open series resistor, or open annunciator allows the output of U4 or U8 to stay low. If you suspect one of the above faults, attach a 1K ohm resistor between your probe and the +5 V supply. If the driver is working correctly, the levels will be 0.1 or 5V.

IF THE ENTRY DISPLAY IS BLANK OR IF ALL DOTS ARE ON

1. If the ENTRY display is blank, or if all dots are on, the alpha display shift register may not be working properly. To run the front panel display diagnostics, press **[SHIFT] [FREE RUN]**. Set an oscilloscope to display TTL levels at 2 µs/Div.
2. With the oscilloscope, check P4-4 (ALPHA CLOCK, block G). You should find a series of seven 0.3 to 0.4 µs wide, low going pulses. If these pulses are present, proceed to step 5.
3. Check U3D pin 11 for the pulses described in step 2. If there is no signal at U3D pin 11, check U3D pin 13 (LTE) for a continuous series of high going pulses 0.36 µs wide with a period of 1.36 µs. If no signal appears, troubleshoot the display processor (block D).
4. If LTE is correct at U3D pin 13, check U3D pin 12 (CLK CTL). You should find approximately 10 µs wide, high going pulses that are used to gate on the clock pulses to the alpha displays. If no signal appears, troubleshoot the display processor (block D). If both LTE and CLK CTL are correct, replace U3.
5. Check U2 pin 1. You should find approximately 0.8 µs wide, low going TTL pulses. If there are no pulses, troubleshoot the display processor (block D).
6. Check U2 pin 9 (DATA). You should find TTL activity in bursts of seven that correspond in time with the seven clock pulses at P4-4. If this activity is present, the alpha display shift register is working.

SIGNATURE ANALYSIS

The Digital Signal Analysis Options

Option 1 — Freerun DSA

You can force the display processor to repetitively count through its entire address space, and use a signature analyzer to determine if the correct signatures appear on D0 through D7, A8 through A10, and +5VF.

Option 2 — DSA Using the Display Memory Routine

You can enable the DSA mode to use the DSA routine in the display processor memory, and use a signature analyzer to determine if the correct signatures appear on D0 through D7, A8 through A10, the parallel I/O ports, and many other signal lines. This routine does not check the annunciator latches or drivers, the instrument bus interface latches, or any of the signals on the display driver assembly that have non-TTL levels.

Freerun DSA

When you select the freerun DSA mode, you force the display processor to do all instruction fetches from external memory. Because there is no external memory, and because D0 through D7 are pulled up, the front panel processor fetches FF hexadecimal instruction operating codes. After executing this instruction, the display processor increments its program counter and does an instruction fetch from the next location. In this way, the display processor repetitively counts through its entire memory space.

1. To enable the freerun DSA mode, connect TP8 (EA) to TP7 (+5.2V).
2. Connect the signature analyzer as follows:

START and STOP	U1 pin 23
Trigger	Falling edge
CLOCK	U3 pin 8
Trigger	Leading edge

3. Check the signatures listed below:

Mnemonic	J1 Pin #	Signature
D0 D1	11 10	H62U C21A
D2 D3	9 8	HA07 H0AA
D4 D5	7 6	P030 4442
D6 D7	5 4	4U2A 0772
A8 A9	1 2	9635 1734
A10 +5.2VF	3 17	8P54 7A70

DSA USING THE DISPLAY MEMORY ROUTINE

1. Connect TP5 (DSA EN) to TP6 (GND)

2. Connect the signature analyzer as follows:

START	TP1
Trigger	Falling edge
STOP	TP2
Trigger	Leading edge
CLOCK	TP3
Trigger	Rising edge
GND	TP4

Under these conditions, the +5.2V signature should be H9U2, indicating that all processor instructions are being executed correctly, the ROM checksum is correct, and that the internal RAM is good.

3. Change the signature analyzer as follows:

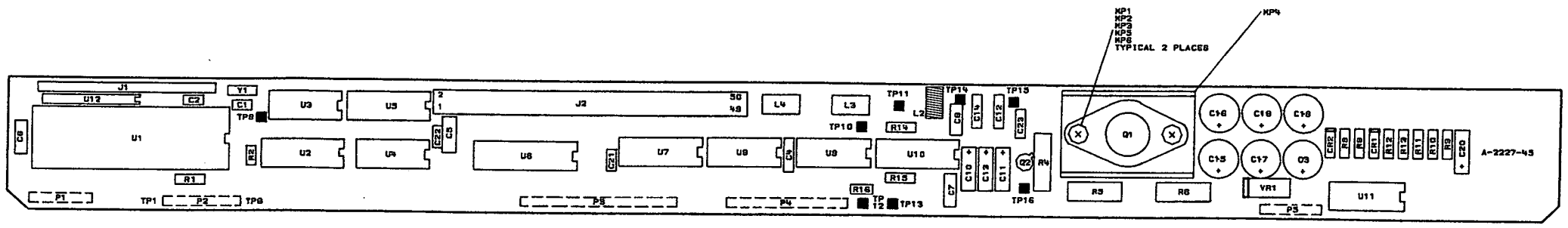
START trigger	Leading edge
STOP trigger	Falling edge

4. Check the signatures listed below:

Mnemonic	U1 Pin #	Signature
D0 D1	12 13	CPAC 20U1
D2 D3	14 15	5P21 8F24
D4 D5	16 17	FP86 023P
D6 D7	18 19	185F H576
P10 P11	27 28	C606 06F6
P12 P13	29 30	5868 39C4
P14 P15	31 32	H2A6 5FC3

Mnemonic	U3D Pin #	Signature
ALPHA CLOCK	11	F81C

Mnemonic	U9C Pin #	Signature
CLR	11 8	7551 CH4A



HP Part Number: 08340-60008

Figure A3-1. A3 Display Processor, Component Location Diagram

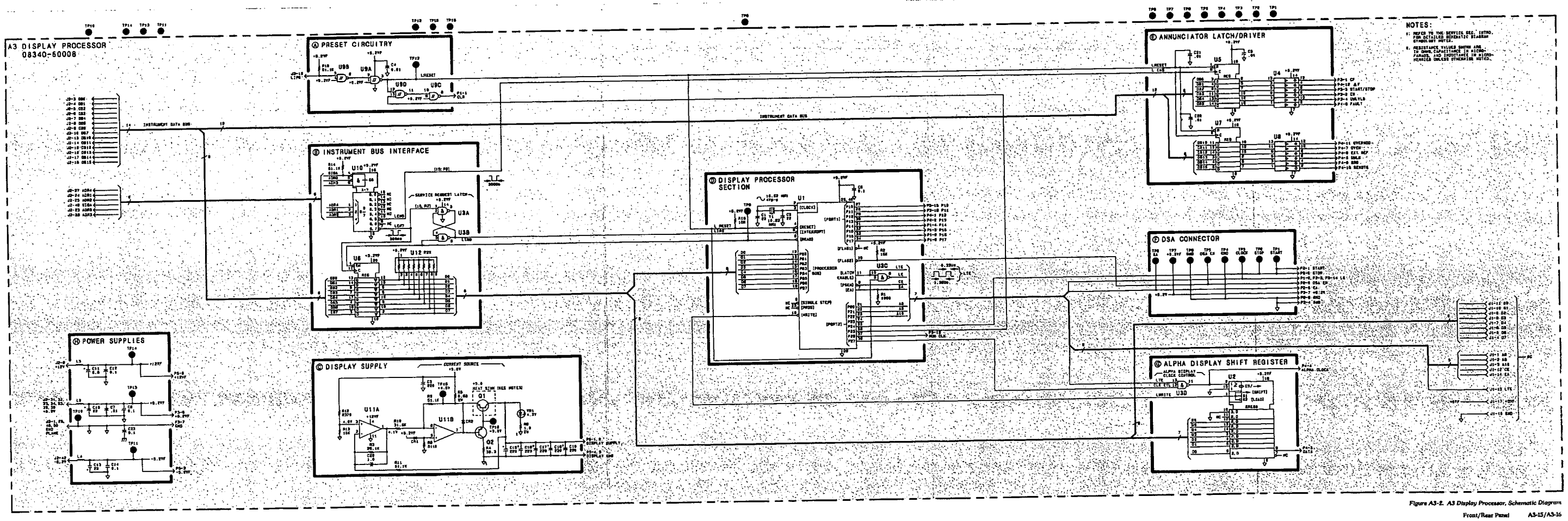


Figure A3-2. A3 Display Processor, Schematic Diagram

Table A3-1. A3 Display Processor Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	**08340-60008**	**7**	**1**	**DISPLAY PROCESSOR ASSEMBLY**	**28480**	**08340-60008**
A3C1	0160-3875	3	2	CAPACITOR-FXD 22PF ±5% 200VDC CER 0±30	28480	0160-3875
A3C2	0160-3875	3		CAPACITOR-FXD 22PF ±5% 200VDC CER 0±30	28480	0160-3875
A3C3	0180-0552	9	1	CAPACITOR-FXD 220UF ±20% 10VDC TA	28480	0180-0552
A3C4	0160-2055	9	3	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C6	0160-4841	5	1	CAPACITOR-FXD .1UF +80 −20% 50VDC CER	28480	0160-4841
A3C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C8	0160-4084	8	4	CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A3C9				NOT ASSIGNED		
A3C10	0180-0228	6	2	CAPACITOR-FXD 22UF±10% 15VDC TA	56289	150D226X9015B2
A3C11	0180-0116	1	1	CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A3C12	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A3C13	0180-0228	6		CAPACITOR-FXD 22UF±10% 15VDC TA	56289	150D226X9015B2
A3C14	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A3C15	0180-3240	8	5	CAPACITOR-AL 220 UF 10VDC	28480	0180-3240
A3C16	0180-3240	8		CAPACITOR-AL 220 UF 10VDC	28480	0180-3240
A3C17	0180-3240	8		CAPACITOR-AL 220 UF 10VDC	28480	0180-3240
A3C18	0180-3240	8		CAPACITOR-AL 220 UF 10VDC	28480	0180-3240
A3C19	0180-3240	8		CAPACITOR-AL 220 UF 10VDC	28480	0180-3240
A3C20	0180-0291	3	1	CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A3C21	0160-3879	7	2	CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A3C22	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A3C23	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A3CR1	1901-0033	2	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3J1	1251-6787	6	1	SOCKET STRIP-6 CONTACT	28480	1251-6787
A3J2	1251-5746	5	1	CONNECTOR 50-PIN M POST TYPE	28480	1251-5746
A3L1				NOT ASSIGNED		
A3L2	08340-80001	2	1	COIL-TOROID	28480	08340-80001
A3L3	9100-1788	6	2	CHOKE-WIDE BAND ZMAX=680 OHM⅛ 180 MHZ		
				02114	VK200	20/48
A3L4	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM⅛ 180 MHZ		
				02114	VK200	20/48
A3MP1	0340-1143	6	1	INSULATOR-XSTR ALUMINUM	28480	0340-1143
A3MP2	0590-0526	6	1	INSERT-NB 4-40	28480	0590-0526
A3MP3				NOT ASSIGNED		
A3MP4	1205-0085	8	1	HEAT SINK TO-66-CS	28480	1205-0085
A3MP5	2200-0105	4	2	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP6	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
				NOTE: A3P1-5 must be cut to length before replacement.		
A3P1	1251-6798	9	5	CONNECTOR-PC 36 MALE IR	28480	1251-6798
A3P2	1251-6798	9		CONNECTOR-PC 36 MALE IR	28480	1251-6798
A3P3	1251-6798	9		CONNECTOR-PC 36 MALE IR	28480	1251-6798
A3P4	1251-6798	9		CONNECTOR-PC 36 MALE IR	28480	1251-6798
A3P5	1251-6798	9		CONNECTOR-PC 36 MALE IR	28480	1251-6798
A3Q1	1853-0413	9	1	TRANSISTOR PNP 2N6049 SI TO-66 PD=75W	28480	1853-0413
A3Q2	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A3R1	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A3R2	0698-7260	7	2	RESISTOR 10K 1% .05W F TC=0±100	24546	C3-1/8-T0-1002-F
A3R3	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-2612-F
A3R4	0698-3396	2	1	RESISTOR 38.3 1% .5W F TC=0±100	28480	0698-3396
A3R5	0811-1553	1	1	RESISTOR .68 5% 2W PW TC=0±800	75042	BWH2-11/16-J
A3R6	0811-1666	7	1	RESISTOR 1 5% 2W PW TC=0±800	75042	BWH2-1R0-J
A3R7				NOT ASSIGNED		
A3R8	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R9	0757-0458	7	4	RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A3R10	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-3162-F
A3R11	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A3R12	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0±100	24546	C4-1/8-T0-2371-F
A3R13	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A3R14	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A3R15	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A3R16	0698-7260	7		RESISTOR 10K 1% .05W F TC=0±100	24546	C3-1/8-T0-1002-F
A3TP1-8				NOT ASSIGNED		
A3TP9	0360-2050	8	8	TERMINAL TEST POINT, PCB	28480	0360-2050
A3TP10	0360-2050	8		TERMINAL TEST POINT, PCB	28480	0360-2050
A3TP11	0360-2050	8		TERMINAL TEST POINT, PCB	28480	0360-2050
A3TP12	0360-2050	8		TERMINAL TEST POINT, PCB	28480	0360-2050

Table A3-1. A3 Display Processor Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3TP13	0360-2050	8		TERMINAL TEST POINT, PCB	28480	0360-2050
A3TP14	0360-2050	8		TERMINAL TEST POINT, PCB	28480	0360-2050
A3TP15	0360-2050	8		TERMINAL TEST POINT, PCB	28480	0360-2050
A3TP16	0360-2050	8		TERMINAL TEST POINT, PCB	28480	0360-2050
A3U1	1820-2865	0	1	IC-8-BIT MICROCOMPUTER; 11MHZ OPERATION	28480	1820-2865
A3U2	1820-1975	1	1	IC SHF-RGTR TTL LS NEG-EDGE-TRIG PRL-IN	01295	SN74LS165N
A3U3	1820-1287	8	1	IC BFR TTL LS NAND QUAD 2-INP	01295	SN74LS37N
A3U4	1820-0668	7	2	IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A3U5	1820-1196	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A3U6	1820-1997	7	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A3U7	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A3U8	1820-0668	7		IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A3U9	1820-1425	6	1	IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74LS132N
A3U10	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A3U11	1826-0161	7	1	IC OP AMP GP QUAD 14-DIP-P PKG	04713	MLM324P
A3U12	1810-0398	9	1	NETWORK-RES 10-SIP22.0K OHM X 9	11236	750-101-R22K
A3VR1	1902-1359	9	1	DIODE-ZNR 4.3V 2% PD=5W IR=10UA	28480	1902-1359
A3Y1	0410-1295	8	1	CRYSTAL-10.92 MHZ	28480	0410-1295

A5 Keyboard and A7 Lower Keyboard Circuit Description

ASSEMBLY PURPOSE

The A5 keyboard and the A7 lower keyboard assemblies provide the mechanical mounting for all instrument key assemblies. The key annunciators are also located on these assemblies. The keyboard assemblies communicate with the instrument microprocessor via the A6 keyboard interface assembly.

Because both the A5 keyboard assembly and the A7 lower keyboard assembly operate the same way, they are covered together in the following circuit description.

ANNUNCIATORS (BLOCK A)

Annunciator LEDs are controlled from the keyboard interface assembly. Latches ground the cathode, allowing current to flow from the +5.2V supply.

MAIN KEYBOARD AND LOWER KEYBOARD (BLOCK B)

The two keyboards contain a total of 58 keys that have a multi-finger contact structure. Each key shorts one column line and one row line to digital ground. When you press a key, the column and row signals are encoded by the keyboard interface. There is no general pattern followed for encoding columns and rows.

A5 Keyboard and A7 Lower Keyboard Component-Level Troubleshooting

IF AN ANNUNCIATOR IS NOT WORKING PROPERLY

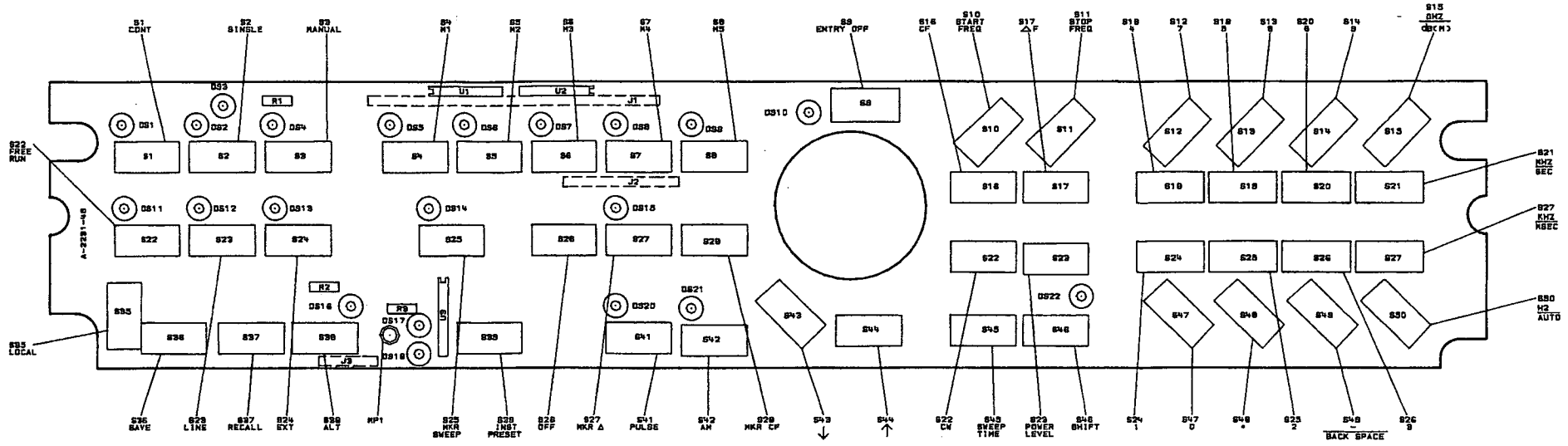
1. If one of the front panel LEDs stays on all the time, troubleshoot the annunciator latches (A6, block E).
2. If one of the front panel LEDs never comes on, even when you press **[INSTR PRESET]**, the cause is probably a bad LED.

   To determine if the output of a latch is correct, check the output of A6U6, A6U7, A6U16, or A6U17, and press and hold **[INSTR PRESET]**. The voltage should be approximately 0.4V at all outputs.

   If the voltage is correct, replace the appropriate LED. If not, troubleshoot the annunciator latches (A6, block E).

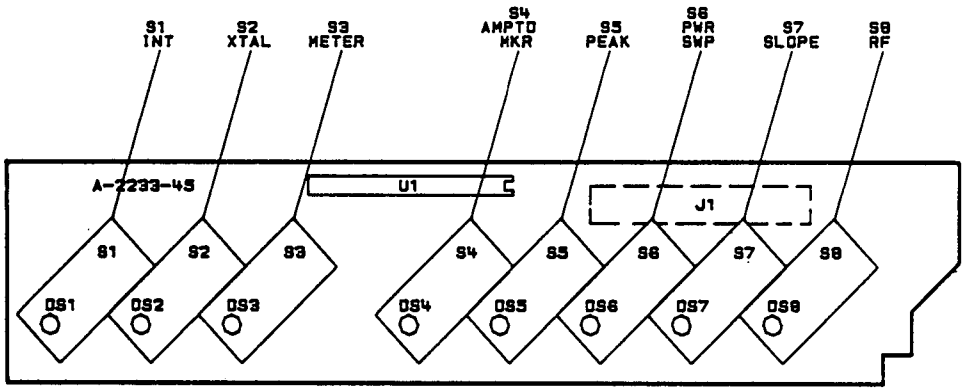
IF A KEY IS NOT WORKING PROPERLY

1. Determine the ROW number and the COLUMN number of the key that is not working correctly. Check the appropriate ROW and then the appropriate COLUMN at A6U1 or A6U10. Each signal should go low (0V) when the key is pressed.
2. If the row or column signal stays high, check for an open connector between the A5 or A7 keyboard and the A6 keyboard interface assembly. If there is no open trace or connector, replace the key.
3. If the row or column signal stays low, measure the resistance of this signal line to ground.
   - If the resistance is 1Ω or less, either the signal trace is shorted to ground, or the key is broken and is shorting the trace to ground.
   - If the resistance is greater than 1Ω, the associated input to A6U1 or A6U10 is probably shorted. Replace A6U1 or A6U10, as required.



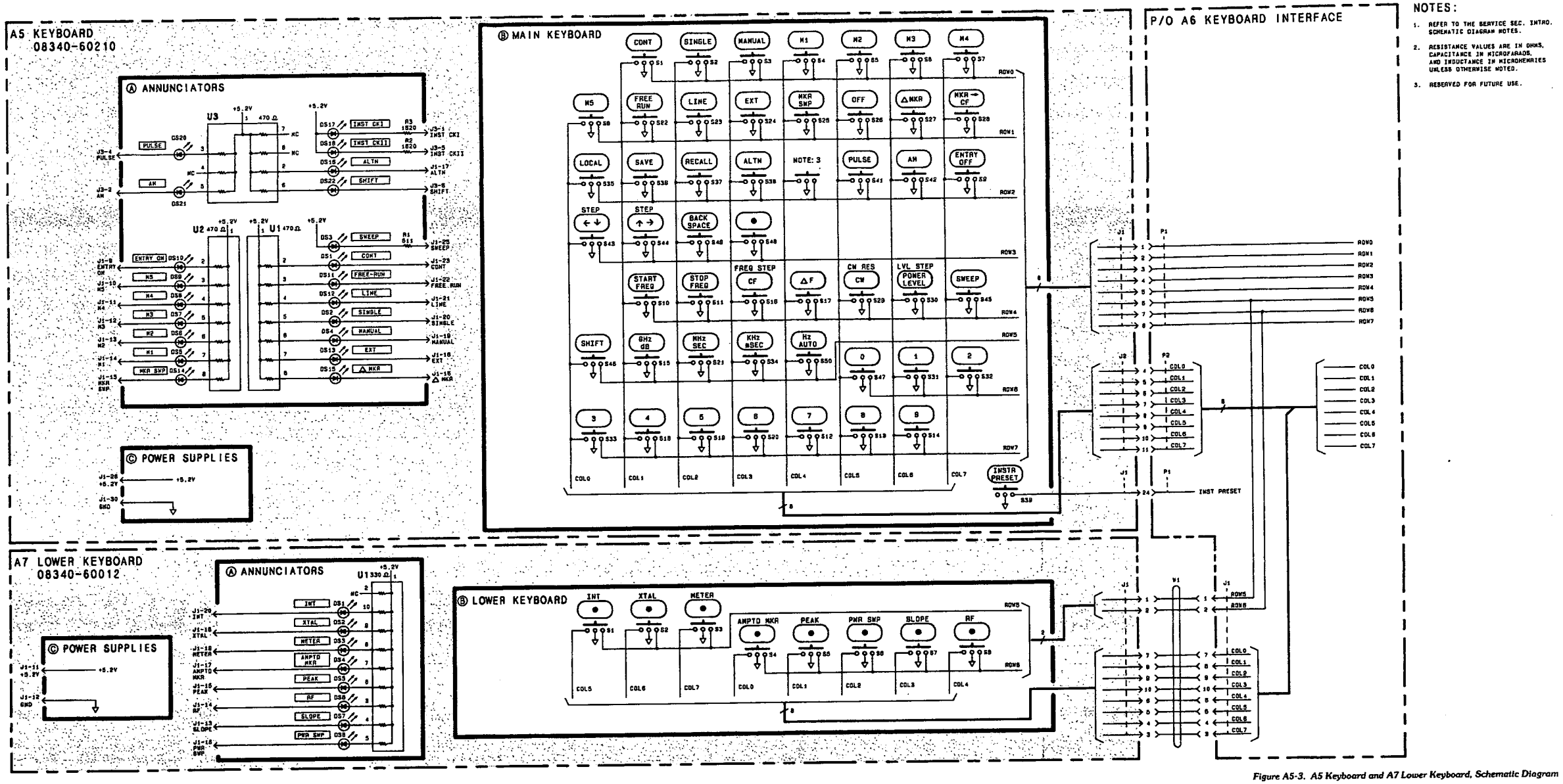
HP Part Number: 08340-60210

Figure A5-1. A5 Keyboard, Component Location Diagram



HP Part Number: 08340-60012

Figure A5-2. A7 Lower Keyboard Component Location Diagram



NOTES:

1. REFER TO THE SERVICE SEC. INTRO. SCHEMATIC DIAGRAM NOTES.
2. RESISTANCE VALUES ARE IN OHMS, CAPACITANCE IN MICROFARADS, AND INDUCTANCE IN MICROHENRIES UNLESS OTHERWISE NOTED.
3. RESERVED FOR FUTURE USE.

Figure A5-3. A5 Keyboard and A7 Lower Keyboard, Schematic Diagram

Table A5-1. A5 Keyboard Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5	**08340-60210**	**3**	**1**	**KEYBOARD**	**28480**	**08340-60210**
A5DS1	1990-0858	6	18	L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS2	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS3	1990-0857	5	1	L.E.D. (GREEN) 150 UCD	28480	1990-0857
A5DS4	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS5	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS6	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS7	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS8	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS9	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS10	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS11	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS12	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS13	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS14	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS15	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS16	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS17	1990-0856	4	2	L.E.D. (RED) 150 UCD	28480	1990-0856
A5DS18	1990-0856	4		L.E.D. (RED) 150 UCD	28480	1990-0856
A5DS19	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS20	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS21	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5DS22	1990-0858	6		L.E.D. (YELLOW) 150 UCD	28480	1990-0858
A5J1	1251-6799	0	1	CONNECTOR HEADER 36 MIR	28480	1251-6799
A5J2	1251-6787	6	2	SOCKET STRIP-6 CONTACT	28480	1251-6787
A5J3	1251-6787	6		SOCKET STRIP-6 CONTACT	28480	1251-6787
A5MP1	0590-0526	6	1	THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
A5MP2	5041-2732	2	1	KEY CAP "CONT"	28480	5041-2732
A5MP3	5041-2735	5	1	KEY CAP "FREE RUN"	28480	5041-2735
A5MP4	5041-2738	8	1	KEY CAP "LOCAL"	28480	5041-2738
A5MP5	5041-2733	3	1	KEY CAP "SINGLE"	28480	5041-2733
A5MP6	5041-2736	6	1	KEY CAP "LINE"	28480	5041-2736
A5MP7	5041-2739	9	1	KEY CAP "SAVE"	28480	5041-2739
A5MP8	5041-2734	4	1	KEY CAP "MANUAL"	28480	5041-2734
A5MP9	5041-2737	7	1	KEY CAP "EXT"	28480	5041-2737
A5MP10	5041-2731	1	1	KEY CAP "ALT"	28480	5041-2731
A5MP11	5041-2740	2	1	KEY CAP "RECALL"	28480	5041-2740
A5MP12	5041-2712	8	1	KEY CAP "M1"	28480	5041-2712
A5MP13	5041-2713	9	1	KEY CAP "M2"	28480	5041-2713
A5MP14	5041-2725	3	1	KEY CAP "MKR SWP"	28480	5041-2725
A5MP15	5041-0720	4	1	KEY CAP "INST PREST"	28480	5041-0720
A5MP16	5041-2714	0	1	KEY CAP "M3"	28480	5041-2714
A5MP17	5041-0692	9	1	KEY CAP "OFF"	28480	5041-0692
A5MP18	5041-2715	1	1	KEY CAP "M4"	28480	5041-2715
A5MP19	5041-2718	4	1	KEY CAP "MKR DELTA"	28480	5041-2718
A5MP20	5041-2729	7	1	KEY CAP "PULSE"	28480	5041-2729
A5MP21	5041-2716	2	1	KEY CAP "M5"	28480	5041-2716
A5MP22	5041-2726	4	1	KEY CAP "MKR TO CF"	28480	5041-2726
A5MP23	5041-2748	0	1	KEY CAP "AM"	28480	5041-2748
A5MP24	5041-2748	0	1	KEY CAP "ENTRY OFF"	28480	5041-2748
A5MP25	5041-2748	0	2	KEY CAP "ARROW DOWN"	28480	5041-2747
A5MP26	5041-2748	0		KEY CAP "ARROW UP"	28480	5041-2747
A5MP27	5041-2719	5	1	KEY CAP "START FREQ"	28480	5041-2719
A5MP28	5041-2721	9	1	KEY CAP "CF"	28480	5041-2721
A5MP29	5041-2724	2	1	KEY CAP "CW"	28480	5041-2724
A5MP30	5041-2727	5	1	KEY CAP "SWEEP TIME"	28480	5041-2727
A5MP30	5041-2727	5	1	KEY CAP "SWEEP TIME"	28480	5041-2727
A5MP31	5041-2720	8	1	KEY CAP "STOP FREQ"	28480	5041-2720
A5MP32	5041-2722	0	1	KEY CAP "DELTA FREQ"	28480	5041-2722
A5MP33	5041-2723	1	1	KEY CAP "PWR LVL"	28480	5041-2723
A5MP34	5041-2745	7	1	KEY CAP "SHIFT"	28480	5041-2745
A5MP35	5041-0643	0	1	KEY CAP "7"	28480	5041-0643
A5MP36	5041-0640	7	1	KEY CAP "4"	28480	5041-0640
A5MP37	5041-0637	2	1	KEY CAP "1"	28480	5041-0637
A5MP38	5041-0646	3	1	KEY CAP "0"	28480	5041-0646
A5MP39	5041-0644	1	1	KEY CAP "8"	28480	5041-0644
A5MP40	5041-0641	8	1	KEY CAP "5"	28480	5041-0641
A5MP41	5041-0638	3	1	KEY CAP "2"	28480	5041-0638
A5MP42	5041-0647	4	1	KEY CAP "DECIMAL"	28480	5041-0647
A5MP43	5041-0645	2	1	KEY CAP "9"	28480	5041-0645
A5MP44	5041-2747	9	1	KEY CAP "6"	28480	5041-2747
A5MP45	5041-0639	4	1	KEY CAP "3"	28480	5041-0639

Table A5-1. A5 Keyboard Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5MP46	5041-2747	9	1	KEY CAP "BACK SPACE"	28480	5041-2748
A5MP47	5041-2741	3	1	KEY CAP "GHZ/DBM"	28480	5041-2741
A5MP48	5041-2742	4	1	KEY CAP "MHZ/SEC"	28480	5041-2742
A5MP49	5041-2743	5	1	KEY CAP "KHZ/MSEC"	28480	5041-2743
A5MP50	5041-2744	6	1	KEY CAP "HZ AUTO"	28480	5041-2744
A5MP51	5040-8858	3	21	LED STDF STRP, 2 PER	28480	5040-8858
A5MP52	5041-2730	0	1	KEY CAP "FM"	28480	5041-2730
A5R1	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A5R2	0757-0428	1	2	RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A5R3	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A5S1-50	5060-9436	7	50	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A5U1	1810-0203	5	3	NETWORK-RES 8-SIP 470.0 OHM X 7	01121	208A471
A5U2	1810-0203	5		NETWORK-RES 8-SIP 470.0 OHM X 7	01121	208A471
A5U3	1810-0203	5		NETWORK-RES 8-SIP 470.0 OHM X 7	01121	208A471

Table A5-2. A7 Lower Keyboard Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7	**08340-60012**	**3**	**1**	**LOWER KEYBOARD ASSEMBLY**	**28480**	**08340-60012**
A7DS1	1990-0670	0	8	L.E.D. (YELLOW) 1 MCD	28480	1990-0670
A7DS2	1990-0670	0		L.E.D. (YELLOW) 1 MCD	28480	1990-0670
A7DS3	1990-0670	0		L.E.D. (YELLOW) 1 MCD	28480	1990-0670
A7DS4	1990-0670	0		L.E.D. (YELLOW) 1 MCD	28480	1990-0670
A7DS5	1990-0670	0		L.E.D. (YELLOW) 1 MCD	28480	1990-0670
A7DS6	1990-0670	0		L.E.D. (YELLOW) 1 MCD	28480	1990-0670
A7DS7	1990-0670	0		L.E.D. (YELLOW) 1 MCD	28480	1990-0670
A7DS8	1990-0670	0		L.E.D. (YELLOW) 1 MCD	28480	1990-0670
A7J1	1251-4634	8		CONNECTOR HEADER 20 M2R	28480	1251-4634
A7MP1	5041-0318	6	8	KEY CAP-QUARTER LT PIPE	28480	5041-0318
A7S1	5060-9436	7	8	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A7S2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A7S3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A7S4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A7S5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A7S6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A7S7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A7S8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A7U1	1810-0272	8	1	NETWORK-RES 10-SIP330.0 OHM X	9	01121210A331

A6 Keyboard Interface Circuit Description

ASSEMBLY PURPOSE

The A6 keyboard interface assembly provides the communications link between the instrument microprocessor, the front panel rotary pulse generator (RPG), and A5 and A7 keyboards. The interface contains all data buffers, annunciator latches, and interrupt circuitry to monitor the front panel keyboards and annunciators. RPG control circuitry (counters/timers) and the instrument preset circuitry are also located on the A6 assembly.

KEYBOARD ENCODER/DATA BUFFER (BLOCK A)

Two 8-to-3-line priority encoders encode the keyboard row and column information. When you press a key, that key grounds one row line and one column line. The row and column is encoded and presented in active low binary form at the encoder outputs. This information is immediately available at the inputs of the inverting output buffer, which converts the six bits to active-high signals.

Keyboard encoders U10 and U1:

Column or Row Selected	Encoder Output		
	Pin 9	Pin 7	Pin 6
0	1	1	1
1	0	1	1
2	1	0	1
3	0	0	1
4	1	1	0
5	0	1	0
6	1	0	0
7	0	0	0
	LSB		MSB

If you simultaneously press more than one key, the priority encoders only encode the lowest column and row number.

The main instrument microprocessor can disable the encoders with a latched control bit. This control line locks out the keyboard.

If the encoders are not disabled, pressing any key generates a service request (LSRQ) to the instrument processor. The processor then outputs the encoder address and reads the encoded key information.

KEY UP TIMER (DEBOUNCE) (BLOCK B)

Refer to Figure A6-1.

The key released timing function prevents key bounce from causing multiple keydown interrupts to the microprocessor by disabling the key down circuitry as soon as a valid key down is detected, and not re-enabling it until all keys have been up continuously for 50 ms.

When you press a key, the REPEAT DISABLE signal goes high if the KEYBOARD LOCKOUT signal is low. The REPEAT DISABLE signal is inverted twice and combined with the timing one-shot output that goes high for 50 ms after the positive transition of the LOW KEY DOWN signal. The output causes the reset line of a flip-flop to go high, enabling the flip-flop. The key down SRQ line is connected to the clock line, and when a valid key down is detected, the flip-flop is set. The output goes directly to the enable of the key down one-shot (block C), which prevents detecting any further key closures until this enable goes high.

When the key is released the active LOW KEY DOWN line goes high, firing the one-shot for 50 ms, which continues to disable the key down circuitry until it has timed out.

At the end of 100 ms, the one-shot output goes low, causing the key down disable flip-flop to be cleared, which re-enables the key down flip-flop (block C).

KEY DOWN TIMER (BLOCK C)

Refer to Figure A6-1.

The active low keydown signal fires a one-shot set for approximately 20 ms pulses. The output goes low for 20 ms, and on its rising edge it clocks a flip-flop whose input is connected to the active-low keydown signal. If a key is still down at this time, the flip-flop resets indicating that a valid key stroke has been detected. When a valid key stroke is detected, the flip-flop output goes high, producing HI KEY DN SRQ (high key down service request).

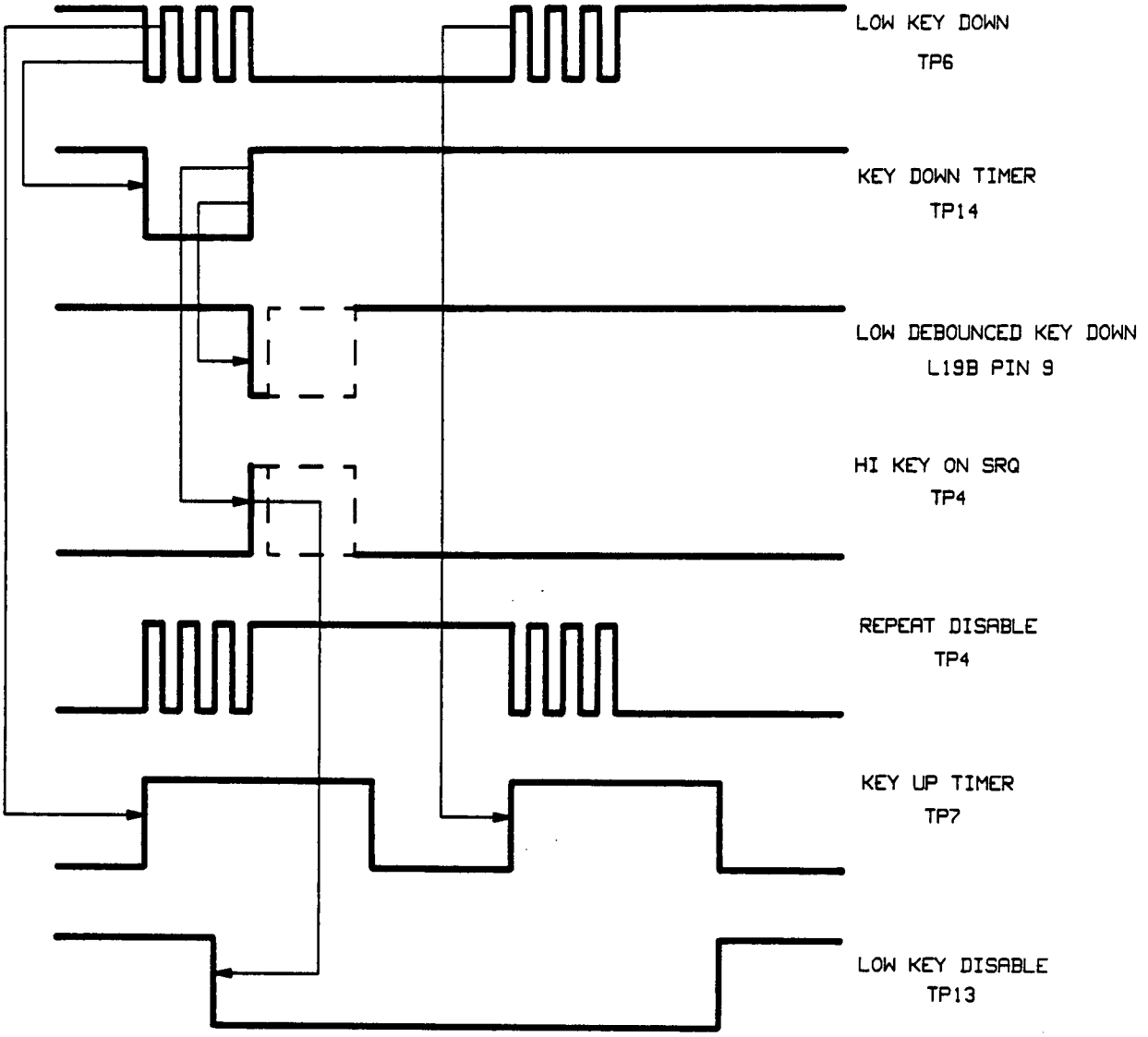


Figure A6-1. Key Up/Down Timing

SRQ BUFFER (BLOCK I)

The HI KEY DN SRQ signal is combined with the active-high RPG SRQ signal to generate LSRQ to the instrument microprocessor.

The HI KEY DN SRQ signal is also present at the keyboard buffer, which contains the encoded key information. When this bit is read by the microprocessor during a LSRQ service routine, it indicates that a key generated the service request.

After reading the encoded information, the microprocessor strobes the address decoder (block F), indicating that key information has been read and preparing the key down timer circuitry for the next keyboard input.

REPEAT FUNCTION CIRCUITS (BLOCK D)

The repeat key function consists of two timing circuits. The first is a 500 ms timer, triggered by the output of the key down flip-flop (block C) when a valid key down is detected. After 500 ms, the rising edge of the output of this one-shot clocks a flip- flop. The flip-flop input is connected to the active low KEY DOWN line from the encoders (block A). If a key is still down 500 ms after it is detected, the flip-flop is reset, activating the repeat function. The output of this flip-flop goes high releasing the reset of the second timer and allows it to generate high going pulses at a 5 Hz rate.

The second timer generates an output that goes through an inverter and becomes LOW REPEAT for the key down flip-flop.

RPG COUNTERS DATA BUFFERS (BLOCK G)

When you rotate the front panel knob, the rotary pulse generator (RPG) generates two pulses that are 90 degrees out of phase with each other.

Two 4-bit up/down counters count up or down, depending on the direction you turn the RPG. The two signals from the RPG are connected to the up/down input and to the clock input of each counter. If the clock line goes high while the up/down line is low, the counters count down. If you turn the RPG in the opposite direction, the up/down line is high when the clock line goes high, and the counters count up. When the counter counts down below 0, the output is reset to all ones and counted down again.

The outputs of the up/down counters are always present at the inputs to the non-inverting bus driver from which the instrument processor reads the present count.

The microprocessor clears the up/down counters after it reads the information, to ready them for the next count period.

RPG COUNT WINDOW TIMER (BLOCK H)

The clock line from the RPG that goes to the up/down counters is connected to the clock of a 70 ms one-shot. The first pulse on the RPG clock line fires the one-shot. At the end of 70 ms, the one-shot output clocks a flip-flop. If the RPG is enabled, the input to this flip-flop is low, and the output goes high, causing the LSRQ (block I) line to go low, indicating a service request to the microprocessor. The output also goes to the input of the inverting output buffer in block A. The output of the buffer is read by the microprocessor during the service request routine. A low on this line indicates that the RPG needs microprocessor service.

The RPG SRQ line also goes to the disable count input of the up/down counters in block G, disabling any further counting until the processor services the RPG service request.

After the microprocessor reads the information from the up/down counters, it generates a reset strobe that sets the RPG SRQ flip-flop, clears the up/down counters, and prepares the entire circuit for another cycle.

ANNUNCIATOR LATCHES (BLOCK E)

Four 8-bit latches store LED and control information. Twenty-nine bits control the various front panel LEDs. KEYBOARD LOCKOUT is the lockout for the rest of the keyboard, and prevents any keyboard entries.

The ENTRY ON signal turns on the enabled LED, and enables the RPG SRQ flip-flop in block H. The green SWEEP LED is driven by an inverter controlled by a NAND gate, which forces the LED on when LIPS (low instrument preset) or LSPLD (low sweep LED control) is low.

ADDRESS DECODER (BLOCK F)

The address decoder decodes four strobes from the five address lines and the I/O strobe (SIOB). Outputs clock the annunciator latches in block E, reset the key down and RPG service request circuitry, and act as a read strobe that enables the coded key information, the RPG count information, and the two bits that indicate which circuit requested service onto the bus to be read by the microprocessor.

POWER SWITCH AND STANDBY LED

During standby operation, the power switch grounds the LSBY line, activating the fan relay and signaling the power supplies to turn off.

NOTE: When the fan relay is on, the fan is off.

A6 Keyboard Interface Component-Level Troubleshooting

HOW TO CHECK THE KEYBOARD ENCODER/DATA BUFFER (BLOCK A)

1. Check KEYBOARD LOCKOUT (U1 pin 5). This signal should be low, unless the instrument is in REMOTE mode. If it is high, troubleshoot the annunciator latches (block E).

2. Check LOW KEY DOWN (U10 pin 14). This signal should be high, and go low when a key is pressed. If this signal is correct, go to step 6.

3. If LOW KEY DOWN stays high when a key is pressed, check U10 pin 5 (the enable signal). This signal should also be high and go low when a key is pressed. If the enable signal is correct, go to step 5.

NOTE: If COL 1 or ROW 3 functions incorrectly in step 4 or 5, L STEPUP may be the cause. Troubleshoot L STEPUP before you troubleshoot the keyboard.

4. If the enable signal is not correct, either U1 is bad or the appropriate input to U1 is not being pulled low by the key row. Check the appropriate key row input to U1. This signal should be high and go low each time the associated key is pressed.

- If the key row functions correctly, replace U1.
- If the key row does not function correctly, troubleshoot the keyboard (A 5 and A7 Block B).

5. If U10 pin 5 functions correctly, either U10 is bad or the appropriate input to U10 is not being pulled low by the key column. Check the appropriate key column input to U10. This signal should be high and go low each time the associated key is pressed.

- If the key column functions correctly, replace U10.
- If the key column does not function correctly, troubleshoot the keyboard (A5 and A7 block B).

6. If all the rest of the A6 assembly circuitry is functioning correctly, but a keystroke or RPG number is not communicated to the instrument, the buffer (U11) may not be functioning correctly. With an oscilloscope, check LEN 7 at U11 pin 1 or 19. Set the oscilloscope to 0.1 µs/Div. You should find 300 to 400 ns wide, low going pulses each time you press a key, or repetitive pulses if you hold a key down. If not, troubleshoot the address decoder (block F).

7. Using LEN 7 to trigger the oscilloscope, check the outputs of U11 during the output enable pulse. You should find:

• Pin 18	Low if a key is pressed
• Pin 3	Low if the front panel knob is rotated
• Pins 5, 7, 9, 12, 14, and 16	High or Low depending on the key code of the key pressed (see schematic)

8. If one or more output is not correct, check the corresponding input. Because U11 is an inverting buffer you should find the inverted version of the signals described in step 7.

- If the levels are correct at the input, replace U11.
- If the signals are not correct, troubleshoot the device(s) from which the incorrect signal(s) come(s).

HOW TO TROUBLESHOOT L STEPUP (BLOCK A)

1. Check the cathode of CR2 or CR3. L STEPUP should be high and only go low when pin 22 on the rear panel 8410 interface connector is grounded. If this signal is high and stays high when the input is shorted to ground, check the front panel ribbon cable and rear panel cable assembly for an open wire. If L STEPUP is low all the time, go to step 3.

2. With the diodes installed, check the voltage at the anode of each diode both with L STEPUP open and with L STEPUP shorted to ground. The anodes should be at approximately 5V when L STEPUP is open and at approximately 0.4V when L STEPUP is shorted to ground. If the voltage at either anode is 0.2V or less when L STEPUP is grounded, that diode is probably shorted. If the voltage at either anode remains at 5V when L STEPUP is grounded, that diode is open.

3. If L STEPUP stays low, lift the cathodes of CR2 and CR3 and check the signal L STEPUP with an ohmmeter to determine if there is a short to ground. If L STEPUP is not shorted to ground, check CR2 and CR3 as described in step 2.

4. Check U10 pin 3 (COL 1) and pin 1 (ROW 3) for a high when no key is pressed. If either signal is low, either the COL or ROW line is shorted, or the encoder (U1 or U10) input is shorted.

HOW TO CHECK THE KEY UP TIMER (BLOCK B)

1. Check KEYBOARD LOCKOUT. This signal should be low unless the instrument is in REMOTE mode. If this signal is not correct, troubleshoot the annunciator latches (block E).

2. With an oscilloscope, check LOW KEY DOWN. Set the oscilloscope to 100 ms/Div. This signal should go low each time a key is pressed, and remain low until the key is released. If this signal is not correct, troubleshoot the keyboard encoder/data buffer (block A).

3. Connect the trigger of the oscilloscope to TP6 (LOW KEY DOWN) and trigger on the rising edge. Set the oscilloscope to 10 ms/div and check TP7 (the output of the key up timer). You should find a high going pulse, 45 to 55 ms wide, each time a key is **released**.

   - If not, replace U9B.
   - If the duration of this pulse is not correct, check/replace R7 or C24.

4. Check TP13 (LOW KEY DISABLE). This signal should go low when HI KEY DN SRQ goes high, and should remain low for 45 to 55 ms after LOW KEY DOWN goes high. If LOW KEY DISABLE is correct, go to step 10.

5. Check U4A pin 1. This signal should go high when a key is pressed, and should remain high for 45 to 55 ms after the key is released. If the signal at U4A pin 1 is **not** correct, go to step 8.

6. Check TP3 (HI KEY DN SRQ). Set the oscilloscope to trigger on the low going edge of TP6 (LOW KEY DOWN). You should find a 100 us to 20 ms wide, high going pulse that occurs 15 to 25 ms after the low going edge of LOW KEY DOWN. If HI KEY DN SRQ is not correct, troubleshoot the key down timer (block C).

7. If HI KEY DN SRQ is correct, check U4A pins 2 and 4 to make sure they are pulled high by R11. If these inputs are also correct, replace U4.

8. Check TP4 (U14D pin 12). Set the oscilloscope to 100 ns/Div, and trigger on the high going edge of LOW KEY DOWN. This signal should remain high for a minimum of 100 ns after a key is **released**. If it is low all the time, either U8 or U14 is bad.

9. If the signal at TP4 says high, check U14B pin 4 (REPEAT DISABLE). REPEAT DISABLE should be an inverted version of LOW KEY DOWN. If it is not, replace U14. If it is correct, either U8 is bad or C23 is shorted.

10. If LOW KEY DISABLE is correct, probe U4A pin 5 (REPEAT RESET). This signal should go high when HI KEY DN SRQ goes high, and remain high for 45 to 55 ms after LOW KEY DOWN goes high.

11. If REPEAT RESET is not correct, either the output of U4A is bad or the input to U9A pin 3 is bad. Lift U4A pin 5, recheck for the correct signal at U4A pin 5, and replace the appropriate part.

HOW TO CHECK THE KEY DOWN TIMER (BLOCK C)

1. Check U8C pin 5 (KEYBOARD LOCKOUT). This signal should be low unless the instrument is in REMOTE mode. If not, troubleshoot the annunciator latches (block E).

2. Check the output of U8C pin 6. This signal should be an inverted version of KEYBOARD LOCK-OUT. If not, replace U8.

3. Check U20 pin 10 (LOW KEY DISABLE). This signal should go low when HI KEY DN SRQ goes high, and should remain low for 45 to 55 ms after LOW KEY DOWN goes high. If not, troubleshoot the key up timer (block B).

4. Check LOW KEY DOWN. Set the oscilloscope to 100 ms/Div. This signal should go low each time a key is pressed and remain low until the key is released. If not, troubleshoot the keyboard encoder/data buffer (block A).

5. Connect the trigger of the oscilloscope to TP6 (LOW KEY DOWN) and trigger on the falling edge. Set the oscilloscope to 10 ms/Div and check TP14 (the output of the key down timer). You should find a 15 to 25 ms wide, low going pulse each time a key is pressed. If not, replace U20B. If the pulse is there, but the duration is not correct, check/replace R5 or C17.

6. Check HI KEY DN SRQ. Each time a key is pressed you should find a 100 us to 20 ms wide, high going pulse that starts at the same time that the output of the key down timer (TP14) goes high. If HI KEY DN SRQ is correct, go to step 10.

7. Check TP12 (LOW REPEAT). This signal should remain high unless a key is held down for longer than approximately one-half second. If not, troubleshoot the repeat function circuits (block D).

8. Check U19B pin 10 (LEN 6). Set the oscilloscope to 0.2 us/Div. You should find a low going, 300 to 400 ns wide pulse each time a key is pressed (this signal may be difficult to find unless you use a storage scope. Refer to HOW TO CHECK THE ADDRESS DECODER for further information). If the signal is not present, troubleshoot the address decoder (block F).

9. If LEN 6 is correct, either the output of U19B (pin 8) is bad or one of the three destinations of HI KEY DN SRQ is bad (U11 Block A, U4 Block B, U19 Block C, or U3 Block I). Determine and replace the defective part.

10. If HI KEY DN SRQ is correct, check U19B pin 9 (LOW DEBOUNCED KEY DOWN). You should find low going, 15 to 25 ms wide pulses that start when the signal at TP14 goes high.

11. If LOW DEBOUNCED KEY DOWN is not correct, either the output of U19B is bad or U9A pin 1 (Block D) input is bad.

HOW TO CHECK THE REPEAT FUNCTION CIRCUITS (BLOCK D)

1. With an oscilloscope, check U9A pin 3 (REPEAT RESET). Set the oscilloscope to 20 ms/Div and trigger off the LOW going edge of LOW KEY DOWN (TP6). REPEAT RESET should go high 15 to 25 ms after LOW KEY DOWN goes low, and should remain high for 45 to 55 ms after LOW KEY DOWN goes high. If not, troubleshoot the key up timer (block C).
2. Check U9 pin 1 (LOW DEBOUNCED KEY DOWN). This signal should go low 15 to 25 ms after LOW KEY DOWN goes low, and remain low 100 us to 20 ms (depending on how quickly the microprocessor services the HI KEY DN SRQ). If this not, troubleshoot the key down timer (block C).
3. Check U4 pin 10 (REPEAT DISABLE). This signal should go high when a key is pressed and go low as soon as the key is released. If not, troubleshoot the key up timer (block B).
4. Check TP9 (U9A pin 4). Set the oscilloscope to 100 ms/Div and trigger on the high going edge of HI KEY DN SRQ (A6TP3). Press any key and hold it down. This signal should go low for approximately 400 ms, and then go high for approximately 100 ms. If there is no signal, replace U9. If signal is present, but the duration is not correct, check/replace R3 or C7.
5. Check TP5 (U4 pin 8). Press any key and hold it down. TP5 should be low and remain low for approximately 400 ms. It should then go high and remain high until the key is released. If the signal at TP5 is correct, go to step 7.
6. Lift U4B pin 8 and check at the pin for the signal described in step 5. If this signal is now correct, check for shorts along the trace. If there are no shorts, replace U5. If the signal is not correct after you replace U5, replace U4.
7. Check U5 pin 3. Set the oscilloscope to 50 ms/Div and select rising edge triggering. When you press and hold a key you should find a high going pulse every 100 ms. If this signal is correct, go to step 9.
8. If the signal at U5 pin 3 goes high (when U5 Pin 4 goes high) and remains high until the key is released, C8 is shorted. If the signal is a square wave, CR1 is probably open.
9. Adjust the oscilloscope to 20 us/Div. Verify that the high going pulses are approximately 20 us wide. If the 20 us wide, high going pulses are spaced very close together (< 100 ms), CR1 is probably shorted.
10. If the signal at U5 pin 3 is correct, check TP12 (LOW REPEAT). Set the oscilloscope to 50 ms/Div and triggering on the low going edge of this signal. You should find an inverted version of the signal at U5 pin 3.

HOW TO CHECK THE ANNUNCIATOR LATCHES (BLOCK E)

1. Check U6 pin 1 (ANNUNCIATOR RESET). This signal should be high, and go low when you press **[INSTR PRESET]**. If not, troubleshoot the instrument preset buffer (block J).
2. Check U6 pin 11 (LEN 5). Set the oscilloscope to 200 ns/Div and trigger on the low going edge of this pulse. You should find a low going, 300 to 400 ns wide pulse each time you press a key that has a LED associated with it. If not, troubleshoot the address decoder (block F).

If One Or More Front Panel LEDs Never Light

1. Perform steps 1, 2, and 3 at the beginning of the HOW TO CHECK ANNUNCIATOR LATCHES.
2. Check the voltage at the appropriate output of the annunciator latches (U6, U7, U16, or U17). When you press **[INSTR PRESET]**, the voltage at all of the outputs should be low (approximately 0.4V). If the appropriate output is low, but the LED is off, replace the LED.

If One Or More Annunciator Latch Outputs are Not Correct

1. Perform steps 1, 2, and 3 at the beginning of HOW TO CHECK ANNUNCIATOR LATCHES.
2. If one or more of the outputs from the annunciator latches (U6, U7, U16, and U17) is not correct, connect A60TP13 (LSTS) to ground to enable the instrument digital signal analysis.
3. To verify that a suspected latch output is not working, set the oscilloscope to 100 us/Div and check that output. If the output is working, you should find TTL activity (< 0.4V for low and > 3.5V for high).
4. Check the appropriate data bus input for this section of the latch. Set the oscilloscope to 10 us/Div and triggering on the low going edge of this signal. You should find a series of low going pulses, 2 to 4 us wide. The low level should be very near 0V and the high level should be very near $+5$V. If the signal is correct, proceed to step 6.
5. Check the same data bus line at the motherboard end of the front panel ribbon cable. If the signal appears correctly at the motherboard, repair or replace the ribbon cable. If no signal appears at the motherboard, refer to the A60 processor troubleshooting.
6. For control signals, troubleshoot the following:

Bad Signal	Troubleshoot
ENTRY ON (U6 pin 19)	RPG Count Window Timer (block H)
KEYBOARD LOCKOUT (U6 pin 2)	Key Up Timer (block B) Keyboard Encoder/Data Buffer (block A) Key Down Timer (block C)
INSTR PRESET LOCKOUT (U16 pin 2)	Instrument Preset Buffer (block J)

If the Front Panel SWEEP LED Does Not Operate Correctly

1. With the instrument sweeping, check U2D pin 13 (LSPLD). Set the oscilloscope to approximately the same ms/Div as the sweep time of the synthesizer. You should find both high and low TTL levels, with the low level corresponding to when the sweep LED should be on. If LSPLD is correct, proceed to step 4.

2. Measure LSPLD at the motherboard end of the ribbon cable. If the signal is present at the motherboard, replace the ribbon cable.

3. If no signal appears at the motherboard, disconnect the 50 pin ribbon cable from the keyboard interface assembly and recheck for this signal. If there still is no signal at the motherboard, check for this signal on the A58 sweep generator. If the signal is present, check for shorts along the signal path on the A6 assembly. If there are no shorts, replace U2.

4. Check U2D pin 11. You should find an inverted version of LSPLD. If not, check for shorts along the signal path. If there are no shorts, replace U2.

5. Check the signal at U2 pin 8. It should be the same as LSPLD. If the signal at U2 pin 8 is correct, but the SWEEP LED is not flashing, replace the green SWEEP LED. If the signal at U2 pin 8 is not correct, check for shorts along the signal path. If there are no shorts, replace U2.

HOW TO CHECK THE ADDRESS DECODER (BLOCK F)

1. Measure the voltage between U15 pin 8 (GND) and chassis ground. If this voltage is not 0V, repair/replace the front panel ribbon cable.

2. Ground A60TP13 to place the instrument into the DSA mode. Check U15 pins 1 through 6 (A0 through A4 and SIOB). Set the oscilloscope to 2 us/Div and triggering on the low going edge. You should find bus activity (both high and low levels) on every line. If the signals are present, go to step 5.

3. At the motherboard end of the ribbon cable, measure the signal(s) not present in step 2. If a signal is present at the motherboard, replace the ribbon cable.

4. If no signal appears at the motherboard, disconnect the 50 pin ribbon cable from the A6 assembly and recheck for the signal. If there is still no signal at the motherboard, troubleshoot the signal on the A60 processor assembly. If the signal is present, check for shorts along the signal path on the A6 assembly. If there are no shorts, replace U15.

5. If all of the inputs to U15 are correct, check U15 pins 7, 9, 10, and 11 (LEN 4 through LEN7). Set the oscilloscope to 200 ns/Div. You should find 200 to 400 ns wide, low going pulses. If LEN 4 through LEN 7 are correct, the address decoder is operating properly.

HOW TO CHECK THE RPG COUNTERS/DATA BUFFERS (BLOCK G)

1. Check TP1 (CLK). Set the oscilloscope to 10 ms/Div. You should find a repetitive TTL signal when you rotate the front panel knob. If the signal is present, proceed to step 3.
2. Remove the 902 (white/black/red) wire from the RPG connector and check CLK right at the wire. If the signal is not present, replace the RPG. If the signal is present, C25 may be shorted. If not, replace U8.
3. Check the U8E pin 10. The inverted version of CLK should be present. If the signal is correct, proceed to step 5.
4. If the signal is not present at U8E pin 10, either U8 is bad or one of the inputs driven by this signal is preventing the signal from changing.
5. Check TP2 (UP/DOWN). Set the oscilloscope to 10 ms/div. You should find a repetitive TTL signal when the RPG is rotated. If the signal is present, proceed to step 7.
6. Remove the 901 (white/black/brown) wire from the RPG connector and check the signal at the wire. If the signal is not present, replace the RPG. If the signal is present, C26 may be shorted. If not, replace U8.
7 Check the U8E pin 12. The inverted version of UP/DOWN should be present. If the signal is correct, proceed to step 9.
8. If the signal is not present at U8E pin 12, either U8 is bad or one of the inputs driven by this signal is preventing the signal from changing.
9. Check U13 or U18 pin 8 (LEN 6) and U 12 pin 1 or 19 (LEN 7). Set the oscilloscope to 200 ns/Div and trigger on the low going edge. You should find 200 to 400 ns wide, low going pulses each time you rotate the RPG. If not, troubleshoot the address decoder (block F).
10. Check U13 or U18 pin 7 (HI RPG SRQ). Set the oscilloscope to 20 ms/division. HI RPG SRQ should be low, and go high for 100 us to 20 ms each time you rotate the front panel knob. If not, troubleshoot the RPG count window timer (block H).
11. Check the U13 and U18 pins 13 through 16 and pin 19. Set the oscilloscope to 20 ms/Div and trigger on the high going edge. Each time you rotate the front panel knob (very slowly counter clockwise) you should find a series of pulses on these pins. If not, either U13 or U18 is bad or, the input to the bus buffer (U12) is bad.
12. Check U12 pins 3, 5, 7, 9, 12, 14, 16, and 18. Set the oscilloscope to 200 ns/Div and trigger on the low going edge of LEN7 (U12 pin 1 or 19). Rotate the front panel knob slowly in both directions and verify that both high and low levels are present at each output of U12 during the first 200 to 400 ns after the trigger. If not, replace U12.
13. If all of the outputs are correct, but you still suspect that the microprocessor is not getting the data, verify that these signals are getting through the front panel ribbon cable by checking at the motherboard. Set the oscilloscope as in step 12. Note that if one of these data lines is open, several front panel LEDs will also be incorrect.

HOW TO CHECK THE RPG COUNT WINDOW TIMER (BLOCK H)

1. Check U13 or U18 pin 8 (LEN 6) and U12 pin 1 or 19 (LEN 7). Set the oscilloscope to 200 ns/Div and trigger on the low going edge. You should find 200 to 400 ns wide, low going pulses each time you rotate the front panel knob. If not, troubleshoot the address decoder (block F).
2. Check U19A pin 2 (ENTRY ON). This signal should be low when an active function is displayed in the entry display. Press **[START FREQ]**; the signal should go low. If not, troubleshoot the annunciator latches (block E).
3. Check U20 pin 2 (CLK). Set the oscilloscope to 10 ms/Div. You should find a repetitive TTL signal when you rotate the front panel knob. If not, troubleshoot the RPG counters/data buffer (block G).
4. Connect the trigger of the oscilloscope to TP1 (CLK) and trigger on the falling edge. Check TP15 (the output of the RPG count window timer). You should find a low going pulse 65 to 75 ms wide each time you rotate the front panel knob. If not, replace U20. If the duration of this pulse is not correct, check/replace R6 or C22.
5. Check U19A pin 6 (HI RPG SRQ). Each time you rotate the front panel knob, you should find a 100 us to 20 ms wide, high going pulse that goes high when TP15 goes high.

HOW TO CHECK THE SERVICE REQUEST BUFFER (BLOCK I)

1. Check U3A pin 1 (LSRQ). Set the oscilloscope 100 us/Div and trigger on the low going edge. Press **[CW]** and rotate the front panel knob. You should find a 100 us wide, low going pulse each time you rotate the RPG. If so, proceed to step 4.
2. Check TP8 (HI RPG SRQ). Set the oscilloscope to trigger on the high going edge. Each time you rotate the front panel knob, you should find a 100 us wide, high going pulse. If so, replace U3.
3. Press any key; You should find a 100 us wide, low going pulse on U3A pin 1 (LSRQ) when the key is pressed.
4. If LSRQ is not correct, check TP3 (HI KEY DN SRQ). Set the oscilloscope to trigger on the high going edge. Each time you press a key, you should see a 100 us wide high going pulse. If so, replace U3.
5. If TP3 is not correct, the problem can be either U3, or the low down timer (block C).

HOW TO CHECK THE INSTRUMENT PRESET BUFFER (BLOCK J)

1. Check U3D pin 12 (INSTR PR LOCKOUT). This signal should be low unless the instrument is in REMOTE mode. If this signal is high, troubleshoot the annunciator latches (block E).
2. Check U3D pin 11 (INSTR PRESET). This signal should be high and go low when you press **[INSTR PRESET]**. If this signal is correct, proceed to step 6.
3. If INSTR PRESET stays high, check for an open circuit on both the A5 and the A6 assemblies. You can manually ground this signal at A6P1 pin 24 to verify that the signal at U3D pin 11 goes low at the same time. This cuts the problem in half.

4. If INSTR PRESET is low, disconnect the A6 assembly from the A5 keyboard. If INSTR PRESET is now correct, remove the INSTR PRESET key switch from the A5 keyboard and check for shorts. If no shorts exist, replace the key switch.

5. If INSTR PRESET is correct, check U3D pin 13. The signal at this pin should be low, and go high when INSTR PRESET goes low. If not, check for shorts along the trace. If there are no shorts, replace U3.

6. Check U3C pin 10 (LIPS). LIPS should be high and go low when you press **[INSTR PRESET]**. If LIPS is correct, go to step 9.

7. If LIPS is always low, disconnect the front panel ribbon cable from the A6 assembly and check LIPS on the motherboard. If LIPS is still low, troubleshoot the A52 assembly or the A60 assembly.

8. If LIPS is correct, the problem can be U3, a short along the signal trace, or U8.

9. Check U8A pin 2. This signal should be low and go high when you press **[INSTR PRESET]**. If so, go to step 10.

11. If the signal at U8 pin 2 is correct, check U2 pin 3 (ANNUNCIATOR RESET). This signal should be high and go low when you press **[INSTR PRESET]**.

A6 KEYBOARD INTERFACE SIGNATURE ANALYSIS

A limited amount of digital signature analysis (DSA) is available on the keyboard interface. All of the latched LED bits and control Bits, as well as the strobes, can be tested for correct operation by using the main instrument DSA routine below, and a signature analyzer.

1. Ground the A60TP13. Turn the instrument to STANDBY and then on.

2. Connect Signature Analyzer as follows:

START	A60TP3
Trigger	Rising edge
STOP	A60TP4
Trigger	Rising edge
CLOCK	A60TP25
Trigger	Rising edge
GRND	Chassis ground or ground pin.

3. Check the following signatures.

Mnemonic	A6J3 Pin #	Signature
DB0 DB1	3 4	H186 CFPH
DB2 DB3	5 6	H077 0942
DB4 DB5	7 8	CC29 63CP
DB6 DB7	9 10	F77H 2757
DB8 DB9	11 12	P702 67A8
DB10 DB11	13 14	FU51 9PA2
DB12 DB13	15 16	3H44 37FH
DB14 DB15	17 18	CF15 H186
ADR0 ADR1	23 24	AUCU U154
ADR2 ADR3	25 26	012F 8U24
ADR4 SIOB	27 47	7UUF 3704

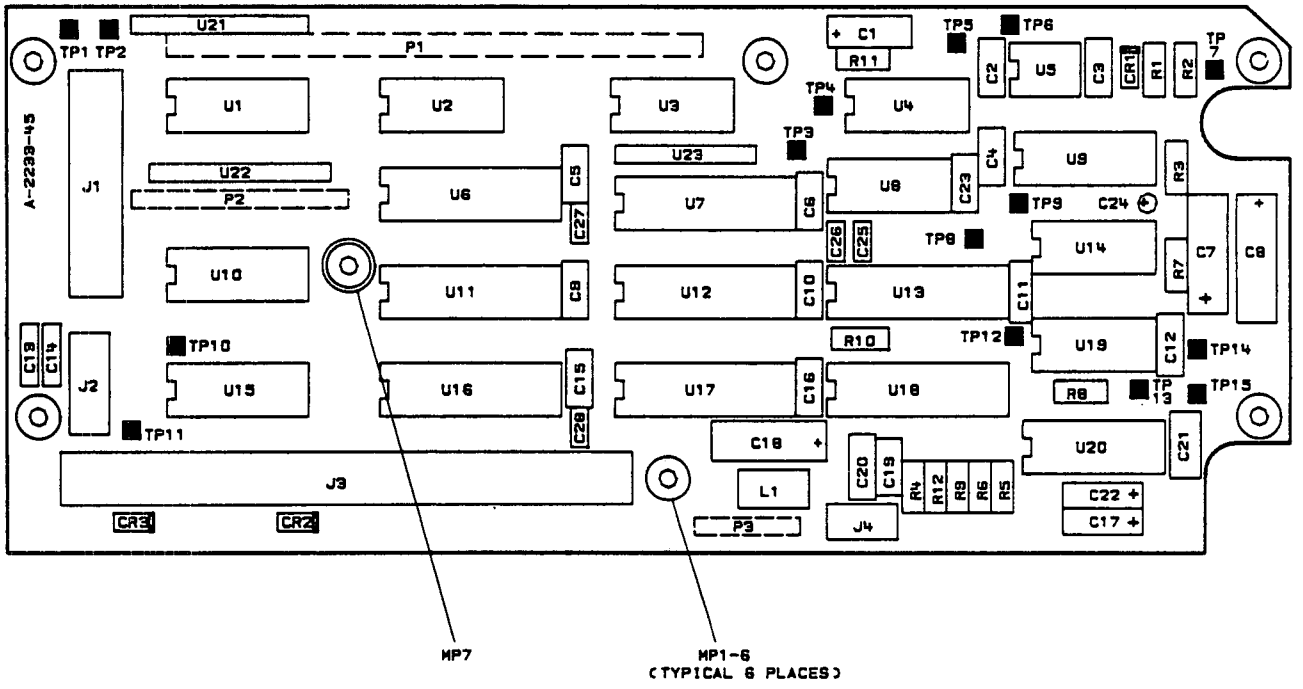
Mnemonic	A6U15 Pin #	Signature
LEN 4 LEN 5 LEN 6	11 10 9	P769 U034 FAFP

Mnemonic	A6U6 Pin #	Signature
MKR SWP M1	12 9	8H01 2156
M2 M3	15 6	79U9 F8A6
M4 M5	16 5	AA19 H973
ENTRY ON KEYBOARD LOCKOUT	19 2	AP4U 7C63

Mnemonic	A6U7 Pin #	Signature
ALTN EXT	19 2	FH92 A070
SINGLE MAN	16 5	5F49 C892
FREE LINE	15 6	7124 F5C5
CONT DELTA MRKR	12 9	C03U 5C2A

Mnemonic	A6U16 Pin #	Signature
PEAK XTAL	12 9	CC23 0UFP
AMPTD MRKR PWR SWP	15 6	6614 C5A1
INT RF	16 5	12FC 10PH
EXT INST PR LOCKOUT	19 2	H7A5 20CH

Mnemonic	A6U17 Pin #	Signature
AM SLOPE	19 2	38U3 086U
PULSE INST CK I	16 5	P6A0 FH41
INST CK II FM	15 6	9A82 CAU3
SHIFT	12 9	0F6P 6155



HP Part Number: 08340-60235

Figure A6-2. A6 Keyboard Interface Component Location Diagram

Figure A6-3. A6 Keyboard Interface Schematic Diagram

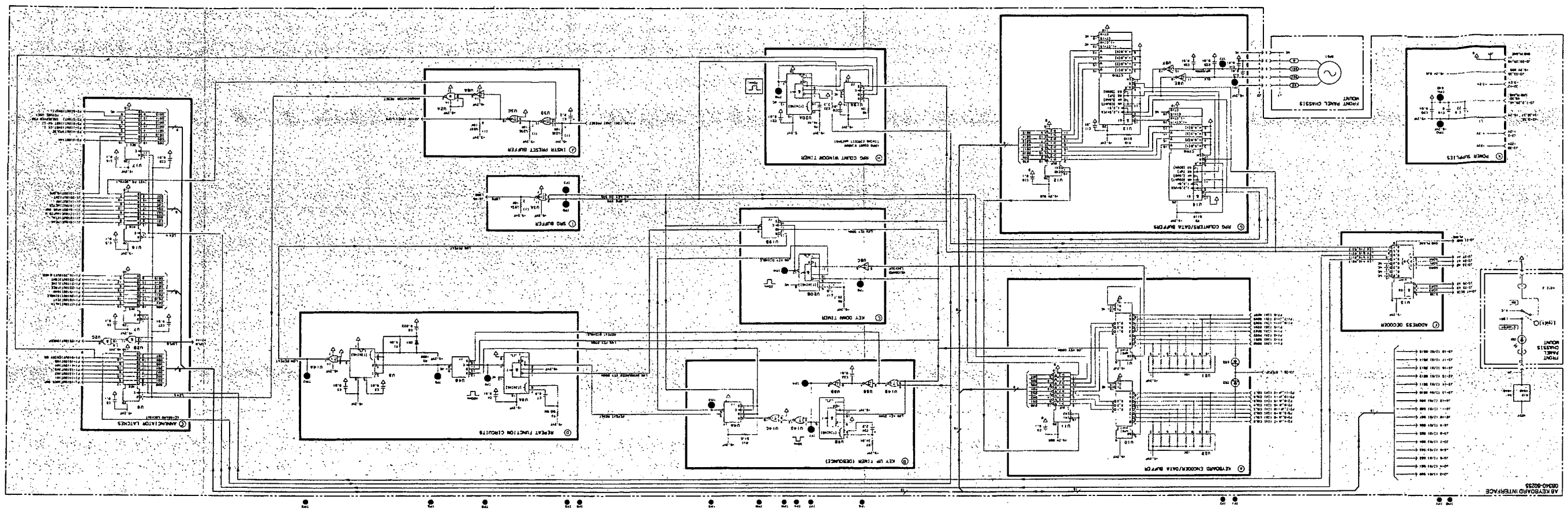


Table A6-1. A6 Keyboard Interface Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A6	**08340-60235**	**2**	**1**	**KEYBOARD INTERFACE**	**28480**	**08340-60235**
A6C1	0180-0197	8	2	CAPACITOR-FXD 2.2UF ±10% 20VDC TA	56289	150D225X9020A2
A6C2	0160-2055	9	10	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C5	0160-4084	8	7	CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A6C6	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A6C7	0180-0116	1	1	CAPACITOR-FXD 6.8UF ±10% 35VDC TA	56289	150D685X9035B2
A6C8	0160-0162	5	1	CAPACITOR-FXD .022UF ±10% 200VDC POLYE	28480	0160-0162
A6C9	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A6C10	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A6C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C15	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A6C16	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A6C17	0180-0291	3	1	CAPACITOR-FXD 1UF ±10% 35VDC TA	56289	150D105X9035A2
A6C18	0180-0228	6	1	CAPACITOR-FXD 22UF ±10% 15VDC TA	56289	150D226X9015B2
A6C19	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A6C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C22	0180-0197	8		CAPACITOR-FXD 2.2UF ±10% 20VDC TA	56289	150D225X9020A2
A6C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C24	0180-2731	0	1	CAPACITOR-FXD 2.2UF ±10% 20VDC TA	28480	0180-2731
A6C25	0160-3879	7	4	CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A6C26	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A6C27	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A6C28	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A6CR1	1901-0050	3	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR2	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6CR3	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A6J1	1251-4634	8	2	CONNECTOR HEADER 20 M2R	28480	1251-4634
A6J2	1251-6868	4	1	CONNECTOR HEADER 5 M IR	28480	1251-6868
A6J3	1251-5746	5	1	CONNECTOR HEADER 50 M2R	28480	1251-5746
A6J4	1251-6793	4	1	CONNECTOR HEADER 3 M IR	28480	1251-6793
A6L1	9100-1788	6	1	CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A6MP1	0380-0043	7	6	SPACER-RVT-ON .375-IN-LG .14-IN-ID	28480	0380-0043
A6MP2	0380-0043	7		SPACER-RVT-ON .375-IN-LG .14-IN-ID	28480	0380-0043
A6MP3	0380-0043	7		SPACER-RVT-ON .375-IN-LG .14-IN-ID	28480	0380-0043
A6MP4	0380-0043	7		SPACER-RVT-ON .375-IN-LG .14-IN-ID	28480	0380-0043
A6MP5	0380-0043	7		SPACER-RVT-ON .375-IN-LG .14-IN-ID	28480	0380-0043
A6MP6	0380-0043	7		SPACER-RVT-ON .375-IN-LG .14-IN-ID	28480	0380-0043
A6MP7	0380-0111	0	1	STANDOFF-RVT-ON .25-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
A6P1	1251-6787	6	5	SOCKET STRIP 6 CONTACT	28480	1251-6787
A6P2	1251-6799	0	2	CONNECTOR HEADER 36 M IR	28480	1251-6799
A6P3	1251-6799	0		CONNECTOR HEADER 36 M IR	28480	1251-6799
A6R1	0683-6855	3	1	RESISTOR 6.8M 5% .25W FC TC=-900/+1100	01121	CB6855
A6R2	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A6R3	0757-0464	5	1	RESISTOR 90.9K 1% .125W F TC=0±100	03292	C4-1/8-T0-9092-F
A6R4	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0±100	24546	C4-1/8-T0-4641-F
A6R5	0698-3449	6	1	RESISTOR 28.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-2872-F
A6R6	0698-3162	0	1	RESISTOR 46.4K 1% .125W F TC=0±100	24546	C4-1/8-T0-4642-F
A6R7	0757-0123	3	1	RESISTOR 34.8K 1% .125W F TC=0±100	28480	0757-0123
A6R8	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A6R9	0757-0438	3	3	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A6R10	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A6R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A6R12	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0±100	24546	C4-1/8-T0-4641-F
A6TP1	0360-0535	0	15	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP8	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP9	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION

Table A6-1. A6 Keyboard Interface Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6TP11	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP12	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP13	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP14	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6TP15	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A6U1	1820-1851	2	2	IC ENCDR TTL LS	01295	SN74LS148N
A6U2	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A6U3	1820-1272	1	1	IC BFR TTL LS NOR QUAD 2-INP	01295	SN74LS33N
A6U4	1820-1112	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A6U5	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	01295	NE555P
A6U6	1820-1730	6	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A6U7	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A6U8	1820-1416	5	1	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A6U9	1820-1437	0	1	IC MV TTL LS MONOSTBL DUAL	01698	SN74LS221N
A6U10	1820-1851	2		IC ENCDR TTL LS	01295	SN74LS148N
A6U11	1820-1917	1	1	IC BFR TTL LS LINE DRVR OCTL	01295	SN74LS240N
A6U12	1820-2024	3	1	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A6U13	1820-2270	1	2	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	34335	AM25LS2569DC
A6U14	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A6U15	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A6U16	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A6U17	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A6U18	1820-2270	1		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	34335	AM25LS2569DC
A6U19	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A6U20	1820-1437	0	1	IC MV TTL LS MONOSTBL DUAL	01295	SN74LS221N
A6U21	1810-0280	8	2	NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A6U22	1810-0280	8		NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A6U23	1810-0206	8	1	NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103

Rear Panel Component-Level Information

Figure G-1 and Table G-1 provide a list of rear panel replaceable parts.

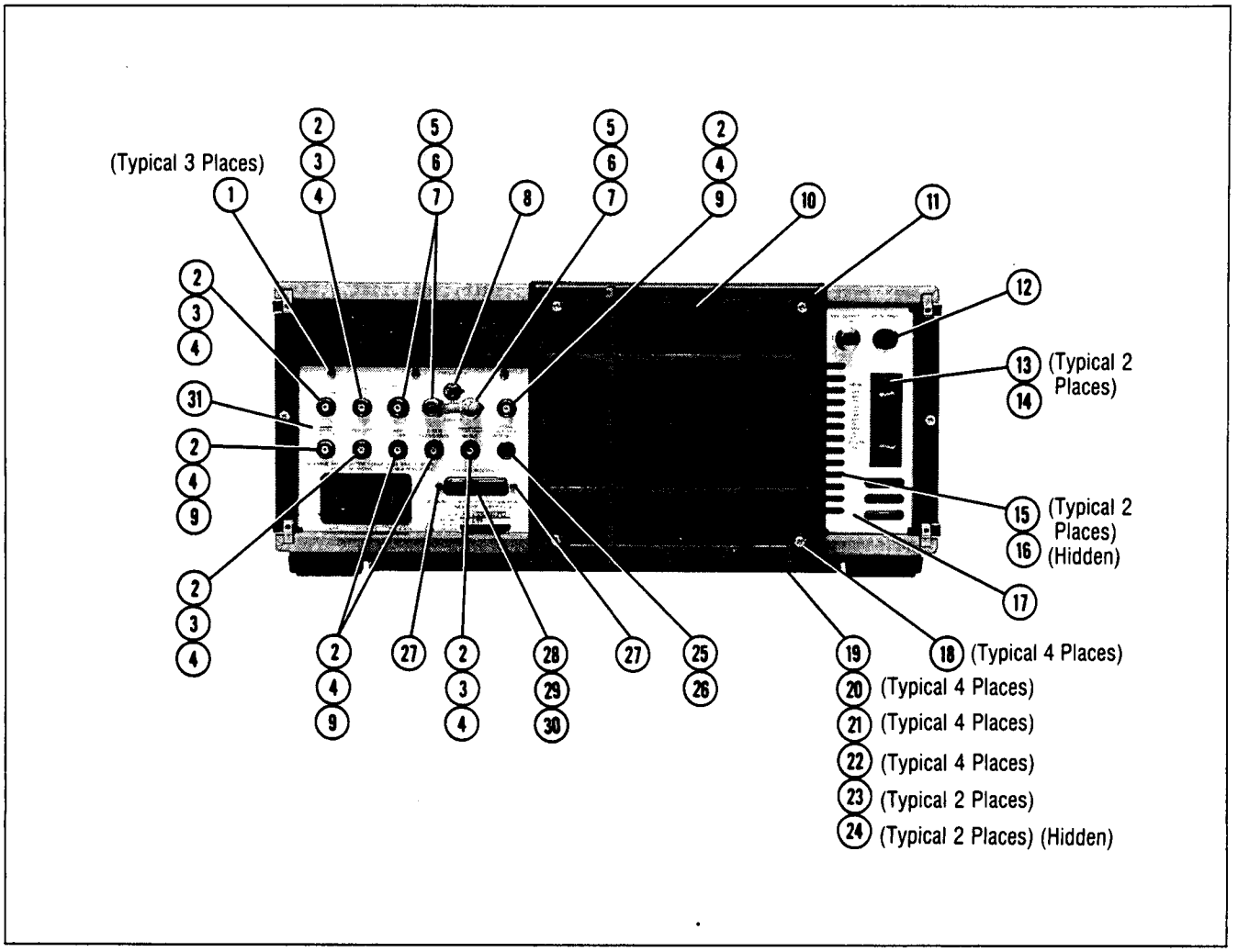


Figure G-1. Rear Panel Replaceable Parts

Table G-1. Rear Panel Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				REAR PANEL		
1	2200-0105	4	99	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
2	1250-0083	1	8	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
3	0360-1632	0	4	TERMINAL-SLDR LUG LK-MTG FOR-#3/8-SCR	28480	0360-1632
4	2950-0001	8	8	NUT-HEXB=-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
5	1250-0102	5	3	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0102
6	2190-0068	5	3	WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
7	2950-0054	1	3	NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
8	3101-0163	5	1	SWITCH KIT	28480	3101-0163
9	2190-0016	3	4	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
10	08340-00018	3	1	FAN FILTER	28480	08340-00018
11	08340-00017	2	1	GRILL AIR	28480	08340-00017
12	6960-0009	1	1	HOLE PLUG .531-D-HOLE	28480	6960-0009
13	0380-0644	4	2	STANDOFF-HEX .400-IN-LG 6-32 THD	28480	0380-0644
14	2420-0002	6	2	NUT-HEX-DBL-CHAM 6-32-THD .109-IN-THK	28480	2420-0002
15	2360-0115	4	37	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
16	08340-00056	9	1	DEFLECTOR-AIR	28480	08340-00056
17	08340-00011	6	1	PANEL-REAR (AUX OUTPUT)	28480	08340-00011
18	2360-0119	8	10	SCREW-MACK 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
19	08340-00016	1	1	BASE PLATE-FAN	28480	08340-00016
20	1520-0230	3	4	SHOCK MOUNT	28480	1520-0230
21	85660-20092	4	4	SNUBBER SHOCK MOUNT	28480	85660-20092
22	2360-0196	1	4	SCREW-MACH 6-32 .375-IN-LG 100 DEG	28480	2360-0196
23	2190-0009	4	2	WASHER-LK INT T NO. 8 .168-IN-ID	28480	2190-0009
24	2510-0051	6	2	SCREW-MACH 8-32 .625-IN-LG PAN-HD-POZI	28480	2510-0051
25	1251-6781	0	1	CONECTOR RECEPTACLE 3 MALE CONTACT	28480	1251-6781
26	2190-0104	0	1	WASHER-LK INTL T 7/16 IN .439-IN-ID	28480	2190-0104
27	1251-2943	7	2	CONNECTOR-RACK & PANEL LOCK	28480	1251-2942
28	1251-0064	0	1	CONNECTOR 25-PIN F D SERIES	28480	1251-0064
29	1251-3653	9	26	CONNECTOR CONTACT FEMALE .025	28480	1251-3653
30	1251-7374	9	1	CONNECTOR HOUSING-28 FEMALE 2R	28480	1251-7374
31	08340-00010	5	1	REAR PANEL	28480	08340-00010

RF Section
(Power Level Control) **H**

A27 Level Control Circuit Description

ASSEMBLY PURPOSE

The A27 level control assembly performs the following functions:

- Flatness compensation — provides error compensation to the ALC loop control as a function of frequency.
- Power sweep control — uses the RF sweep to generate a microprocessor controlled power level sweep.
- Test ADC (analog-to-digital-converter) — monitors any one of several dc levels via an analog multiplexer. The ADC sends a digital equivalent of the chosen dc voltage to the microprocessor.

BAND SWITCH CONTROL (BLOCK A)

Bits 0, 1, and 2 are latched off of the data bus on the rising edge of strobe WBAND (band information I/O). These bits produce the encoded latched band information HLB0, HLB1, and HLB2.

LHET (low heterodyne) is decoded from the inverted outputs of HLB1 and HLB2. LHET is high when either of the inverted HLB1 or HLB2 outputs are low.

ADDRESS DECODING (BLOCK B)

I/O strobe decoding consists of two 3-to-8-line decoders and one NAND gate connected as an inverter. The two decoders decode address lines A0 through A4, and SIOA I/O strobe, to produce input and output strobes for the RF section.

20 GHZ BREAKPOINT SLOPE COMPENSATION (BLOCK C)

The 20 GHz breakpoint is used to compensate for directional coupler forward losses, and detector losses that occur beyond 20 GHz. This breakpoint occurs when the voltage on the −0.25 V/GHz line is −5.0V.

This block has a gain of −2.0, for an output of 0.00 to 0.5 V/GHz, depending on the DAC input.

9 GHZ BREAKPOINT SLOPE COMPENSATION (BLOCK D)

The 9 GHz breakpoint is used to compensate for detector losses. This breakpoint occurs when the voltage on the −0.25 V/GHz line is −2.25V.

This block has a gain of −1.0, for an output of 0.00 to 0.25 V/GHz, depending on the DAC input.

ATTENUATOR SLOPE COMPENSATION (BLOCK E)

Attenuator slope compensation increases or decreases the level reference voltage as a function of frequency. When this reference increases, it causes the leveling circuitry to increase the output power as a function of frequency, to compensate for power losses in the attenuator or cabling between the detector coupler and the instrument output.

In low band, the slope circuitry compensates for the frequency response of the low band detector. Because the detector can have either a positive or negative slope versus frequency, this compensation circuit is bipolar.

The rate at which the output power increases is determined by a constant written into the attenuator slope compensation DAC, which is different for each RF attenuator step, because the frequency response is different for each step.

−0.25 V/GHz from the A28 SYTM driver assembly is the frequency reference for this circuit. With a gain of −0.83, this block has an output of 0.00 to 0.21 V/GHz, depending on the DAC input.

COMPENSATION SUMMING AMPLIFIER (BLOCK F)

The inverting summing amplifier sums four compensation terms with correct polarity and gain:

- 20 GHz Breakpoint Slope Compensation
- 9 GHz Breakpoint Slope Compensation
- Attenuator Slope Compensation
- Cable Slope Compensation

At the output, the correction voltage has a value of 0V = 0 dBm, with a correction factor of 1.25 dB/V.

CABLE SLOPE COMPENSATION (BLOCK G)

This block provides temperature compensation for front panel output options that have a short cable length. The compensation at 25°C is approximately 0.0027 dB/GHz.

In rear panel options, which have a long cable, R71 is removed and R70 is replaced with a short to provide 0.0052 dB/GHz compensation at 25°C.

Because the resistance of RT1 decreases with temperature, the amount of compensation increases with temperature.

ALC REFERENCE GENERATOR (BLOCK H)

A 10-bit multiplying DAC controls the reference voltage for the level control circuits. For accuracy, a precision +10.00V reference in the power supply circuitry provides a temperature compensated reference voltage to the DAC. From this 10.00V reference, the DAC creates a current that is a function of the 10-bit digital input. The digital inputs are latched off the instrument data bus by two latches. The latched outputs are pulled to a +5V reference.

The output of this block is a voltage between 0 and −10V.

POWER SWEEP GENERATOR (BLOCK I)

The level sweep DAC provides the power sweep function by sweeping the level reference as a function of the sweep ramp.

The reference voltage for the level sweep DAC is the RF sweep ramp, which varies linearly between 0 and +10V, as the frequency sweeps between the start and stop frequencies.

REFERENCE LEVEL SUMMING AMPLIFIER (BLOCK J)

The ALC reference level DAC output, and the power sweep level DAC output are summed at unity gain. The +10.00V reference is also summed in this block, with a gain of 0.5, to provide a −5V offset at the level reference output. The output can be adjusted by the main level DAC between approximately −5.12 and +5.11V. This voltage represents a change in output power of +25.55 to −25.60 dBm, and represents a slope of approximately −0.2 V/dB. The exact slope and offset are corrected in software by the instrument controller.

FAIL TEST LED (BLOCK K)

The fail test LED indicates when an error condition is detected on the level control assembly during self test. The microprocessor turns this LED on and off.

ADC CONTROL LATCH (BLOCK L)

Six control signals are latched off the data bus when the WADCC (ADC control) strobe goes low:

- L CONVERT ALWAYS
- L DON'T CONVERT
- LA MUX0
- LA MUX1
- LA MUX2
- H SRQ DISABLE

ADC CLOCK/CONTROL (BLOCK M)

The ADC clock is generated by a schmitt trigger input NAND gate with RC feedback. The clock is controlled by several digital signals. When one of the control signals is low, the clock is disabled and its output is high. After a period of time, the feedback input is also high. If the clock circuit is enabled by all the clock control signals going high, the output goes low. The feedback input moves towards 0V at a rate determined by the RC time constant of R21 and C32. When this voltage reaches the NAND gate trigger threshold, the clock output goes high. The feedback input moves towards Vout at a rate determined by the RC time constant. When this voltage reaches the NAND gate trigger threshold, the clock output goes low, and the cycle repeats until one of the control lines goes low.

The clock circuit is disabled when the ADC is being read. When L CONVERT ALWAYS is low the clock is enabled. The clock is disabled when the conversion complete latch resets.

ADC INPUT MULTIPLEXER (BLOCK N)

The ADC input multiplexer allows the microprocessor to select which analog input line the ADC will convert to digital information for use by the microprocessor.

The ADC latch control signals determine the channel selected. The multiplexer output is connected to a buffer amplifier summing node, allowing each channel to have a different gain and offset.

Channel 0 (the DET LVL input) is bipolar, with a gain of one that yields a full scale input range of ±5.0V. The scale factor of this voltage is −0.2 V/dB, or ±25 dB full scale.

Channels 1 through 7 are voltages that the microprocessor can use to determine that major portions of the instrument are functioning correctly.

If the microprocessor peaks the SYTM, so that more power is available, MOD LVL changes proportionally. If less power is available, this voltage changes in the opposite direction. MOD LVL provides feedback to the microprocessor for auto-peaking and auto-tracking.

TEST ADC (BLOCK O)

Test ADC measures the voltage of a preselected line and converts that voltage to digital information. Reading the output of the test ADC, the microprocessor monitors the voltage of the selected line.

Example:

The synthesizer normally places the power level that you select in the front panel ENTRY and POWER dBm displays. Under the conditions listed below, the power level you select may not be the same as the actual power output.

- When the RF power output is unleveled.
- When the instrument is in the external leveling mode.
- When AM is on (a dc voltage on the AM input causes a change in the actual RF output power).

When any of the conditions above happen, the test ADC monitors the DETLVL input from the ALC circuitry and converts it to digital information. The microprocessor reads the information and converts it to an equivalent power level (dBm). This value appears in the front panel POWER dBm display.

The tracking analog-to-digital converter contains:

- A D-to-A converter and reference amplifier
- An up/down counter
- A window comparator (controls the up/down counter)
- Data latches (to store conversion data)

A reference current (derived from the precision 10.00V reference), is multiplied by four in the ADC and divided as required for the digital output of the internal 10-bit up/down counter.

The voltage range from the ADC input multiplexer −5 to +5V. −5V yields a digital value of 0, 0V = 512, and +5V = 1023.

When the data hold line is high, digital information appears at the outputs of the tracking ADC. If the data hold line is brought low, the information present at the ADC and at the up/down counters is frozen in the output latch/buffers. When the microprocessor is ready for the ADC data, the RLEVEL strobe goes low, enabling the bus buffer outputs, placing the ADC data on the instrument data bus, to be read by the microprocessor.

The RLEVEL strobe is also connected to the data hold on the ADC, so that the information in the ADC latches cannot be changed while it is read. The ADC requires that the data hold line cannot be brought low for 150 ns after the rising edge of the ADC clock, to allow settling of the counter outputs. The ADC clock cannot run while the ADC is read.

Attenuator Sensing

A line connected to the input of DB10 of the ADC data output buffers is grounded when the attenuator is installed in the instrument. This bit is read when the microprocessor does a read level operation. This information is used to determine if the attenuator is installed only if the calibration data is damaged and the default values must be used.

ADC WINDOW COMPARATOR (BLOCK P)

Because the ADC clock must not run when the voltage into the ADC is not changing, an external window comparator (in addition to the window comparator internal to the test ADC) senses when to turn on the ADC clock, allowing the ADC to function.

The window comparator senses the summing node of the current DAC internal to the test ADC, and the input current through the test ADC sense resistor. When the input current does not match the current output from the ADC, an offset voltage proportional to the error between the two currents exists. Both the internal window comparator and the external window comparator sense this voltage. The external comparator triggers when this voltage exceeds approximately ± 1 LSB of the ADC. This comparator then begins a conversion. The ADC clock is turned off until the input voltage changes by more than approximately 2 LSB maximum.

A low offset operational amplifier provides a gain of approximately 20, to provide a larger voltage representing one LSB to the comparators. A filter prevents transients or noise generated by the clock circuit from triggering the comparators when the voltage is within the window. To provide a significant increase in resolution, the input buffer must have an input offset voltage much lower than the comparator input offset voltage.

CONVERSION COMPLETE TIMER/SRQ LATCH (BLOCK Q)

The conversion-complete timer allows the clock to run for eight clock pulses after the window comparator signals that the ADC has converted the input voltage to within ± 1 LSB of the actual value. This allows the ADC time to convert the input voltage to within ± 0.5 LSB before its clock is stopped (assuming the input voltage is not changing).

The window comparator output (L OUTSIDE WINDOW) is inverted to drive low enable of the counter. The counter is enabled to count up when the voltage converted is inside the window. After eight counts, the carry out goes low and clocks both the ADC clock control flip-flop (block M), and the SRQ latch. The ADC clock control flip-flop D input (block M) is grounded so it resets, turning the clock off.

The SRQ latch input comes from H SRQ DISABLE (block L). If H SRQ DISABLE is low, the SRQ latch is reset. The output of this latch goes to the status buffer (block R), to be read by the microprocessor, and to an SRQ delay circuit. The SRQ delay circuit allows only one A-D SRQ every 100 ms, to limit the microprocessor time devoted to servicing the ADC. LA-D SRQ also goes to the ADC clock/control circuitry (block M), which disables the ADC clock until the SRQ is cleared by the RLEVEL strobe.

In the delay circuit, an input transistor conducts when the ADC is not requesting service. When A-D SRQ goes low, the transistor turns off, charging an output capacitor until the voltage at the input of an OR gate causes its output (LCHNG) to go low. This signals the microprocessor that a change has occurred. When the microprocessor reads the ADC, the SRQ latch is set so its output goes high, the transistor again turns on, pulling the input to the OR gate low, the output high.

The change detectors output a low going pulse on the LCHNG line to the digital interface assembly, to indicate a change on the unleveled or overmod inputs to the level control assembly.

The inputs (LUNLVL and LOMD) also go to an output status buffer (block R) that can be read by the processor to determine what signal has changed state.

STATUS BUFFER (BLOCK R)

Several bits of information about level control assembly functions must be communicated to the instrument processor, and several ADC control lines must be asserted by the microprocessor.

A bus buffer puts several bits of information on the data bus when the RSTAT strobe goes low (block B). Four signals are communicated to the processor:

- LA-D SRQ
- LUNLVL
- LOMD
- LOW BD INSTALLED

POWER SUPPLIES (BLOCK S)

There is standard power supply filtering on the +20, +5, −5, −10, and −15V supplies to prevent noise propagation. There are also a +15 and +10V regulated supplies, derived from the +20 VDC supply.

A low current +10V supply is tied to the +5.2V supply to prevent the digital inputs to the DACs from being greater than the Vdd supply when the instrument is turned on.

The +10V precision reference is the reference voltage for the level DAC (block H), and produces precision offsets for the breakpoint and attenuator compensation circuits.

Table A27-1. A27 Control P1 Pin I/O (1 of 2)

Pin	Mnemonic	Levels	Source	Destination
1 32	−5.2V −5.2V	−5.2V −5.2V	XA53P1-18, 36 XA53P1-18, 36	*S *S
2 33	+20V +20V	+20V +20V	XA52P1-16, 40 XA52P1-16, 40	*S *S
3 34	+5.2V +5.2V	+5.2V +5.2V	XA52P1-17, 18, 41, 42 XA52P1-17, 18, 41, 42	*S *S
4 35	−10V −10V	−10V −10V	XA53P1-12, 13, 31, 32 XA53P1-12, 13, 31, 32	*S *S
5 36	−15V −15V	−15V −15V	XA56P1-15, 30 XA56P1-15, 30	*S *S
6 37	GND GND	0V 0V	A62 STAR GND A62 STAR GND	*S *S
7 38	GND PLANE GND PLANE	0V 0V	IN GROUND IN GROUND	*S *S
8 39	HADCEN LATTN	TTL (HIGH TRUE) TTL (LOW TRUE)	XA21P1-1 A62J20-14	M 0
9 40	ADR0 ADR1	TTL TTL	XA60P1-17 XA60P1-73	*B *B
10 41	ADR2 ADR3	TTL TTL	XA60P1-18 XA60P1-74	*B *B
11 42	ADR4 SIOA	TTL TTL (LOW TRUE)	XA60P1-19 XA60P1-15	*B *B
12 43	WLEVEL WBAND	TTL (LOW TRUE) TTL (LOW TRUE)	B B	XA24P1-33 XA28P1-29
13 44	WYTMSLP	TTL (LOW TRUE)	B	XA28P1-30
14 45	WYTMCTL RSTAT	TTL (LOW TRUE) TTL (LOW TRUE)	B B	XA28P1-8 *
15 46	W11R2 HLB0	TTL (LOW TRUE) TTL (HIGH TRUE)	B A	XA23P1-15 *
16 47	HLB1 HLB2	TTL (HIGH TRUE) TTL (HIGH TRUE)	A A	* *

A single letter in the source or destination column refers to a function block on this assembly schematic.

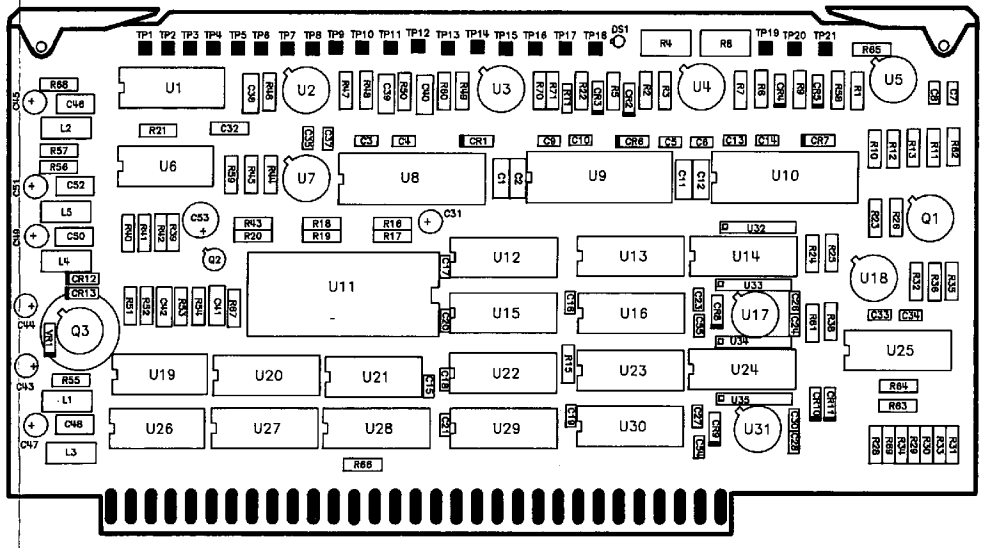
An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A27-1. A27 Control P1 Pin I/O (2 of 2)

Pin	Mnemonic	Levels	Source	Destination
17 48	RFSWP LOMD	10V/SWEEP TTL (LOW TRUE)	XA57P1-42 XA26P1-8	I Q R
18 49	RGND RGND	0V 0V	STAR GND POINT STAR GND POINT	*S *S
19 50	GND PLANE GND PLANE	0V 0V	INSTRUMENT GROUND INSTRUMENT GROUND	*S *S
20 51	LHET −.25V/GHZ	TTL (LOW TRUE) −.25V/GHZ	A XA28P1-40	* *
21 52	LCHNG LUNLVL	TTL (LOW TRUE) TTL (LOW TRUE)	* XA26P1-36	Q Q R
22 53	DB0 DB1	TTL TTL	*XA60P1-20 *XA60P1-76	*L *L
23 54	DB2 DB3	TTL TTL	*XA60P1-21 *XA60P1-77	*L *L
24 55	DB4 DB5	TTL TTL	*XA60P1-22 *XA60P1-78	*L *L
25 56	DB6 DB7	TTL TTL	*XA60P1-23 *XA60P1-79	*L *L
26 57	DB8 DB9	TTL TTL	*XA60P1-24 *XA60P1-80	*L *L
27 58	DB10 DB11	TTL TTL	*XA60P1-25 *XA60P1-81	*L *L
28 59	RGND WMOD	0V TTL (LOW TRUE)	STAR GND POINT B	*S *
29 60	DETVL RGND	−0.2V/dB, 0V=0dB 0V	XA25P1-33 STAR GND POINT	N *S
30 61	LVLREF MODLVL	0.2V/dB, 0V=0dB 0 TO −3V LEVELED	T XA26P1-32	XA25P1-13 N
31 62	BVSWP LVLCOR	10V SWEEP 1.25 dB/V, 0V=0dB	XA58P1-40 G	N XA25P1-14

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60237

Figure A27-1. A27 Level Control Component Location Diagram

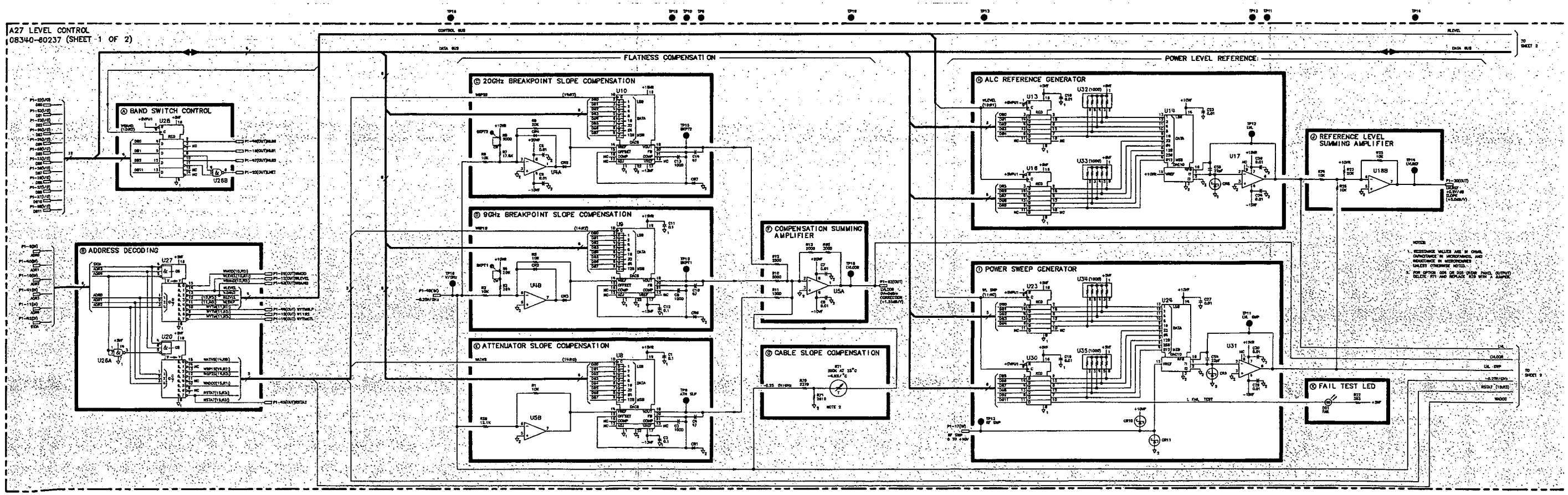


Figure A27-2. A27 Level Control Schematic (1 of 2)

A27 LEVEL CONTROL
08340-60237 (SHEET 2 OF 2)

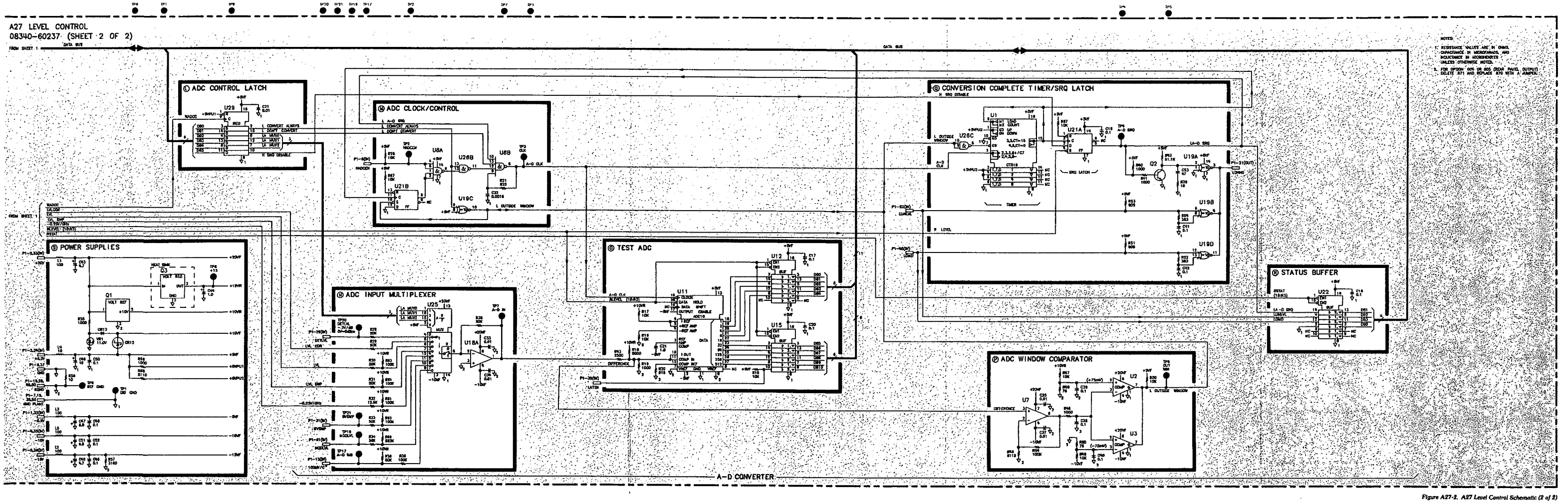


Figure A27-2. A27 Level Control Schematic (2 of 2)

Table A27-2. A27 Level Control Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A27	**08340-60237**	**4**	**1**	**LEVEL CONTROL ASSEMBLY**	**28480**	**08340-60237**
A27C1	0160-4084	8	16	CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C2	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C3	0160-3878	6	3	CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A27C4	0160-3876	4	3	CAPACITOR-FXD 47PF ±20% 200VDC CER	28480	0160-3876
A27C5	0160-3879	7	18	CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C6	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C7	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C8	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C9	0160-3878	6		CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A27C10	0160-3876	4		CAPACITOR-FXD 47PF ±20% 200VDC CER	28480	0160-3876
A27C11	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C12	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C13	0160-3878	6		CAPACITOR-FXD 1000PF ±20% 100VDC CER	28480	0160-3878
A27C14	0160-3876	4		CAPACITOR-FXD 47PF ±20% 200VDC CER	28480	0160-3876
A27C15	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C16	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C17	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C18	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C19	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C20	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C21	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C22				NOT ASSIGNED		
A27C23	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C24	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C25				NOT ASSIGNED		
A27C26	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C27	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C28	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C29				NOT ASSIGNED		
A27C30	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C31	0180-2661	5	2	CAPACITOR-FXD 1UF ±10% 50VDC TA	25088	D1R0GS1A50K
A27C32	0160-4846	0	1	CAPACITOR-FXD 1500PF ±5% 100VDC CER	28480	0160-4846
A27C33	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C34	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C35	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C36				NOT ASSIGNED		
A27C37	0160-3879	7		CAPACITOR-FXD .01UF ±20% 100VDC CER	28480	0160-3879
A27C38	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C39	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C40	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C41	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C42	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C43	0180-0630	4	2	CAPACITOR-FXD 4.7UF ±20% 50VDC TA	28480	0180-0630
A27C44	0180-2661	5		CAPACITOR-FXD 1UF ±10% 50VDC TA	25088	D1R0GS1A50K
A27C45	0180-0630	4		CAPACITOR-FXD 4.7UF ±20% 50VDC TA	28480	0180-0630
A27C46	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C47	0180-2617	1	2	CAPACITOR-FXD 6.8UF ±10% 35VDC TA	25088	D6R8GS1B35K
A27C48	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C49	0180-2697	7	1	CAPACITOR-FXD 10UF ±10% 25VDC TA	28480	0180-2697
A27C50	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C51	0180-2617	1		CAPACITOR-FXD 6.8UF ±10% 35VDC TA	25088	D6R8GS1B35K
A27C52	0160-4084	8		CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A27C53	0180-0500	7	1	CAPACITOR-FXD 47UF ±20% 20VDC TA	28480	0180-0500
A27C54	0160-3875	3	2	CAPACITOR-FXD 22PF ±5% 200VDC CER 0±30	28480	0160-3875
A27C55	0160-3875	3		CAPACITOR-FXD 22PF ±5% 200VDC CER 0±30	28480	0160-3875
A27CR1	1901-0050	3	8	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A27CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A27CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A27CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A27CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A27CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A27CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A27CR8	1901-0518	8	5	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A27CR9	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A27CR10	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A27CR11	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A27CR12	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A27CR13	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A27DS1	1990-0486	6	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684

Table A27-2. A27 Level Control Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A27L1	9140-0210	1	4	INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A27L2	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A27L3	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A27L4	9140-0114	4	1	INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A27L5	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A27MP1	1200-0173	5	2	INSULATOR-XSTR DAP-GL	28480	1200-0173
A27MP2	1205-0011	0	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A27MP3	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A27MP4, 5	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A27MP6	4040-0755	2	1	EXTR-PC BD VIO POLYC .062-BD-THKNS	28480	4040-0755
A27Q1	1826-0730	6	1	IC V RGLTR-V-REF-FXD 10V TO-5 PKG	28480	1826-0730
A27Q2	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A27Q3	1826-0512	2	1	IC 78M15C V RGLTR TO-39	04713	MC78M15CG
A27R1	0698-6360	6	7	RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A27R2	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A27R3	0698-6977	1	1	RESISTOR 30K .1% .125W F TC=0±25 (RECOMMENDED REPLACEMENT)	28480	0698-6977
A27R4	2100-3353	8	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN (RECOMMENDED REPLACEMENT)	28480	2100-3353
A27R5	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A27R6	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A27R7	0698-3136	8	1	RESISTOR 17.8K 1% .125W F TC=0±100	24546	C4-1/8-T0-1782-F
A27R8	2100-3207	1	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	28480	2100-3207
A27R9	0698-6630	3	1	RESISTOR 20K .1% .125W F TC=0±25	28480	0698-6630
A27R10	0698-6320	8	2	RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A27R11	0698-6347	9	1	RESISTOR 1.5K .1% .125W F TC=0±25	28480	0698-6347
A27R12	0698-6631	4	2	RESISTOR 2.5K .1% .125W F TC=0±25	28480	0698-6631
A27R13	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A27R14				NOT ASSIGNED		
A27R15	0757-0442	9	6	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A27R16	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A27R17	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A27R18	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A27R19	0698-6362	8	1	RESISTOR 1K .1% .125W F TC=0±25	28480	0698-6362
A27R20	0757-0418	9	1	RESISTOR 619 1% .125W F TC=0±100	24546	C4-1/8-T0-619R-F
A27R21	0757-0421	4	1	RESISTOR 825 1% .125W F TC=0±100	24546	C4-1/8-T0-825R-F
A27R22	0698-3446	3	3	RESISTOR 383 1% .125W F TC=0±100	24546	C4-1/8-T0-383R-F
A27R23	0699-0118	2	1	RESISTOR-20K OHM .1% .1W	28480	0699-0118
A27R24	0699-0144	4	2	RESISTOR-10K OHM .1% .1W	28480	0699-0144
A27R25	0699-0144	4		RESISTOR-10K OHM .1% .1W	28480	0699-0144
A27R26	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A27R27				NOT ASSIGNED		
A27R28	0698-6353	7	8	RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A27R29	0698-6353	7		RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A27R30	0698-6353	7		RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A27R31	0698-6353	7		RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A27R32	0698-8191	5	1	RESISTOR 12.5K .1% .125W F TC=0±25	19701	MF4C1/8-T9-1252-B
A27R33	0698-6353	7		RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A27R34	0698-6977	1	1	RESISTOR 30K .1% .125W F TC=0±25	28480	0698-6977
A27R35	0698-6353	7		RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A27R36	0698-6353	7		RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A27R37				NOT ASSIGNED		
A27R38	0698-6353	7		RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A27R39	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A27R40	0757-0280	3	5	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A27R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A27R42	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A27R43	0698-6631	4		RESISTOR 2.5K .1% .125W F TC=0±25	28480	0698-6631
A27R44	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A27R45	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A27R46	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A27R47	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A27R48	0757-0398	4	2	RESISTOR 75 1% .125W F TC=0±100	24546	C4-1/8-T0-75R0-F
A27R49	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A27R50	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A27R51	0757-0422	5	2	RESISTOR 909 1% .125W F TC=0±100	24546	C4-1/8-T0-909R-F
A27R52	0698-3446	3		RESISTOR 383 1% .125W F TC=0±100	24546	C4-1/8-T0-383R-F
A27R53	0757-0422	5		RESISTOR 909 1% .125W F TC=0±100	24546	C4-1/8-T0-909R-F
A27R54	0698-3446	3		RESISTOR 383 1% .125W F TC=0±100	24546	C4-1/8-T0-383R-F
A27R55	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F

Table A27-2. A27 Level Control Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A27R56	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A27R57	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A27R58	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1212-F
A27R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A27R60	0757-0398	4		RESISTOR 75 1% .125W F TC=0±100	24546	C4-1/8-T0-75R0-F
A27R61	0698-6358	2	4	RESISTOR 100K .1% .125W F TC=0±25	28480	0698-6358
A27R62	0698-6358	2		RESISTOR 100K .1% .125W F TC=0±25	28480	0698-6358
A27R63	0698-6358	2		RESISTOR 100K .1% .125W F TC=0±25	28480	0698-6358
A27R64	0698-6358	2		RESISTOR 100K .1% .125W F TC=0±25	28480	0698-6358
A27R65	0811-3575	1	1	RESISTOR-3K OHM 2% .12W	28480	0811-3575
A27R66	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A27R67	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A27R68	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A27R69	0698-8824	1	1	RESISTOR 562K 1% .125W F TC=0±100	28480	0698-8824
A27R70	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0±100 STANDARD INSTRUMENT	24546	C4-1/8-T0-2371-F
				OPTION 004 AND 005, R.P. RF OUT, REPLACE A27R70 WITH A SHORT CIRCUIT		
A27R71	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0±100 STANDARD INSTRUMENT	24546	C4-1/8-T0-2611-F
				OPTION 004 AND 005 INSTRUMENTS DELETE A27R71		
A27RT1	0837-0105	1	1	THERMISTOR BEAD 200K-OHM TC=-4.9%/C-DEG	28480	0837-0105
A27TP1-21	0360-0535	0	21	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A27U1	1820-1435	8	1	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS669N
A27U2	1826-0026	3	2	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A27U3	1826-0026	3		IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A27U4	1826-0092	3	3	IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A27U5	1826-0092	3		IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A27U6	1820-1415	4	1	IC SCHMITT-TRIG TTL LS NAND DUAL 4-INP	01295	SN74LS13N
A27U7	1826-0471	2	3	IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A27U8	1826-0798	6	3	IC-5018 C1 DAC	18324	NE5018F
A27U9	1826-0798	6		IC-5018 C1 DAC	18324	NE5018F
A27U10	1826-0798	6		IC-5018 C1 DAC	18324	NE5018F
A27U11	1826-0881	8	1	IC-8560 C1 ADC	28480	1826-0881
A27U12	1820-1491	6	3	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A27U13	1820-1196	8	5	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A27U14	1826-0921	7	2	D/A 10-BIT 16 CBRZ/SDR CMOS (RECOMMENDED REPLACEMENT)	07050	MP7533MP
A27U15	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A27U16	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A27U17	1826-0471	2		IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A27U18	1826-0092	3		IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A27U19	1820-1297	0	1	IC GATE TTL LS EXCL-NOR QUAD 2-INP	01295	SN74LS266N
A27U20	1820-1216	3	2	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A27U21	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A27U22	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A27U23	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A27U24	1826-0921	7		D/A 10-BIT 16 CBRZ/SDR CMOS (RECOMMENDED REPLACEMENT)	07050	MP7533MP
A27U25	1826-0609	8	1	IC MULTIPLXR ANLG 16-DIP-C PKG	06665	MUX08FQ
A27U26	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A27U27	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A27U28	1820-1195	7	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A27U29	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A27U30	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A27U31	1826-0471	2		IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A27U32	1810-0318	3	4	RESISTIVE NETWORK-6 PINS	01121	206A102
A27U33	1810-0318	3		RESISTIVE NETWORK-6 PINS	01121	206A102
A27U34	1810-0318	3		RESISTIVE NETWORK-6 PINS	01121	206A102
A27U35	1810-0318	3		RESISTIVE NETWORK-6 PINS	01121	206A102
A27VR1	1902-3171	7	1	DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%	28480	1902-3171

A28 SYTM Driver Circuit Description

ASSEMBLY PURPOSE

The SYTM driver provides the magnet drive current to the SYTM coil to tune the SYTM frequency under all conditions. Because the SYTM uses an open-loop tracking scheme, all differences in tracking conditions must be compensated for by this assembly without the benefit of feedback. The A28 SYTM driver also provides the rest of the instrument with voltages proportional to frequency (−0.25 V/GHz, 1.0/0.5 V/GHz, and 1.4 V/GHz).

OFFSET COMPENSATION (BLOCK A)

The offset compensation circuitry adds a correction current at the beginning of the magnet drive current ramp, independent of frequency. The offset, digitally input by the instrument microprocessor, affects the entire operating range of the SYTM and has a range of ±200 MHz. The offset compensation output is summed in the compensation summing amplifier (see Figure A28-1).

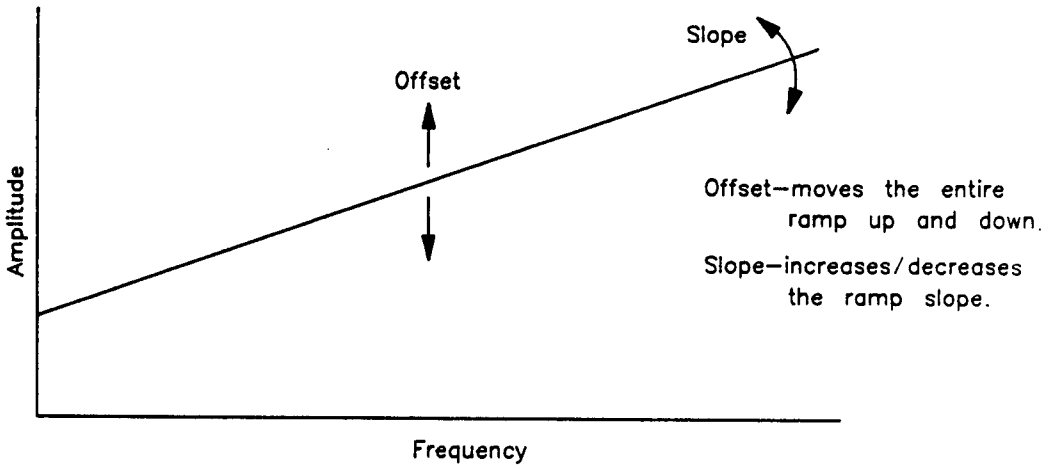


Figure A28-1. Magnet Drive Offset and Slope Compensation

DELAY COMPENSATION (BLOCK B)

The SYTM magnet eddy currents oppose any change in coil current. During a sweep, while the input current is ramping, the eddy currents set up a magnetic field that partially cancels the magnetic field required to tune the SYTM passband. To offset this, a compensation current is added to the current driving the SYTM.

The start of the compensation ramp goes through a buffer, is rounded by an integrator, and scaled by the scaling DAC. The slope of the rest of the ramp is set by the output DAC (see Figure A28-2).

The scaling DAC and the output DAC give the instrument microprocessor control over the gain of the delay correction. The faster the sweep speed, the greater the compensation.

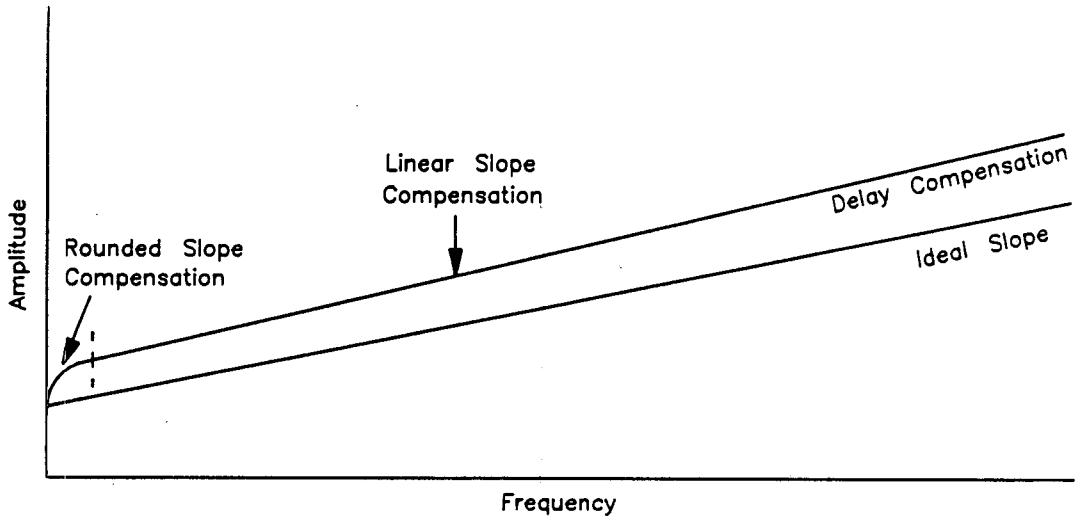


Figure A28-2. Magnet Drive Delay Compensation

SLOPE COMPENSATION (BLOCK C)

The slope compensation circuitry adds a correction current proportional to frequency that varies the slope of the SYTM magnet drive current ramp (see Figure A28-1).

In addition to the correction provided by the slope DAC, three breakpoints correct for the non-linearities of the SYTM magnet.

COMPENSATION SUMMING AMPLIFIER (BLOCK D)

The currents generated by the slope, offset, and delay compensation circuitry are amplified in the summing amplifier. An output transistor buffers the operational amplifier output, allowing the amplifier to have a higher output voltage capability. The compensation summing amplifier pulls the passband of the SYTM over the range of −220 MHz to +625 MHz. An output offset adjustment allows setting the compensation level to the SYTM.

VOLTAGE REFERENCE (BLOCK E)

The +20V supply provides the input to the +10 VREF and +15 VF output regulators. An inverting amplifier generates the −10 VREF supply for use on the SYTM driver assembly.

POWER SUPPLIES (BLOCK F)

The power supplies coming to the assembly are:

- +20V
- +5.2V
- −10V
- −15V
- −40V

All supplies (except −40V) are low-pass filtered.

PROGRAMMABLE SCALAR (BLOCK G)

The pretune line, a voltage proportional to YO frequency, comes to the SYTM driver board. It is adjusted to give −2.5 V/GHz, with an accuracy of ±6.5mV.

The programmable voltage divider uses a precision resistor array to attenuate the PRETUNE voltage, giving a voltage proportional to SYTM frequency. The overall accuracy depends on the accuracy of the PRETUNE line, as well as that of the resistor array.

The latched band information from the digital control circuitry (block I) is the input for an analog switch. The outputs of the switch are input to the −0.25 V/GHz circuitry, and the SYTM current driver.

−0.25V/GHz (BLOCK H)

The −0.25 V/GHz line is the most widely used signal on the SYTM driver assembly. During high band operation, it is a buffered version of the voltage out of the programmable scaler. The input amplifier has a low offset voltage (maximum 1.6 mV, 0 to 70°C) and keeps the output within 1.6 mV of the input signal. During low band operation, the instrument frequency is equal to the YO frequency offset by 3.7 GHz. The −0.25 V/GHz line uses the PRETUNE voltage, scales it down to −0.25 V/GHz and adds an offset voltage that equals (0.25 V/GHz) X (3.7 GHz), or 0.925V. This signal is generated using the +10V reference, offset adjustment V/GHz, and PRETUNE.

Analog switches select between the low band and high band conditions. A sample and hold circuit removes the discontinuities present due to changing the band number and PRETUNE at different times.

DIGITAL CONTROL (BLOCK I)

The following digital control signals are used on the SYTM driver assembly:

Input Digital Control Lines

- L YO KICK. Gating control signal for the HTRACK and HENDKICK output signals.
- L WSYTMCTL. Enable control line for the input data latch that provides instrument processor control of several output control lines.
- L WSYTMSLP and L WBAND. Input control lines from the instrument processor for compensation control outputs.
- HLB0, HLB1, and HLB2. Control signals providing latched band information that is decoded to generate low and high band control lines.

Output Digital Control Lines

- H TRACK. Output control for analog switches in the −0.25 V/GHz circuitry (block H) to remove band change discontinuities.
- H ENDKICK. High output when the SYTM and YO kick pulses are off. Routed to the A24 assembly to be read by the instrument processor. If the signal remains low for more than 90 ms, a kick error is indicated.
- L KICK TRIGGER. When set high momentarily, initiates the SYTM kick pulse (block L). L KICK TRIGGER is an active low signal, approximately 20 µs wide.
- L WR SLOPE COMP, L WR OFFSET COMP, LWR DELAY COMP, and LWR RISE COMP. DAC enable control lines to latch the instrument processor inputs into the offset, delay, and slope compensation circuitry.

+1.0/+0.5 V/GHz (BLOCK J)

This block provides a voltage proportional to the instrument frequency. The standard instrument sensitivity is +0.5 V/GHz. You can configure the instrument to a sensitivity of +1.0 V/GHz by adding two jumpers (W1 and W2) on the STYM driver assembly. In this configuration, the output is limited to approximately +19V (+20V supply tolerance and 0.4V saturation across the output transistor).

A current source with an output of approximately 1.2 mA, gives an offset of approximately +5V. An output capacitor ensures that the 0 dB gain crossover for the loop has a slope of −6 dB/octave. Protection diodes protect the circuitry from voltages that may inadvertently be applied to the output.

CURRENT DRIVER (BLOCK K)

The current driver input node sensitivity is 4 MHz/mV. The impedance of the line can be as much as 2.6K ohms. To keep leakage current errors less than 1 MHz, the leakage currents must be kept below 100 nA. To do this, guard traces driven by a buffered version of the same voltage are placed around the sensitive traces.

Because of the inductance of the SYTM coil, a voltage spike is generated when the current ramp resets. The zener diode prevents this voltage kick from exceeding the breakdown voltage for the transistors by controlling the maximum allowed rate of change of current from the driver. An emitter diode protects the base-emitter junction of the output transistor from large voltages that could cause a breakdown. A bypass capacitor provides low capacitance in series with the output zener diode to reduce the effect of the zener diode's junction capacitance.

The zener diode protection circuit clamps the inductive voltage at approximately 140V. This circuit protects the drive transistor (on the A47 assembly) in case the SYTM driver assembly is pulled out while the instrument is on. The breakdown voltage of the drive transistor is 400V.

During a bandswitch, the −0.25 V/GHz voltage is more accurate for holding the SYTM at the desired current than is the normal attenuated PRETUNE voltage. At these times, the −0.25 V/GHz line is gated to override the attenuated PRETUNE voltage to hold the SYTM and avoid the undesired kick pulses due to discontinuities on the attenuated PRETUNE line. When the instrument is in low band, the SYTM magnet is tuned to about 4 GHz to keep the YIG sphere from interfering with the output.

KICK PULSE (BLOCK L)

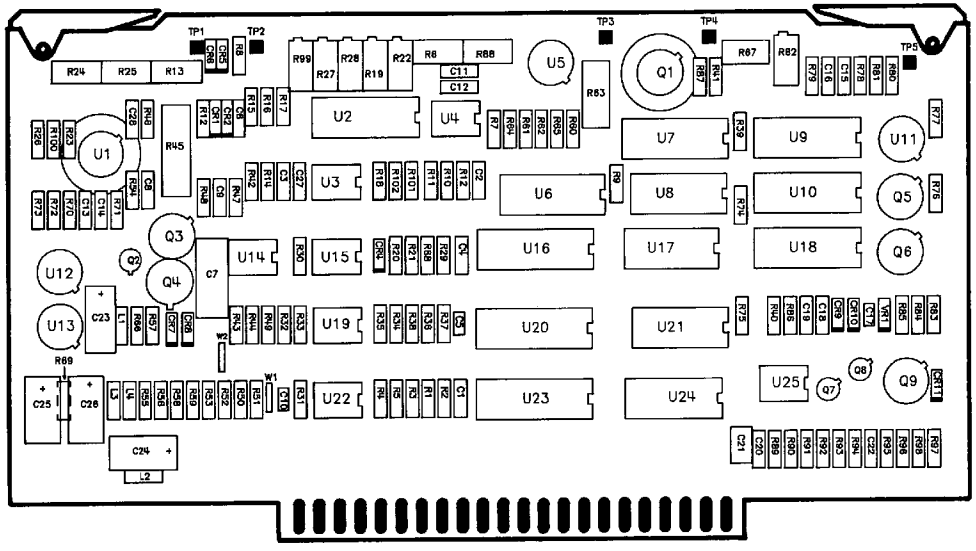
The STYM is kicked positive in frequency until a predetermined current is reached, then the SYTM is kicked negative in frequency until a second predetermined current is reached. The SYTM settles from that point. The kick pulses minimize the differences between the various sweep conditions (continuous, line, external, single, and alternate). They are not needed at bandcrossings because the SYTM's past history at bandcrossings is similar to that provided by the kick pulses.

Table A28-1. A28 SYTM Driver P1 Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1 23	+20V +20V	+20V +20V	XA52P1-16, 40 XA52P1-16, 40	*L *L
2 24	+5.2V +5.2V	+5.2V +5.2V	XA52P1-17, 18, 41, 42 XA52P1-17, 18, 41, 42	*L *L
3 25	−10V −10V	−10V −10V	XA53P1-12, 13, 31, 32 XA53P1-12, 13, 31, 32	*L *L
4 26	−15V HSP	−15V TTL (HIGH TRUE)	XA56P1-15, 30 XA57P1-13	*L *I
5 27	SYTM COIL −/−40V SYTM COIL −/−40V	−40V/−40V −40V/−40V	A62J18-12/XA53P1-11, 30 A62J18-12/XA53P1-11, 30	H H
6 28	GMD GND	0V 0V	A62 STAR GND A62 STAR GND	*L *L
7 29	1.4V/GHZ WBAND	C TTL (LOW TRUE)	XA24P1-6 XA27P1-43	 B
8 30	WYTMCTL WYTMSLP	TTL (LOW TRUE) TTL (LOW TRUE)	XA27P1-14 XA27P1-44	I C
9 31	 HLB0	 TTL (HIGH TRUE)	 XA27P1-46	 *I
10 32	RSTAT HLB1	TTL (LOW TRUE) TTL (HIGH TRUE)	XA27P1-45 XA27P1-16	NOT USED *I
11 33	DB0 HLB2	TTL TTL (HIGH TRUE)	*XA60P1-20 XA27P1-47	*NOT USED *I
12 34	DB2 DB1	TTL TTL	*XA60P1-21 *XA60P1-76	*NOT USED *NOT USED
13 35	DB4 DB3	TTL TTL	*XA60P1-22 *XA60P1-77	*B C I *B C I
14 36	DB6 DB5	TTL TTL	*XA60P1-23 *XA60P1-78	*B C *B C I
15 37	DB8 DB7	TTL TTL	*XA60P1-24 *XA60P1-79	*B C *B C
16 DB10 38	TTL DB9	*XA60P1-25 TTL	*B C *XA60P1-80	 *B C
17 39	+1.0V/GHZ +1.0V/GHZ RTN	1.0V/GHZ 0V	F F	A62J31-27 A62J31-13
18 40	HENDKICK −.25V/GHZ	TTL (HIGH TRUE) −.25V/GHZ	I E	XA24P1-31 *B C F H
19 41	SYTMDB YOKICK	−22V TO −39V TTL (HIGH TRUE)	H XA54P1-21	A62J32-2 I
20 42	SYTMDC SYTM COIL +	−.6V TO −6V −40V TO −25V	H H	A62J32-4 *
21 43	RGND RGND	0V 0V	STAR GND POINT STAR GND POINT	*L *L
22 44	PRETUNE SYTMRES	−2.5V/GHZ 0V≅2 GHZ −.9V LOW BAND CW	XA54P1-24 H	*C D E J A62J32-5

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60256

Figure A28-3. A28 SYTM Driver Component Location Diagram

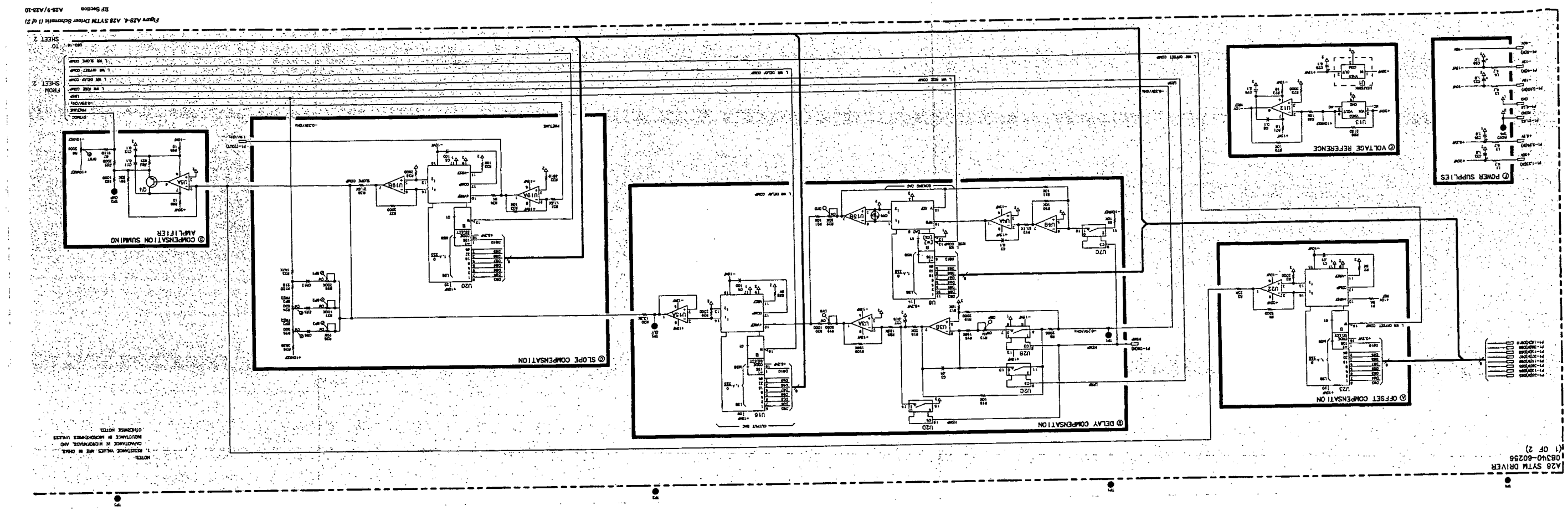


Figure A28-4 A28 SYTM Driver Schematic (1 of 2)

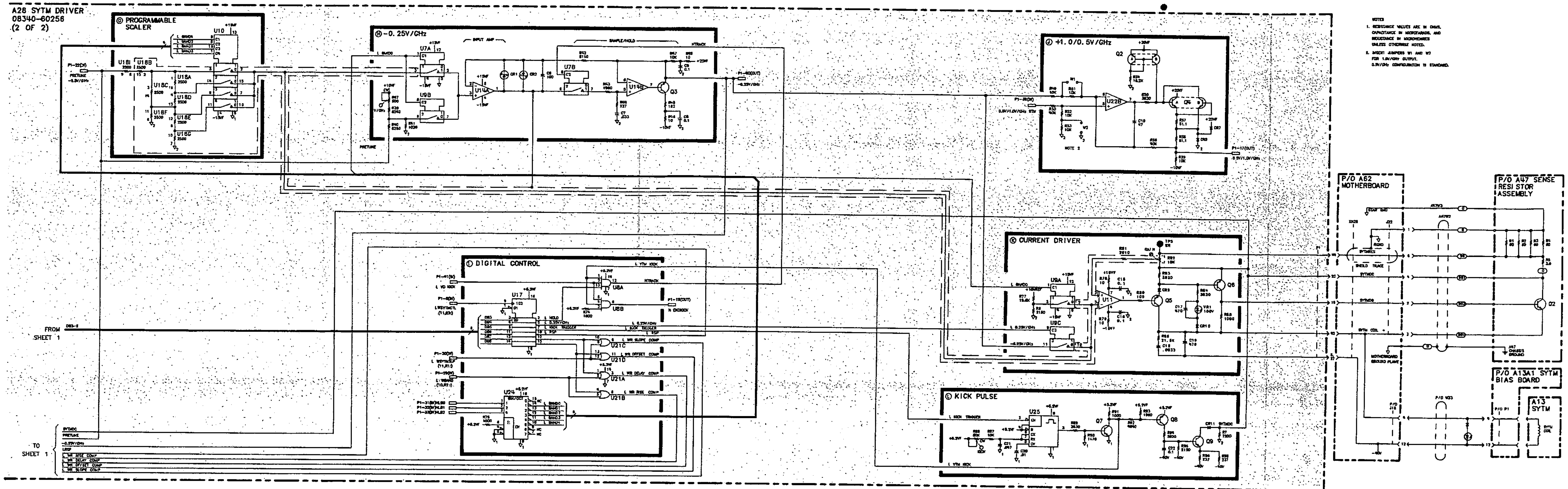


Figure A28-4. A28 SYTM Driver Schematic (2 of 2)

Table A28-2. SYTM Driver Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A28	**08340-60256**	**7**	**1**	**SYTM DRIVER ASSEMBLY**	**28480**	**08340-60256**
A28C1	0160-4832	4	3	CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A28C2	0160-4841	5	12	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C3	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C4	0160-4801	7	4	CAPACITOR-FXD 100PF ±5% 100VDC CER	28480	0160-4801
A28C5	0160-4801	7		CAPACITOR-FXD 100PF ±5% 100VDC CER	28480	0160-4801
A28C6	0160-4801	7		CAPACITOR-FXD 100PF ±5% 100VDC CER	28480	0160-4801
A28C7	0160-0163	6	1	CAPACITOR-FXD .033UF ±10% 200VDC POLYE	28480	0160-0163
A28C8	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C9	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C10	0160-4805	1	1	CAPACITOR-FXD 47PF ±5% 100VDC CER 0±30	28480	0160-4805
A28C11	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C12	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C13	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C14	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C15	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C16	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C17	0160-4801	7		CAPACITOR-FXD 100PF ±5% 100VDC CER	28480	0160-4801
A28C18	0160-4833	5	1	CAPACITOR-FXD .022UF ±10% 100VDC CER	28480	0160-4833
A28C19	0160-4822	2	1	CAPACITOR-FXD 1000PF ±5% 100VDC CER	28480	0160-4822
A28C20	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A28C21	0160-4834	6	1	CAPACITOR-FXD .047UF ±10% 100VDC CER	28480	0160-4834
A28C22	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28C23	0180-0269	5	4	CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
A28C24	0180-0269	5		CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
A28C25	0180-0269	5		CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
A28C26	0180-0269	5		CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
A28C27	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A28C28	0160-4841	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4841
A28CR1	1901-0518	8	3	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A28CR2	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A28CR3				NOT ASSIGNED		
A28CR4	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A28CR5	1901-0050	3	8	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A28CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A28CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A28CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A28CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A28CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A28CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A28CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A28L1	9140-0144	0	4	INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A28L2	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A28L3	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A28L4	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A28MP1	1205-0011	0	2	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A28MP2	1480-0073	6	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A28MP3	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A28MP4	4040-0747	2	1	EXTR-PC BD GRA POLYC .062-BD-THKNS	28480	4040-0747
A28Q1	1854-0361	8	2	TRANSISTOR NPN 2N4239 SI TO-5 PD=6W	04713	2N4239
A28Q2	1853-0316	1	1	TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
A28Q3	1853-0038	4	3	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A28Q4	1854-0475	5	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A28Q5	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A28Q6	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A28Q7	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A28Q8	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A28Q9	1854-0361	8		TRANSISTOR NPN 2N4239 SI TO-5 PD=6W	04713	2N4239
A28R1	0698-6320	8	6	RESISTOR 5K .1% .125W F TC=0±25	28480	0698-6320
A28R2	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	28480	0698-6320
A28R3	0698-6624	5	8	RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A28R4	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A28R5	0698-6627	8	1	RESISTOR 25K .1% .125W F TC=0±25	28480	0698-6627
A28R6	2100-3207	1	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	28480	2100-3207
A28R7	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A28R8	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A28R9	0757-0442	9	9	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A28R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F

Table A28-2. A28 SYTM Driver Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A28R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A28R12	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A28R13	2100-3358	3	1	RESISTOR-TRMR 1M 20% C SIDE-ADJ 1-TRN	28480	2100-3358
A28R14	0698-3453	2	3	RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A28R15	0698-6360	6	8	RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A28R16	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A28R17	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A28R18	0698-6630	3	1	RESISTOR 20K .1% .125W F TC=0±25	28480	0698-6630
A28R19	2100-3739	6	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	32997	3292X-1-5001
A28R20	0757-0280	3	7	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-TO-1001-F
A28R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A28R22	2100-3611	1	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	32997	3292X-1-5002
A28R23	0757-1094	9	2	RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A28R24	2100-3351	6	2	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A28R25	2100-3350	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A28R26	0698-3153	9	4	RESISTOR 3.83K 1% .125W F TC=0±100	24546	C4-1/8-T0-3831-F
A28R27	2100-0544	3	1	RESISTOR-TRMR 100K 10% C SIDE-ADJ 17-TRN	32997	3292X-1-104
A28R28	2100-3750	9	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	28480	2100-3750
A28R29	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A28R30	0757-0289	3	1	RESISTOR 13.3K 1% .125W F TC=0±100	24546	C4-1/8-T0-1332-F
A28R31	0698-3136	8	1	RESISTOR 17.8K 1% .125W F TC=0±100	24546	C4-1/8-T0-1782-F
A28R32	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-T0-6811-F
A28R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A28R34	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	28480	0698-6320
A28R35	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	28480	0698-6320
A28R36	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A28R37	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A28R38	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-2152-F
A28R39	0698-6406	1	1	RESISTOR 8.54K .1% .1W F TC=0+4	28480	0698-6406
A28R40	0698-8061	8	1	RESISTOR 8.25K .1% .125W F TC=0±25	19701	MF4C1/8-T9-8251-B
A28R41	0698-8498	5	1	RESISTOR 1.02K .1% .125W F TC=0±25	28480	0698-8498
A28R42	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A28R43	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A28R44	0698-3442	9	3	RESISTOR 237 1% .125W F TC=0±100	24546	C4-1/8-T0-237R-F
A28R45	0757-0802	5	1	RESISTOR 162 1% .5W F TC=0±100	28480	0757-0802
A28R46	0757-0346	2	8	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A28R47	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A28R48	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A28R49	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A28R50	0698-6363	9	2	RESISTOR 40K .1% .125W F TC=0±25	28480	0698-6363
A28R51	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A28R52	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A28R53	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A28R54	0757-0447	4	1	RESISTOR 16.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-1622-F
A28R55	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0±100	24546	C4-1/8-T0-3831-F
A28R56	0698-6363	9		RESISTOR 40K .1% .125W F TC=0±25	28480	0698-6363
A28R57	0757-0394	0	2	RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A28R58	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A28R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A28R60	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A28R61	0698-6353	7	1	RESISTOR 50K .1% .125W F TC=0±25	28480	0698-6353
A28R62	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A28R63	0698-3637	4	1	RESISTOR 820 5% 2W MO TC=0±200	28480	0698-3637
A28R64	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A28R65	0698-6624	5		RESISTOR 2K .1% .125W F TC=0±25	28480	0698-6624
A28R66	0698-0084	9	3	RESISTOR 2.15K 1% .125W F TC=0±100	24546	C4-1/8-T0-2151-F
A28R67	2100-3351	6		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A28R68	0698-6320	8		RESISTOR 5K 1% .125W F TC=0±100	24546	C4-1/8-T0-5001-F
A28R69	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A28R70	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A28R71	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A28R72	0698-6320	8		RESISTOR 5K .1% .125W F TC=0±25	03888	PME55-1/8-T9-5001-B
A28R73	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A28R74	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A28R75	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A28R76	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0±100	24546	C4-1/8-T0-2151-F
A28R77	0698-3157	3	1	RESISTOR 19.6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A28R78	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A28R79	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A28R80	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F

Table A28-2. A28 SYTM Driver Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A28R81	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0±100	24546	C4-1/8-T0-2611-F
A28R82	2100-0670	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	32997	3292X-1-103
A28R83	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0±100	24546	C4-1/8-T0-3831-F
A28R84	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A28R85	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A28R86	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A28R87	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A28R88	2100-3354	9	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
A28R89	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0±100	24546	C4-1/8-T0-3831-F
A28R90	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A28R91	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A28R92	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0±100	24546	C4-1/8-T0-4641-F
A28R93	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0±100	24546	C4-1/8-TO-1961-F
A28R94	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-5621-F
A28R95	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0±100	24546	C4-1/8-T0-2151-F
A28R96	0698-3442	9		RESISTOR 237 1% .125W F TC=0±100	24546	C4-1/8-T0-237R-F
A28R97	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-7501-F
A28R98	0698-3442	9		RESISTOR 237 1% .125W F TC=0±100	24546	C4-1/8-T0-237R-F
A28R99	2100-3753	2	1	RESISTOR-TRMR 200K 10% C SIDE-ADJ 17-TRN	28480	2100-3753
A28R100	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0±100	24546	C4-1/8-T0-215R-F
A28R101	0698-3453	2		RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A28R102	0698-3453	2		RESISTOR 196K 1% .125W F TC=0±100	24546	C4-1/8-T0-1963-F
A28TP1	0360-0535	0	5	TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A28TP2	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A28TP3	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A28TP4	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A28TP5	0360-0535	0		TERMINAL-TEST POINT .330IN ABOVE	28480	0360-0535
A28U1	1826-0512	2	1	IC V RGLTR-FXD-POS 14.4/15.6V TO-39 PKG	28480	1826-0512
A28U2	1826-0811	4	3	IC SWITCH ANLG QUAD 16-DIP-C PKG	06665	SW-01FQ
A28U3	1826-0785	1	6	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A28U4	1826-0785	1		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A28U5	1826-0471	2	3	IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-07CJ SELECTED
A28U6	1826-0699	6	1	IC CONV 8-B-D/A 16-DIP-C PKG	24355	AD7524AD
A28U7	1826-0720	4	1	IC SWITCH ANLG QUAD 16-DIP-C PKG	06665	SW-02FQ
A28U8	1820-1203	8	1	IC GATE TTL LS AND TPL 3-INP	01295	SN74LS11N
A28U9	1826-0811	4		IC SWITCH ANLG QUAD 16-DIP-C PKG	06665	SW-01FQ
A28U10	1826-0811	4		IC SWITCH ANLG QUAD 16-DIP-C PKG	06665	SW-01FQ
A28U11	1826-0471	2		IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-07CJ SELECTED
A28U12	1826-0471	2		IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-07CJ SELECTED
A28U13	1826-0853	4	1	IC V RGLTR-V-REF-FXD 9.95/10.05V TO-99	28480	1826-0853
A28U14	1826-0785	1		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A28U15	1826-0785	1		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A28U16	1826-1174	4	3	D/A 8-BIT 20-DIP-C	28480	1826-1174
A28U17	1820-2056	1	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS378N
A28U18	1810-0535	6	1	NETWORK-RES 16-DIP2.5K OHM X 8	28480	1810-0535
A28U19	1826-0785	1		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A28U20	1826-1174	4		D/A 8-BIT 20-DIP-C	28480	1826-1174
A28U21	1820-2657	8	1	IC GATE TTL ALS OR QUAD 2-INP	01295	SN74ALS32N
A28U22	1826-0785	1		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C	01295	TL072ACJG
A28U23	1826-1174	4		D/A 8-BIT 20-DIP-C	28480	1826-1174
A28U24	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A28U25	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	18324	NE555N
A28VR1	1902-0175	5	1	DIODE-ZNR 100V 5% PD=1W IR=5UA	28480	1902-0175
A28W1	1460-1489	8	2	WIREFORM BE CU AG	28480	1460-1489
A28W2	1460-1489	8		WIREFORM BE CU AG	28480	1460-1489
A28X1	1251-2194	1	4	CONNECTOR-SGL CONT SKT .021-IN-BSC-SZ	28480	1251-2194

Power Supplies
Component-Level Service I

CONTENTS

A19 CAPACITOR ASSEMBLY

A35 RECTIFIER

CONTENTS (Cont'd)

A52 POSITIVE REGULATOR

A53 NEGATIVE REGULATOR

CONTENTS (Cont'd)

A56 −15V REGULATOR

A19 Capacitor Assembly Circuit Description

ASSEMBLY PURPOSE

The A19 capacitor assembly contains the full-wave bridge rectifiers and line filters for the +20V and −10V power supplies. Also located on this assembly is a power-on safety indicator. When this indicator is illuminated, (see block C, below), there are hazardous voltages present on the A62 motherboard.

+20V RECTIFIER (BLOCK A)

The +20V full-wave bridge rectifier consists of CR1 through CR4. A high frequency filter suppresses conducted line emissions by attenuating diode reverse recovery transients. A capacitor decreases the high frequency currents on the +20V UNREG line.

−10V RECTIFIER (BLOCK B)

The −10V full-wave bridge rectifier includes schottky barrier power rectifiers, which increase the efficiency of the low voltage power supplies. A high frequency filter suppresses conducted line emissions. A capacitor decreases the high frequency currents on the −10V UNREG line.

POWER-ON SAFETY INDICATOR (BLOCK C)

The POWER-ON LED (DS1) is on when the unregulated supply filter capacitors contain enough energy to present a potential safety hazard. Because the instrument has no on/off line power switch, if the instrument is plugged in to ac line power to ac line power, the unregulated supplies and +22V regulated supply are active.

A19 Capacitor Assembly Component-Level Troubleshooting

WARNING

When the instrument is connected to ac line power and/or the A19 power-on safety indicator LED is on, there are voltages present inside the instrument that can cause personal injury or death. Only qualified personnel, who are aware of the hazards involved, should perform service on this instrument with its protective covers removed.

CAUTION

The crowbar circuitry on this assembly protects the instrument, do not operate the supply without it.

To avoid non-repairable damage to assemblies, do not reinstall the A19, A35, A52, or A53 assemblies unless ac mains is disconnected from the instrument.

To protect static sensitive components, troubleshoot this assembly only at a work station equipped with an anti-static surface, and wear a grounding strap. When handling a printed circuit board, hold it by the edges; never touch the finger contacts.

Never short a capacitor with a screwdriver or other direct short.

THE POWER-ON SAFETY INDICATOR (DS1)

When the power-on safety indicator LED is on, hazardous voltages exist on the A62 motherboard. Wait for this LED to go out before removing the A19 assembly. The A19 extender board is designed to be used with the instrument is on its left side (ON/STANDBY switch down, output connector up), with the A19 assembly resting on the side rail.

CAPACITOR REPLACEMENT

When you replace an electrolytic capacitor, place the capacitor's pressure relief valve directly over the hole in the PC board. This ensures correct capacitor polarity.

IF THE MAIN LINE FUSE BLOWS

Remove the aluminum electrolytic capacitors C5 through C9.

- If the problem disappears, one of these capacitors is shorted. Use a process of elimination to discover the defective capacitor.
- If the problem persists, try to isolate the cause to one of the two rectifier circuits as follows:

  1. The transformer secondary windings that power the rectifiers go first to the A62 motherboard where they are attached with screws. Unplug the instrument from ac line power, and wait for the power-on safety indicator to go out.
  2. Remove the A19 assembly (to make the screws accessible) and remove one of the red secondary wires that power the +20V rectifier (be careful to isolate the exposed wire from all other circuits on the motherboard).
  3. Install the A19 assembly and connect the instrument to ac line power.
  4. If necessary, repeat this procedure to disconnect the −10V secondary. If either rectifier circuit is at fault, suspect a shorted component. If the problem persists, suspect an A62 motherboard short.

IF THE +20V RECTIFIER OUTPUT VOLTAGE IS INCORRECT

1. Make sure the instrument is in STANDBY and power to the instrument is nominal (120V in the 120V line option, etc.).
2. Ensure that the line voltage selector cam is installed properly.
3. Measure TP1 (or directly across C5 or C6) for +35V.

   a. If the voltage is low, unplug the instrument from ac line power and wait for the power-on safety indicator to go out.

   b. Remove the A35 and A52 assemblies.

   c. Connect the instrument to ac line power and measure TP1 again. If the voltage at TP1 is now approximately +35 VDC, disconnect the instrument from ac line power and wait for the power-on safety indicator to go out.

   d. Observing all safety precautions, reinstall A35 and A52 one at a time to determine which is at fault. Refer to the appropriate troubleshooting guide.

   e. If the problem persists after A35 and A52 are removed, suspect an open rectifier diode. If these are good, suspect the transformer.

IF THE −10V RECTIFIER OUTPUT VOLTAGE IS INCORRECT

1. Make sure the instrument is in STANDBY and power to the instrument is nominal (120V in the 120V line option, etc.).
2. Ensure that the line voltage selector cam is installed properly.
3. Check for +18 VDC directly across C7, C8, or C9.
   a. If the voltage is low, unplug the instrument from ac line power and wait for the power-on safety indicator to go out.
   b. Remove the A53 assembly.
   c. Connect the instrument to ac line power and measure across the capacitor again. If the voltage is now approximately +18 VDC, disconnect the instrument from ac line power and wait for the power-on safety indicator to go out.
   d. Observing all safety precautions, reinstall A53 to determine if it is at fault. Refer to the appropriate troubleshooting guide.
   e. If the problem persists after A53 is removed, suspect an open rectifier diode. If these are good, suspect the transformer.
4. If DS1 is out, but the −10V UNREG voltage level appears correct, check DS1 and R3.

Table A19-1. A19 Power Supply Destinations

Power Supply	Destination Assemblies
+20V UNREG	A35, A52
−10V UNREG	A53

A35 Rectifier Circuit Description

ASSEMBLY PURPOSE

The A35 rectifier assembly consists of the following circuits:

- −40V Rectifier
- +22V Regulator
- +5V Rectifier
- Overvoltage Protection

−40V RECTIFIER (BLOCK A)

The −40V rectifier consists of CR1 through CR4. A high frequency filter decreases conducted line emissions. C5 decreases the high frequency currents on the −40V unregulated line.

OVERVOLTAGE PROTECTION (BLOCK B)

The overvoltage protection circuitry is a crowbar circuit that fires if the line voltage selector cam is set to a low line voltage and the instrument is plugged into a high voltage outlet. This circuit blows the main fuse in the line module.

+5V RECTIFIER (BLOCK C)

The +5V rectifier is a full-wave, center-tapped rectifier. Power rectifier U1 is a single-chip dual schottky barrier rectifier. High frequency filters decrease conducted line emissions.

+22V REGULATOR (BLOCK D)

The +22V regulator consists of a three-terminal adjustable regulator, adjustment circuitry, and ripple rejection capacitors. A protection diode prevents capacitive discharge into the regulator if the input is shorted, or when line power is removed. Output diodes protect the loads from damage due to reverse polarity power supply voltages in the event of an instrument fault.

NOTE: This supply is active as long as the instrument is connected to ac line power.

+22V CROWBAR/SUPPLY-ON INDICATOR (BLOCK E)

If there is an overvoltage condition on the regulated output, the supply is shorted to ground to protect the instrument loads. Transients are filtered out to prevent premature firing of the SCR. The power-on safety indicator lights when the regulator supply voltage reaches +17V.

The tolerance of the +22V supply is +22V ±5% (1.1V).

POWER FROM THE MOTHERBOARD

The A62 motherboard distributes all secondary ac and unregulated DC power to the assemblies that require them. The power-on safety indicator is active when the instrument is plugged in to ac line power, and warns that hazardous voltages are present on the motherboard in the power supply area. (The same circuit is used to generate the 60 Hz LINE TRIGGER signal for the internal sweep circuitry).

If DS1 fails to light when the instrument is connected to ac line power, first suspect a fuse failure, then an LED. An LED failure should not cause failure of the LINE TRIGGER function.

POWER SUPPLY HEAT SINK

The instrument power supply heat sink, on the rear panel, is the primary cooling system for the +20, +12, +5.2, −10, and −40V power supply series pass elements (see section E, motherboard) for placement and identity of these series pass elements on the A62 motherboard/heatsink).

A35 Rectifier Component-Level Troubleshooting

WARNING

When the instrument is plugged in to ac line power and/or the A19 power-on safety indicator LED is on, there are voltages present inside the instrument that can cause personal injury or death. Any servicing of this instrument with protective covers removed should be performed only by qualified personnel who are aware of the hazards involved.

CAUTION

The crowbar circuitry on this assembly protects the instrument, do not operate the supply without it.

To avoid non-repairable damage to assemblies, do not reinstall the A19, A35, A52, or A53 assemblies unless ac mains is disconnected from the instrument.

To protect static sensitive components, troubleshoot this assembly only at a work station equipped with an anti-static surface, and wear a grounding strap. When handling a printed circuit board, hold it by the edges; never touch the finger contacts.

The thermal connection between the voltage regulator U2, the full wave rectifier U1, and the A35 heat sink is the dominant factor in the two devices' long term reliability. when installing or replacing either of these parts. Use only oil based thermal compound (HP Part Number 6040-0454 CD0).

DO NOT use silicone based thermal compound. Silicone based oil migrates past element sockets, switch contacts, or printed circuit board edge connectors, raising contact resistance, or electrically isolating the contacts. Silicone based thermal compounds disperse into the air, depositing themselves anywhere in the instrument. Heat increases the rate of dispersion.

HOW TO APPLY THERMAL COMPOUND

When installing or replacing a pass transistor or voltage regulator, apply thermal compound as follows:

1. Apply a thin coating of thermal compound (HP Part Number 6040-0454 CD0) to both sides of the insulating washer. The coating should provide a thin but continuous layer of compound from component-to-washer and washer-to-heatsink. An excessive amount of compound reduces its ability to transfer heat.

2. Tighten the pass element mounting screws with seven inch-pounds of force. Tightening with less force diminishes the heat transfer capability of the thermal compound. Tightening with greater force can damage the mounting hardware.

The A35 rectifier assembly contains three separate and isolated power circuits.

−40V RECTIFIER

When a crowbar SCR fails, it usually shorts. If the instrument blows line fuses and you trace the problem to the A35 assembly, check Q1 for a short (also check VR1). If the overvoltage protection circuit does not work, VR1 is probably open.

+5V RECTIFIER

The +5V rectifier has two diodes in one package. If this unregulated supply malfunctions, check for an open or shorted diode.

+22V REGULATOR

Because the +22V regulator source is the +20V UNREG line, the A19 capacitor assembly must be present to test this regulator. The tolerance of this supply is +20.90 to +23.10V (measured at TP1).

HOW TO DETERMINE SUPPLY/LOAD FAILURE

1. Unplug the instrument from ac line power.
2. After the power-on safety indicator goes out, remove the A35 assembly and place it on an extender board.
3. Before installing the extender board in the instrument, apply thin, nonconductive tape to the extender board +22V output fingers (use colored tape, if possible, to make it highly visible, so you remember to remove it when you are through troubleshooting). **Do not** apply tape to the A35 printed circuit board fingers.
4. Reinstall the A35 assembly and connect the instrument to ac line power. If the power supply now operates properly, suspect a short on an instrument assembly that uses +22V. Refer to Table A35-1, for a list of these assemblies.
5. Remove the tape from the extender board fingers and clean the fingers using the following procedure.

How to Clean Printed Circuit Board Fingers

1. Mix one part de-ionized (or de-chlorinated) water with two parts isopropyl alcohol.
2. Apply this solution to a clean, lint free, cloth (HP Part Number 9310-0039 CD3).
3. Rub the PC board fingers carefully, then dry them with a clean part of the cloth.

+22V LOAD FAILURE

1. After performing the above procedure, and cleaning the extender board fingers, unplug the instrument from ac line power and wait for the power-on safety indicator to go out; reinstall the A35 assembly.

NOTE: Always unplug the instrument from ac line power and wait for the power-on safety indicator to go out before removing or installing any assembly or cable.

2. Remove each assembly that uses +22V, one at a time, to determine which one is faulty.
3. Remove any cables listed that carry the affected supply (see Table A35-1).

+22V POWER SUPPLY FAILURE

If the power supply output does not return to normal after you tape the extender board +22V fingers, refer to the following:

The +22V Output Voltage is Approximately 0.8 to 1.0V

1. Crowbar Circuit Verification

   If the output voltage is approximately 0.8 to 1.0V the crowbar circuit is engaged.

   a. Connect the instrument to a auto-transformer set for 0V output.

   b. While monitoring the supply output voltage, slowly increase the auto-transformer output voltage. If the crowbar fires before the supply output reaches +22V suspect VR2.

2. Regulator Verification

   a. If the power supply output reaches +22V, stop increasing auto-transformer voltage.

   b. Measure the voltage across pin 1 and the case of U2 (regulator). If the voltage is not approximately 1.25V suspect U2.

   c. Measure the voltage from the input and the output of U2. If there is little or no voltage, U2 is probably shorted.

The +22V Output Voltage is Approximately 0V

1. Initial Checks

   a. Ensure that ac line voltage is nominal, and that the line voltage selector cam is installed properly in the line filter module, FL1.

   b. Ensure that the proper fuse value is installed.

   c. If the line voltage and fuse are correct, and the power supply input fuse (F1) is blown, suspect regulator U2.

2. Regulator Verification

   a. Measure across pin 1 and the case of U2. If the voltage is not approximately 1.25V suspect U2.

   b. Measure the +20V UNREG (P1-7). If this voltage is less than approximately +30V, troubleshoot the +20V rectifier (refer to the A19 troubleshooting).

   c. Examine the +22V supply for burnt or discolored components.

   d. Suspect a shorted capacitor, diode, or crowbar SCR if the procedures above do not isolate the problem.

The +22V Output Voltage is Incorrect (Tolerance is +22V ±1.1V)

1. Ensure that ac mains voltage is nominal and that the line voltage selector PC board is installed with the proper line voltage selected.

2. Measure the +20V UNREG input with respect to ground. If the voltage is less than approximately +30V, troubleshoot the +20V Rectifier (see the A19 assembly troubleshooting).

3. With an oscilloscope, check the output voltage for oscillations. If the output is approximately 1.25V, C10 is probably shorted.

4. Try readjusting R3 (+22V adjustment).

Table A35-1. A35 Power Supply Destinations

Power Supply	Destination Assemblies/Connectors
−40V UNREG	A53
+5V UNREG	A52, A62J1, A62J31
+22V	A61, A62J1, A62J3

Table A35-2. A19 Capacitor Assembly P1 Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1	+20V AC1	+20 VAC	A62 LUG (2)	*A
13	+20V AC1	+20 VAC	A62 LUG (2)	*A
2	+20V AC2	+20 VAC	A62 LUG (2)	*A
14	+20V AC2	+20 VAC	A62 LUG (2)	*A
3	−10V AC1	−10 VAC	A62 LUG (6)	*B
15	−10V AC1	−10 VAC	A62 LUG (6)	*B
4	−10V AC1	−10 VAC	A62 LUG (6)	*B
16	−10V AC1	−10 VAC	A62 LUG (6)	*B
5	−10V AC2	−10 VAC	A62 LUG (6)	*6
17	−10V AC2	−10 VAC	A62 LUG (6)	*B
6	−10V AC2	−10 VAC	A62 LUG (6)	*B
18	−10V AC2	−10 VAC	A62 LUG (6)	*B
7	−10V RETURN	+6.4V AT 13.3 GHZ	XA53P1-2, 20	B C
19	−10V RETURN	+6.4V AT 13.3 GHZ	XA53P1-2, 20	B C
8	−10V RETURN	+6.4V AT 13.3 GHZ	XA53P1-2, 20	B C
20	−10V RETURN	+6.4V AT 13.3 GHZ	XA53P1-2, 20	B C
9	+20V UNREG	+31.2V	XA35P1-7, 25	*A
21	+20V UNREG	+31.2V	XA35P1-7, 25	*A
10	GND	0V	A62 STAR GND	*A
22	GND	0V	A62 STAR GND	*A
11	−10V UNREG	−10V	B C	XA53P1-27, 28
23	−10V UNREG	−10V	B C	XA53P1-27, 28
12	−10V UNREG	−10V	B C	XA53P1-27, 28
24	−10V UNREG	−10V	B C	XA53P1-27, 28

A single letter in the source or destination column refers to a function block on this assembly schematic.

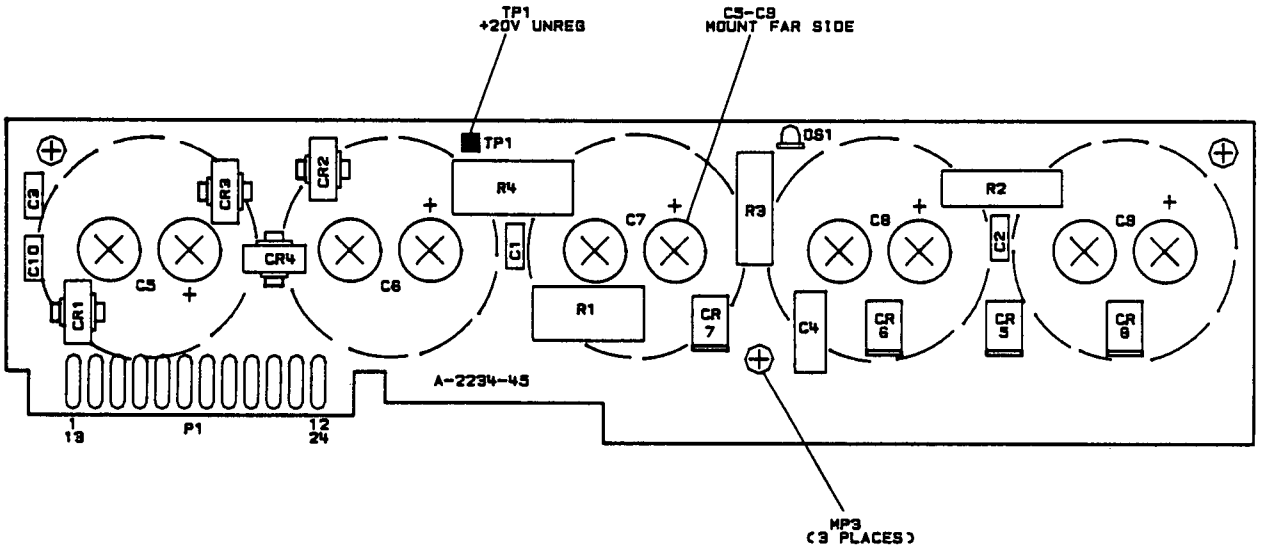
An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A35-3. A35 Rectifier P1 Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1 19	+5V UNREG +5V UNREG	+7 TO +9V +7 TO +9V	C C	* *
2 20	+5V UNREG +5V UNREG	+7 TO +9V +7 TO +9V	C C	* *
3 21	+5V UNREG +5V UNREG	+7 TO +9V +7 TO +9V	C C	* *
4 22	GND GND	0V 0V	A62 STAR GND A62 STAR GND	*C *C
5 23				
6 24	−40V UNREG −40V UNREG	−40V −40V	A B A B	* *
7 25	+20V UNREG +20V UNREG	+31.2V +31.2V	D D	* *
8 26	+5V AC1 +5V AC1	7V AC 7V AC	A62 LUG (5) A62 LUG (5)	*C *C
9 27	+5V AC1 +5V AC1	7V AC 7V AC	A62 LUG (5) A62 LUG (5)	*C *C
10 28	+5V AC1 +5V AC1	7V AC 7V AC	A62 LUG (5) A62 LUG (5)	*C *C
11 29				
12 30	+5V AC2 +5V AC2	7V AC 7V AC	A62 LUG (5) A62 LUG (5)	*C *C
13 31	+5V AC2 +5V AC2	7V AC 7V AC	A62 LUG (5) A62 LUG (5)	*C *C
14 32	+5V AC2 +5V AC2	7V AC 7V AC	A62 LUG (5) A62 LUG (5)A	*C *C
15 33	−40V AC1 −40V AC1	−40V AC −40V AC	A62 LUG (4) A62 LUG (4)	*A *A
16 34	−40V AC2 −40V AC2	−40V AC −40V AC	A62 LUG (4) A62 LUG (4)	*A *A
17 35				
18 36	+22V +22V	22V 22V	D E D E	* *

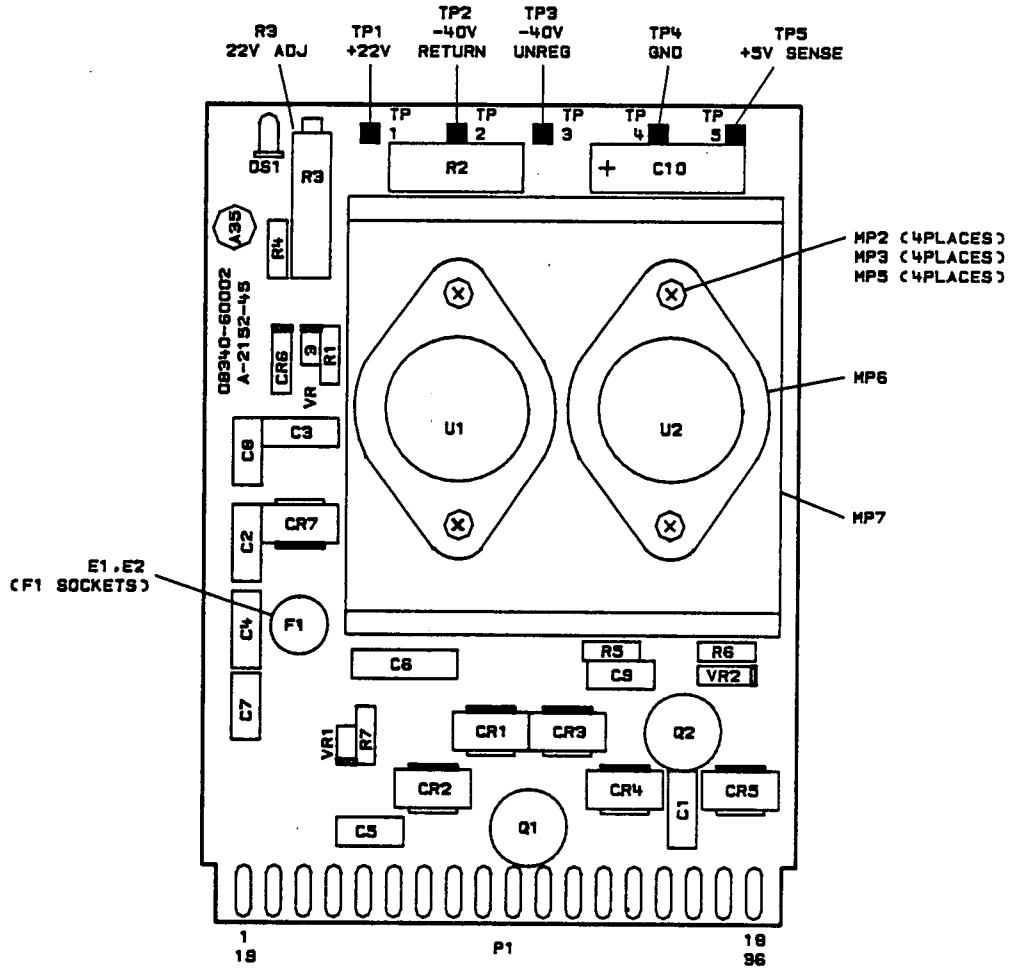
A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60258

Figure A35-1. A19 Capacitor Assembly Component Location Diagram



HP Part Number: 08340-60259

Figure A35-2. A35 Rectifier Component Location Diagram

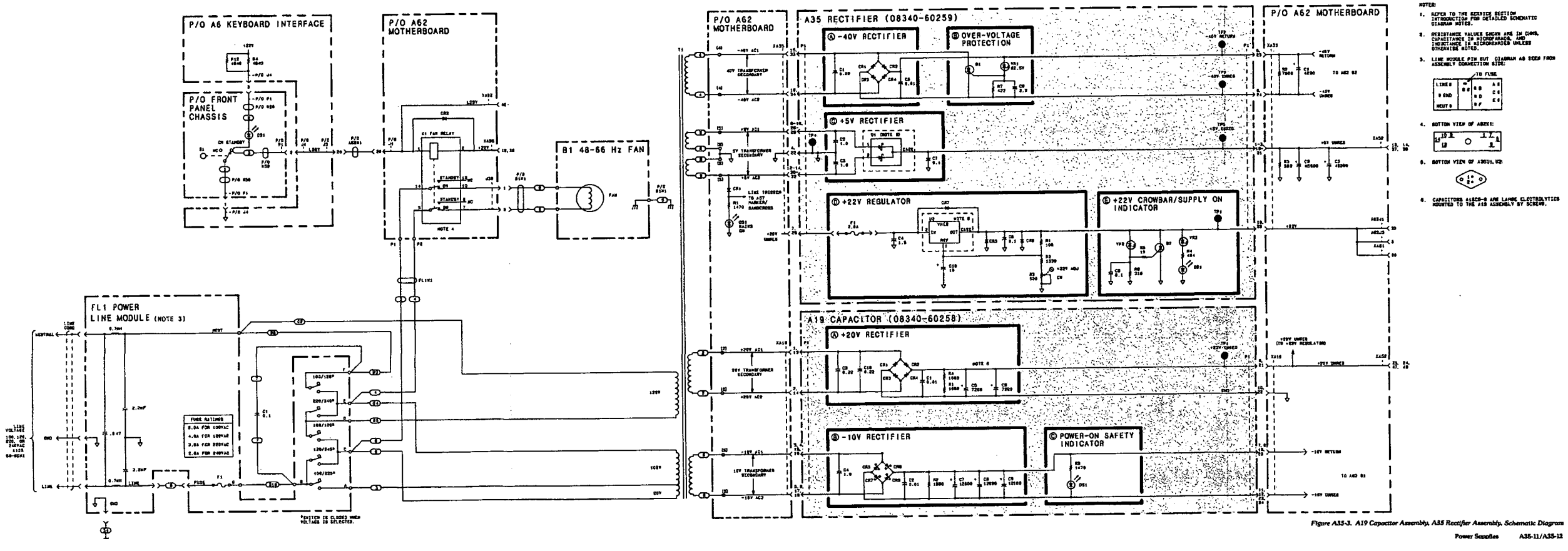


Figure A33-3. A19 Capacitor Assembly, A35 Rectifier Assembly, Schematic Diagram

Table A35-4. A19 Capacitor Assembly Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A19	**08340-60258**	**9**	**1**	**CAPACITOR ASSEMBLY**		
A19C1	0160-2055	9	2	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A19C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A19C3	0160-6143	4	2	CAPACITOR-FXD .22UF ±20% 160VDC CER	28480	0160-6143
A19C4	0160-5647	1	1	CAPACITOR-FXD 1UF ±10% 100VDC CER	28480	0160-5647
A19C5	0180-2603	5	2	CAPACITOR-FXD 7200UF+75-10% 50VDC AL	28480	0180-2603
A19C6	0180-2603	5		CAPACITOR-FXD 7200UF+75-10% 50VDC AL	28480	0180-2603
A19C7	0180-2671	7	3	CAPACITOR-FXD .012F+75-10% 30VDC AL	00853	500123U030AC2A
A19C8	0180-2671	7		CAPACITOR-FXD .012F+75-10% 30VDC AL	00853	500123U030AC2A
A19C9	0180-2671	7		CAPACITOR-FXD .012F+75-10% 30VDC AL	00853	500123U030AC2A
A19C10	0160-6143	4		CAPACITOR-FXD .22UF ±20% 200VDC CER	28480	0160-6143
A19CR1	1901-0662	3	4	DIODE-PWR RECT 100V 6A	04713	MR751
A19CR2	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A19CR3	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A19CR4	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A19CR5	1901-0935	3	4	DIODE-PWR RECT 45V 8A	28480	1901-0935
A19CR6	1901-0935	3		DIODE-PWR RECT 45V 8A	28480	1901-0935
A19CR7	1901-0935	3		DIODE-PWR RECT 45V 8A	28480	1901-0935
A19CR8	1901-0935	3		DIODE-PWR RECT 45V 8A	28480	1901-0935
A19DS1	1990-1146	7	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-1146
A19MP1	2190-0011	8	10	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
A19MP2	2680-0129	8	10	SCREW-MACH 10-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A19MP3	2360-0113	2	3	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A19MP4	08340-00019	4	1	CAP SHIELD	28480	08340-00019
A19R1	0764-0016	8	2	RESISTOR 1K 5% 2W MO TC=0±200	28480	0764-0016
A19R2	0698-3407	6	1	RESISTOR 1.96K 1% .5W F TC=0±100	28480	0698-3407
A19R3	0757-1078	9	1	RESISTOR 1.47K 1% .5W F TC=0±100	28480	0757-1078
A19R4	0764-0016	8		RESISTOR 1K 5% 2W MO TC=0±200	28480	0764-0016
A19TP1	0360-0535	0	1	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION

Table A35-5. A35 Rectifier Assembly Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A35	**08340-60259**	**0**	**1**	**RECTIFIER ASSEMBLY**	**28480**	**08340-60259**
A35C1	0160-6143	4	1	CAPACITOR-FXD .22UF ±20% 160VDC	28480	0160-6143
A35C2	0160-6499	3	3	CAPACITOR-FXD 1UF ±20% 63VDC MET-POLYE	28480	0160-6499
A35C3	0160-6499	3		CAPACITOR-FXD 1UF ±20% 63VDC MET-POLYE	28480	0160-6499
A35C4	0160-6499	3		CAPACITOR-FXD 1UF ±20% 63VDC MET-POLYE	28480	0160-6499
A35C5	0160-2055	9	2	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A35C6	0160-0128	3	1	CAPACITOR-FXD 2.2UF ±20% 50VDC CER	28480	0160-0128
A35C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A35C8	0160-3094	8	2	CAPACITOR-FXD .1UF ±10% 100VDC CER	28480	0160-3094
A35C9	0160-3094	8		CAPACITOR-FXD .1UF ±10% 100VDC CER	28480	0160-3094
A35C10	0180-2129	0	1	CAPACITOR-FXD 10UF±10% 50VDC TA	56289	150D106X9050R2
A35CR1	1901-0662	3	6	DIODE-PWR RECT 100V 6A	04713	MR751
A35CR2	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A35CR3	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A35CR4	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A35CR5	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A35CR6	1901-0028	5	1	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A35CR7	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A35DS1	1990-1148	9	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-1148
A35F1	2110-0425	0	1	FUSE 2A 125V .25X.27	28480	2110-0425
A35MP1				NOT ASSIGNED		
A35MP2	0340-0994	3	2	TRANSISTOR INS-TO-3	28480	0340-0994
A35MP3	0590-0526	6	1	THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
A35MP4	1200-0081	4	1	INSULATOR-FLG-BSHG NYLON	28480	1200-0081
A35MP5	2200-0107	6	4	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A35MP6	6040-0454	0		THERMAL COMPOUND SYNTH	28480	6040-0454
A35MP7	08340-00009	2	1	HEAT SINK RECTIFIER	28480	08340-00009
A35P1	1251-2313	6	2	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A35P2	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A35Q1	1884-0018	5	2	THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A35Q2	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A35R1	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A35R2	0698-3406	5	1	RESISTOR 1.33K 1% .5W F TC=0±100	28480	0698-3406
A35R3	2100-3123	0	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A35R4	0698-0082	7	1	RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A35R5	0757-0346	2	1	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A35R6	0698-3444	1	1	RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A35R7	0698-3447	4	1	RESISTOR 422 1% .125W F TC=0±100	24546	C4-1/8-T0-422R-F
A35TP1-5	0360-0535	0	5	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A35U1	1906-0239	0	1	DIODE-CT-RECT 45V 30A	01281	SD-241
A35U2	1826-0423	4	1	IC V RGLTR TO-3	27014	LM317K
A35VR1	1902-0197	1	1	DIODE-ZNR 82V 5% PD=1W IR=5UA	28480	1902-0197
A35VR2	1902-1249	6	1	DIODE-ZNR 24.9V 5% DO-15 PD=1W TC=+.081%	28480	1902-1249
A35VR3	1902-0202	9	1	DIODE-ZNR 15V 5% PD=1W IR=5UA	28480	1902-0202

A52 Positive Regulator Circuit Description

ASSEMBLY PURPOSE

The A52 positive regulator contains circuitry for the:

- +20V supply
- +12V supply
- +5.2V supply
- Voltage accuracy sensing circuitry
- ON/STANDBY and SHUTDOWN functions

The +20V supply is a self-starting regulator, with a precision reference to accurately set the output voltage. With the exception of the independent +22V standby supply (see the A35 assembly), all supplies are dependent on the +20V output.

NOTE: The +20 and +5.2V supplies are critical, low noise supplies with a specified periodic and random deviation (PARD) less than 100 μV peak. The +12V supply is non-critical, with a specified PARD less than 5 mV peak.

+10V/+4.9V REFERENCE (BLOCK A)

A zener regulator creates a stable +10V reference (+10 VR) for use in the +20V regulator (block B), the standby/overtemperature shutdown (block E), and the voltage sense circuitry (block L).

Bias for the zener regulator is supplied by +20V UNREG. If +10VR is incorrect, check for excessive supply loading. There is a problem if the value of +10V REF changes significantly as you cycle the line switch.

The +4.9V reference (+4.9VR) is generated by a divider network, and is used for the comparators in standby/overtemperature shutdown (block E), and in the voltage sense circuits (block L).

+20V REGULATOR (BLOCK B)

The +20V regulator is the master regulator for the instrument power supply system. Except for the +22V standby supply (which is on continuously), all instrument supplies are dependent on the +20V supply.

The +20V startup current source, driven from the internal +10V reference (block A), forms a 6 ma (nominal) current sink.

In standby, the output of block E (LSOS) is low, and the current from Q14 is shorted to ground. When the instrument is on, the current from Q14 goes to the base of the motherboard darlington pass transistor, causing the +20V output to increase.

The DC Feedback Loop (Error Correction Circuit)

When the +20V output exceeds +10V, the error correction circuitry begins to function. TP2 provides both a check of the reference voltage source, and a +10.00V reference for instrument troubleshooting.

The DC feedback loop (error correction circuit) receives the +20V through a voltage divider and compares it to the output of the voltage source. The output of the error amplifier goes to the base of the motherboard darlington transistor, completing the loop. The error amplifier acts as negative feedback to regulate the output voltage.

Noise Filtering

A noise filter cleans up broadband noise on the integrated reference voltage source, and slows down the startup transient.

Foldback Current Limiting

Foldback resistors form the current sense resistor for the foldback current limit circuit. As the current from the motherboard transistor exceeds 2.4A, the voltage at the emitter of Q8 decreases, turning this transistor on. This allows current to flow through the transistor, sinking base current from the motherboard transistor, reducing its current output.

Foldback current limit:

- Reduces the supply output current capability as its output voltage drops (as when driving a short).
- Makes power dissipation less with the supply shorted, than when the supply is in normal operation (see Table A52-1).

Table A52-1. Power Supply Output Current Capability

Supply	Maximum Out	Short Circuit Current
+20	2.4A	<.5A
+12	1.8A	No Foldback (>2A)
+5	10A	<3A
−5	1.8A	No Foldback (>2A)
−10	6.0A	<3A
−15	1.8A	No Foldback (>2A)
−40	1.7A	<.5A

+20V CROWBAR/SUPPLY ON INDICATOR (BLOCK C)

This block monitors the +20V regulator output. If the voltage exceeds approximately 23V, the supply is shorted to ground, protecting instrument loads. The yellow LED near shows the +20V supply status. The +20V supply tolerance is ±5%, or 1.0V.

REFERENCE OSCILLATOR SUPPLY (BLOCK D)

When HSTD (high internal 10 MHz standard enable) is set high by the microprocessor, this block provides the +20V reference oscillator supply to the A51 10 MHz reference oscillator.

STANDBY/OVERTEMP SHUTDOWN (BLOCK E)

In STANDBY, LSBY (low standby) is pulled low by the front panel ON/STANDBY switch, driving the output of this block low, which pulls the base of the motherboard darlington transistor to ground. This shuts down the +20V supply, along with all other supplies that are dependent on it.

When the ON/STANDBY switch is in the ON position, LSBY rises to +22V. The output of this block goes high, releasing the base of the motherboard darlington transistor. The +20V supply starts, and the CLK input to the flip-flop goes high. This transition clocks a zero into the flip-flop, resetting any overtemperature condition that may have occurred. During initial power-up, the flip-flop is reset to ensure that the instrument is always operational (the overtemp flag is cleared) when turned on.

The Heat Sink Sensor

The main heat sink temperature sensor is a normally open bi-metalic switch that closes when the heat sink reaches 100° C. The sensor is tied from LHSOT (low heat sink overtemperature sensor) to ground. When the switch closes, LHSOT is pulled low, forcing the output of the input comparator high. This sets the flip-flop output high, forcing the output of the output comparator high, which turns on the red overtemp LED. When this happens, LSOS goes low, shutting all instrument power supplies down except the +22V supply. The only way to clear the overtemperature condition is to turn the instrument to standby, and then back on.

GROUNDS AND COMMONS (BLOCK F)

To isolate power ground currents from sensitive circuitry in the regulators, power ground (plain ground) sense ground (ground 1), and +20V ground (ground 2) are separated at the edge connector fingers. The +5.2V sense ground (ground 3) is taken from +5.2V sense (−).

+5.2V REGULATOR (BLOCK G)

+20V provides the reference voltage, and powers the loop error correction amplifiers. The +5.2V output is sensed on the A62 motherboard at the main 5V power distribution point. The +5.2V sense (+) comes back to this assembly, through a voltage divider, and is compared to the generated reference by an error amplifier. The error amplifier output voltage regulates the motherboard and pass transistor through two current driver devices. The +5.2V sense (−), from the central ground distribution point (STAR ground) on the motherboard, provides ground reference (ground 3).

Foldback current limit operates in the same way as in the +20V supply.

+5.2V CROWBAR/PROTECTION (BLOCK H)

When +5.2V out exceeds approximately 6.2V, the zener conducts, biasing the crowbar SCR on and shorting the +5.2V output to ground. This protects load circuits from an overvoltage condition. A yellow LED shows the status of the +5.2V supply. The +5.2V supply tolerance is ±5% (0.26V).

MICROPROCESSOR PROTECTION (BLOCK I)

If the −5.2V supply is more positive than −4.5V, the protection transistor turns on, shorting the adjustment terminal of the +12V regulator (block E) to ground, pulling the +12V output to +1.3V. This protects the microprocessor from excessive power dissipation.

If you make any repairs to the +12V or −5V supplies, check the operation of this circuit **before** you turn the instrument on.

+12V REGULATOR (BLOCK J)

The +12V regulator is an adjustable three-terminal device, whose output voltage is adjusted with feedback resistors. A factory selected resistor compensates for variations in regulator characteristics (increasing the value increases the +12V output).

The input capacitor provides regulator stability. A noise filter increases the regulator ripple rejection and lowers its output impedance. A protection diode protects the regulator from damage due to charge stored on the reference capacitor if there is a short from the +12V output to ground. An output diode protects the +12V power supply loads from reverse polarity power if there is a short between +12V and a negative power supply.

+12V CROWBAR/POWER ON INDICATOR (BLOCK K)

When +12V out exceeds approximately 13.5V, the supply output is shorted to ground. This protects load circuits from the overvoltage. A yellow LED shows the +12V power supply status, and begins to light when the output of A62U1 is approximately +7.6V. The +12V supply tolerance is ±5% (0.6V).

VOLTAGE SENSE (BLOCK L)

When the +5.2V, +12V, or the +20V supply goes out of regulation, its comparator output goes low, shorting a delay capacitor to ground. This forces HPUP (high power up) low, pulling LIPS (low instrument preset) low.

HNUP (high negative up) is connected to the A53 negative regulator assembly, and the A56 −15V supply assembly. This line is pulled low if any of these supplies go out of regulation.

Approximately 300 mS after all supplies come into regulation, HPUP and LIPS go high. These signals are used by the microprocessor (and several other circuits) to control instrument activity and to ensure proper inititalization.

A52 Positive Regulator Component-Level Troubleshooting

WARNING

When the instrument is connected to ac line power and/or the A19 power-on safety indicator LED is on, there are voltages at points inside the instrument that can cause injury or death. Any servicing of this instrument with protective covers removed should be done only by trained personnel who are aware of the hazards involved.

CAUTION

The crowbar circuitry on this assembly protects the instrument, do not operate the supply without it.

To avoid non-repairable damage to assemblies, do not reinstall the A19, A35, A52, or A53 assemblies unless ac mains is disconnected from the instrument.

This assembly contains static sensitive components. Troubleshoot this assembly only at a work station equipped with an anti-static surface, and use a grounding strap that provides a path to ground of between 1 MΩ and 2.5 MΩ. Always handle printed circuit boards by the edges; never touch the finger contacts.

The thermal connection between the voltage regulator U2, the full wave rectifier U1, and the A35 heat sink is the dominant factor in the two devices' long term reliability. when installing or replacing either of these parts. Use only oil based thermal compound (HP Part Number 6040-0454 CD0).

DO NOT use silicone based thermal compound. Silicone based oil migrates past element sockets, switch contacts, or printed circuit board edge connectors, raising contact resistance, or electrically isolating the contacts. Silicone based thermal compounds disperse into the air, depositing themselves anywhere in the instrument. Heat increases the rate of dispersion.

HOW TO APPLY THERMAL COMPOUND

When installing or replacing a pass transistor or voltage regulator, apply thermal compound as follows:

1. Apply a thin coating of thermal compound (HP Part Number 6040-0454 CD0) to both sides of the insulating washer. The coating should provide a thin but continuous layer of compound from component-to-washer and washer-to-heatsink. An excessive amount of compound reduces its ability to transfer heat.

2. Tighten the pass element mounting screws with seven inch-pounds of force. Tightening with less force diminishes the heat transfer capability of the thermal compound. Tightening with greater force can damage the mounting hardware.

IF ALL SUPPLIES ARE DOWN

1. Check the +20V regulator in block B (+20V ±5%).

   If this supply is down, the rest of the instrument supplies (except the +22V supply) will be down.

NOTE: If more than one supply has failed, and the +20V supply is not one of them, refer to section I, POWER SUPPLIES, in the *HP 8340B/8341B Assembly-Level Service Manual*.

HOW TO DETERMINE SUPPLY/LOAD FAILURE

1. Unplug the instrument from ac line power.
2. After the power-on safety indicator goes out, remove the A52 assembly and place it on an extender board.
3. Before installing the extender board in the instrument, apply thin, nonconductive tape to the extender board +20V output fingers (use colored tape, if possible, to make it highly visible, so you remember to remove it when you are through troubleshooting). **Do not** apply tape to the A52 printed circuit board fingers.
4. Reinstall the A52 assembly and plug the instrument in to ac line power. If the power supply now operates properly, suspect a short on an instrument assembly that uses +20V.
5. Remove the tape from the extender board fingers and clean the fingers using the following procedure.

CAUTION

NEVER clean PC board fingers with an eraser. NEVER use tap water in the cleaning solution. Chloride contamination from tap water, from salt (skin contact), or from any other source, can cause reliability problems. Always wear a ground strap when handling any internal component or assembly.

How to Clean Printed Circuit Board Fingers

1. Mix one part de-ionized (or de-chlorinated) water with two parts isopropyl alcohol.
2. Apply this solution to a clean, lint free, cloth (HP Part Number 9310-0039 CD3).
3. Rub the PC board fingers carefully, then dry them with a clean part of the cloth.

+20V LOAD FAILURE

1. One at a time, remove each assembly that uses +20V.
2. Remove any cables that carry the affected supply (refer to table A52-2).

+20V POWER SUPPLY FAILURE

If the power supply output does not return to normal after you tape off the extender board +20V fingers, refer to the following:

The +20V Output Voltage is Approximately 0.8 to 1.0V

1. Crowbar Circuit Verification

   If the output voltage is approximately 0.8 to 1.0V the crowbar circuit is engaged.

   a. Connect the instrument to a auto-transformer set for 0V output.

   b. While monitoring the supply output voltage, slowly increase the auto-transformer output voltage. If the crowbar fires before the supply output reaches +20V suspect VR1.

2. Regulator Verification

   a. If the power supply output reaches +20V, stop increasing auto-transformer voltage.

   b. Check for +10V at the base of Q12. If Q12, Q13, and Q14 are operating correctly, check the precision +10V reference, U2, and the operational amplifier, U1.

   c. Measure the voltage across R7. If the voltage is not 0.6V (6 mA through Q14), check for 0.6V across R6 (6 mA through Q13).

   d. Measure the emitter voltage of Q12. The current through Q12 should also be approximately 6 mA [(+10 VR − 0.7V) ÷ 1620 = 5.7 mA].

   e. Check the voltage across CR7 (block E). If the voltage is 0.6V, the base current of A62Q3 is being drawn away by U4D.

   f. If the voltage across CR7 is 0.6V, check the input pins of U4D (block E). Pin 11 should be approximately +20V, and pin 10 should be +4.9V. If they are, suspect U4. A failure of U4C (block E) can draw A62Q3 base current, but you can verify this only by changing U4 or lifting CR7.

   g. Measure the voltage across the base and emitter of A62Q3 (P1-7 and 8). If the voltage is not approximately 1.25V, suspect A62Q3. Measure the voltage between A62Q3 collector and emitter. If there is little or no voltage the transistor is probably shorted.

The +20V Output Voltage is Approximately 0V

1. Initial Checks

   a. Ensure that ac mains voltage is nominal, and that the line voltage selector cam is installed properly in the line filter module, FL1.

   b. Ensure that the proper fuse value is installed.

   c. If the line voltage and fuse are correct, and the power supply input fuse (F1) is blown, suspect A62Q3.

2. Regulator Verification

   a. Measure the +20V UNREG (P1-23). If this voltage is less than approximately +30V, troubleshoot the +20V rectifier (see A19 troubleshooting).

   b. Measure across the base and emitter of A62Q3 (P1-7 and 32). If the voltage is not approximately 1.25V suspect A62Q3.

3. Current Limit Checks

   a. Check for 0.6V across the emitter/base junction of Q8, indicating that the current foldback circuit is engaged and is shutting down A62Q3.

   b. Measure Q8 emitter to collector. If the voltage is approximately 0.2V or less, Q8 may be shorted.

   c. Examine the +20V supply for burnt or discolored components.

   d. Suspect a shorted capacitor, diode, or crowbar SCR if the procedures above do not isolate the problem.

The +20V Output Voltage is Incorrect (Tolerance is +20V ±1.1V)

1. Ensure that ac mains voltage is nominal and that the line voltage selector cam is installed with the proper line voltage selected.

2. Measure the +20V UNREG input with respect to ground. If the voltage is less than approximately +30V, troubleshoot the +20V Rectifier (see the A19 troubleshooting).

3. With an oscilloscope, check the output voltage for oscillations. If the supply is oscillating, check the precision 10V reference for oscillations. Check loop frequency compensation capacitors C1, C2, C4, and C5.

4. Check the voltage out of U2, and the values of divider resistors R13 and R15. Make sure the feedback path to U1 is not open.

5. Check C4 and C5 by removing them from the circuit. C4 and C5 can cause supply noise or temperature instability if they leak. The voltage at U1 pin 2 must be 1/2 of the supply output voltage.

+12V REGULATOR

Supply tolerance = +12V ±5% (0.6V).

If the +12V regulator is down, remember that this supply comes up only when the +5.2V and −5.2V supplies both operate properly. If the A53 negative regulator assembly is not installed, the +12V supply does not function.

1. Measure the base of Q3 in block I.

   If it is on (0.6V or greater), VR4 is open, or the −5.2V supply is down.

   If it is off, U6B pin 1 in block L is causing the problem if the +12V U1 ADJ line is low.

2. Use the **SUPPLY/LOAD FAILURE DETERMINATION** procedure to determine if the +12V supply has failed or is being forced into current limit by a short elsewhere in the instrument.

3. If the problem is load related, troubleshoot similar to the +20V load failure section. If the +12V supply is at fault, proceed as follows:

+12V POWER SUPPLY FAILURE

If the power supply output does not return to normal after you tape off the extender board +12V fingers, refer to the appropriate troubleshooting below:

NOTE: After you repair the +12V supply, make sure the output is +12.0V ±0.6V. Change factory select resistor R29 if necessary. Increase R29 to increase the +12V output.

The +12V Output Voltage is Approximately 0.8 to 1.0V

1. Crowbar Circuit Verification

   If the output voltage is approximately 0.8 to 1.0V the crowbar circuit is engaged.

   a. Connect the instrument to a auto-transformer set for 0V output.

   b. While monitoring the supply output voltage, slowly increase the auto-transformer output voltage. If the crowbar fires before the supply output reaches +12V suspect VR2.

2. Regulator Verification

   a. If the power supply output reaches +12V, stop increasing auto-transformer voltage.

   b. Measure the voltage across pin 1 and the case of A62U1 (regulator). If the voltage is not approximately 1.25, suspect A62U1.

   c. Measure the voltage from the input to the output of A62U1. If there is little or no voltage, A62U1 is probably shorted.

The +12V Output Voltage is Approximately 0V

1. Initial Checks

   a. Ensure that ac mains voltage is nominal, and that the line voltage selector cam is installed properly in the line filter module, FL1.

   b. Ensure that the proper fuse value is installed.

   c. If the line voltage and fuse are correct, and the power supply input fuse (F1) is blown, suspect A62U1.

2. Regulator Verification

   a. Measure across pin 1 and the case of A62U1. If the voltage is not approximately 1.25V suspect A62U1.

   b. Measure the +20V regulator output (TP4). If this voltage is incorrect, troubleshoot the +20V power supply.

   c. Examine the +12V supply for burnt or discolored components.

   d. Suspect a shorted capacitor, diode, or crowbar SCR if the procedures above do not isolate the problem.

The +12V Output Voltage is Incorrect (Tolerance is +12V ±0.6V)

1. Ensure that ac line voltage is nominal and that the line voltage selector cam is installed with the proper line voltage selected.

2. Measure the +20V regulator output (TP4). If this voltage is incorrect, troubleshoot the +20V power supply.

3. With an oscilloscope, check the output voltage for oscillations.

4. If the output voltage is approximately 1.25V, either A62C6 or A62C7 is probably shorted, or Q3 or U6B are on.

REFERENCE OSCILLATOR SUPPLY

1. If the +20V switched supply does not come up, or will not shut down, check driver Q4, and pass element Q5 in block D.

2. Ensure that HSTD (internal 10 MHz standard enable) is getting to the assembly properly.

+5.2V REGULATOR

Supply tolerance = +5.2V ±5% (0.26V).

Because the +5.2V supply and the +20V supply are similar, refer to the +20V supply section to determine if the failure is caused by a supply failure or by a shorted assembly elsewhere in the instrument. If the supply has failed, proceed as follows:

+5.2V POWER SUPPLY FAILURE

The +5.2V Output Voltage is Approximately 0.8 to 1.0V

1. Crowbar Circuit Verification

   If the output voltage is approximately 0.8 to 1.0V the crowbar circuit is engaged.

   a. Connect the instrument to a auto-transformer set for 0V output.

   b. While monitoring the supply output voltage, slowly increase the auto-transformer output voltage. If the crowbar fires before the supply output reaches +5.2V suspect VR3.

2. Regulator Verification

   a. If the power supply output reaches +5.2V, stop increasing auto-transformer voltage.

   b. Check the emitter-base voltage of Q7, Q10, and A62Q4. It should be approximately 0.6V. Check for emitter-collector shorts.

   c. Measure the collector-emitter voltage of A62Q4. If there is little or no voltage, A62Q4 is probably shorted.

The +5.2V Output Voltage is Approximately 0V

1. Initial Checks

   a. Ensure that ac line voltage is nominal, and that the line voltage selector cam is installed properly in the line filter module, FL1.

   b. Ensure that the proper fuse value is installed.

   c. If the line voltage and fuse are correct, and the power supply input fuse (F3) is blown, suspect A62Q4.

2. Regulator Verification

   a. Measure the +5V UNREG (P1-13). If this voltage is less than approximately +9.5V, troubleshoot the +5V regulator (see A35 troubleshooting).

   b. Measure the base-emitter voltage of Q7, Q10, and A62Q4. It should be approximately 0.6V.

3. Current Limit Checks

   a. Check for 0.6V across the emitter-base of Q6. This indicates that the current foldback circuit is engaged and that it is shutting down A62Q4.

   b. Measure Q6 emitter-collector. If the voltage is approximately 0.2V or less, Q6 may be shorted.

   c. Examine the +12V supply for burnt or discolored components.

   d. Suspect a shorted capacitor, diode, or crowbar SCR if the procedures above do not isolate the problem.

The +5.2V Output Voltage is Incorrect (Tolerance is +5.2V ±0.26V)

1. Ensure that ac mains voltage is nominal and that the line voltage selector PC board is installed with the proper line voltage selected.
2. Measure the +5V UNREG. If this voltage is less than approximately +9.5V, troubleshoot the +5V rectifier (see A35 troubleshooting).
3. With an oscilloscope, check the output voltage for oscillations. Check frequency compensation capacitors C12, C13, and C16.
4. Check the value of divider resistors R67 and R68.
5. Make sure the feedback path to U3 is not open.
6. Check C13 and C14 by removing them from the circuit. They are likely to cause supply noise or temperature instability if they leak.

Table A52-2. A52 Power Supply Destination Chart

Power Supply	Destination Assemblies/Connectors
+20V	A21 through A28, A34, A36, A38, A40 through A43, A53 through A55, A57 through A61
+5.2V	A21 through A28, A34, A36, A37, A39 through A43, A54, A55, A57 through A60, A62J2, A62J19
+12V	A23, A57 through A61, A62J1

Table A52-3. A52 Positive Regulator Supply Limits

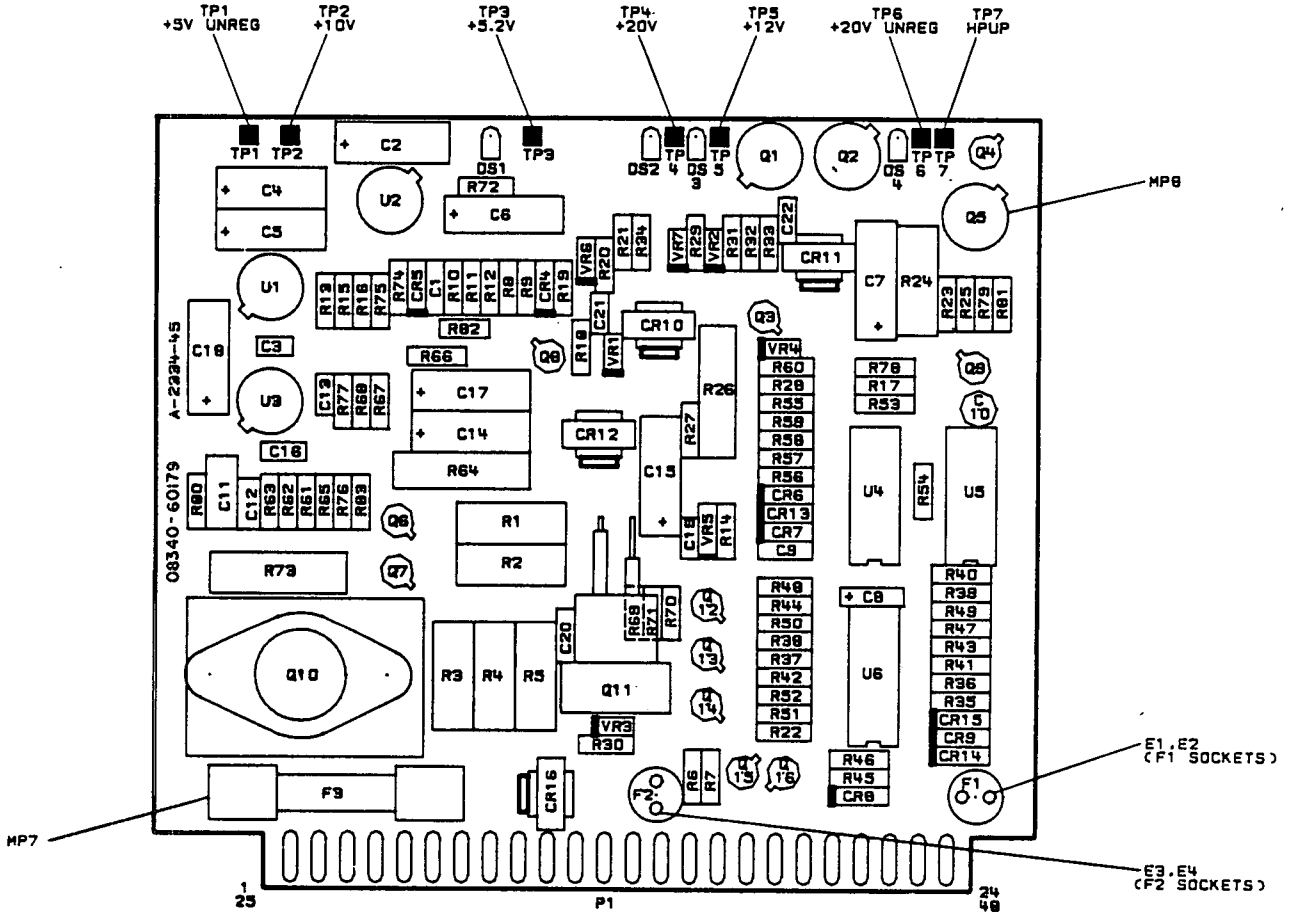
Power Supply	A52 TP	Ground	Limits
+20V	4	P1-19	+19.00 – +21.00V
+12V	5	P1-19	+11.4 – +12.6V
+5.2V	P1-17	P1-19	+4.94 – +5.46V

Table A52-4. A52 Positive Regulator P1 Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1 25	Q4C Q4C		A62Q4-COLLECTOR A62Q4-COLLECTOR	G G
2 26	Q4C Q4C		A62Q4-COLLECTOR A62Q4-COLLECTOR	G G
3 27	Q4B Q4B		A62Q4-BASE A62Q4-BASE	G G
4 28	Q4E Q4E		A62Q4-EMITTER A62Q4-EMITTER	G G
5 29	Q4E Q4E		A62Q4-EMITTER A62Q4-EMITTER	G G
6 30	Q3C Q3C		A62Q3-COLLECTOR A62Q3-COLLECTOR	A B E A B E
7 31	Q3B		A62Q3-BASE	B B
8 32	Q3E Q3E		A62Q3-EMITTER A62Q3-EMITTER	B B
9 33	+12V +12V	+12V +12V	J K J K	*L *L
10 34	+12V UI ADJ	+10.5V	J	*I L
11 35	+12V UNREG +12V UNREG	+20V +20V	J J	*J *J
12 36	LHSOT LIPS	TTL (LOW TRUE) TTL (LOW TRUE)	A62J31-30 *L	E *
13 37	+5V UNREG +5V UNREG	+7 TO +9V +7 TO +9V	XA35P1-1-3, 19-21 XA35P1-1-3, 19-21	*G *G
14 38	+5V UNREG +5V UNREG	+7 TO +9V +7 TO +9V	XA35P1-1-3, 19-21 XA35P1-1-3, 19-21	*G *G
15 39	+5V SENSE (+) +5V SENSE (−)	+5.2V 0V	G F	L F
16 40	+20V +20V	+20V +20V	B C B C	*D J L *D J L
17 41	+5.2V +5.2V	+5.2V +5.2V	G H G H	* *
18 42	+5.2V +5.2V	+5.2V +5.2V	G H G H	* *
19 43	GND GND	0V 0V	A62 STAR GND A62 STAR GND	*F *F
20 44	+20V REF OSC HNUP	0V/+20V TTL (HIGH TRUE)	D XA53P1-17; XA56P1-1, 16	A62J3-1 *I
21 45	HSTD LSBY	TTL (HIGH TRUE) 0V TO +22V	XA59P1-66 A62J1-20	D E
22 46	−5.2V HPUP	−5.2V TTL (HIGH TRUE)	XA53P1-7, 25 L	*A *
23 47	+20V UNREG +20V UNREG	+31.2V +31.2V	XA35P1-7, 25 XA35P1-7, 25	*A *A
24 48	+20V UNREG +20V UNREG	+31.2V +31.2V	XA35P1-7, 25 XA35P1-7, 25	*A *A

A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60179

Figure A52-1. A52 Positive Regulator Component Location Diagram

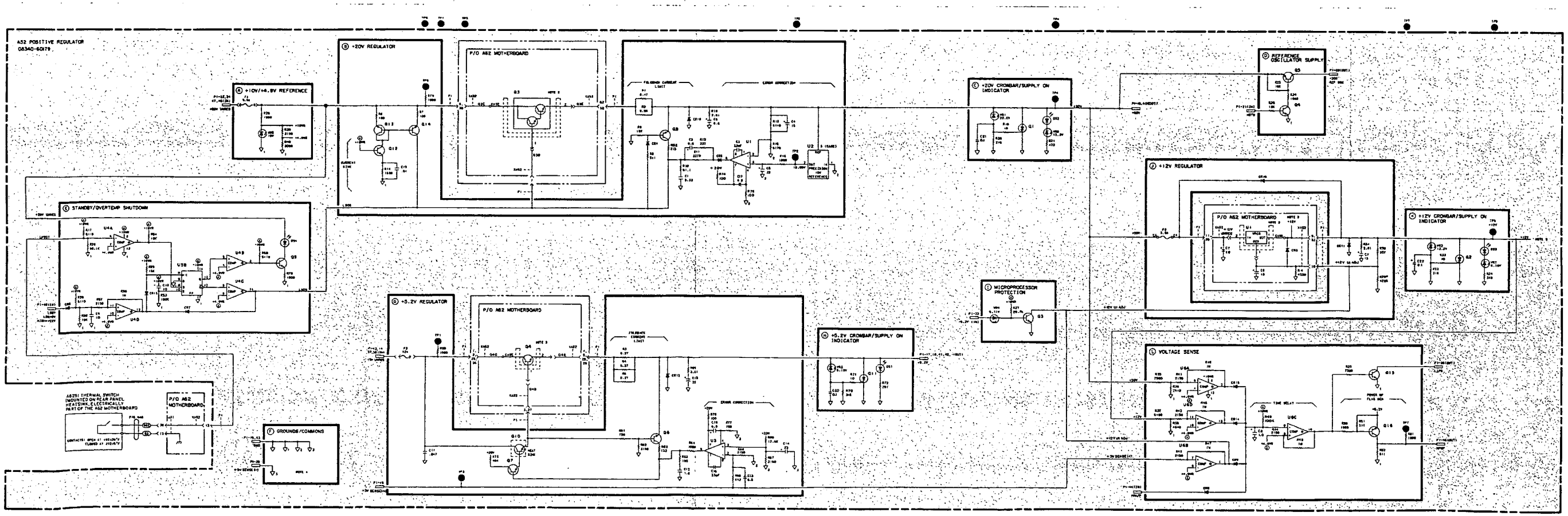


Figure A52-2. A52 Positive Regulator, Schematic Diagram

Table A52-5. A52 Positive Regulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A52	**08340-60179**	**3**	**1**	**POSITIVE REGULATOR ASSEMBLY**	**28480**	**08340-60179**
A52C1	0160-5338	7	1	CAPACITOR-FXD .33UF ±10% 50VDC CER	28480	0160-5338
A52C2	0180-0116	1	4	CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A52C3	0160-4807	3	1	CAPACITOR-FXD 33PF ±5% 100VDC CER 0±30	28480	0160-4807
A52C4	0180-1746	5	2	CAPACITOR-FXD 15UF±10% 20VDC TA	56289	150D156X9020B2
A52C5	0180-0228	6	3	CAPACITOR-FXD 22UF±10% 15VDC TA	56289	150D226X9015B2
A52C6	0180-0116	1		CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A52C7	0180-1746	5		CAPACITOR-FXD 15UF±10% 20VDC TA	56289	150D156X9020B2
A52C8	0160-4005	3		CAPACITOR-FXD 1UF±20% 100VDC CER	28480	0160-4005
A52C9	0160-4835	7	1	CAPACITOR-FXD .1UF ±10% 50VDC CER	28480	0160-4835
A52C10	0180-2811	7		CAPACITOR-FXD 10UF±20% 35VDC TA	28480	0180-2811
A52C11	0160-4834	6	1	CAPACITOR-FXD .047UF ±10% 100VDC CER	28480	0160-4834
A52C12	0160-4005	3	1	CAPACITOR-FXD 1UF ±20% 100VDC CER	28480	0160-4005
A52C13	0180-2617	1	1	CAPACITOR-FXD 6.8UF ±10% 35VDC TA	28480	0180-2617
A52C14	0180-0228	6		CAPACITOR-FXD 22UF±10% 15VDC TA	56289	150D226X9015B2
A52C15	0180-0228	6		CAPACITOR-FXD 22UF±10% 15VDC TA	56289	150D226X9015B2
A52C16	0160-4386	3	1	CAPACITOR-FXD 33PF ±5% 200VDC CER 0±30	28480	0160-4386
A52C17	0180-0116	1		CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A52C18	0180-0116	1		CAPACITOR-FXD 6.8UF±10% 35VDC TA	56289	150D685X9035B2
A52C19	0160-4832	4	1	CAPACITOR-FXD .01UF ±10% 100VDC CER	28480	0160-4832
A52C20-22	0160-4084	8	3	CAPACITOR-FXD .1UF ±20% 50VDC CER	28480	0160-4084
A52CR1-3				NOT ASSIGNED		
A52CR4	1901-0033	2	9	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR9	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR10	1901-0662	3	4	DIODE-PWR RECT 100V 6A	04713	MR751
A52CR11	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A52CR12	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A52CR13	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR15	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A52CR16	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A52DS1-3	1990-1147	8	3	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-1147
A52DS4	1990-1145	6	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-1145
A52F1	2110-0618	3	1	FUSE 5A 125V NTD .25X.27	28480	2110-0618
A52F2	2110-0332	8	1	FUSE 3A 125V .25X.27	28480	2110-0332
A52F3	2110-0249	6	1	FUSE 12A 250V NTD 1.25X.25 UL	28480	2110-0249
A52MP1	08340-20073	2	1	MTG BLOCK DIODE	28480	08340-20073
A52MP2	0520-0129	8	1	SCREW-MACH 2-56 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A52MP3	2190-0014	1	1	WASHER-LK INTL T NO. 2 .089-IN-ID	28480	2190-0014
A52MP4	2950-0014	3	1	NUT-HEX-DBL-CHAM 1/4-28-THD .219-IN-THK	00000	ORDER BY DESCRIPTION
A52MP5	5040-6847	6	1	EXTRACTOR, RED	28480	5040-6847
A52MP6	1251-2313	6	4	CONN. SGL CONN.	28480	1251-2313
A52MP7	1251-2313	6	4	CONN. SGL CONN.	28480	1251-2313
A52MP8	1251-2313	6		CONN. SGL CONN.	28480	1251-2313
A52MP9	1251-2313	6		CONN. SGL CONN.	28480	1251-2313
A52MP10	5000-9043	6	1	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
A52MP11	2110-0643	4	1	FUSEHOLDER-CLIP TYPE 15A 250 V	28480	2110-0643
A52MP12				NOT ASSIGNED		
A52MP13	8150-0014	3	1	WIRE 22AWG BL 300V PVC 7X30 105C	28480	8150-0014
A52MP14	2190-0027	6	1	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0027
A52Q1	1884-0018	5	2	THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A52Q2	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A52Q3	1854-0477	7	4	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A52Q4	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A52Q5	1853-0213	7	1	TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
A52Q6	1854-0404	0	3	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A52Q7	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A52Q8	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A52Q9	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A52Q10	1854-0441	5	1	TRANSISTOR NPN SI PD=5.8W FT=800KHZ	28480	1854-0441
A52Q11	1884-0046	9	1	THYRISTOR-SCR VRRM=50	03508	C230F
A52Q12	1854-0637	1	1	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A52Q13	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A52Q14	1853-0314	9	1	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A52Q15	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A52Q16	1853-0034	0	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034

Table A52-5. A52 Positive Regulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A52R1	0812-0021	8	1	RESISTOR .47 5% 3W PW TC = 0 ±90	91637	CW2B1-3-T2-47/100-J
A52R2	0811-4507	1	1	RESISTOR .56 5% 3W PW TC = 0 ±90	28480	0811-4507
A52R3	0811-4506	0	3	RESISTOR .27 5% 3W PW TC = 0 ±90	28480	0811-4506
A52R4	0811-4506	0		RESISTOR .27 5% 3W PW TC = 0 ±90	28480	0811-4506
A52R5	0811-4506	0		RESISTOR .27 5% 3W PW TC = 0 ±90	28480	0811-4506
A52R6	0757-0401	0	7	RESISTOR 100 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-101-F
A52R7	0757-0401	0		RESISTOR 100 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-101-F
A52R8	0757-0416	7	3	RESISTOR 511 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-511R-F
A52R9	0757-0442	9	7	RESISTOR 10K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1002-F
A52R10	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-51R1-F
A52R11	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-2371-F
A52R12	0698-3442	9	2	RESISTOR 237 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-237R-F
A52R13	0757-0438	3	5	RESISTOR 5.11K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-5111-F
A52R14	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1621-F
A52R15	0757-0438	3		RESISTOR 5.11K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-5111-F
A52R16	0757-0280	3	5	RESISTOR 1K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1001-F
A52R17	0757-0438	3		RESISTOR 5.11K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-5111-F
A52R18	0698-8817	2	3	RESISTOR 2.61 1% .125W F TC = 0 ±100	28480	0698-8817
A52R19	0757-0346	2	3	RESISTOR 10 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-10R0-F
A52R20	0698-3444	1	3	RESISTOR 316 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-316R-F
A52R21	0698-3447	4	1	RESISTOR 422 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-422R-F
A52R22	0757-0440	7	2	RESISTOR 7.5K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-7501-F
A52R23	0757-0442	9		RESISTOR 10K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1002-F
A52R24	0698-3407	6	2	RESISTOR 1.96K 1% .5W F TC = 0 ±100	28480	0698-3407
A52R25	0757-0442	9		RESISTOR 10K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1002-F
A52R26	0698-3407	6		RESISTOR 1.96K 1% .5W F TC = 0 ±100	28480	0698-3407
A52R27	0698-3449	6	1	RESISTOR 28.7K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-2872-F
A52R28	0757-0461	2	1	RESISTOR 68.1K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-6812-F
A52R29*	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-4221-F
A52R30	0698-3442	9		RESISTOR 237 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-237R-F
A52R31	0698-8817	2		RESISTOR 2.61 1% .125W F TC = 0 ±100	28480	0698-8817
A52R32	0698-3444	1		RESISTOR 316 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-316R-F
A52R33	0757-0346	2		RESISTOR 10 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-10R0-F
A52R34	0698-3445	2	1	RESISTOR 348 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-348R-F
A52R35	0757-0440	7		RESISTOR 7.5K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-7501-F
A52R36	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-2611-F
A52R37	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC = 0 ±100	19701	MF4C1/8-T0-6191-F
A52R38	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-4641-F
A52R39	0757-0279	0	4	RESISTOR 3.16K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-3161-F
A52R40	0698-6348	0	1	RESISTOR 3K .1% .125W F TC = 0 ±25	28480	0698-6348
A52R41	0698-0084	9	5	RESISTOR 2.15K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-2151-F
A52R42	0698-0084	9		RESISTOR 2.15K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-2151-F
A52R43	0698-0084	9		RESISTOR 2.15K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-2151-F
A52R44	0698-0084	9		RESISTOR 2.15K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-2151-F
A52R45	0698-8827	4	5	RESISTOR 1M 1% .125W F TC = 0 ±100	28480	0698-8827
A52R46	0698-8827	4		RESISTOR 1M 1% .125W F TC = 0 ±100	28480	0698-8827
A52R47	0698-8827	4		RESISTOR 1M 1% .125W F TC = 0 ±100	28480	0698-8827
A52R48	0698-8827	4		RESISTOR 1M 1% .125W F TC = 0 ±100	28480	0698-8827
A52R49	0757-0465	6		RESISTOR 100K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1003-F
A52R50	0698-0083	8	1	RESISTOR 1.96K 1% .125W F TC = 0 ±100	24546	C4-1/8-TO-1961-F
A52R51	0757-0416	7		RESISTOR 511 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-511R-F
A52R52	0757-0416	7		RESISTOR 511 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-511R-F
A52R53	0757-0465	6	1	RESISTOR 100K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1003-F
A52R54	0757-0442	9		RESISTOR 10K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1002-F
A52R55	0757-0442	9		RESISTOR 10K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1002-F
A52R56	0698-8827	4		RESISTOR 1M 1% .125W F TC = 0 ±100	28480	0698-8827
A52R57	0698-0084	9		RESISTOR 2.15K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-2151-F
A52R58	0757-0442	9		RESISTOR 10K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1002-F
A52R59	0757-0438	3		RESISTOR 5.11K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-5111-F
A52R60	0757-0438	3		RESISTOR 5.11K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-5111-F
A52R61	0757-0420	3	1	RESISTOR 750 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-751-F
A52R62	0757-0279	0		RESISTOR 3.16K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-3161-F
A52R63	0757-0401	0		RESISTOR 100 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-101-F
A52R64	0757-0159	5	1	RESISTOR 1K 1% .5W F TC = 0 ±100	28480	0757-0159
A52R65	0698-8466	7	1	RESISTOR 942 .5% .125W F TC = 0 ±50	28480	0698-8466
A52R66	0757-0279	0		RESISTOR 3.16K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-3161-F
A52R67	0757-0279	0		RESISTOR 3.16K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-3161-F
A52R68	0698-8464	5	1	RESISTOR 12.6K .5% .125W F TC = 0 ±50	28480	0698-8464
A52R69	0698-8817	2		RESISTOR 2.61 1% .125W F TC = 0 ±100	28480	0698-8817
A52R70	0698-3444	1		RESISTOR 316 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-316R-F

Table A52-5. A52 Positive Regulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A52R71	0757-0346	2		RESISTOR 10 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-10R0-F
A52R72	0698-3443	0	1	RESISTOR 287 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-287R-F
A52R73	0698-0090	7	1	RESISTOR 464 1% .5W F TC = 0 ±100	28480	0698-0090
A52R74	0757-0401	0		RESISTOR 100 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-101-F
A52R75	0757-0401	0		RESISTOR 100 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-101-F
A52R76	0757-0401	0		RESISTOR 100 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-101-F
A52R77	0757-0401	0		RESISTOR 100 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-101-F
A52R78	0757-0280	3		RESISTOR 1K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1001-F
A52R79	0757-0280	3		RESISTOR 1K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1001-F
A52R80	0757-0280	3		RESISTOR 1K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1001-F
A52R81	0757-0280	3		RESISTOR 1K 1% .125W F TC = 0 ±100	24546	C4-1/8-T0-1001-F
A52R82	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0±100	28480	0698-7220
A52R83	0698-3437	2	1	RESISTOR 133 1% .125W F TC=0±100	28480	0698-3437
A52TP1	0360-0535	0	7	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A52TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A52TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A52TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A52TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A52TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A52TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A52U1	1820-0223	0	2	IC OP AMP GP TO-99 PKG	3L585	CA301AT
A52U2	1826-0742	0	1	IC V RGLTR-V-REF-FXD 10V TO5 PKG	28480	1826-0742
A52U3	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A52U4	1826-0138	8	2	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A52U5	1820-1531	5	1	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	3L585	CD4013AF
A52U6	1826-0138	8		IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A52VR1	1902-3252	5	1	DIODE-ZNR 22.6V 2% DO-35 PD=.4W	28480	1902-3252
A52VR2	1902-3193	3	2	DIODE-ZNR 13.3V 5% DO-35 PD=.4W	28480	1902-3193
A52VR3	1902-0049	2	2	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A52VR4	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A52VR5	1902-3160	4	1	DIODE-ZNR 10V 2% DO-35 PD=.4W TC=+.06%	28480	1902-3160
A52VR6	1902-3193	3		DIODE-ZNR 13.3V 5% DO-35 PD=.4W	28480	1902-3193
A52VR7	1902-0049	2		DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049

A53 Negative Regulator Circuit Description

ASSEMBLY PURPOSE

The A53 assembly contains all circuitry for the −10V, −5.2V, and −40V power supplies, as well as voltage sensing circuitry to flag the A52 positive regulator assembly if one of these supplies goes out of tolerance.

NOTE: The −10 and −40V supplies are critical, low-noise supplies. They are limited to a periodic and random deviation (PARD) of less than 100 μV peak. The −5.2V supply is primarily a digital (ECL) supply, and has a PARD specification of 5mV.

−10V REGULATOR (BLOCK A)

This power supply differs from many others in that the return side of the supply is regulated, and the unregulated side is common to the output. The motherboard darlington regulates the voltage difference between the −10V RETURN and ground. The amplitude of the −10V RETURN is regulated as necessary so that the −10V UNREG line is always −10V with respect to ground.

There is frequency compensation, and an output capacitor provides a minimum load capacitance and lower output impedance. Foldback current limiting is used as on the +5.2 and +20V supplies.

The voltage at the base of the foldback transistor is set by a voltage divider. The voltage at one end of the divider is set by the voltage drop across the current sense resistors, and the voltage at the other end of the divider is set by the output voltage of the supply.

When the voltage at the base of the foldback transistor reaches 0.7V, the device conducts and removes some portion of the base current supplied to the motherboard darlington transistor by the error amplifier. When the output voltage of the supply is low (during turn on or short circuit) a relatively small sense resistor current brings the foldback transistor base voltage above threshold, which turns it on, limiting the current supplied to the motherboard darlington transistor.

−10V CROWBAR/SUPPLY ON INDICATOR (BLOCK B)

If the supply output exceeds approximately 11V, the zener conducts, biasing the crowbar SCR on, which shorts the supply output to ground, protecting load circuits from an overvoltage condition. A yellow LED shows the −10V supply operational status. The −10V supply tolerance is −10V ±5% (0.5V).

−5.2V REGULATOR (BLOCK C)

The −5.2V regulator is a monolithic three-terminal adjustable negative device. The adjustment terminal is nominally 1.25V more negative than the output terminal.

The reference capacitor increases ripple rejection for the regulator, and the protection diode provides a discharge path for the reference capacitor and protects load circuits from damage due to reverse polarity power caused by an instrument failure.

−5.2V CROWBAR/SUPPLY ON INDICATOR (BLOCK D)

If the −5.2V output exceeds approximately −6.2V, the zener conducts, biasing the crowbar SCR on, which shorts the −5.2V supply to ground. A yellow LED shows the operational status of the supply. The −5.2V supply tolerance is −5.2V ±5%, or 0.26V.

−40V REGULATOR (BLOCK E)

This circuit is similar to the −10V regulator: the −40V return line is regulated, not the −40V unregulated line (see block A description).

The +20V REF provides reference for the regulator, and powers the error amplifier. An SCR limits the error amplifier negative supply. An input capacitor protects the error amplifier input stage.

Current limit operation is similar to the −10V current limit. Feedback is completed off the A53 assembly, using remote sense at the main −40V distribution point on the motherboard. −40V SENSE comes back on the A53 assembly to complete the loop. To reduce noise in the supply, ground reference connects to main ground at the edge fingers. A diode protects load circuits from reverse polarity supply caused by an insturment failure.

−40V CROWBAR/SUPPLY ON INDICATOR (BLOCK F)

If the −40V output exceeds approximately 44.2V, the zener conducts, biasing the crowbar SCR, which shorts the −40V supply to ground, protecting load circuits from an overvoltage condition. A yellow LED shows the supply operational status. The −40V supply tolerance is −40V ±5% (2.0V).

VOLTAGE SENSE (BLOCK H)

The −4.64V reference section provides a reference voltage to compare with each supply output. If a supply is out of regulation (low output), the corresponding supply comparator output goes low. This forces the output comparator output high, biasing the power up transistor on, which pulls HNUP (high negative up) low (for HNUP, high = +20V, low = +0.2V).

In the event of a crowbar (or short to ground) on the −10V supply, a clamp diode and a current limit resistor prevent the −40V supply from damaging the supply comparator. Output diodes isolate the supply comparator outputs, allowing you to check each supply independently.

GROUNDS AND COMMONS (BLOCK I)

This block shows the critical power and signal ground distribution system on the assembly.

A53 Negative Regulator Component-Level Troubleshooting

WARNING

When the instrument is connected to ac line power and/or the A19 power-on safety indicator LED is on, there are voltages present inside the instrument that can cause personal injury or death. Any servicing of this instrument with protective covers removed should be performed only by qualified personnel who are aware of the hazards involved.

CAUTION

The crowbar circuitry on this assembly protects the instrument, do not operate the supply without it.

To avoid non-repairable damage to assemblies, do not reinstall the A19, A35, A52, or A53 assemblies unless ac mains is disconnected from the instrument.

This assembly contains static sensitive components. Troubleshoot this assembly only at a work station equipped with an anti-static surface, and use a grounding strap that provides a path to ground of between 1 MΩ and 2.5 MΩ. Always handle printed circuit boards by the edges; never touch the finger contacts.

The thermal connection between the pass transistors/voltage regulators main heat sink is the dominant factor in the two devices' long term reliability. when installing or replacing either of these parts. Use only oil based thermal compound (HP Part Number 6040-0454 CD0).

DO NOT use silicone based thermal compound. Silicone based oil migrates past element sockets, switch contacts, or printed circuit board edge connectors, raising contact resistance, or electrically isolating the contacts. Silicone based thermal compounds disperse into the air, depositing themselves anywhere in the instrument. Heat increases the rate of dispersion.

HOW TO APPLY THERMAL COMPOUND

When installing or replacing a pass transistor or voltage regulator, apply thermal compound as follows:

1. Apply a thin coating of thermal compound (HP Part Number 6040-0454 CD0) to both sides of the insulating washer. The coating should provide a thin but continuous layer of compound from component-to-washer and washer-to-heatsink. An excessive amount of compound reduces its ability to transfer heat.
2. Tighten the pass element mounting screws with seven inch-pounds of force. Tightening with less force diminishes the heat transfer capability of the thermal compound. Tightening with greater force can damage the mounting hardware.

−10V REGULATOR

The −10V supply tolerance is −10V ±5%, or 0.5V.

1. Ensure that the −5.2V supply (crowbar, etc) is not pulling the −10V supply down.
2. Remove the −5.2V fuse (F1). If the −10V supply still does not functional, proceed as follows:

SUPPLY/LOAD FAILURE DETERMINATION

1. Unplug the instrument from ac line power.
2. After the power-on safety indicator goes out, remove the A53 assembly and place it on an extender board.
3. Before installing the extender board in the instrument, apply thin, non-conductive tape to the extender board −10V output fingers (use colored tape, if possible, to make it highly visible, so you remember to remove it when you are through troubleshooting). **Do not** apply tape to the A53 assembly fingers.
4. Re-install the A53 assembly and connect the instrument to ac line power. If the power supply now operates properly suspect a short on one of the instrument assemblies that use −10V. Refer to Table A53-1, for a list of these assemblies.

Table A53-1. A53 Power Supply Destination Chart

Power Supply	Destination Assemblies/Connectors
−10V	A21 through A28, A34, A36, A38 through A43, A54, A55, A57 through A61, A62J2, A62J18, A62J19
−40V	A22, A23, A28, A34, A40, A54, A55, A56, A62J2, A62J19
−5.2V	A23, A27, A34, A52, A57 through A61, A62J1, A62J2, A62J19

5. Remove the tape from extender board fingers and clean the fingers using the following procedure.

CAUTION

NEVER clean PC board fingers with an eraser. NEVER use tap water in the cleaning solution. Chloride contamination from tap water, from salt (skin contact), or from any other source, can cause reliability problems. Always wear a ground strap when handling any internal component or assembly.

How to Clean Printed Circuit Board Fingers

1. Mix one part de-ionized (or de-chlorinated) water with two parts isopropyl alcohol.
2. Apply this solution to a clean, lint free, cloth (HP Part Number 9310-0039 CD3).
3. Rub the PC board fingers carefully, then dry them with a clean part of the cloth.

−10V LOAD FAILURE

1. After performing the above procedure, and cleaning the extender board fingers, reinstall the A53 assembly.

NOTE: Always unplug the instrument from ac line power and wait for the power-on safety indicator to go out before removing or installing any assembly or cable.

2. One at a time, remove each assembly that uses −10V, and determine which one is faulty.
3. Remove any cables that carry the affected supply (see Table A53-1).

−10V POWER SUPPLY FAILURE

If the power supply output does not return to normal after you tape off the extender board −10V output fingers, refer to the following:

The −10V Output Voltage is Approximately −0.8 to −1.0V

1. Crowbar Circuit Verification

   If the output voltage is approximately −0.8 to −1.0V the crowbar circuit is engaged.

   a. Connect the instrument to a auto-transformer set for 0V output.

   b. While monitoring the supply output voltage, slowly increase the auto-transformer output voltage. If the crowbar fires before the supply output reaches −10V suspect VR1.

2. Regulator Verification

   a. If the power supply output reaches −10V, stop increasing auto-transformer voltage.

   b. The emitter-base voltage of A62Q1 should be approximately 1.2V. Check for an emitter-collector short.

   c. The emitter-base voltage of Q4 should be 0.35 to 0.5V. Check for an emitter-collector short.

The −10V Output Voltage is Approximately 0 to +0.7V

1. Initial Checks

   a. Ensure that ac line voltage is nominal, and that the line voltage selector cam is installed properly in the line filter module, FL1.

   b. Ensure that the proper fuse value is installed.

   c. If the line voltage and fuse are correct, and the power supply input fuse (F3) is blown, suspect transistor A62Q1.

   d. Measure the −10V RETURN (P1-2) with respect to −10V UNREG (P1-9). If this voltage is less than approximately −16V, troubleshoot the −10V rectifier (refer to A19 troubleshooting)

2. Regulator Verification

   a. Check the base-emitter voltage of A62Q1. It should be approximately 1.2V.

   b. Check the base-emitter voltage of Q4. It should be 0.35 to 0.5V.

3. Current Limit Checks

   a. Check for 0.6V across the emitter-base junction of Q4. This indicates that the current foldback circuit is engaged, and is shutting down A62Q1.

   b. Check the emitter-collector voltage of Q4. If the voltage is approximately 0.2V or less, Q4 may be shorted.

   c. Examine the −10V supply for burnt or discolored components.

   d. Suspect a shorted capacitor, diode, or crowbar SCR if the procedures above do not isolate the problem.

The −10V Output Voltage is Incorrect (Tolerance is −10V ±0.5V)

   a. Ensure that ac mains voltage is nominal and that the line voltage selector cam is installed with the proper line voltage selected.

   b. Measure the −10V RETURN (P1-2) with respect to −10V UNREG (P1-9). If the voltage is less than approximately −16V, troubleshoot the −10V Rectifier (see A19 troubleshooting).

   c. With an oscilloscope, check the output voltage for oscillations.

   d. Check the values of divider resistors R8, R9, and R10. Ensure that the feedback path to U4 is not open.

   e. Check C5 by removing it from the circuit. C5 can cause supply noise or temperature instability if it leaks.

−40V REGULATOR

The −40V supply tolerance is ±5% (2.0V).

1. Because the −40V regulator circuit is very similar to the −10V regulator circuit, troubleshooting techniques are very similar. Refer to the −10V regulator troubleshooting, above. The major difference between the two supplies is that while the −10V supply uses a darlington series pass element for supply regulation, the −40V supply uses a discrete transistor.

NOTE: Along with the −40V output pins, tape −40V sense, and jumper the anode of CR12 to TP4.

2. When you check for proper A62Q2 operation, measure its base-emitter voltage. If this voltage is not approximately 0.6V to 0.7V, suspect A62Q2.

−5.2V REGULATOR

The −5.2V supply tolerance is ±5% (0.26V).

1. Determine if the −5.2V supply has failed or is being forced into current limit by a short elsewhere in the instrument (see SUPPLY/LOAD FAILURE DETERMINATION, above). If the problem is load related, troubleshoot similar to the −10V Load Failure section. If the −5.2V supply is at fault, proceed as follows:

−5.2V POWER SUPPLY FAILURE

If the power supply output does not return to normal after the extender board −5.2V output pins are taped off, refer to the appropriate sections below:

The −5.2V Output Voltage is Approximately −0.8 to −1.0V

1. Crowbar Circuit Verification

   If the output voltage is approximately −0.8 to −1.0V the crowbar circuit is engaged.

   a. Connect the instrument to a auto-transformer set for 0V output.

   b. While monitoring the supply output voltage, slowly increase the auto-transformer output voltage. If the crowbar fires before the supply output reaches −5.2V suspect VR2.

2. Regulator Verification

   a. If the power supply output reaches −5.2V, stop increasing auto-transformer voltage.

   b. Measure the voltage across pin 1 and the case of U1. If the voltage is not approximately 1.25V, suspect U1.

   c. Measure the voltage between the input and output of U1. If there is little or no voltage, U1 is probably shorted.

The −5.2V Output Voltage is Approximately 0V

1. Initial Checks

   a. Ensure that ac mains voltage is nominal, and that the line voltage selector PC board is installed properly in the line filter module, FL1.

   b. Ensure that the proper fuse value is installed.

   c. If the line voltage and fuse are correct, and the power supply input fuse (F1) is blown, suspect regulator U1.

2. Regulator Verification

   a. Measure the −10V REGULATOR output (TP5). If this voltage is incorrect, troubleshoot the −10V power supply.

   b. Measure across pin 1 and the case of U1. If the voltage is not approximately 1.25V, suspect U1.

   c. Examine the −5.2V supply for burnt or discolored components.

   d. Suspect a shorted capacitor, diode, or crowbar SCR if the procedures above do not isolate the problem.

The −5.2V Output Voltage is Incorrect (Tolerance is −5.2V ±0.26V)

1. Ensure that ac mains voltage is nominal and that the line voltage selector cam is installed with the proper line voltage selected.

2. Measure the −10V REGULATOR output (TP5). If the voltage is incorrect, troubleshoot the −10V power supply.

3. With an oscilloscope, check the output voltage for oscillations.

4. If the output is approximately 1.25V, C14 is probably shorted.

Table A53-2. A53 Negative Regulator Supply Limits

Power Supply	A53 TP	Ground	Limits
−40V	4	P1-14	−42.00 to −38.00V
−10V	5	P1-14	−10.5 to −9.5V
−5.2V	3	P1-14	−5.46 to −4.94V

A56 −15V Regulator Circuit Description

ASSEMBLY PURPOSE

The A56 assembly contains the −15V regulator and voltage sense circuitry to flag the A52 positive regulator if an out-of-tolerance condition occurs in the supply.

−15V REGULATOR (BLOCK A)

The −15V regulator is a monolithic three-terminal adjustable negative device, designed to maintain a constant 1.25V difference between the OUT terminal and the ADJ terminal.

An output capacitor improves the regulator ripple rejection, and a protection diode provides a discharge path for the output capacitor in the event of a short from the −15V output to ground. An output diode protects against an inadvertent short between the −15V output and a high current positive supply (clamps −15V OUT at approximately +0.8V, protecting load circuits from damage).

−15V CROWBAR/SUPPLY ON INDICATOR (BLOCK B)

If the −15V output exceeds approximately −17.8 Volts, the zener conducts, biasing the crowbar SCR, which shorts the −15V supply to ground, protecting instrument load circuits from an overvoltage condition. A yellow LED shows the supply status. The −15V supply tolerance is ±5%, or 0.75V.

LOW VOLTAGE SENSE (BLOCK C)

If the −15V output exceeds −12.1V, the output transistor turns off and HNUP (high negative up) goes high. HNUP is used on the A52 positive regulator assembly to monitor the −15V output and determine if it is within tolerance.

A56 −15V Regulator Component-Level Troubleshooting

CAUTION

The crowbar circuitry on this assembly protects the instrument, do not operate the supply without it.

This assembly contains static sensitive components. Troubleshoot this assembly only at a work station equipped with an anti-static surface, and use a grounding strap that provides a path to ground of between 1 MΩ and 2.5 MΩ. Always handle printed circuit boards by the edges; never touch the finger contacts.

The thermal connection between the pass transistors/voltage regulators main heat sink is the dominant factor in the two devices' long term reliability. when installing or replacing either of these parts. Use only oil based thermal compound (HP Part Number 6040-0454 CD0).

DO NOT use silicone based thermal compound. Silicone based oil migrates past element sockets, switch contacts, or printed circuit board edge connectors, raising contact resistance, or electrically isolating the contacts. Silicone based thermal compounds disperse into the air, depositing themselves anywhere in the instrument. Heat increases the rate of dispersion.

HOW TO APPLY THERMAL COMPOUND

When installing or replacing a pass transistor or voltage regulator, apply thermal compound as follows:

1. Apply a thin coating of thermal compound (HP Part Number 6040-0454 CD0) to both sides of the insulating washer. The coating should provide a thin but continuous layer of compound from component-to-washer and washer-to-heatsink. An excessive amount of compound reduces its ability to transfer heat.

2. Tighten the pass element mounting screws with seven inch-pounds of force. Tightening with less force diminishes the heat transfer capability of the thermal compound. Tightening with greater force can damage the mounting hardware.

Because the −15V supply is very similar to the −5.2V supply, its troubleshooting techniques are similar. Refer to the −5.2V REGULATOR troubleshooting section, above.

The −15V supply tolerance is ±5% (0.75V).

Table A56-1. A56 Power Supply Destination Chart

Power Supply	Destination Assemblies
−15V	A27, A28, A54, A57 through A61

Table A56-2. A56 −15V Regulator Limit

Power Supply	A56 TP	Ground	Limit
−15V	TP2	P1-5	−15.75V to −14.25V

Table A53-3. A53 Negative Regulator P1 Pin I/O

Pin	Mnemonic	Levels	Source	Destination
1 19	Q2E Q2E		A62Q2-EMITTER A62Q2-EMITTER	E E
2 20	−10V RETURN −10V RETURN	+6.4V AT 13.3 GHZ +6.4V AT 13.3 GHZ	A62Q1-COLLECTOR A62Q1-COLLECTOR	XA19P1-7, 8, 19, 20 A XA19P1-7, 8, 19, 20 A
3 21	−40V RETURN Q2B	12.7 AT 13.3 GHZ	A62Q2-COLLECTOR A62Q2-BASE	*E E
4 22	Q1B −40V RETURN	12.7V AT 13.3 GHZ	A62Q1-BASE A62Q2-COLLECTOR	A *E
5 23	−40V SENSE (+) −40V SENSE (−)	0V −40V	D E	*E *
6 24	−40V UNREG −40V UNREG	−40V −40V	XA35P1-6, 24 XA35P1-6, 24	*E *E
7 25	Q1E Q1E		A62Q1-EMITTER A62Q1-EMITTER	A A
8 26	Q1E Q1E		A62Q1-EMITTER A62Q1-EMITTER	A A
9 27	−10V UNREG −10V UNREG	−10V −10V	XA19P1-11, 12, 23, 24 XA19P1-11, 12, 23, 24	A A
10 28	−10V UNREG −10V UNREG	−10V −10V	XA19P1-11, 12, 23, 24 XA19P1-11, 12, 23, 24	A A
11 29	−40V +20V	−40V +20V	E F XA52P1-16, 40	*H *A E H
12 30	−10V −40V	−10V −40V	A B E F	*C G H *H
13 31	−10V −10V	−10V −10V	A B A B	*C G H *C G H
14 32	GND −10V	0V −10V	A62 STAR GND A B	*D *C G H
15 33	GND GND	0V 0V	A62 STAR GND A62 STAR GND	*D *D
16 GND 34	0V GND	A62 STAR GND 0V	*D A62 STAR GND	 *D
17 35	HNUP GND	TTL (HIGH TRUE) 0V	*H A62 STAR GND	* *D
18 36	−5.2V −5.2V	−5.2V −5.2V	C D C D	*H *H

A single letter in the source or destination column refers to a function block on this assembly schematic.

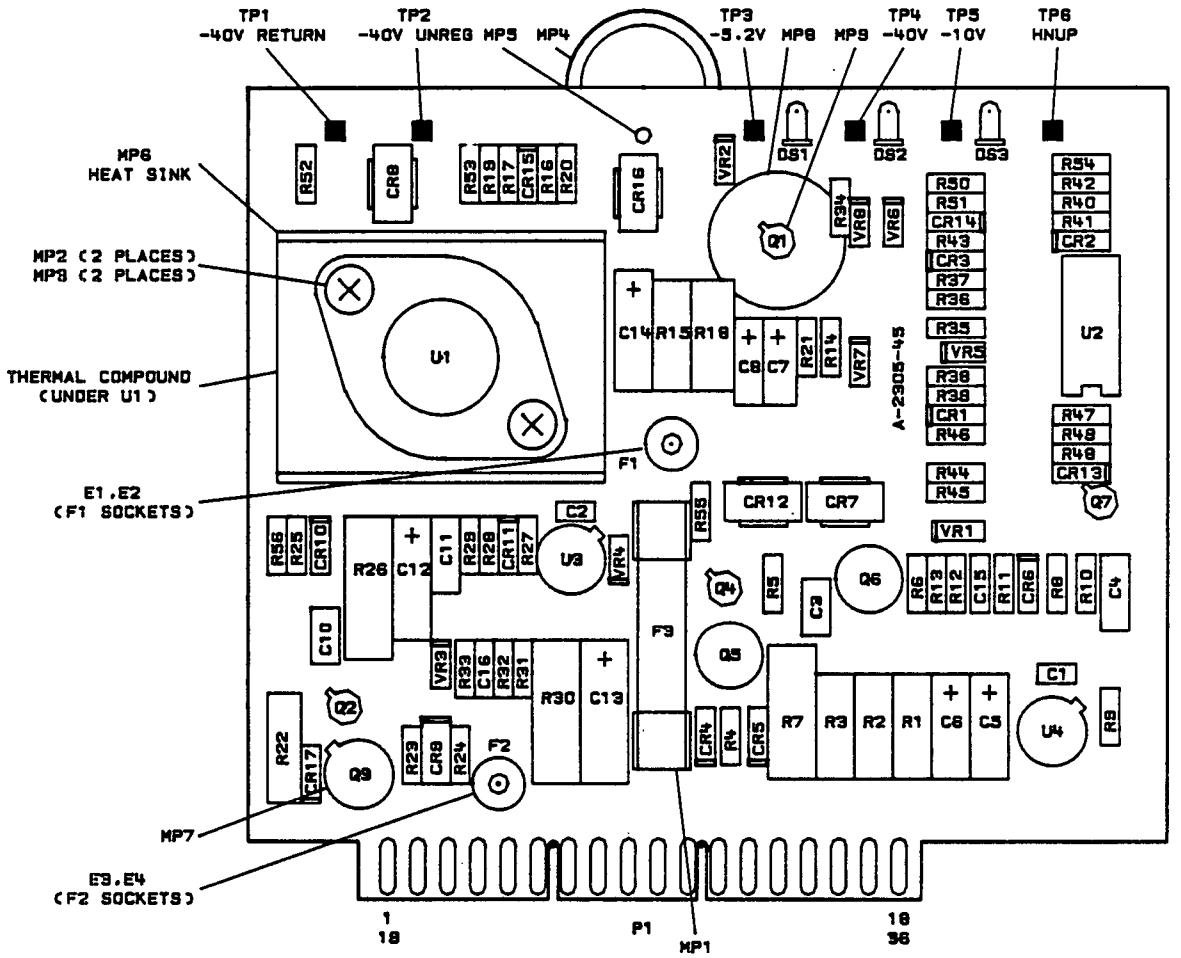
An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.

Table A56-4. A56 −15V Regulator P1 I/O

Pin	Mnemonic	Levels	Source	Destination
1 16	HNUP HNUP	TTL (HIGH TRUE) TTL (HIGH TRUE)	*C *C	* *
2 17				
3 18	−40V/−40V SENSE(−) −40V/−40V SENSE (−)	−40V −40V	XA53P1-11, 30/XA53P1-23 XA53P1-11, 30/XA53P1-23	*A *A
4 19	−10V −10V	−10V −10V	XA53P1-12, 13, 31, 32 XA53P1-12, 13, 31, 32	*NOT USED *NOT USED
5 20	GND GND	0V 0V	A62 STAR GND A62 STAR GND	*D *D
6 21				
7 22				
8 23				
9 24				
10 25				
11 26				
12 27				
13 28				
14 29				
14 30	−15V −15V	−15V −15V	A B A B	*C *C

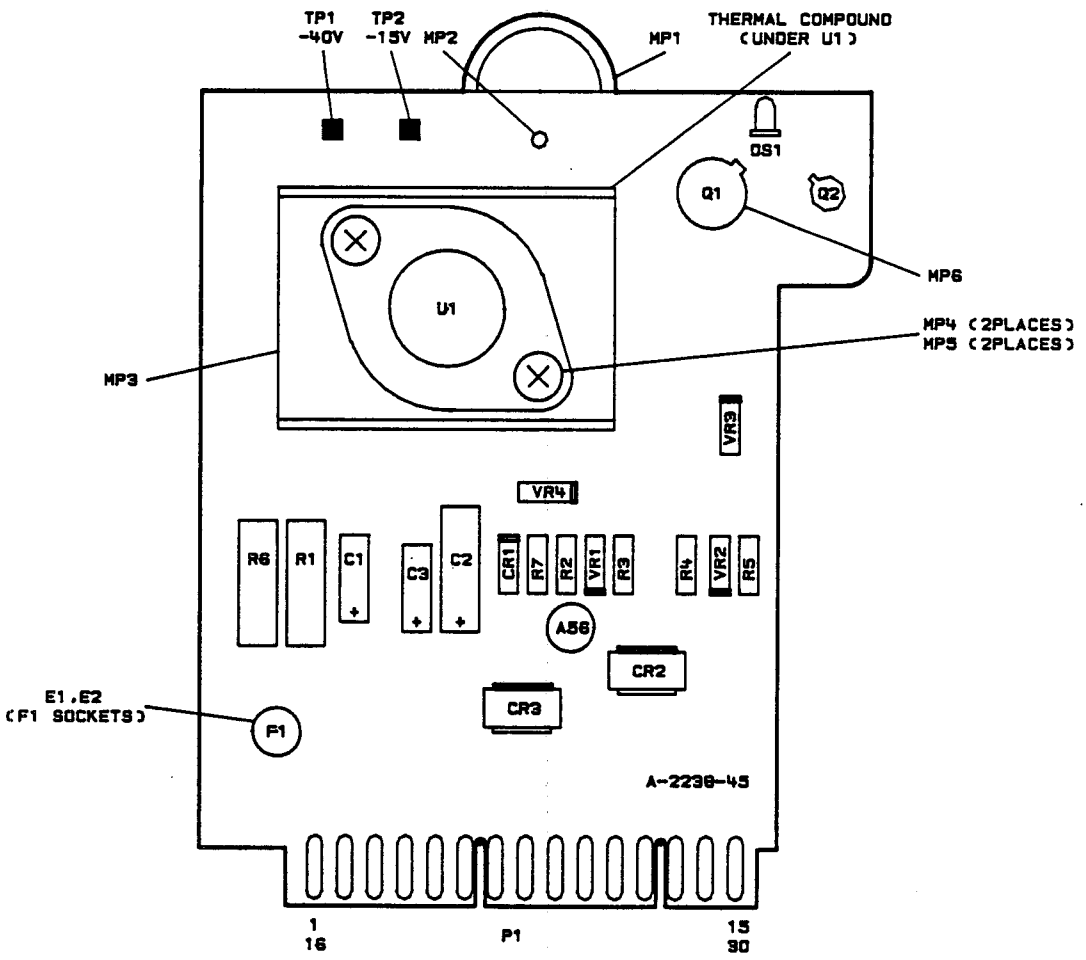
A single letter in the source or destination column refers to a function block on this assembly schematic.

An asterisk (*) denotes multiple sources or destinations; refer to the A62 motherboard wiring list for a complete representation of signal sources and destinations.



HP Part Number: 08340-60161

Figure A56-1. A53 Negative Regulator Component Location Diagram



HP Part Number: 08340-60029

Figure A56-2. A56 −15V Regulator Component Location Diagram

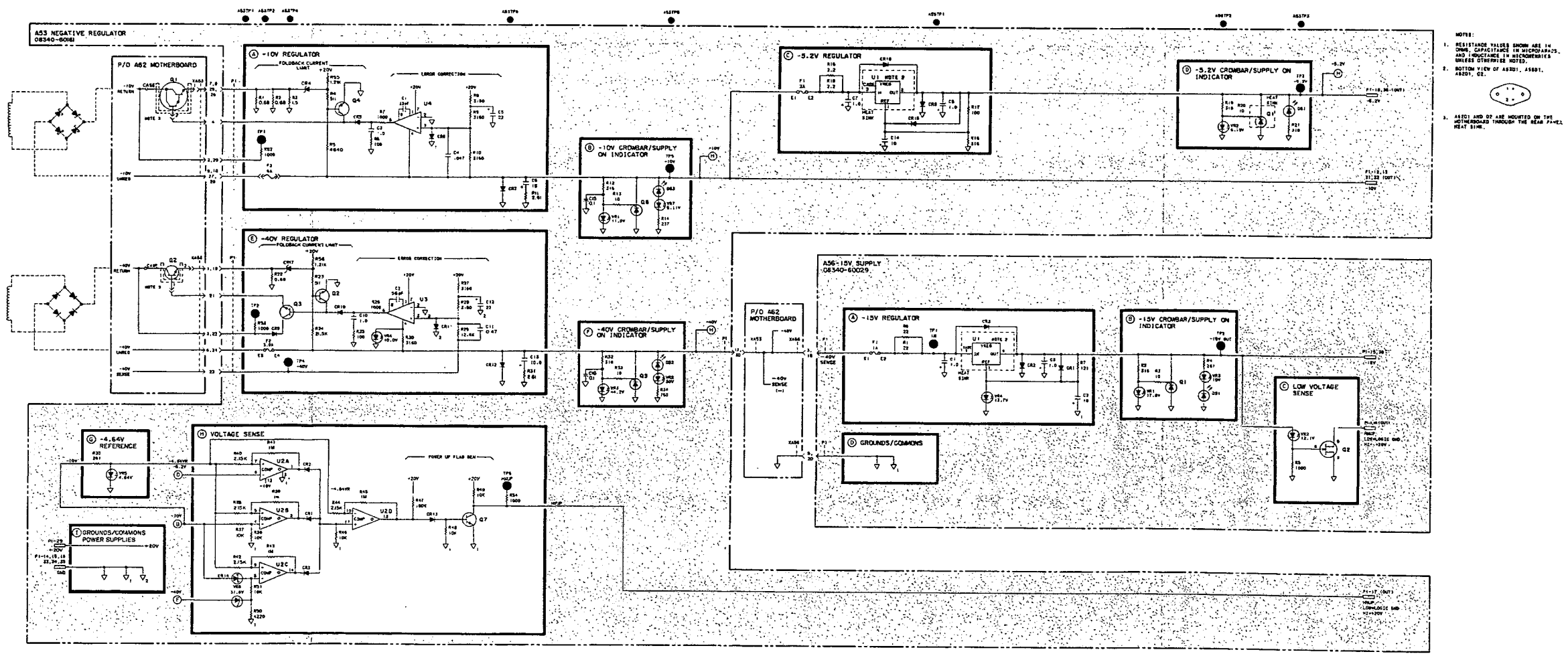


Figure A56-3. A53 Negative Regulator and A56 – 15V Regulator, Schematic Diagram

Table A56-5. A53 Negative Regulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A53	**08340-60161**	**4**	**1**	**NEGATIVE REGULATOR ASSEMBLY**	**28480**	**08340-60161**
A53C1	0160-4807	3	1	CAPACITOR-FXD 33PF ±5% 100VDC CER 0±30	28480	0160-4807
A53C2	0160-4804	0		CAPACITOR-FXD 56PF ±5% 100VDC CER 0±30	28480	0160-4804
A53C3	0160-4535	4	2	CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A53C4	0160-4834	6	2	CAPACITOR-FXD .047UF ±10% 100VDC CER	28480	0160-4834
A53C5	0180-0228	6	2	CAPACITOR-FXD 22UF±10% 15VDC TA	56289	150D226X9015B2
A53C6	0180-1746	5	1	CAPACITOR-FXD 15UF±10% 20VDC TA	56289	150D156X9020B2
A53C7	0180-0291	3	2	CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A53C8	0180-0291	3		CAPACITOR-FXD 1UF±10% 35VDC TA	56289	150D105X9035A2
A53C9				NOT ASSIGNED		
A53C10	0160-4535	4		CAPACITOR-FXD 1UF ±10% 50VDC CER	28480	0160-4535
A53C11	0160-4834	6		CAPACITOR-FXD .047UF ±10% 100VDC CER	28480	0160-4834
A53C12	0180-0228	6		CAPACITOR-FXD 22UF±10% 15VDC TA	56289	150D226X9015B2
A53C13	0180-2610	4	1	CAPACITOR-FXD 10UF±10% 75VDC TA	00904	T110A106K075AS
A53C14	0180-0374	3	1	CAPACITOR-FXD 10UF±10% 20VDC TA	56289	150D106X9020B2
A53C15	0160-4835	7	2	CAPACITOR-FXD .1UF±10% 50VDC CER	02798	CAC04X7R104K050A
A53C16	0160-4835	7	2	CAPACITOR-FXD .1UF±10% 50VDC CER	02798	CAC04X7R104K050
A53CR1	1901-0033	2	9	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR4	1901-1068	5	2	DIODE-SCHOTTKY SM SIG	28480	1901-1068
A53CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR7	1901-0662	3	4	DIODE-PWR RECT 100V 6A	04713	MR751
A53CR8	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A53CR9	1901-0028	5	1	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A53CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR11	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR12	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A53CR13	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR14	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A53CR15	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A53CR16	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A53CR17	1901-1068	5		DIODE-SCHOTTKY SM SIG	28482	1901-1068
A53DS1	1990-1148	9	3	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-1148
A53DS2	1990-1148	9		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-1148
A53DS3	1990-1148	9		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-1148
A53E1	1251-2313	6	4	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A53E2	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A53E3	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A53E4	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A53F1	2110-0425	0	1	FUSE 2A 125V .25X.27	28480	2110-0425
A53F2	2110-0332	8	1	FUSE 3A 125V .25X.27	28480	2110-0332
A53F3	2110-0056	3	1	FUSE 6A 250V NTD 1.25X.25 UL IEC	75915	312006
A53MP1	2110-0643	4	1	FUSEHOLDER-CLIP TYPE 15A 250 V	28480	2110-0643
A53MP2	0590-0526	6	1	THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
A53MP3	2200-0105	4	1	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A53MP4	5040-6852	3	1	EXTRACTOR, ORANGE	28480	5040-6852
A53MP5	5000-9043	6	1	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
A53MP6	85662-00029	7	1	HEAT SINK	28480	85662-00029
A53MP7				NOT ASSIGNED		
A53MP8	1205-0011	0	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A53MP9	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A53Q1	1884-0244	9	1	THYRISTOR-SCR VRRM=400	3L585	S2600D
A53Q2	1854-0404	0	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A53Q3	1854-0271	9	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A53Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A53Q5	1884-0018	5	2	THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A53Q6	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A53Q7	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A53R1	0811-1079	6	3	RESISTOR .68 5% 3W PW TC=0±90	91637	CW2B1-3-T2-68/100-J
A53R2	0811-1079	6		RESISTOR .68 5% 3W PW TC=0±90	91637	CW2B1-3-T2-68/100-J
A53R3	0811-1220	9	1	RESISTOR 1.5 5% 3W PW TC=0±50	05524	CW-2B-39
A53R4	0757-0416	7	2	RESISTOR 511 1% .125W F TC=0±100	03292	C4-1/8-T0-511R-F
A53R5	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0±100	03292	C4-1/8-T0-4641-F
A53R6	0757-0401	0	3	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A53R7	0757-0159	5	2	RESISTOR 1K 1% .5W F TC=0±100	28480	0757-0159
A53R8	0757-0279	0	5	RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A53R9	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A53R10	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F

Table A56-5. A53 Negative Regulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A53R11	0698-8817	2	2	RESISTOR 2.61 1% .125W F TC=0±100	28480	0698-8817
A53R12	0698-3444	1	5	RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A53R13	0757-0346	2	3	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A53R14	0698-3442	9	1	RESISTOR 237 1% .125W F TC=0±100	24546	C4-1/8-T0-237R-F
A53R15	0811-1080	9	2	RESISTOR 2.2 5% 3W PW TC=0±50	28480	0811-1080
A53R16	0698-3444	1		RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A53R17	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A53R18	0811-1080	9		RESISTOR 2.2 5% 3W PW TC=0±50	28480	0811-1080
A53R19	0698-3444	1		RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A53R20	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A53R21	0698-3444	1		RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A53R22	0811-1079	6	1	RESISTOR .68 5% 3W PW TC=0±90	28480	0811-1079
A53R23	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	03292	C4-1/8-T0-511R-F
A53R24	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0±100	03292	C4-1/8-T0-2152-F
A53R25	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A53R26	0757-0159	5		RESISTOR 1K 1% .5W F TC=0±100	28480	0757-0159
A53R27	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A53R28	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A53R29	0698-8464	5	1	RESISTOR 12.6K .5% .125W F TC=0±50	28480	0698-8464
A53R30	0698-3410	1	1	RESISTOR 3.16K 1% .5W F TC=0±100	28480	0698-3410
A53R31	0698-8817	2		RESISTOR 2.61 1% .125W F TC=0±100	28480	0698-8817
A53R32	0698-3444	1		RESISTOR 316 1% .125W F TC=0±100	24546	C4-1/8-T0-316R-F
A53R33	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A53R34	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0±100	24546	C4-1/8-T0-751-F
A53R35	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0±100	24546	C4-1/8-T0-2610-F
A53R36	0757-0442	9	9	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A53R37	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A53R38	0698-0084	9	4	RESISTOR 2.15K 1% .125W F TC=0±100	03292	C4-1/8-T0-2151-F
A53R39	0698-8827	4	4	RESISTOR 1M 1% .125W F TC=0±100	03292	C4-1/8-T0-2151-F
A53R40	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0±100	03292	C4-1/8-T0-2151-F
A53R41	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	03292	CT4
A53R42	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0±100	03292	C4-1/8-T0-2151-F
A53R43	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	03292	CT4
A53R44	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0±100	03292	C4-1/8-T0-2151-F
A53R45	0698-8827	4		RESISTOR 1M 1% .125W F TC=0±100	03292	CT4
A53R46	0757-0442	9		RESISTOR 10K 1% .125W F TC = 0 ±100	24546	C4-1/8-TO-1002-F
A53R47	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A53R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A53R49	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A53R50	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A53R51	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A53R52	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A53R53	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A53R54	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A53R55	0757-0274	5	2	RESISTOR 1.21K 1% .125W F TC=0±100	03292	CT4-1/8-TO-1211-F
A53R56	0757-0274	5	2	RESISTOR 1.21K 1% .125W F TC=0±100	03292	CT4-1/8-TO-1211-F
A53TP1	0360-0535	0	6	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A53TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A53TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A53TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A53TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A53TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A53U1	1826-0523	5	1	IC 337 V RGLTR TO-3	27014	LM337K
A53U2	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A53U3	1820-0223	0	2	IC OP AMP GP TO-99 PKG	3L585	CA301AT
A53U4	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A53VR1	1902-3171	7	1	DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%	28480	1902-3171
A53VR2	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A53VR3	1902-3330	0	1	DIODE-ZNR 44.2V 2% DO-35 PD=.4W	28480	1902-3330
A53VR4	1902-0025	4	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A53VR5	1902-3083	0	1	DIODE-ZNR 4.64V 2% DO-35 PD=.4W	28480	1902-3083
A53VR6	1902-3291	2	1	DIODE-ZNR 31.6V 2% DO-35 PD=.4W	28480	1902-3291
A53VR7	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A53VR8	1902-0244	9	1	DIODE-ZNR 30V 5% PD=1W IR=5UA	28480	1902-0244

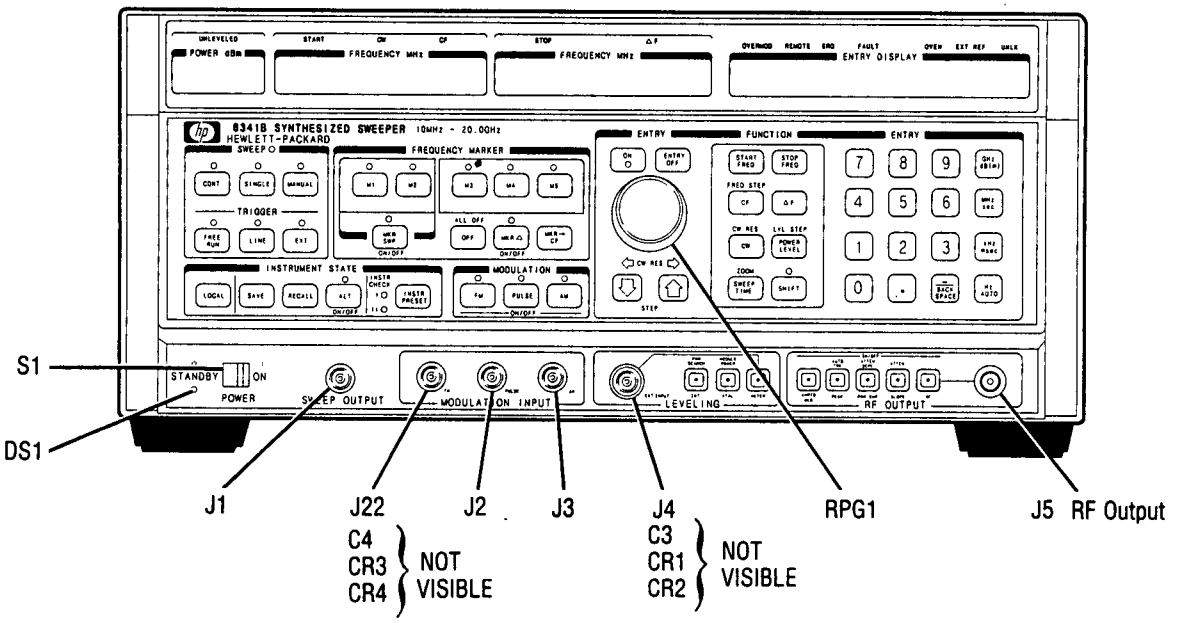
Table A56-6. A56 −15V Regulator Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A56	**08340-60029**	**2**	**1**	**−15V REGULATOR ASSEMBLY**	**28480**	**08340-60029**
A56C1	0180-2505	6	1	CAPACITOR-FXD 1UF ± 10% 75VDC TA	56289	150D105X9075B2
A56C2	0180-2129	0	1	CAPACITOR-FXD 10UF ± 10% 50VDC TA	56289	150D106X9050R2
A56C3	0180-0291	3	1	CAPACITOR-FXD 1UF ± 10% 35VDC TA	56289	150D105X9035A2
A56CR1	1901-0033	2	1	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A56CR2	1901-0662	3	2	DIODE-PWR RECT 100V 6A 04713 MR751		
A56CR3	1901-0662	3		DIODE-PWR RECT 100V 6A 04713 MR751		
A56DS1	1990-1147	8	1	LED-LAMP LUM-INT = 1MCD IF = 20MA-MAX BVR = 5V	28480	1990-1147
A56E1	1251-2313	6	2	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A56E2	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A56F1	2110-0047	2	1	FUSE 1A 125V .25X.27	71400	GMW-1
A56MP1	5040-6849	8	1	EXTRACTOR, P.C. BOARD	28480	5040-6849
A56MP2	5000-9043	6	1	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
A56MP3	08340-00030	9	1	HEAT SINK	28480	08340-00030
A56MP4	0590-0526	6	1	THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
A56MP5	2200-0105	4	1	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A56Q1	1884-0244	9	1	THYRISTOR-SCR VRRM = 400	3L585	S2600D
A56Q2	1855-0414	4	1	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A56R1	0811-1084	3	2	RESISTOR 22 5% 3W PW TC = 0 ± 30	28480	0811-1084
A56R2	0698-3444	1	1	RESISTOR 316 1% .125W F TC = 0 ± 100	24546	C4-1/8-T0-316R-F
A56R3	0757-0346	2	1	RESISTOR 10 1% .125W F TC = 0 ± 100	24546	C4-1/8-T0-10R0-F
A56R4	0698-3132	4	1	RESISTOR 261 1% .125W F TC = 0 ± 100	24546	C4-1/8-T0-2610-F
A56R5	0757-0280	3	1	RESISTOR 1K 1% .125W F TC = 0 ± 100	24546	C4-1/8-T0-1001-F
A56R6	0811-1084	3		RESISTOR 22 5% 3W PW TC = 0 ± 30	28480	0811-1084
A56R7	0757-0403	2	1	RESISTOR 121 1% .125W F TC = 0 ± 100	24546	C4-1/8-T0-121R-F
A56TP1	0360-0535	0	2	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A56TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A56U1	1826-0523	5	1	IC 337 V RGLTR TO-3	27014	LM337K
A56VR1	1902-3224	1	1	DIODE-ZNR 17.8V 5% DO-35 PD = .4W	28480	1902-3224
A56VR2	1902-3182	0	1	DIODE-ZNR 12.1V 5% DO-35 PD = .4W	28480	1902-3182
A56VR3	1902-0025	4	1	DIODE-ZNR 10V 5% DO-35 PD = .4W TC = +.06%	28480	1902-0025
A56VR4	1902-3197	7	1	DIODE-ZNR 13.7V 2% DO-35 PD = .4W	28480	1902-3197

Major Assemblies and Components Location – Chassis Parts
Component-Level Service J

CONTENTS

FRONT PANEL



REAR PANEL

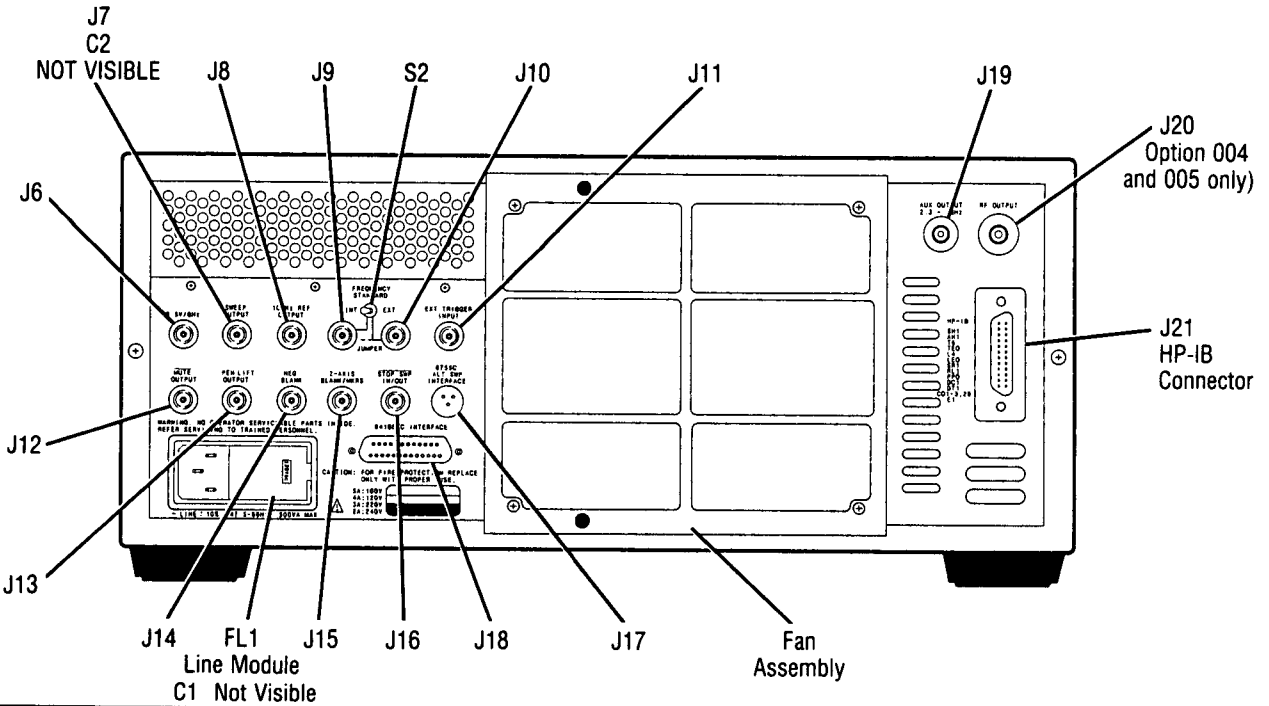


Figure J-1. Front and Rear Panels

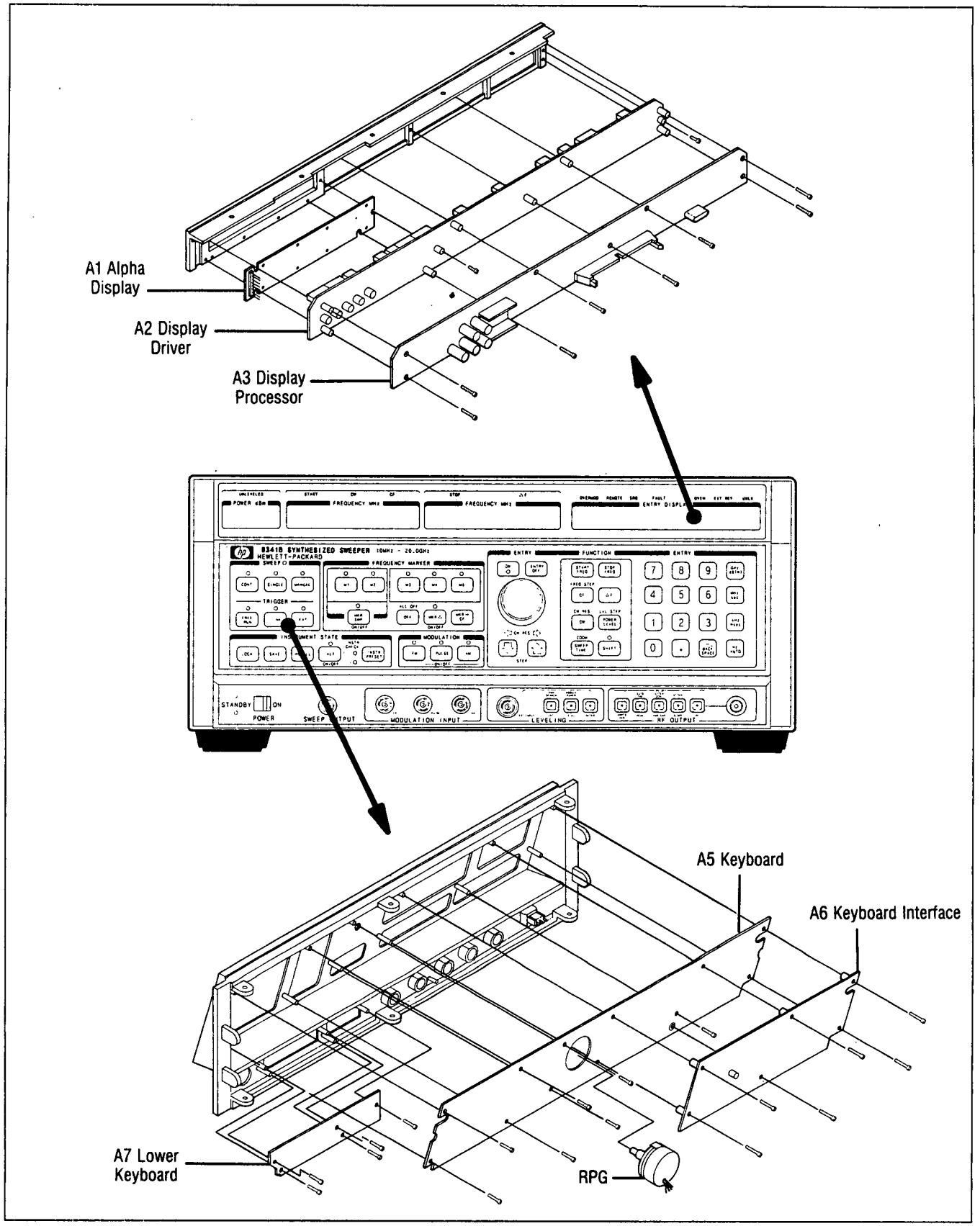


Figure J-2. Front Panel Assemblies

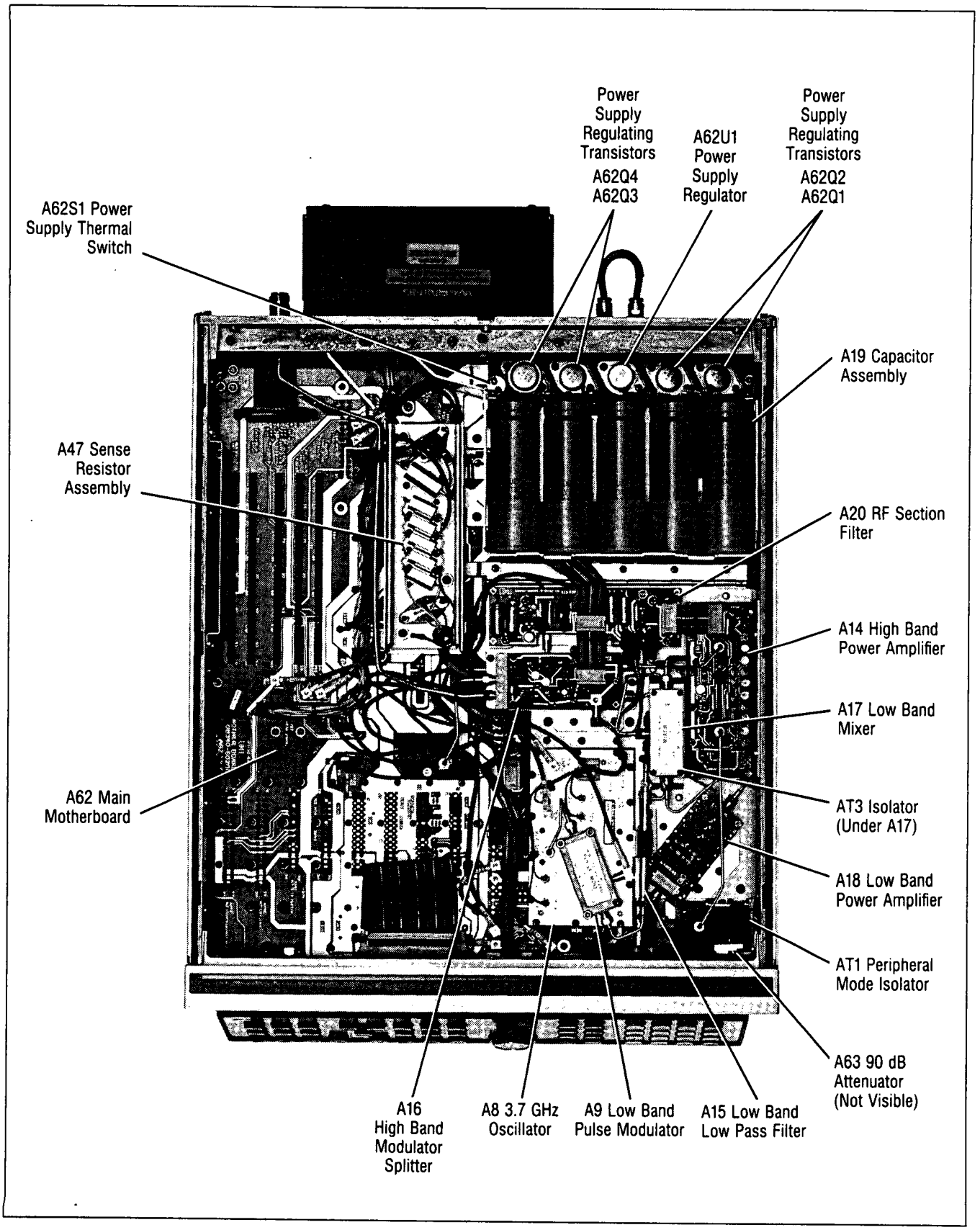


Figure J-3. HP 8341B Top View

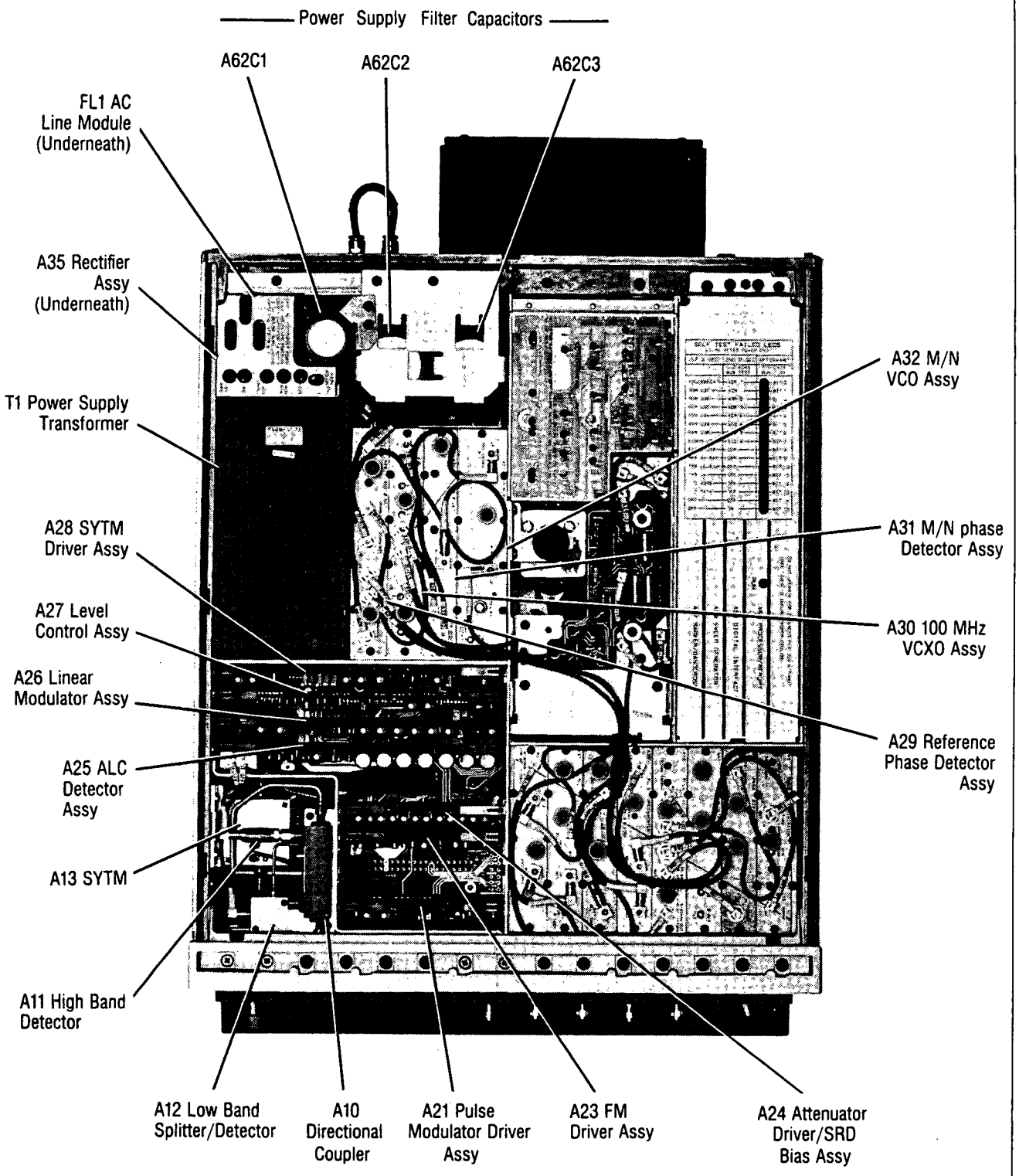


Figure J-4. HP 8341B - Bottom View (1 of 2)

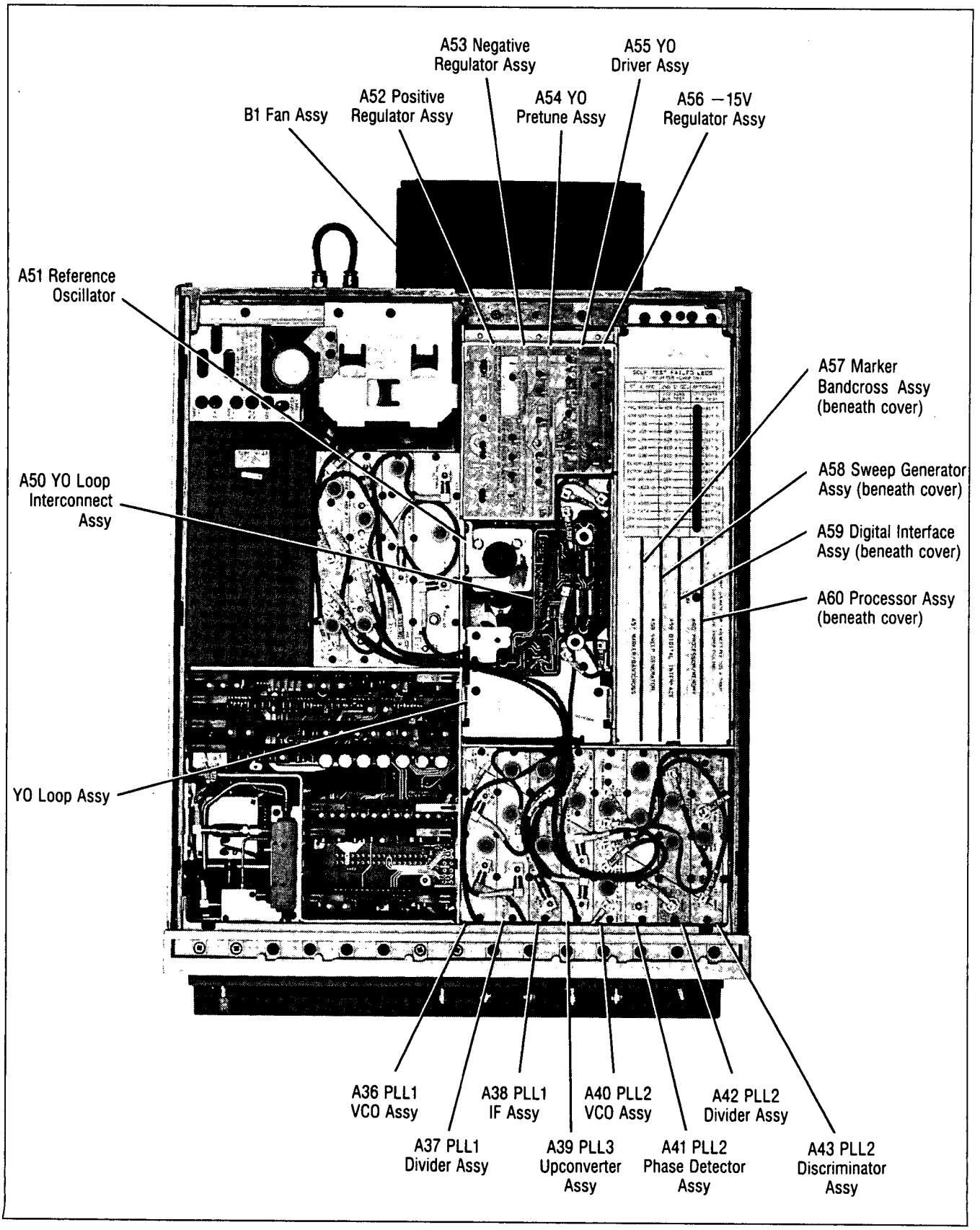


Figure J-4. HP 8341B - Bottom View (2 of 2)

Table J-1. Miscellaneous Electrical Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				MISCELLANEOUS ELECTRICAL PARTS		
A63	08340-60175	9	1	90 DB PROGRAMMABLE ATTENUATOR	28480	08340-60175
AT1	0960-0638	8	1	PERIPHERAL MODE ISOLATOR	28480	0960-0638
AT3	0960-0701	4	1	3.7 GHZ ISOLATOR	28480	0960-0701
B1	08340-60055	4	1	FAN ASSEMBLY Includes B1W1 and the following parts:	28480	08340-60055
	0360-0535	0	2	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0890-0029	0	1	TUBING-HS .187-D/.093-RCVD .02-WALL	28480	0890-0029
	0890-0983	5		TUBING-HS .125-D/.062-RCVD .02-WALL	28480	0890-0983
	1251-4223	1	2	CONNECTOR- CONT F .025	28480	1251-4223
	1251-6796	7	1	CONNECTOR HOUSING- 3 FEMALE IR	28480	1251-6796
	1400-0249	0	1	CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
	1520-0230	3	4	SHOCK MOUNT .27-EFF-HGT 2-LB-LOAD-CAP	28480	1520-0230
	2190-0017	4	2	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
	2200-0770	9	10	SCREW-MACH 4-40 .188-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
	2360-0119	8	4	SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0196	1	4	SCREW-MACH 6-32 .375-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
	2510-0135	7	2	SCREW-MACH 8-32 2.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2680-0137	8	1	SCREW-MACH 10-32 .188-IN-LG PAN-HD-SLT	00000	ORDER BY DESCRIPTION
	3160-0371	1	1	FAN-TBAX 180-CFM 115V 50/60-HZ	28480	3160-0371
	8150-0011	0	1	WIRE 22AWG G 300V PVC 7X30 105C	28480	8150-0011
	8150-0447	6	1	WIRE 24AWG BK 300V PVC 7X32 80C	28480	8150-0447
	08340-00012	7	1	HOUSING FAN (TOP)	28480	08340-00012
	08340-00013	8	1	HOUSING FAN (BOTTOM)	28480	08340-00013
	08340-00014	9	1	HOUSING FAN (GRILLE)	28480	08340-00014
	08340-00016	1	1	BASE PLATE	28480	08340-00016
	08340-00017	2	1	GRILL AIR FILTER	28480	08340-00017
	08340-00018	3	1	FILTER-AIR	28480	08340-00018
	85660-20092	4	4	SNUBBER-SHOCK MOUNT	28480	85660-20092
C1	0160-4065	5	1	CAPACITOR-FXD .1UF ±20% 250VAC (RMS) (On FL1, line module)	28480	0160-4065
C2	0160-4819	7	1	CAPACITOR-FXD 2200PF ±5% 100VDC CER (On J7, sweep output)	28480	0160-4819
C3	0160-4832	4	2	CAPACITOR-FXD .01UF ±10% 100VDC CER (On J4, external input)	28480	0160-4832
C4	0160-4832	4		CAPACITOR-FXD .01UF ±10% 100VDC CER (On J22, FM input)	28480	0160-4832
CR1	1901-0179	7	4	DIODE-SWITCHING 15V 50MA 750PS DO-7 (On J4, exteral input)	28480	1901-0179
CR2	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7 (On J4, external input)	28480	1901-0179
CR3	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7 (On J22, FM input)	28480	1901-0179
CR4	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7 (On J22, FM input)	28480	1901-0179
DS1	1990-0858	6	1	LED-LAMP LUM-INT=150UCD IF=25MA MAX (On front panel. Standby indicator)	28480	1990-0858
	1450-0615	9	1	LAMPHOLDER	28480	1450-0615
	08340-40002	9	1	L.E.D. MOUNT	28480	08340-40002
F1	2110-0002	9	1	FUSE 2A 250V NTD 1.25X.25 UL (For 240V operation)	75915	312002
F1	2110-0003	0	1	FUSE 3A 250V NTD 1.25X.25 UL (For 200V operation)	75915	312003
F1	2110-0010	9	1	FUSE 5A 250V NTD 1.25X.25 UL (For 100V operation)	75915	312005
F1	2110-0055	2	1	FUSE 4A 250V NTD 1.25X.25 UL (For 120V operation)	75915	312004
FL1	08340-60257	8	1	LINE MODULE-FILTERED REPLACEMENT KIT (Includes 2 metal retainers)	28480	08340-60257
J1				P/O J1W1		
J1W1	08340-60071	4	1	CABLE ASSY-COAX (SWP OUT)	28480	08340-60071
	0590-1251	6	4	NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD	00000	ORDER BY DESCRIPTION
	1250-0870	4	3	CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM	28480	1250-0870
J2				P/O J2W1		
J2W1	08340-60066	7	1	CABLE ASSY-COAX (PULSE)	28480	08340-60066
	0590-1251	6		NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD	00000	ORDER BY DESCRIPTION
	1250-0870	4		CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM	28480	1250-0870

Table J-1. Miscellaneous Electrical Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
J3				P/O J3W1		
J3W1	08340-60069	0	1	CABLE ASSY-COAX (AM)	28480	08340-60069
	0590-1251	6		NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD	00000	ORDER BY DESCRIPTION
	1250-0870	4		CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM	28480	1250-0870
J4				P/O J4W1		
J4W1	08340-60068	9	1	CABLE ASSY-COAX (EXT INPUT)	28480	08340-60068
	00310-48801	0	2	WASHER-SHOULDERED	28480	00310-48801
	0590-1251	6		NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD	00000	ORDER BY DESCRIPTION
	0360-1158	5	1	LUG	28480	0360-1158
	1250-1091	3	1	CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM	28480	1250-1091
J5	5061-5316	6	1	RF OUTPUT CONNECTOR ASSEMBLY	28480	5061-1100
J6	1250-0083	1	8	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	0360-1632	0	4	TERMINAL-SLDR LUG LK-MTG FOR-#3/8-SCR	28480	0360-1632
	2950-0001	8	2	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J7	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	0360-1632	0		TERMINAL-SLDR LUG LK-MTG FOR-#3/8-SCR	28480	0360-1632
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J7W1	08340-60070	3	1	CABLE ASSY-COAX (A62J8 TO R.P. J7)	28480	08340-60070
J8	1250-0102	5	3	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0102
	2190-0068	5	3	WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
	2950-0054	1	3	NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
J8W1	08340-60086	1	1	CABLE ASSY-COAX (A29J5 TO R.P. J8)	28480	08340-60086
J9	1250-0102	5		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0102
	2190-0068	5		WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
	2950-0054	1		NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
J9W1	08340-60089	4	1	CABLE ASSY-COAX (A51J1 TO R.P. J9)	28480	08340-60089
J10	1250-0102	5		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0102
	2190-0068	5		WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
	2950-0054	1		NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
J10W1	08340-60085	0	1	CABLE ASSY-COAX (A29J1 TO R.P. J10)	28480	08340-60085
J11	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3	4	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
J12	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
J13	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	0360-1632	0		TERMINAL-SLDR LUG LK-MTG FOR-#3/8-SCR	28480	0360-1632
J14	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
J15	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
J16	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	0360-1632	0		TERMINAL-SLDR LUG LK-MTG FOR-#3/8-SCR	28480	0360-1632
J17	1251-6781	0	1	CONNECTOR 3-PIN M CIRC AUDIO (Includes mounting hardware)	28480	1251-6781
J18	1251-0064	0	1	CONNECTOR 25-PIN F D SERIES	28480	1251-0064
	1251-2942	7	2	MOUNTING HARDWARE KIT	28480	1251-2942
J19	08340-60127	1	1	CONNECTOR-TYPE N (R.P. AUX OUT)	28480	08340-60127
	2190-0104	0	1	WASHER-LK INTL T 7/16 IN .439-IN-ID	28480	2190-0104
	2950-0132	6	1	NUT-HEX-DBL-CHAM 7/16-28-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J20				REFER TO OPTION 004 AND 005 LISTINGS		
J21				P/O J21W1		
J21W1	8120-3653	9	1	CABLE ASSY-RIBBON (HP-IB) (Includes J21 and mounting hardware)	28480	8120-3653
J22	1250-1091	3	1	BODY-RF CONNECTOR BNC FEMALE; STRAIGHT	03316	28JS124-1
	0360-1158	5	1	TERMINAL-SLDR LUG PL-MTG .062-HOLE-DID	05313	5413-21
	00310-48801	0	2	WASHER SHOULDERED, INSULATING	00000	ORDER BY DESCRIPTION
	0590-1251	6	1	NUT-SPCLY 15/32-32-THD .1-IN-THK .562-WD	00000	ORDER BY DESCRIPTION
RPG1	08340-60197	5	1	ROTARY PULSE GENERATOR REPLACEMENT KIT (Includes locking tangs, connector housing, nut and washer)	28480	08340-60197
S1	3101-2193	5	1	SWITCH-TGL SUBMIN SPDT 2A 250VAC	28480	3101-2193
S2	3101-0163	5	1	FREQUENCY STANDARD SWITCH KIT (Includes mounting hardware)	28480	3101-0163

Table J-1. Miscellaneous Electrical Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
T1	9100-4133	1	1	TRANSFORMER	28480	9100-4133
	08340-60124	8		COMPLETE TRANSFORMER ASSEMBLY (Includes wiring harness and attached lugs) Individual transformer wire solder lugs can be ordered below:	28480	08340-60124
	0360-0037	7	6	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR	28480	0360-0037
	0360-0042	4	2	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR	28480	0360-0042
	0360-0043	5	1	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR	28480	0360-0043
W1	08340-60062	3	1	CABLE ASSY-RIBBON A7J1 TO A6J1	28480	08340-60062
W2	NONE		1	WIRE ASSY-RF MODULE(GND) TO FRONT PANEL		
W3	08340-20198	2	1	CABLE ASSY-RIGID COAX W51 TO A16J2	28480	08340-20198
W4	08340-20116	4	1	CABLE ASSY-RIGID COAX A16J1 TO J19	28480	08340-20116
W5	08340-20241	6	1	CABLE ASSY-RIGID COAX A17J2 TO A16J7	28480	08340-20241
W6	08340-20108	4	1	CABLE ASSY-RIGID COAX A16J6 TO A14J1	28480	08340-20108
W7	08340-20111	8	1	CABLE ASSY-RIGID COAX A14J1 TO AT1J1	28480	08340-20110
W8	08340-20111	9	1	CABLE ASSY-RIGID COAX AT1J2 TO A13J1	28480	08340-20111
W9	08340-20114	2	1	CABLE ASSY-RIGID COAX A8A2J1 TO A9J1	28480	08340-20114
W10	08340-20268	7	1	CABLE ASSY-RIGID COAX A9J2 TO A15J1	28480	08340-20268
W11				NOT ASSIGNED		
W12	08340-20107	3	1	CABLE ASSY-RIGID COAX A17J3 TO A18J1	28480	08340-20107
W13	08340-20223	4	1	CABLE ASSY-RIGID COAX A18J2 TO A12J1	28480	08340-20223
W14	08340-20224	5	1	CABLE ASSY-RIGID COAX A12J2 TO A13J2	28480	08340-20224
W15				NOT ASSIGNED		
W16	08340-20221	2	1	CABLE ASSY-RIGID COAX A13J3 TO A10J1	28480	08340-20221
W17				NOT ASSIGNED		
W18	08340-20119	7	1	CABLE ASSY-RIGID COAX A10J3 TO A63J1(STD)	28480	08340-20119
W19	08340-20117	5	1	CABLE ASSY-RIGID COAX A63J2 TO J5 (STD)	28480	08340-20117
W20	08340-20122	2	1	CABLE ASSY-RIGID COAX A63J2 TO J20 (004)	28480	08340-20122
W21	08340-20121	1	1	CABLE ASSY-RIGID COAX A10J3 TO J5 (001)	28480	08340-20121
W22	08340-20120	0	1	CABLE ASSY-RIGID COAX A10J3 TO J20 (005)	28480	08340-20120
W23	08340-60118	0	1	CABLE ASSY-COAX A30J3 TO A8A1J1	28480	08340-60118
W24	08340-60117	9	1	CABLE ASSY-COAX A62J14 TO A8A1J2	28480	08340-60117
W25	08340-60119	1	1	CABLE ASSY-COAX A62J10 TO A9J3	28480	08340-60119
W26	08340-60115	7	1	CABLE ASSY-COAX A12J3 TO A25J2	28480	08340-60115
W27	08340-60114	6	1	CABLE ASSY-COAX A11J2 TO A25J1	28480	08340-60114
W28	08340-60126	0	1	CABLE ASSY-COAX A62J13 TO A16J3	28480	08340-60126
W29	08340-60125	9	1	CABLE ASSY-COAX A62J25 TO A16J4	28480	08340-60125
W30	08340-60080	5	1	CABLE ASSY-COAX A16A1J2 TO A16J5	28480	08340-60080
W31	08340-60060	1	1	CABLE ASSY-RIBBON A62J19 TO A20J1/A16A1	28480	08340-60060
W32	08340-60058	7	1	CABLE ASSY-RIBBON A20J2 TO A14A1J1	28480	08340-60058
W33	08340-60061	2	1	CABLE ASSY-RIBBON A62J18 TO A13A1J1	28480	08340-60061
W34	08340-60116	8	1	CABLE ASSY-COAX A29J4 TO A37J1	28480	08340-60116
W35	08340-60081	6	1	CABLE ASSY-COAX A39J2 TO A30J2	28480	08340-60081
W36	08340-60073	6	1	CABLE ASSY-COAX A29J3 TO A42J1	28480	08340-60073
W37	08340-60075	8	1	CABLE ASSY-COAX A49J1 TO A44J1	28480	08340-60075
W38	08340-60074	7	1	CABLE ASSY-COAX A49J2 TO A62J6	28480	08340-60074
W39	08340-60078	1	1	CABLE ASSY-COAX A36J1 TO A49J3	28480	08340-60078
W40	08340-60072	5	1	CABLE ASSY-COAX A48J1 TO A49J4	28480	08340-60072
W41	08340-60084	9	1	CABLE ASSY-COAX A33J2 TO A48J2	28480	08340-60084
W42	08340-20197	1	1	CABLE ASSY-RIGID COAX A44J2 TO A45J1	28480	08340-20197
W43	08340-20196	0	1	CABLE ASSY-RIGID COAX AT2J2 TO A46J1	28480	08340-20196
W44	08340-20101	7	1	CABLE ASSY-RIGID COAX A46J2 TO A48U1J1	28480	08340-20101
W45	NONE	1		WIRE ASSY-STAR GND TO LUG BY A62J29		
W46	08340-60184	0	1	WIRE ASSY (Includes W47 and J7W1)	28480	08340-60184
W47	08340-60082	7	1	CABLE ASSY-COAX A62J27 TO A62J4	28480	08340-60082
W48	08340-60079	2	1	CABLE ASSY-COAX A62J5 TO A62J11	28480	08340-60079
W49	08340-60088	3	1	CABLE ASSY-COAX J9 TO J10	28480	08340-60088
W50	08340-60065	6	1	WIRE ASSY- A6J4 TO POWER SWITCH	28480	08340-60065
W51	08340-20195	9	1	CABLE ASSY-RIGID COAX A45J3 TO W3	28480	08340-20195
W52	08340-20233	6	1	CABLE ASSY-RIGID COAX A15J2 TO AT3J1	28480	08340-20233
W53	08340-20227	8	1	CABLE ASSY-RIGID COAX AT3J2 TO A17J1	28480	08340-20227

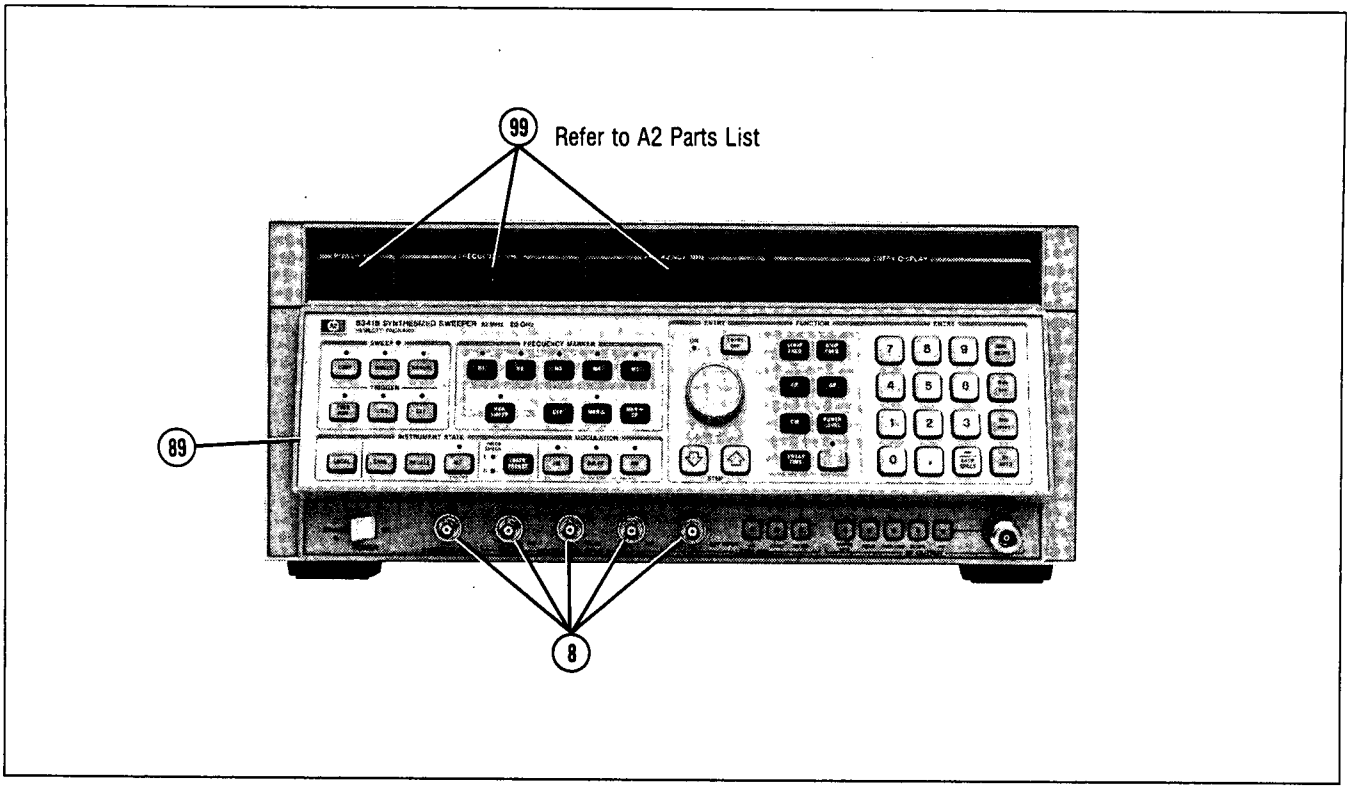


Figure J-5. Miscellaneous Mechanical & Chassis Parts (1 of 6)

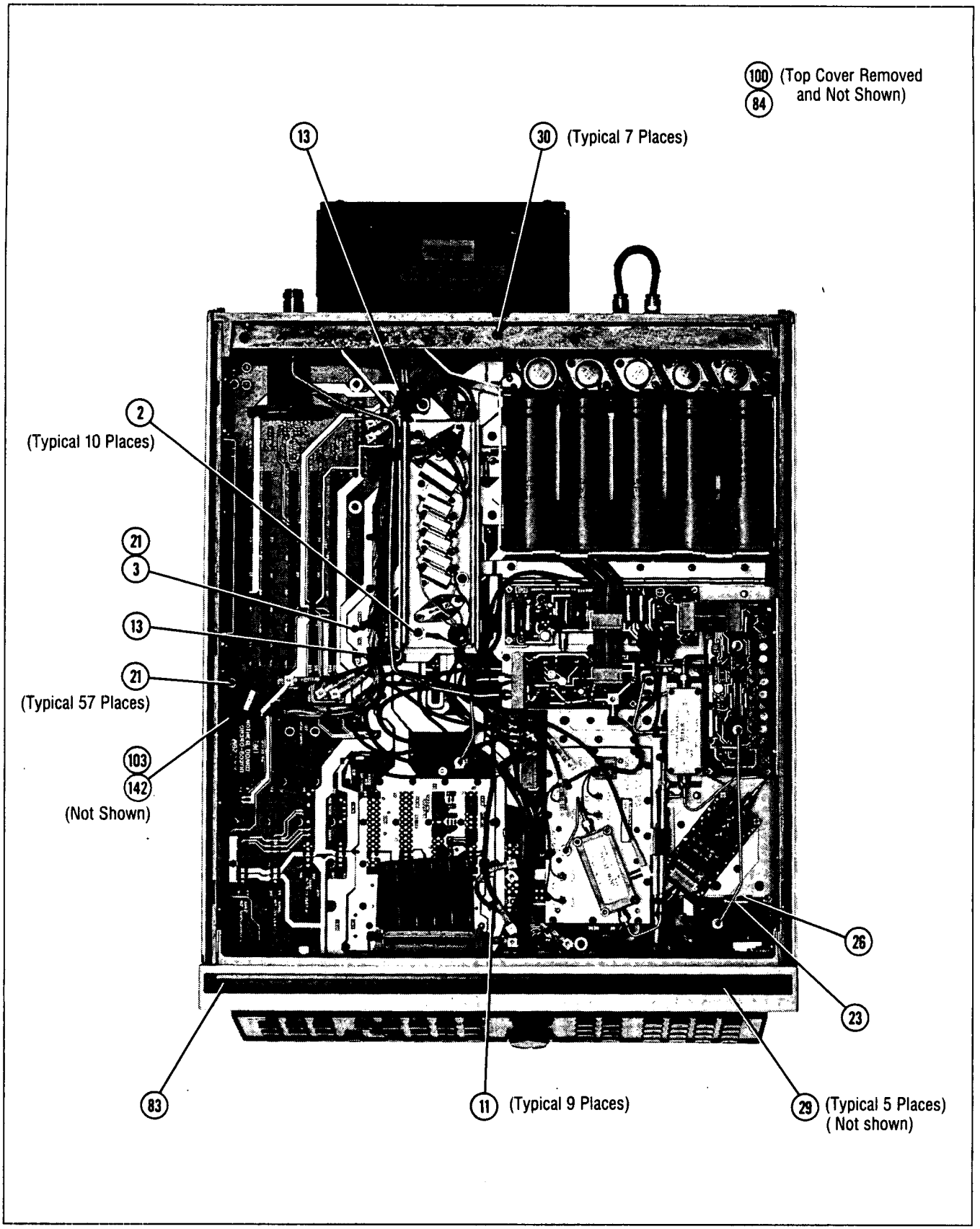


Figure J-5. Miscellaneous Mechanical & Chassis Parts (2 of 6)

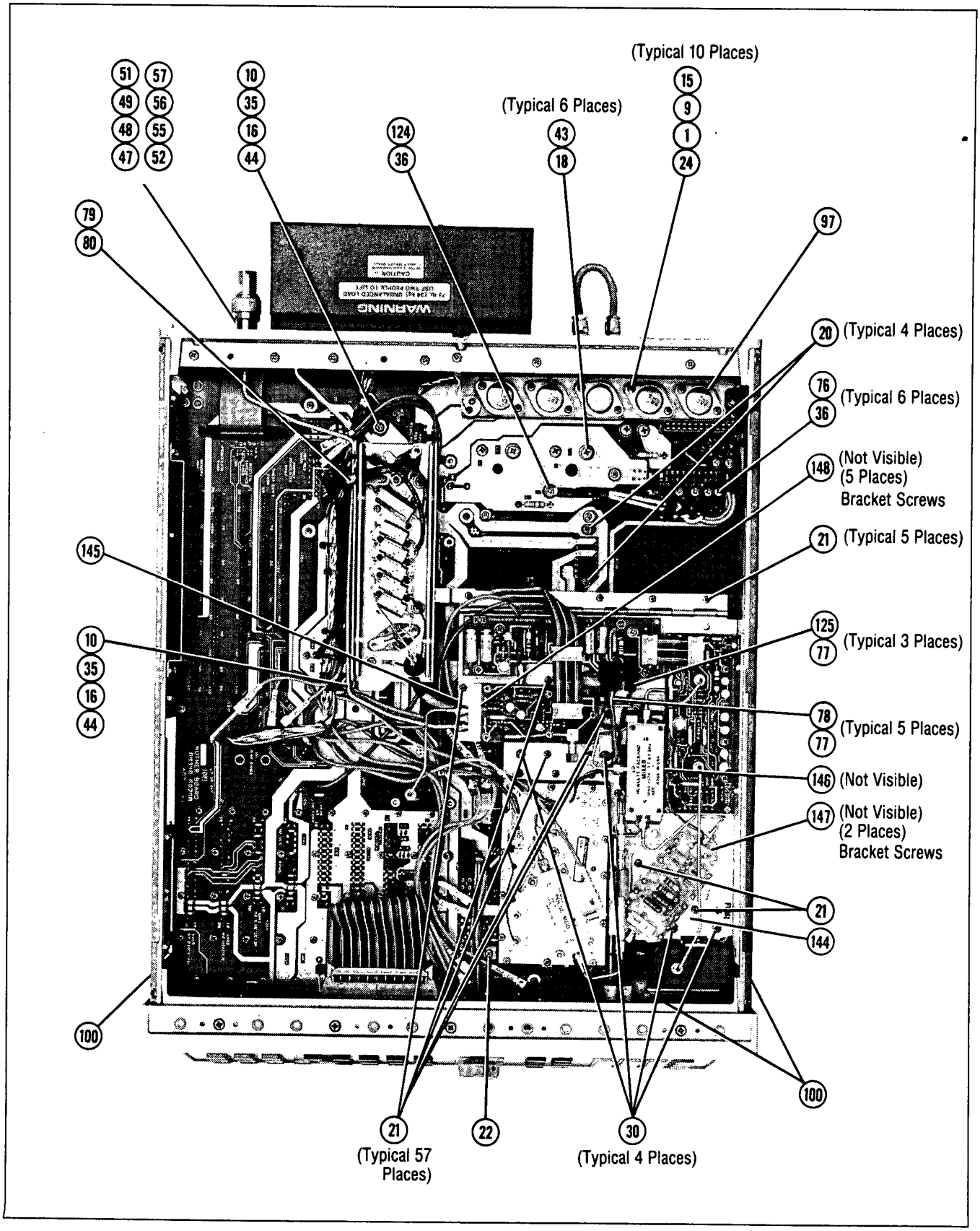


Figure J-5. Miscellaneous Mechanical & Chassis Parts (3 of 6)

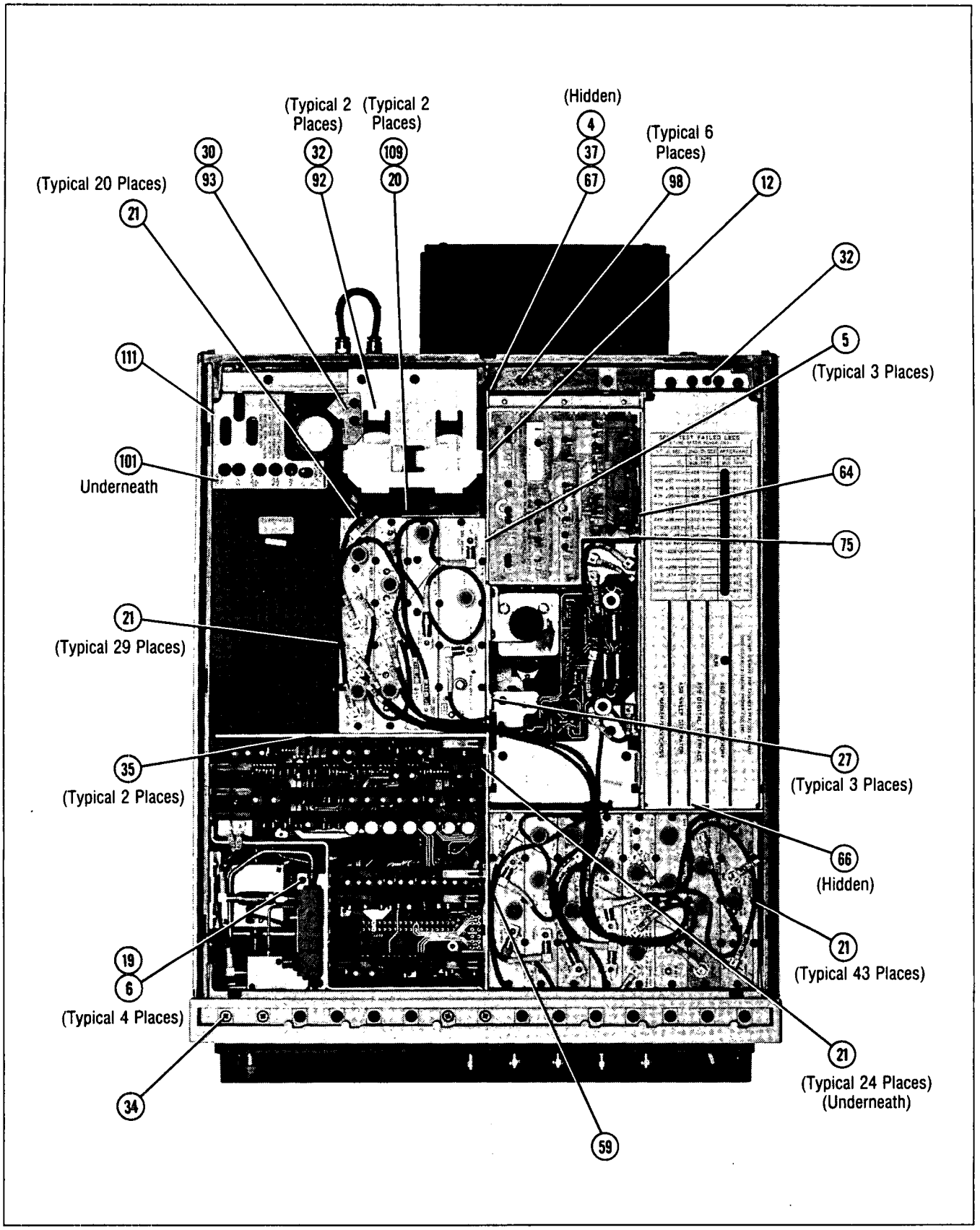


Figure J-5. Miscellaneous Mechanical & Chassis Parts (4 of 6)

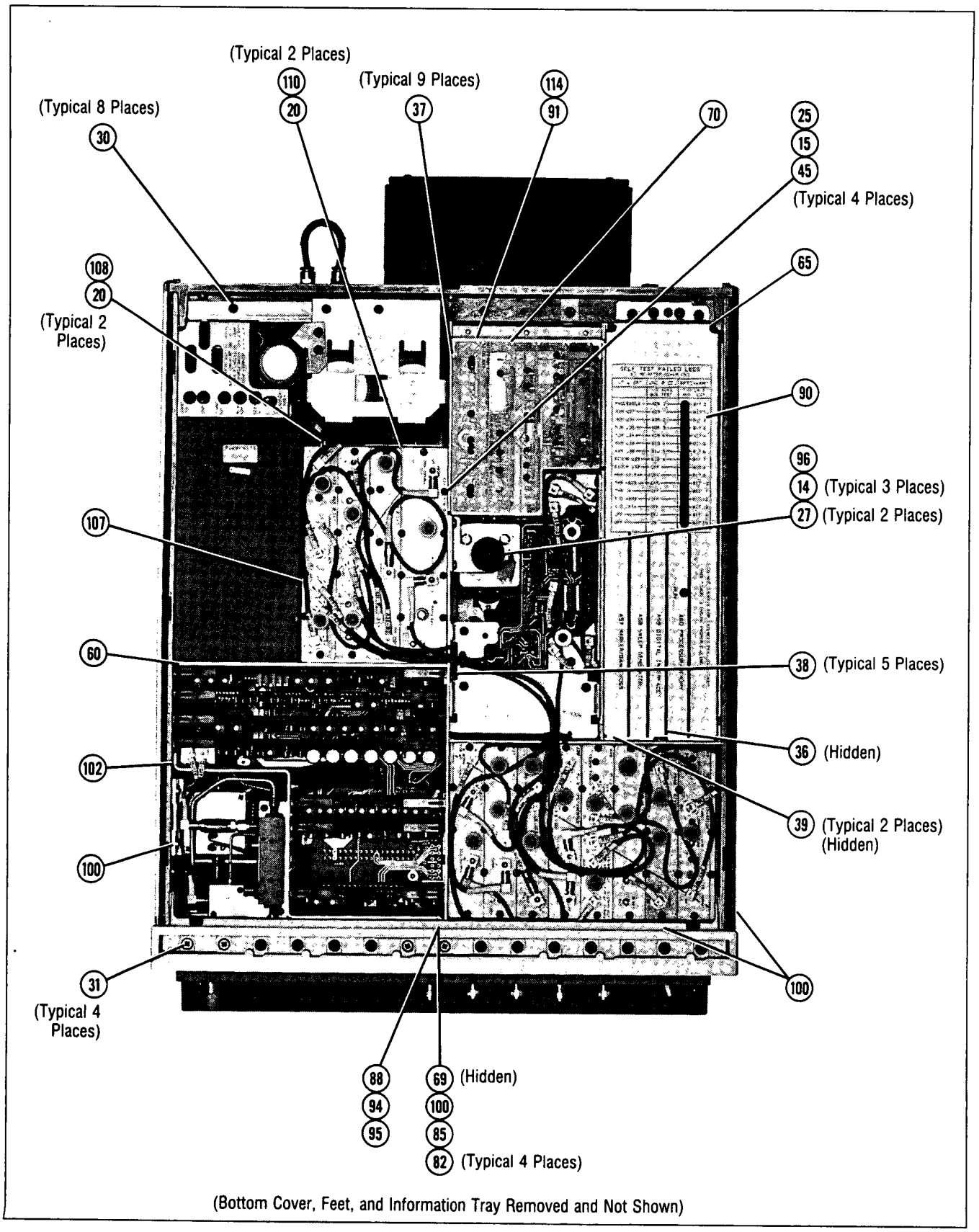


Figure J-5. Miscellaneous Mechanical & Chassis Parts (5 of 6)

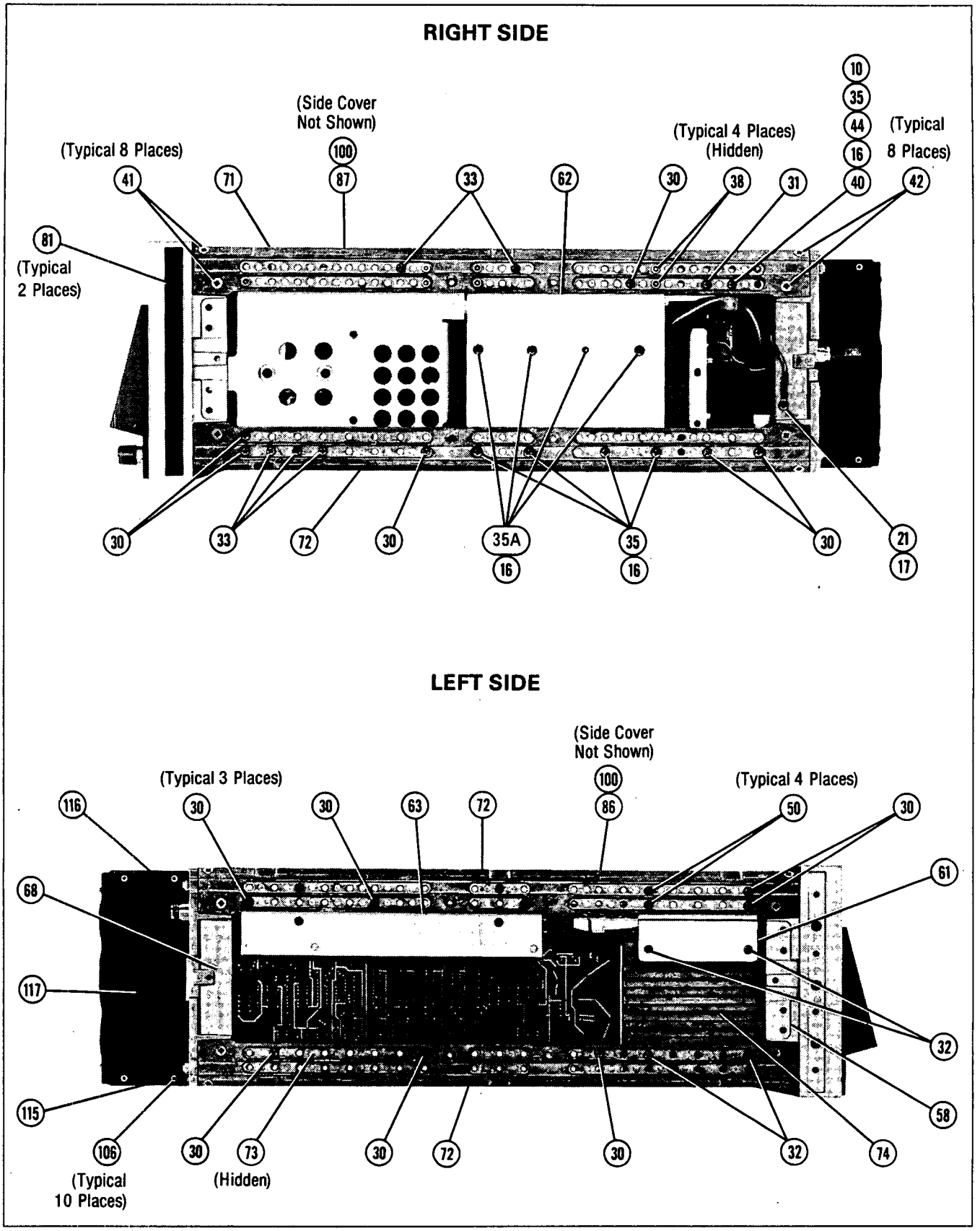


Figure J-5. Miscellaneous Mechanical & Chassis Parts (6 of 6)

Table J-2. Miscellaneous Mechanical & Chassis Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				MISCELLANEOUS MECHANICAL & CHASSIS PARTS		
1	0340-0923	8	10	INSULATOR-BSHG NYLON	28480	0340-0923
2	0360-0037	7	10	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR	28480	0360-0037
3	0360-0042	4	3	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR	28480	0360-0042
4	0400-0082	8	2	GROMMET-CHAN NCH .09-IN-GRV-WD	28480	0400-0082
5	0400-0219	3	3	GROMMET-RND .5-IN-ID .093-IN-GRV-WD	28480	0400-0219
6	0520-0127	6	4	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
7	0570-0632	3	10	SCREW-SPCL 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
8	0590-1251	6	4	NUT-HEX 15/32-32	00000	ORDER BY DESCRIPTION
9	1200-0043	8	5	INSULATOR-XSTR ALUMINUM	28480	1200-0043
10	1400-0031	8	3	CLAMP-CABLE .375-DIA .5-WD NYL	28480	1400-0031
11	1400-0249	0	9	CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
12	1400-0510	8	4	CLAMP-CABLE .15-DIA .62-WD NYL	28480	1400-0510
13	1400-0907	7	2	CLAMP-CABLE .187-DIA .5-WD FRTD-NYLON	95987	3/16-HFR
14	1520-0205	2	3	SHOCK MOUNT .31 HGT.	28480	1520-0205
15	2190-0003	8	14	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0003
16	2190-0006	1	15	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
17	2190-0008	3	1	WASHER-LK EXT T NO. 6 .141-IN-ID	28480	2190-0008
18	2190-0011	8	6	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
19	2190-0045	8	4	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045
20	2200-0103	2	4	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
21	2200-0105	4	111	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
22	2200-0107	6	1	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
23	2200-0141	8	1	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
24	2200-0149	6	10	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
25	2200-0153	2	4	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
26	2200-0166	7	3	SCREW-MACH 4-40 .312-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
27	2360-0111	0	5	SCREW-MACH 6-32 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
28	2360-0113	2	13	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
29	2360-0114	3	5	SCREW-MACH 6-32 .25-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
30	2360-0115	4	34	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
31	2360-0116	5	4	SCREW-MACH 6-32 .312-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
32	2360-0117	6	10	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
33	2360-0119	8	10	SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
34	2360-0122	3	1	SCREW-MACH 6-32 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
35	2360-0197	2	11	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
35A	2360-0193	8	4	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
36	2360-0331	6	9	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	28480	2360-0331
37	2360-0333	8	26	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
38	2360-0334	9	9	SCREW-MACH 6-32 .312-IN-LG 100 DEG	28480	2360-0334
39	2360-0360	1	2	SCREW-MACH 6-32 .438-IN-LG 100 DEG	28480	2360-0360
40	2420-0002	6	2	NUT-HEX-DBL-CHAM 6-32-THD .109-IN-THK	28480	2420-0002
41	0515-1331	5	16	SCREW-MACH M4x0.7x6mm FH 90	28480	0515-1331
42	0515-0896	5	8	SCREW-MACH M4x0.7x10mm FH 90	28480	0515-0896
43	2680-0129	8	6	SCREW-MACH 10-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
44	3050-0066	8	2	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0066
45	3050-0105	6	4	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
46	3050-0227	3	7	WASHER-FL MTLC NO. 6 .149-IN-ID	28480	3050-0227
47	1250-0915	8	1	CONTACT-RF CONN SER APC-N FEMALE	9D949	131-149
48	1250-1577	0	1	CONNECTOR-RF FEMALE TYPE N	28480	1250-1577
49	2190-0104	0	1	WASHER-LK INTL T 7/16 IN .439-IN-ID	28480	2190-0104
50	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
51	2950-0132	6	1	NUT-HEX-DBL-CHAM 7/16-28-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
52	5040-0306	0	1	INSULATOR	28480	5040-0306
53	08340-00011	6	1	PANEL-REAR (AUX OUTPUT)	28480	08340-00011
54	08340-00056	9	1	DEFLECTOR-AIR	28480	08340-00056
55	08555-20093	5	1	CONTACT JACK	28480	08555-20093
56	08555-20094	6	1	BODY-BULKHEAD	28480	08555-20094
57	08761-2027	4	1	INSULATOR	28480	08761-2027
58	5021-5805	4	1	FRAME-FRONT (METRIC)	28480	5021-5805
59	08340-00076	3	1	CENTER DIVIDER	28480	08340-00076
60	08340-00002	5	1	CHASSIS-RF MOD (REAR)	28480	08340-00002
61	08340-00003	6	1	BRACKET-20-30 MOUNT	28480	08340-00003
62	08340-00004	7	1	BRACKET-MOUNT TRANS	28480	08340-00004
63	08340-00005	8	1	SUPPORT-MOM BOARD	28480	08340-00005
64	08340-00020	7	1	DIVIDER PROCESSOR	28480	08340-00020
65	08340-00029	6	1	GUIDE PLATE-PC BOARDS	28480	08340-00029

Table J-2. Miscellaneous Mechanical & Chassis Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
66	08340-00031	0	1	SUPPORT-PC PROCESSOR	28480	08340-00031
67	08340-20051	6	1	SUPPORT-REAR CENTER	28480	08340-20051
68	08340-20234	7	1	FRAME (REAR) MOD (METRIC)	28480	08340-20234
69	08340-20054	9	1	SUPPORT-FRONT CENTER DIVIDER	28480	08340-20054
70	08340-20056	1	1	GUIDE-POWER SUPPLY	28480	08340-20056
71	08340-20236	9	1	STRUT-CORNER (TOP) (METRIC)	28480	08340-20236
72	08340-20238	1	3	STRUT-CORNER MOD (METRIC)	28480	08340-20238
73	85660-00004	6	1	BRACKET-PIVOT PROCESSOR	28480	85660-00004
74	85660-20190	3	1	HOUSING-20-30 MHZ	28480	85660-20190
75	86701-20006	2	1	GUIDE-FRONT PC	28480	86701-20006
76	0360-0037	7	6	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR	28480	0360-0037
77	1251-4223	1	10	CONTACT-CONN U/W-POST-TYPE FEM CRP	28480	1251-4223
78	1251-6594	3	1	CONNECTOR HOUSING-5 FEMALE IR	28480	1251-6594
79	8120-0579	2	1	CABLE-SHLD 22AWG 5-CNDCT JGK-JKT	28480	8120-0579
80	8150-0005	2		WIRE 22AWG BK 300V PVC 7X30 105C	28480	8150-0005
81	5001-0440	1	2	TRIM-SIDE F F	28480	5001-0440
82	5040-7201	8	4	FOOT-BOTTOM	28480	5040-7201
83	5040-7202	9	1	TRIM STRIP (TOP)	28480	5040-7202
84	5061-9435	8	1	COVER FM TOP (METRIC)	28480	5061-9435
85	5061-9447	2	1	COVER FM BOTTOM (METRIC)	28480	5061-9447
86	5061-9462	1	1	COVER SIDE (METRIC)	28480	5061-9462
87	5061-9517	7	1	COVER FM PERFORATED (METRIC)	28480	5061-9517
88	5061-2033	8	1	INFO TRAY ASSY KIT	28480	5061-2033
89	08340-00086	5	1	DRESS PANEL-KEYBOARD	28480	08340-00086
90	08340-00074	1	1	HOLDER-PC COVER	28480	08340-00074
91	08340-00040	1	1	HOLDER-POWER SUPPLY BOARDS	28480	08340-00040
92	08340-00060	5	1	PLATE-CAP HOLDER	28480	08340-00060
93	08340-00061	6	1	HOLDER-CAP HOLDER	28480	08340-00061
94	08340-90246	8	1	INFO CARD #1	28480	08340-90246
95	08340-90247	9	1	INFO CARD #2	28480	08340-90247
96	85660-00025	1	1	SHOCK MOUNT (TOP)	28480	85660-00025
97	85660-00027	3	1	INSULATOR-HEAT SINK	28480	85660-00027
98	86701-00028	6	1	SPRING-FLAT	28480	86701-00028
99	1990-0720	1	1	DISPLAY-SPECIAL 1 HI	28480	1990-0720
100	8160-0226	0	12	RFI RND STR 0500	28480	8160-0226
101	08340-00006	9	1	SUPPORT-PC RECT	28480	08340-00006
102	08340-00008	1	1	CHASSIS RF MOD (FRONT)	28480	08340-00008
103	08340-00064	9	1	POCKET (Holds Cal. Constant Data)	28480	08340-00064
104	6960-0009	1	1	HOLE PLUG .531-D-HOLE	28480	6960-0009
105	0380-0644	4	2	STANDOFF-HEX .400-IN-LG 6-32 THD	28480	0380-0644
106	2200-0164	5	10	SCREW-MACH 4-40 .188-IN-LG	28480	2200-0164
107	5021-3208	7	1	HOUSING-MACHINED	28480	5021-3208
108	86701-00029	7	1	BAFFLE-AIR TOP	28480	86701-00029
109	86701-00024	2	1	SCOOP-AIR	28480	86701-00024
110	86701-00030	0	1	BAFFLE-AIR BOTTOM	28480	86701-00030
111	08340-00067	2		COVER-RECT BOARD	28480	08340-00067
112	08340-00018	3		FAN FILTER	28480	08340-00018
113	08340-00017	2		GRILL-AIR	28480	08340-00017
114	3030-0152	1	2	SCREW-SET 4-40 .312-IN-LG SMALL CUP PT	28480	3030-0152
115	08340-00016	1	1	FAN HOUSING-BOTTOM	28480	08340-00016
116	08340-00012	7	1	FAN HOUSING-TOP	28480	08340-00012
117	08340-00014	9		FAN GRILL HOUSING	28480	08340-00014
118	1520-0230	3	4	SHOCK MOUNT	28480	1520-0230
119	08340-00016	1	1	BASE PLATE-FAN	28480	08340-00016
120	85660-20092	4	4	RUBBER SHOCK MOUNT	28480	85660-20092
121	2360-0196	1	4	SCREW-MACH 6-32 .375-IN-LG 100 DEG	28480	2360-0196
122	2190-0009	4	2	WASHER-LK INT T NO. 8 .168-IN-ID	28480	2190-0009
123	2510-0051	6	2	SCREW-MACH 8-32 .625-IN-LG PAN-HD-POZI	28480	2510-0051
124	0360-0043	5		TERMINAL-SLDR LUG PL-MTG FOR-NO 6-SCR	28480	0360-0043
125	1251-6796	7		CONN-POST TYPE	28480	1251-6796
126	0360-1632	0	4	TERMINAL-SLDR LUG LK-MTG FOR-#3/8-SCR	28480	0360-1632
127	0362-0227	1	2	CONNECTOR-SGL CONT SKT 1 14-MM-BSC-SZ	28480	0362-0227
128	1250-0083	1	8	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
129	1250-0102	5	3	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0102
130	1251-0064	0	1	CONNECTOR 25-PIN F D SERIES	28480	1251-0064
131	1251-2942	7	2	CONNECTOR-RACK & PANEL LOCK	28480	1251-2942
132	1251-3653	9	26	CONNECTOR CONTACT FEMALE .025	28480	1251-3653
133	1251-6781	0	1	CONNECTOR RECEPTACLE 3 MALE CONTACT	28480	1251-6781
134	1251-7374	9	1	CONNECTOR HOUSING-28 FEMALE 2R	28480	1251-7374
135	2190-0016	3	4	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016

Table J-2. Miscellaneous Mechanical & Chassis Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
136	2190-0068	5	3	WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
137	2190-0104	0	1	WASHER-LK INTL T 7/16 IN .439-IN-ID	28480	2190-0104
138	2950-0001	8	8	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
139	2950-0054	1	3	NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
140	08340-00082	1	1	REAR PANEL	28480	08340-00082
141	3101-0163	5	1	SWITCH KIT	28480	3101-0163
142	9222-0090	9	1	PLASTIC JACKET (Holds Cal. Constant Data)	28480	9222-0090
143	08340-00070	7	1	BRACKET	28480	08340-00070
144	08340-00089	4	1	A18 MOUNTING PLATE	28480	08340-00089
145	08340-00090	7	1	A16 MOUNTING PLATE	28480	08340-00090
146	08340-00079	6	1	A17 MOUNTING PLATE	28480	08340-00079
147	2200-0164	5	2	SCREW-MACH 4-40 .188-IN-LG UNCT 82 DEG	00000	ORDER BY DESCRIPTION
148	2200-0165	6	5	SCREW-MACH 4-40 .25-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION

Table J-3. HP 8341B Option Configurations

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				HP 8341B OPTION CONFIGURATIONS		
				OPTION 004: REAR PANEL RF OUTPUT WITH ATTENUATOR		
				DELETE THE FOLLOWING:		
J5	08341-60001	1	1	RF OUTPUT CONNECTOR ASSEMBLY	28480	08341-60001
	08340-20076	5	1	RF CONNECTOR BRACKET	28480	08340-20076
W19	08340-20117	5	1	CABLE ASSY-RIGID COAX A63J2 TO J5	28480	08340-20117
				ADD THE FOLLOWING:		
J20	5061-5304	2	1	RF OUTPUT CONNECTOR (REAR PANEL USE ONLY)	28480	5061-5304
W20	08340-20122	2	1	CABLE ASSY-RIGID COAX A63J2 TO J20	28480	08340-20122
	83592-20063	2	1	PLUG BUTTON-FRONT PANEL	28480	83592-20063
	83595-20004	4	1	FRONT PANEL CONNECTOR SPACER	28480	83595-20004
	1400-0053	4	1	CLAMP-CABLE .172-DIA .375-WD NYL	28480	1400-0053
	2190-0104	0	1	WASHER-LK INTL T 7/16 IN .439-IN-ID	28480	2190-0104
	2950-0132	6	1	NUT-DBL-CHAM 7/16-28-THD .094-IN-THK	28480	2950-0132
	2200-0145	2	1	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	28480	2200-0145
	2190-0019	6	1	WASHER-LK HLCL NO.4 .155-IN-ID	28480	2190-0019
	3050-0105	6	1	WASHER-FL MTLC NO.4 .125-IN-I	28480	3050-0105
				OPTION 806: CHASSIS SLIDE KIT		
				DELETE THE FOLLOWING:		
	5061-9517	7	1	CHASSIS COVER (SIDE) PERFORATED	28480	5061-9517
	5061-9462	1	1	CHASSIS COVER (SIDE)	28480	5061-9462
				ADD THE FOLLOWING:		
	08340-60136	2	1	SLIDE RACK MOUNT	KIT	2848008340-60136
				OPTION 850:INTERFACE CABLE FOR OPERATION WITH HP 8410B/C		
				ADD THE FOLLOWING:		
	08410-60146	9	1	INTERCONNECT CABLE	28480	08410-60146
				OPTION 908: RACK FLANGES WITHOUT HANDLES		
				ADD THE FOLLOWING:		
	5061-9678	1	1	RACK FLANGES WITHOUT HANDLES KIT	28480	5061-9678
				OPTION 913:RACK FLANGES WITH HANDLES		
				ADD THE FOLLOWING:		
	5061-9772	6	1	RACK FLANGES WITH HANDLES KIT	28480	5061-9772