SERVICE MANUAL

4951A
PROTOCOL ANALYZER

SERIAL. NUMBERS

This manual applies directly to instruments with serial numbers prefixed **2406A**

Manual Part No. 04951-90002
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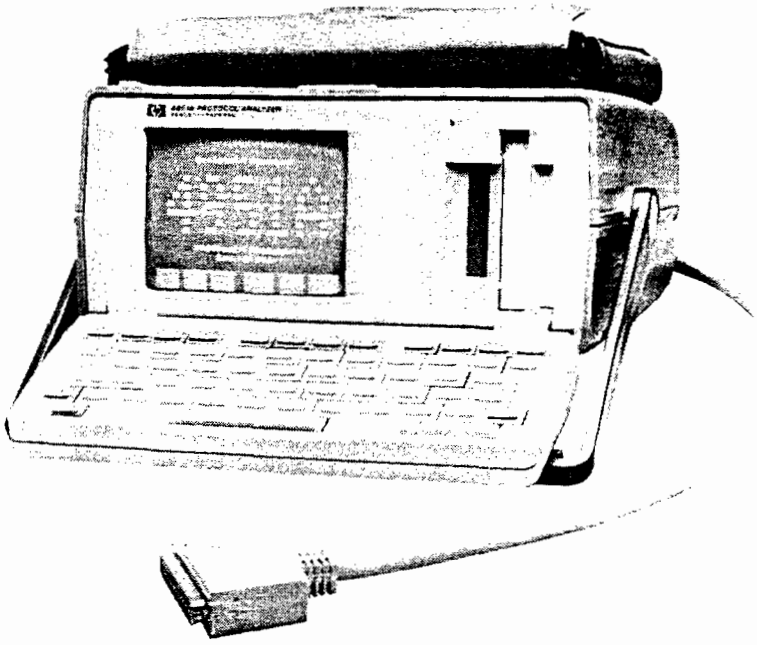


Figure 1-1. HP 4951A Protocol Analyzer

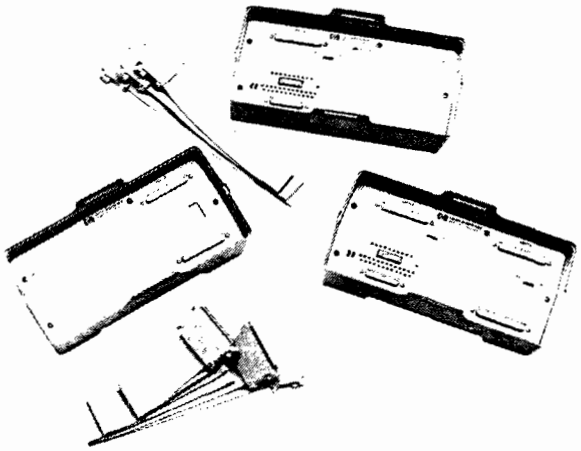


Figure 1-2. HP 4951A Protocol Analyzer Accessories

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information for the HP 4951A Protocol Analyzer, the HP 18173A RS-232C/V.24/the 18174A RS-449 Interface Pod, and the HP 18180A RS-232C/V.24. Basic operating and detailed service information are included. Figure 1-1 shows the Protocol Analyzer and Figure 1-2 shows the available accessories. The manual is divided into eight sections and has four appendixes.

Section I, General Information contains specifications and a brief description of the HP 4951A Protocol Analyzer. General information for each of the Interface Pod accessories is contained in the appropriate appendix.

Section II, Installation gives instructions for setting up the Protocol Analyzer. Installation information for each of the Interface Pod accessories is contained in the appropriate appendix.

Section III, Operation describes basic operating procedures. Operating information for each of the Interface Pod accessories is contained in the appropriate appendix.

Section IV, Performance Verification details the test procedures that verify instrument performance. The complete Performance Verification procedure is contained in this section with the applicable tests repeated in the appropriate appendix.

Section V, Adjustments gives procedures for making all adjustments to the Protocol Analyzer. There are no adjustments to make on the Interface Pods.

Section VI, Replaceable Parts provides information required to order all parts and assemblies for the HP 4951A. Replaceable parts for the accessories are contained in the appropriate appendixes.

Section VII, Manual Changes contains information to backdate the manual for instruments with serial numbers earlier than listed on the Title Page.

Section VIII, Service provides service and troubleshooting information. This includes Theory of Operation, Block Diagrams, Troubleshooting Procedures, Component Locators, and Schematics. The service information for each accessory is located in the appropriate appendix.

Table 1-2. HP 4951A Operating Characteristics

* **Full ASCII keyboard.**

* **Auto-Configure.** Automatically determines a line's protocol, data code, speed, parity, and error checking.

* **Softkey guided measurements.** Simplifies setup and programming.

* **63 triggers.** Trap on characters, error conditions, timers, and/or lead changes.

* **5 timers and counters.** Count events and measure time intervals between triggers.

* **Non-volatile memory.** 32 Kbytes for automatically storing data. Non-volatile memory retains setups, monitors, and simulates programs.

* **Five display formats.** DTE Only, DCE Only, Two line (DTE and DCE), Data and State (DTE and DCE with lead timing), Frame and Packet (decoding of ISO level 2 and 3).

* **Remote.** Transfer data, setups, monitor and simulate menus to and from another HP 4951A or another HP Protocol Analyzer.

* **BERT.** Measure bit errors, block errors, and percent error free seconds.

* **Tape Storage (Option 001).** Mass storage of data, setups, programs, and measurements.

Appendix A, Guide to Interpreting ANSI provides a basic description of ANSI symbology.

Appendix B, HP 18173A RS-232C/V.24 Interface Pod contains description of the instrument, Replaceable Parts, Theory of Operation, Troubleshooting, Component Locator, and Schematic.

Appendix C, HP 18174A RS-449 Interface Pod contains a description of the instrument, Replaceable Parts, Theory of Operation, Troubleshooting, Component Locator, and Schematic.

Appendix D, HP 18180A RS-232C/V.24/RS-449 Interface Pod contains a description of the instrument.

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. Table 1-1 provides the performance standards or limits of this instrument. Instrument characteristics are described in Table 1-2.

Table 1-1. HP 4951A Instrument Specifications

Weight:	Net, 5.7 kg (12.6 lb) Shipping, 9.5 kg (21 lb)
Size:	Height 11.2 cm (4.4 in) Width 25.9 cm (10.2 in) Depth 28.6 cm (11.3 in)
Temperature:	Operating 0°C to +55°C (32°F to 131°F)* Storage -40°C to +75°C (-40°F to +167°F) *Tape drive should only be operated from +5°C to +40°C (+41°F to +104°F)
Altitude:	Operating - 4600 m (15000 ft) Storage - 15300 m (50000 ft)
Power Requirements:	110, 220 VAC, -15% to +15%; 48-66 Hz single phase; Typical less than 15 VA, maximum less than 30 VA

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides information to install and power the HP 4951A Protocol Analyzer. Interface Pod installation information is contained in the respective appendixes.

2-2. INITIAL INSPECTION

Inspect the Protocol Analyzer and accessories for any physical damage sustained in transit. Check that all the items that should accompany the Protocol Analyzer have been received. If accessories are missing or if the unit is received in a damaged condition, notify the nearest HP Sales and Support Office.

2-3. LINE VOLTAGE SELECTION

Before plugging in the HP 4951A, check the line voltage selection on the rear panel above the power jack. It should be correctly configured for your area. The type of fuse is also dependent on the line voltage. To select the line voltage, pry open the cover to the line voltage selector on the back of the HP 4951A. When the wheel is exposed, turn it to the correct voltage and press the cover closed. The fuse does not need to be changed. Table 2-1 lists line voltages and the corresponding HP power cables.

2-4. GROUNDING REQUIREMENTS

The HP 4951A is equipped with a three conductor power cable which when connected to the power outlet, grounds the Protocol Analyzer. Do not operate the Protocol Analyzer from a power outlet that has no ground protection.

1-6. ACCESSORIES

Descriptions of the Interface Pod accessories are located in their respective appendix.

1-7. ACCESSORIES AVAILABLE

HP 18172A	Soft vinyl carrying case for extra Interface Pods
HP 18173A	RS-232C/V.24
HP 18174A	RS-449 Interface Pod
HP 18180A	Combination RS-232C/V.24 and RS-449 Interface Pod
HP 98200A	Certified blank tape cartridges (set of five)

1-8. OPTIONS

Option 001	Integral Tape Unit
Option 003	JIS-8 Character Set
Option 100	Adds accessory HP 18173A
Option 101	Adds accessory HP 18174A
Option 102	Adds accessory HP 18180A
Option 910	Extra Operating and Service Manuals
Option 916	Extra Operating Manual

1-3. SAFETY CONSIDERATIONS

When internal circuits are exposed, caution must be used. Observe all warnings and cautions marked on the instrument or listed in the procedures.

WARNING

8000 volts may be present in the HP 4951A circuitry even when turned off.

CAUTION

The internal circuits of this instrument are static sensitive. Refer to paragraph 8-6 for handling procedures.

1-4. SAFETY SYMBOLS

A complete list of safety symbols used in this manual is given on the page preceding the Table of Contents. Included are symbols and descriptions.

1-5. HP 4951A DESCRIPTION

The HP 4951A is a complete field service data communications Protocol Analyzer. It is small, lightweight and easy-to-use. It contains the essential features needed to verify proper data equipment installation and maintenance. It correctly diagnoses system operating problems and assists in their correction. The Protocol Analyzer can simulate network components, monitor data transmission, and perform bit error tests. Data analysis may be done real time or in the post-processing mode. The 32 Kbytes of nonvolatile memory stores all data, timing, and lead status information. Additional nonvolatile memory keeps all test setups as well as monitor and simulate programs. For long term storage of data and important test programs, the optional mass storage cassette tape (Option 001) stores an additional 512 Kbytes of information.

Six software defined keys (softkeys) provide operator interface to the extensive troubleshooting capability of the HP 4951A. Whenever an instruction indicates use of a soft key, its mnemonic will be enclosed by < >. The user friendly interface, combined with auto-configuration of all data link parameters, allows many complex tasks to be performed quickly and easily, resulting in less network downtime. The HP 4951A has 63 real time triggers and five timers and counters.

2-5. TAGGING FOR SERVICE

If the instrument is returned to Hewlett-Packard for service, complete one of the blue repair tags located in the back of this manual and attach it to the instrument.

2-6. STORAGE AND SHIPMENT

2-7. ORIGINAL PACKAGING

Containers and materials identical to those used in factory packaging are available through any Hewlett-Packard Sales offices. If the instrument is returned to Hewlett-Packard for service, complete and attach the blue repair tag. Mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model and serial number.

2-8. OTHER PACKAGING

Use these general instructions for packaging with commercially available materials:

1. Wrap the instrument in an antistatic material. If shipping to a Hewlett-Packard Sales or Service Office, include a completed blue repair tag.
2. Use a strong shipping container such as a double wall carton with 275 burst test.
3. Use a layer of shock absorbing material, 70-100 mm (3-4 inches)thick. This provides a firm cushion and prevents movement inside the container.
4. Seal the carton securely and mark it FRAGILE to ensure careful handling.

2-9. TURNING ON THE HP 4951A

CAUTION

Do not plug in the instrument until you are sure that the line voltage selection is correct.

CAUTION

Turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

Connect the Interface Pod and press the switch on the back of the instrument to ON. The HP 4951A Protocol Analyzer will automatically perform the Performance Verification test sequence. If the Performance Verification passes, then the top level menu is displayed and the Protocol Analyzer is ready for operation. If Performance Verification does not pass, refer to the troubleshooting procedure in Section VIII.

Figure 2-1. Interface Pod Connection

SECTION III
OPERATION

3-1. INTRODUCTION

This section contains a brief description of operating procedures for the HP 4951A. Complete operating procedures for the Protocol Analyzer and the Interface Pod accessories are located in the Operating Manual (HP 04951-90003). Abbreviated operating procedures for the Interface Pod accessories HP 18173A, HP 18174A, and HP 18180A are located in the respective appendixes.

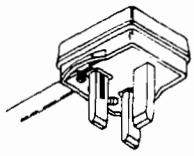
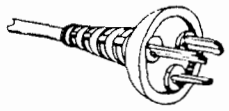
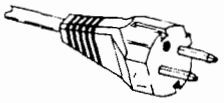
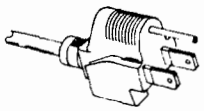
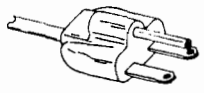
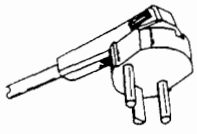
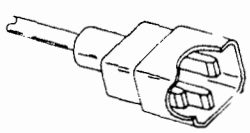
3-2. OPERATION

Six software defined keys, or softkeys, provide operator access to the capabilities of the HP 4951A. When the instrument is turned on, an automatic self test is performed, and the Top Level Menu is displayed. The softkey descriptions appear on the display. Generally, softkeys will be enclosed with < > throughout this manual. Table 3-1 describes the Top Level Menu softkey mnemonics. To select a particular procedure, press the dark gray key on the keyboard corresponding to the softkey displayed on the CRT.

Table 3-1. Top Level Menu

AUTO-CONF	Automatic configuring for on-line monitoring.
SETUP	Manual configuring for monitoring or simulating.
MONITOR	Programs made for monitoring.
SIMULATE	Programs DTE or DCE simulation procedures.
RUN MENU	Executes all tests: monitoring, simulation, or BERT.
EXAMINE DATA	Displays the buffer contents after a test.
MORE	Press MORE on keyboard to display rest of menu.
BERT	Configures Bit Error Rate Tests in conjunction with another HP Protocol Analyzer.
REMOTE	Transmits and receives menu setups and data.
MASS STORE	Provides tape control and catalog functions.
RESET	Sets all menus to the default conditions and clears the buffer.
SELF TEST	Provides access to self test.

Table 2-1. Power Cable Descriptions

Plug Type	Cable HP Part Number	CD	Plug Description	Cable Length (inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	0 6	Straight *BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Rhodesia, Singapore
250V 	8120-1369 8120-0696	0 4	Straight *NZSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	7 2	Straight *CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, So. Africa, India (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight *NEMA5-15P 90° Straight *NEMA5-15P Straight *NEMA5-15P 90° Straight *NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	3	Straight *SEV1011 1959-24507 Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight *NEMA6-15P			United States Canada
220V 	8120-1957 8120-2956	2 3	Straight *DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	6	Straight *CEE22-VI (Systems Cabinet use)			

*Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.
E = Earth Ground; L = Line; N = Neutral

The Top Level Menu accesses all of the other menus. The softkeys enable you to perform all of the instrument functions.

EXIT acts like a halt key during a testing sequence. Press EXIT during a test sequence to stop it at any time. The Top Level Menu will be displayed.

Press MORE to see the second or third set of softkeys in any menu. A small vertical MORE appears at the lower right of the CRT to prompt you whenever there is another set of softkeys in any menu.

The memory is nonvolatile. Turn off the Protocol Analyzer only when the display shows the top level menu to save setups, data, and programs.

CAUTION

Always turn off the Protocol Analyzer before connecting or disconnecting any Interface Pod.

SECTION IV
PERFORMANCE VERIFICATION

4-1. INTRODUCTION

Each time the HP 4951A is powered on, the Performance Verification tests are run. The tests are completed in about 10 seconds and the internal circuits of the instrument do not have to be accessed by the operator. If the HP 4951A fails any of the tests, refer to the Service Section. When the Performance Verification tests are complete and there are no failures, the Top Level Menu is displayed.

Figure 4-1 is a flowchart describing the Performance Verification tests done at instrument turn on. After the automatic test sequence, the operator may manually enter and perform tests for the Interface Pod or the Keyboard or begin using the HP 4951A. When installed, option 001, the Tape Board is automatically tested at power on.

4-2. EQUIPMENT REQUIRED

No equipment is required to perform the Performance Verification tests.

4-3. TEST RECORD

Test results and component failures may be recorded on the test record located at the end of this section. Test results should be used for comparison during maintenance or troubleshooting.

4-4. PERFORMANCE VERIFICATION TESTS

This test sequence verifies functional operation of 95% of the HP 4951A Protocol Analyzer. There are 10 parts to the automatic test sequence. To begin testing, turn on the HP 4951A. The tests outlined in Table 4-1 are automatically performed. The operator may then manually select the Keyboard test (paragraph 4-7) or the Interface Pod test (paragraph 4-8), or start using the Protocol Analyzer.

Table 4-1. Failure Display

TEST	FAILURES
ROM 2	00
ROM 8-1	00
ROM 8-2	00
RAM 2	00
RAM 6	00
RAM 8	00
RAM A	00
RAM C	00
RAM E	00
DLC	00
TAPE	00

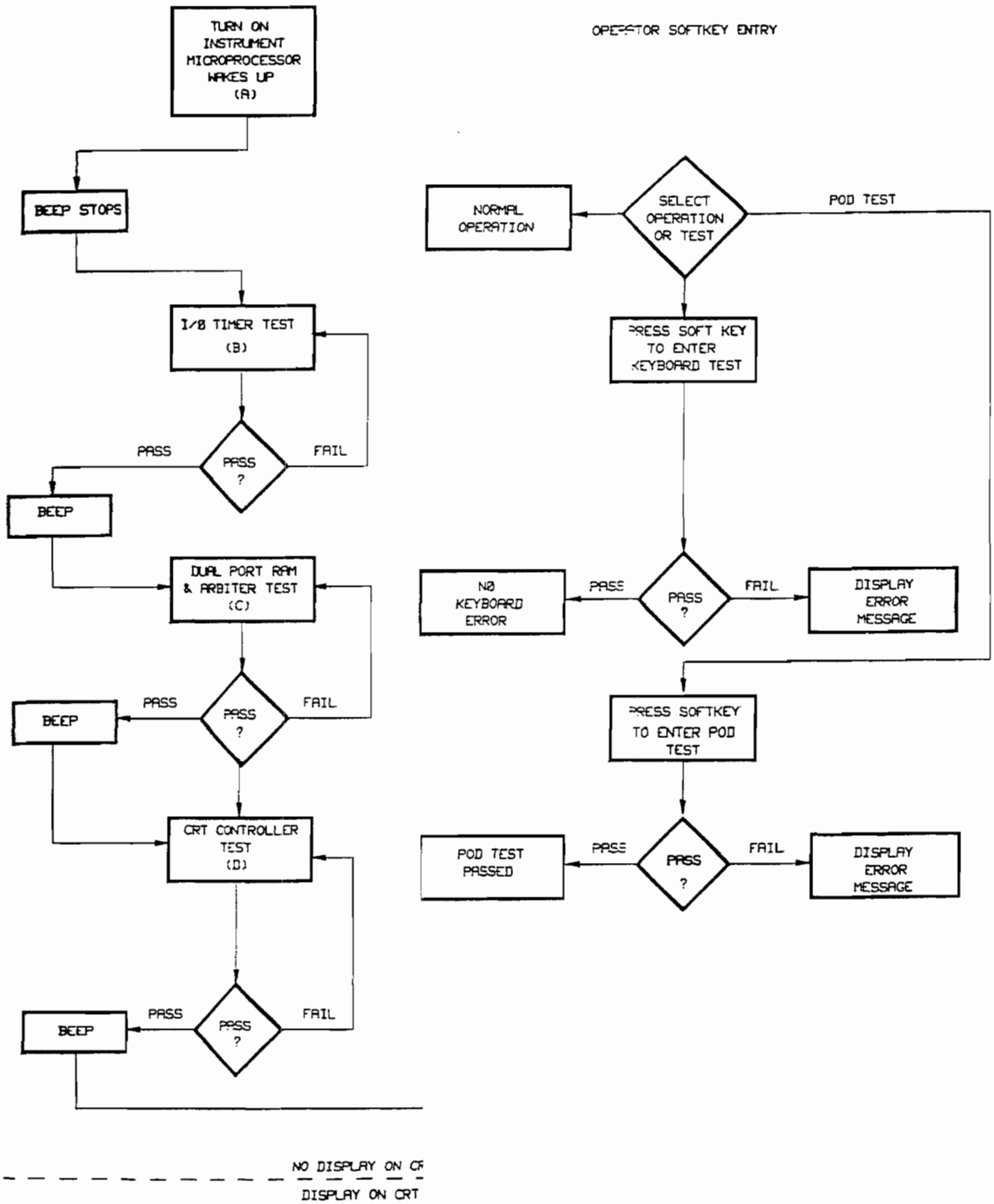
Number of tests = (total number of tests performed)

NOTE

Hold down the EXIT(HALT) key to exit the program.

4-5. PERFORMANCE VERIFICATION FLOWCHART

The flowchart in Figure 4-1 describes the Performance Verification tests. The tests are automatically performed when the instrument is turned on. After the automatic Performance Verification tests, the operator entered tests are described.



ıance Vertication Flow Chart

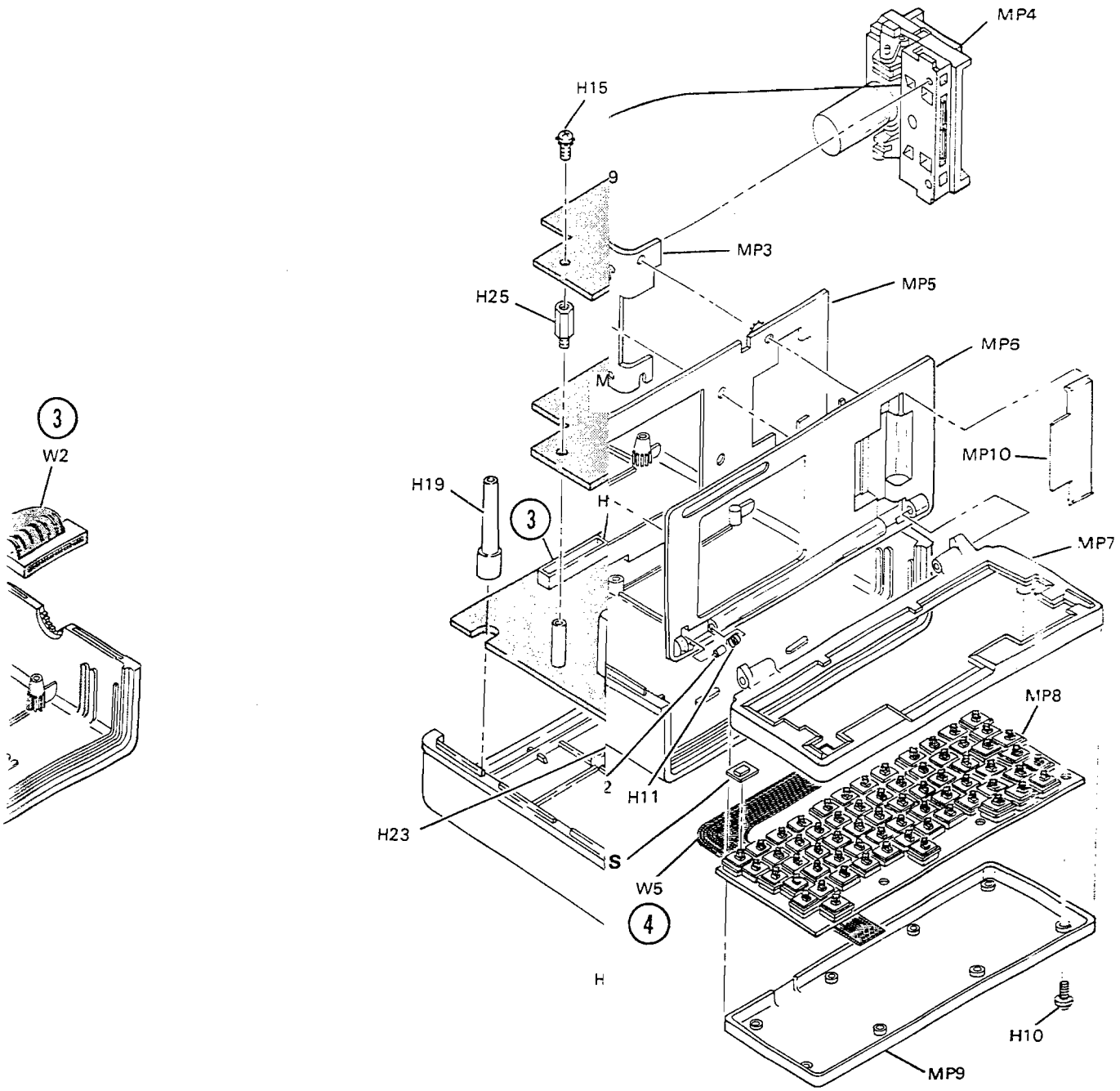


Figure 6-3. 1A Front Panel Assembly

4-6. PERFORMANCE VERIFICATION TEST DESCRIPTIONS

The following is a description of the Performance Verification tests done automatically at instrument turn on. They are referenced to the flowchart in Figure 4-1 by the letter preceding each test. Troubleshooting procedures are located in the Service Section.

The Top Level menu is displayed when the instrument passes the Performance Verification tests. If there is a failure, the Failure Table will remain on the display. An 01 will appear in the Failure column by the failed test. Press EXIT(HALT) to access the Top Level menu.

A. TURN ON INSTRUMENT/MICROPROCESSOR WAKES UP

Test Failure Code

continuous beep

Description

When the beep stops, the microprocessor and the power supply are working.

B. I/O TIMER

Test Failure Code

no beep

Description

Checks that the I/O timer is functioning correctly.

C. DUAL PORT RAM AND ARBITER

Test Failure Code

no beep

Description

Tests the operation of dual port RAM and arbiter circuit.

D. CRT CONTROLLER

Test Failure Code

no beep
no CRT display

Description

Checks operation of the deflection circuits.

E. ROM

Test Failure Code

The ROM test is performed once at turn on. If there are any ROM failures, the Failure Table will flash on the screen, then the Top Level Menu will be displayed.

Description

The microprocessor checks all ROMs (except ROM 0000) and places pass/fail information in memory. If any Rom device fails, the Test Failure Table is displayed. The operator may press EXIT(HALT) to access the Top Level Menu.

F. RAM

Test Failure Code

The RAM test is performed once at turn on. If there are any RAM failures, the Failure Table will flash on the screen, then the Top Level Menu will be displayed.

Description

The microprocessor checks all RAM and places pass/fail information in memory. If any RAM device fails, the Test Failure Table is displayed. The operator may press EXIT(HALT) to access the Top Level Menu.

G. DATA LINK CONTROL CIRCUITRY (DLC)

Test Failure Code

Number of times the test fails is displayed under FAILURES column.

Description

Microprocessor checks the DLC for proper operation.

H. TAPE I/O

Test Failure Code

Bad tape I/O

Description

Checks digital circuitry

4-7. KEYBOARD TEST

Description

The Keyboard test is performed by the operator. It verifies that the HP 4951A correctly identifies each key pressed on the keyboard.

Setup

1. Turn on the HP 4951A.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <KBD TEST>.

Procedure

1. Press any key on the keyboard.
2. The display should read:

LAST KEY PRESSED: "(name of key pressed is displayed)"

NOTE

The cursor down and RETURN keys effectively make the cursor perform the same operation. When the RETURN key is pressed, CURSOR DOWN is displayed.

3. Press EXIT(HALT) to end the test and display the selftest menu.

4-8. INTERFACE POD TEST

Description

This test has two parts: checks that there is an Interface Pod connected to the Protocol Analyzer and verifies that the data lines work.

Set Up

1. Turn on the HP 4951A.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <EXT DLC>.

Procedure

1. When the <EXT DLC> softkey is pressed, the Interface Pod test is automatically performed.

2. Press EXIT(HALT) to return to the selftest menu.

Table 4-2. Performance Verification Test Record

Date of Test Operator	

TEST	PASS	FAIL
Microprocessor		
I/O Timer		
Dual Port RAM and Arbiter		
CRT Controller		
ROM Numbers of failed ROM:		
RAM Numbers of failed RAM:		
DLC		
Tape I/O		
Interface Pod		
Keyboard		
Number of tests performed		

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

This section contains adjustment procedures for the HP 4951A Protocol Analyzer. The adjustments in this section have no affect on the Performance Verification Tests.

5-2. SAFETY CONSIDERATIONS

For your protection and to avoid damage to the instrument, all listed warnings and cautions must be followed. Whenever internal instrument circuits are exposed, exercise caution. Follow the correct procedures for handling static sensitive devices (see paragraph 8-6).

WARNING

8000 volts can be present in the
HP 4951A circuitry even when turned off.

5-3. REQUIRED EQUIPMENT

To perform the adjustments an insulated screwdriver and a hexagonal plastic core adjuster.

WARNING

When adjustments are in the high voltage circuitry,
tools should be insulated or made of non-conductive materials.

Safety glasses should be worn when replacing the CRT.

5-4. INSTRUMENT ACCESS

Access the instrument's internal circuits and assemblies by removing the case top. The case top is secured by four screws located on the bottom of the instrument. Follow the procedure described in the Disassembly Procedure located in Section VIII, paragraph 8-8.

5-5. ADJUSTMENT PROCEDURES

Adjustments should be performed in the sequence given. There are six adjustment procedures for the HP 4951A. The CRT Yoke Centering Ring and Pin Cushion adjustments should only be performed after repairs have been made in the deflection circuit. The adjustments are as follows:

CRT Yoke Centering Ring
Vertical Centering
Vertical Height
Horizontal Centering
Focus
Intensity

To perform the adjustments, remove the case top as described in paragraph 8-8. Perform the following procedures.

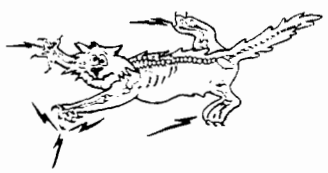
1. Turn on the HP 4951A.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <CRT TEST>.
5. Select <TEST PTRN>.
6. Perform the adjustment procedures.
7. To exit the test pattern, press EXIT/(HALT) 3 times.

Figure 5-1 identifies the location of the adjustment points. Figure 5-2 is the test pattern used to perform all adjustments. Perform each adjustment in the order given.

WARNING

8000 volts can be present in the
HP 4951A circuitry even when turned off.

Safety glasses should be worn.



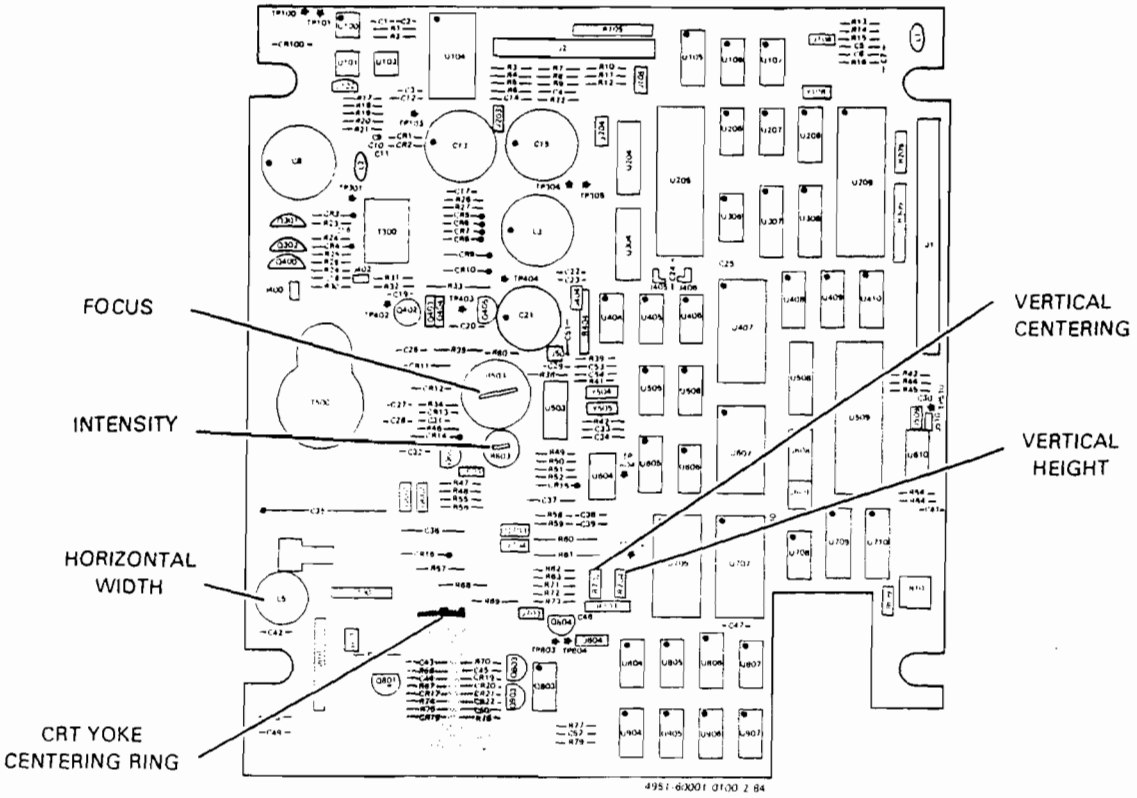


Figure 5-1. HP 4951A Adjustment Points

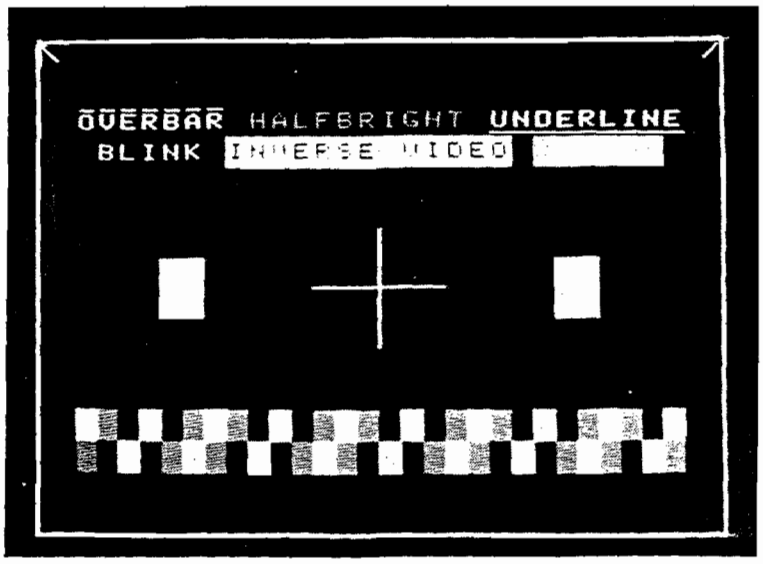


Figure 5-2. HP 4951A Adjustment Test Pattern

5-6. CRT YOKE CENTERING RING

Description

This adjustment centers the test pattern on the CRT display. Perform this adjustment only after performing repairs in the deflection circuit. Figure 5-3 shows the location of the centering rings.

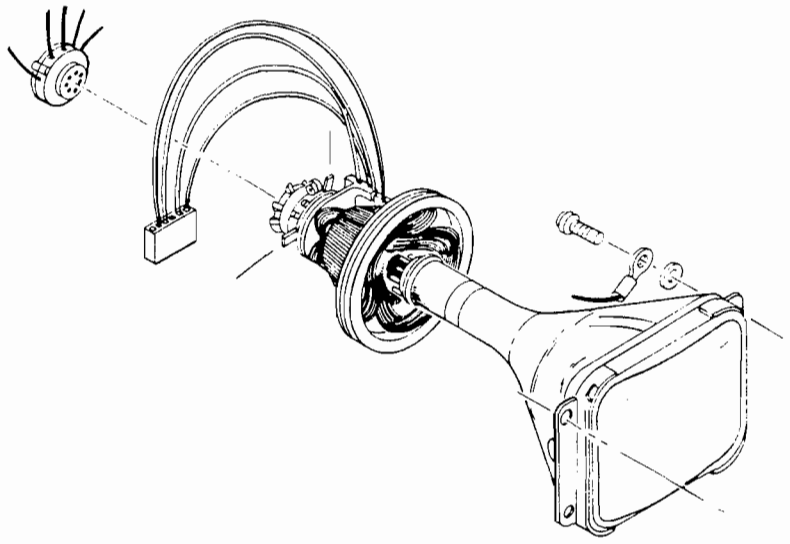


Figure 5-3. CRT Yoke Centering Rings

Procedure

1. Rotate the centering rings to center the test pattern crosshair horizontally and vertically.

2. Set the test pattern as high on the CRT display as possible.

5-7. VERTICAL CENTER

Description

Vertically centers the test pattern.

Procedure

1. With screwdriver turn A1R702 until the test pattern crosshair is vertically centered on the display.

5-8. VERTICAL HEIGHT

Description

This adjustment sets the vertical height of the display characters and CRT display.

Procedure

1. With the insulated screwdriver turn A1R704 until available screen area is filled.

5-9. HORIZONTAL CENTERING (WIDTH)

Description

Adjusts the test pattern width.

Procedure

1. Use the plastic core adjuster to turn A1L5 until the width of the test pattern is centered on the display.

5-10. FOCUS

Description

Adjusts clarity of the characters on the display.

Procedure

1. With the insulated screwdriver adjust A1R503 until the characters on the display are sharply focused.

5-11. INTENSITY

Description

Adjusts the intensity of the characters on the display and makes the full bright and half bright enhancements distinct from one another.

Procedure

1. With an insulated screwdriver adjust A1R603 so that the brightness level provides a clear distinction between character types on the display.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

This section contains information for ordering replacement parts. Table 6-1 lists abbreviations used. Table 6-2 is a manufacturer's code list. Tables 6-3 through 6-6 list the mechanical parts and Table 6-7 lists the replaceable parts. Figures 6-1 through 6-4 are exploded views of the instrument.

6-2. REPLACEABLE PARTS LIST

Table 6-7 lists the replaceable parts in alphanumeric order. Information is given for the Description, Quantity (total used in the instrument), HP Part Number, and Manufacturer's Part Number. Chassis and mechanical parts are listed in Tables 6-3 through 6-6.

6-3. ORDERING INFORMATION

To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office. When ordering a part not listed, include the instrument model number, serial number, with a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table 6-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A = assembly	J = electrical connector (stationary portion); jack	TB = terminal board
B = fan; motor	L = coil; inductor	TP = test point
BT = battery	MP = misc. mechanical part	U = integrated circuit; microcircuit
C = capacitor	P = electrical connector (movable portion); plug	V = electron tube; glow lamp
CR = diode; diode thyristor; varactor	Q = transistor; SCR; triode thyristor	VR = voltage regulator; breakdown diode
DL = delay line	R = resistor	W = cable
DS = annunciator; lamp; LED	RT = thermistor	X = socket
E = misc electrical part	S = switch; jumper	Y = crystal unit (piezo-electric or quartz)
F = fuse	T = transformer	
FL = filter		
H = hardware		

ABBREVIATIONS

A = amperes	DIA = diameter	K = kilo (10^3), kilohm
AC = alternating current	DIP = dual in-line package	
ADD = address	DPDT = double-pole, double-throw	LED = light emitting diode
ADJ = adjust, adjustment	DPST = double-pole, single-throw	LFT = left
AL = aluminum	DR = drive	LG = long
AR = as required	DRVR = driver	LH = lefthand
ASM = algorithmic state machine	DSPL = display	LKWR = lockwasher
ASSY = assembly	DTL = diode-transistor logic	LP = low pass
		LS = low power Schottky
B = base	E = emitter	LSB = least significant bit
BCD = binary coded decimal	ECL = emitter-coupled logic	
BeCu = beryllium copper	ELECT = electrolytic	M = milli (10^{-3}), male, mega (10^6), megohm
BIN = binary	ENCAP = encapsulated	
BLK = black	EXT = external	MET FLM = metal film
BLU = blue	EXTR = extractor	MET OX. = metal oxide
BP = band pass		MHZ = megahertz
BRN = brown	F = female, farads	MFR = manufacturer
BRS = brass	FF = flip-flop	MINTR = miniature
BTU = British thermal unit	FLM = film	MISC = miscellaneous
	FRNT = front	MOM = momentary
C = collector	FXD = fixed	MOS = metal oxide semiconductor
CATH = cathode		MSB = most significant bit
CCW = counterclockwise	G = giga (10^9)	MTCHD = matched
CD PL = cadmium plate	GE = germanium	MTG = mounting
CER = ceramic	GL = glass	MTLC = metallic
CERMET = ceramic met flm	GND = ground(ed)	
CKTS = circuits	GP = General Purpose	N = nano (10^{-9})
C FLM = carbon film	GRA = gray	N.C. = normally closed, no connection
CLK = clock	GRN = green	
CLR = clear		NE = neon
CMOS = complementary metal oxide semiconductor logic	H = henries	NO. = number
	HDW = hardware	N.O. = normally open
COM = common	HEX = hexagon, hexagonal, six	NP = No Polarity
COML = commercial	HP = high pass	NPN = negative-positive-negative
COMP = composition	HR = hour(s)	NPO = negative-positive zero (zero temperature coefficient)
COMPL = complete	HZ = Hertz	
COND = conductor		NRFR = not recommended for field replacement
CONN = connector	IC = integrated circuit	
CONT = contact	ID = inside diameter	NS = normally shorting, nanosecond
CPRSN = compression	IF = intermediate frequency	
CTL = complementary-transistor logic	IN. = inch, inches	NSR = not separately replaceable
	INCAND = incandescent	NYL = nylon
CW = clockwise	INCL = include(s)	
	INSUL = insulation, insulated	OBD = order by description
D = diameter	INT = internal	OD = outside diameter
DC = direct current	INTL = internal	ORN = orange
DEPC = deposited carbon		

Table 6-1. Reference Designations and Abbreviations (Continued)

ABBREVIATIONS

P = pico (10-12)	RVT = rivet	TRN = turn
PC = printed circuit	RWV = reverse working voltage	TTL = transistor-transistor logic
PCA = printed-circuit assembly		TYP = typical
PF = picofarad	S = second	
PIV = Peak Inverse Voltage	SB = slow blow	U (μ) = micro (10-6)
PK = peak	SCR = silicon controlled rectifier	UF = microfarad
PNL = panel	SE = selenium	US = microseconds
PNP = positive-negative-positive	SGL = single	
P-P = peak-to-peak	SI = silicon	V = volt(s)
PPM = parts per million	SHK = shank	VAR = variable
POLYC = polycarbonate	SIP = single in-line package	VCO = voltage controlled oscillator
POLYE = polyethylene	SKT = socket	
POLYSTY = polystyrene	SLDR = solder	VDCW = direct current working volts
PORC = porcelain	SPCG = spacing	VIO = violet
POSN = position(s)	SPDT = single-pole, double-throw	VNP = no polarity voltage
POZI = pozidrive	SPST = single-pole, single-throw	
PRV = peak reverse voltage	SST = stainless-steel	W = watts
PWV = peak working voltage	STL = steel	WT = weight
P/O = part of	SZ = size	WW = wirewound
		WHT = white
R = ring	T = tip	WIP = wiper
RAM = random access memory	TA = tantalum	WIV = working inverse voltage
ROM = read only memory	TEL = telephone	WSHR = washer
RECT = rectifier	T.C. = Temp. Compensated, temp. coefficient	X = times, multiple
RF = radio frequency		
RH = right hand	THKNS = thickness	YEL = yellow
RMS = root-mean-square	TI = titanium	
RND = round	TGL = toggle	ZNR = zener
RT = right hand	THD = thread	
RTL = resistor-transistor logic	THK = thick	ϕ = phi, phase
RTNT = retainer	TOL = tolerance	
RTRY = rotary	TRMR = trimmer	

Table 6-2. Manufacturer's Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
S4013	HITACHI	TOKYO	JP	
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
01456	MICROWAVE DEVELOPMENT LABS INC	NEEDHAM HTS	MA	02194
03888	K D I PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
06383	PANDUIT CORP	TINLEY PARK	IL	60477
08806	GE CO MINIATURE LAMP PROD DEPT	CLEVELAND	OH	44112
1B546	VARO SEMICONDUCTOR INC	GARLAND	TX	75040
12969	UNITRODE CORP	WATERTOWN	MA	02172
17856	SILICONIX INC	SANTA CLARA	CA	95054
19209	GE CO ELEK CAP & BAT PROD DEPT	GAINSVILLE	FL	32601
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
3L585	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	
32293	INTERSIL INC	CUPERTINO	CA	95014
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE	CA	92507
5L813	ASHLAND PRODUCTS CO	CHICAGO	IL	60628
51642	CENTRE ENGINEERING INC	STATE COLLEGE	PA	16801
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
71590	CENTRALAB ELEK DIV GLOBE-UNION INC	MILWAUKEE	WI	50501
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE	PA	16512
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA	PA	19108

Table 6-3. HP 4951A Case and Cover

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				4951A CASE AND COVER		
MP1	04951-40005	3	1	POUCH-SOFT CASE	28480	04951-40005
MP2	5040-4480	9	1	CASE-TOP HALF	28480	5040-4480
MP3	4040-1704	3	1	SHELL CASE BOTTOM 10.077-IN-WD	28480	4040-1704
MP4	4040-2171	0	1	INTERFACE POD HOUSING	28480	4040-2171
MP5	5040-4470	7	1	HANDLE-CASE	28480	5040-4470
MP6	04951-80014	8	2	LABEL HANDLE	28480	04951-80014
MP7	2520-0014	2	4	SCREW-MACH 8-32 4-IN-LG RD-HD-SLT STL	00000	ORDER BY DESCRIPTION
MP8	0380-1693	5	4	STANDOFF	28480	0380-1693
MP9	0424-0458	2	4	SCR-TPG. 8-16	00000	ORDER BY DESCRIPTION

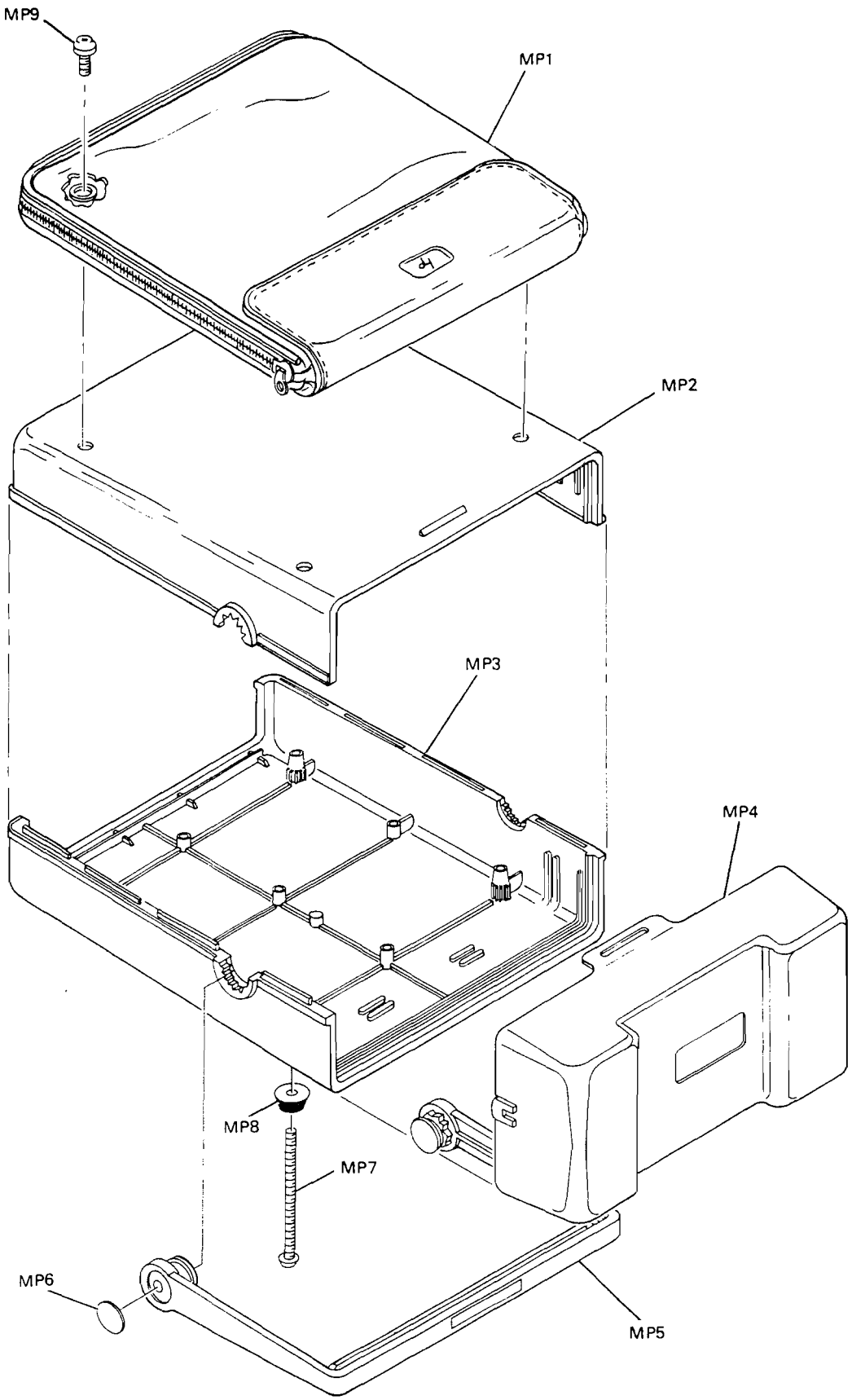


Figure 6-1. HP 4951A Case and Cover

Table 6-4. HP 4951A Rear Panel Assembly

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
E1	9135-0224	7	1	LINE FILTER	28480	9135-0024
E2	3101-0428	5	1	SWITCH RKR BASIC DPDT 6A 250 BLDR-LUG	28480	3101-0428
MP1	5040-4471	8	2	REAR FOOT	28480	5040-4471
H1	1251-2942	7	2	LOCK BOLT, INC NUT, WASHER	28480	1251-2942
T1	9100-4366	2	1	PWR TRANSFORMER	28480	9100-4366
MP2	04951-00001	5	1	BACK PANEL	28480	04951-00001
W1	04951-61609	7	1	CABLE, GROUND	28480	04951-61609
H2	2260-0002	6	1	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	28480	2260-0002
W2	04951-61603	1	1	CABLE, MAIN REAR	28480	04951-61603
W3	04951-61604	2	1	CABLE-POD INTR	28480	04951-61604
H4	2260-0002	6	1	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	28480	2260-0002
H3	2190-0019	6	1	WASHER-LK HLCL NO 4 .115-IN-ID	28480	2190-0019
W4	04951-61610	0	1	CABLE, LINE FILTER	28480	04951-61610
E3	2110-0421	6	1	FUSE- 375A 250V	04480	MDO-3 .8

Table 6-5. HP 4951A Internal Assemblies

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
H15	2360-0117	8	4	SCR MCH 6-32-.375	05610	ORDER BY DESCRIPTION
W6	04951-61602	8	1	CABLE, MAIN	28480	04951-61602
H16	5041-2246	3	1	CONNECTOR	28480	5041-2246
H17	1252-0060	8	1	HEADER, 20 POS	28480	1252-0060
H18	1200-0607	0	1	CONNECTOR	28480	1200-0607
H19	04951-20007	1	4	SPACER, CASE	28480	04951-20007
H20	1251-8827	9	2	CONNECTOR-60 PIN	28480	1251-8827
H21	1251-3751	1	1	HEADER, 8 POS	03418	09-65-1081
H23	1251-3825	0	1	HEADER, 5 POS	03418	09-65-1051
H24	1251-8828	6	1	CONNECTOR-40 PIN	28480	1251-8828
H25	0380-0388	1	4	STDF-HEX .375, 1 IN	28480	0380-0388

Table 6-6. HP 4951A Front Panel Assembly

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
E4	04951-62606	6	1	DEFLECTION YOKE	28480	04951-62606
H5	0460-0135	8	1	IND TAPE	04726	361
E5	2090-0080	9	1	CRT	28480	2090-0080
W1	04951-61609	7	1	CABLE, GROUND	28480	04951-61609
H6	0624-0400	9	4	SCR-TPG 6-19	04771	ORDER BY DESCRIPTION
H7	3050-0001	1	4	WASHER FLAT #8	04604	NO. 1445
H8	0624-0314	3	2	SCR-TPG 4-20	05610	224-08150-382
H9	2360-0117	8	4	SCR MCH 6-32-.375	05610	ORDER BY DESCRIPTION
MP3	04951-00002	4	1	BRACKET, TAPE TRANSPORT	28480	04951-00002
MP4	5061-2246	6	1	TAPE TRANSPORT OPT 001	28480	5061-2246
MP5	04951-00003	5	1	CRT PANEL	28480	04951-00003
MP6	04951-40001	7	1	FRONT PANEL	28480	04951-40001
MP7	04951-40003	9	1	KYBD HSG UPPER	28480	04951-40003
MP8	04951-62605	3	1	KEYBOARD ASSY	28480	04951-62605
MP9	04951-40004	0	1	KYBD HSG LOWER	28480	04951-40004
H10	0570-0025	8	1	SCR-MCH 6-32, .5IN	03380	933-415
H11	1460-1916	6	2	SPRING-CPRSN	05191	ORDER BY DESCRIPTION
H12	04951-20005	9	2	HINGE PIN	28480	04951-20005
MP10	04951-40002	8	1	TAPE COVER	28480	04951-40002
W5	04951-61607	3	1	CABLE, KEYBOARD	28480	04951-61607
W8	04951-61608	4	1	CRT CABLE	28480	04951-61608
W9	04951-62606	6	1	DEFLECTION YOKE	28480	04951-62606
H13	1460-1490	1	2	SPRING	05191	LC-042G-5-SS
MP11	04951-20004	8	1	HINGE PLATE	28480	04951-20004
H14	04951-20006	0	4	CRT SPACER	28480	04951-20006

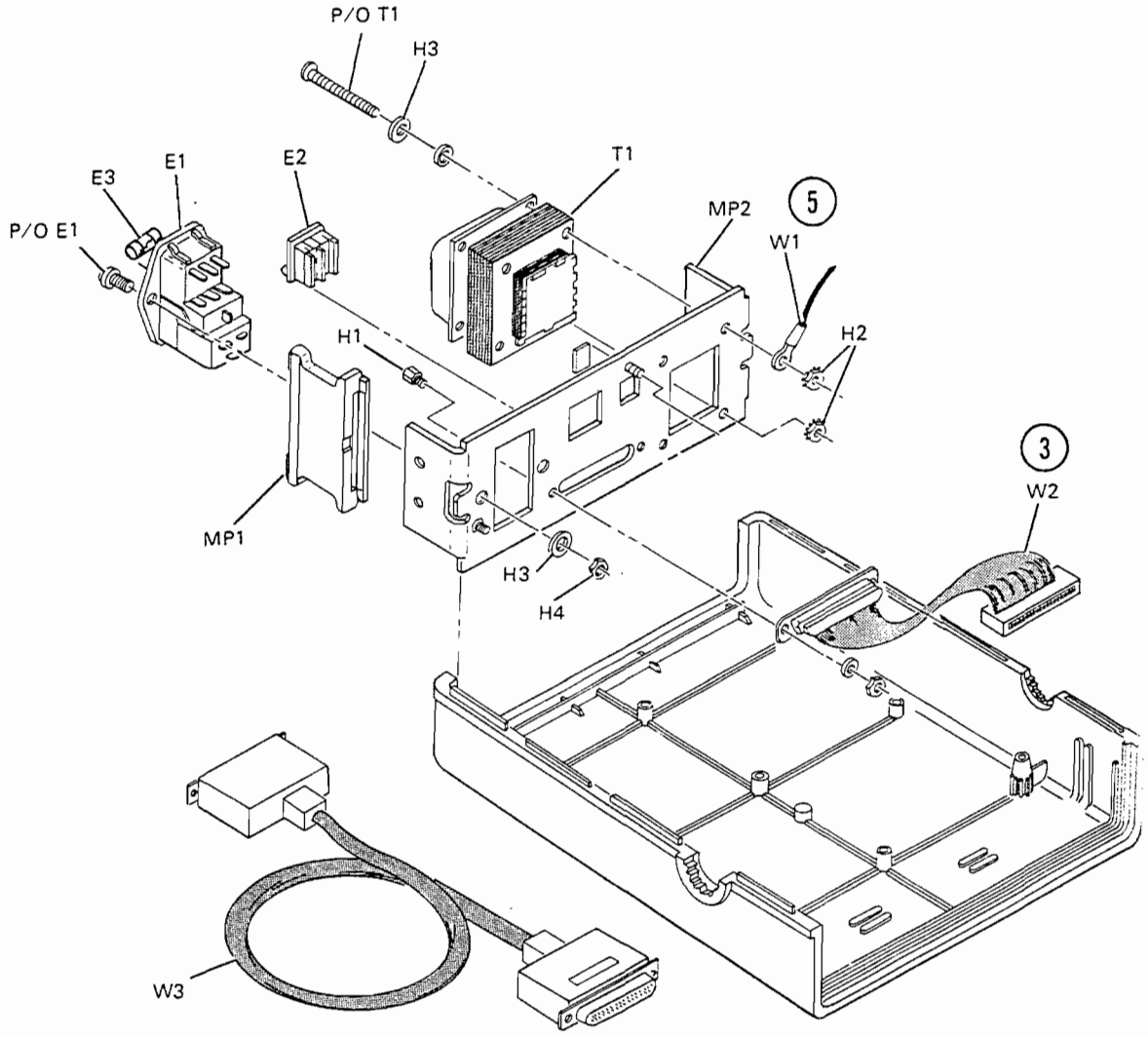


Figure 6-2. HP 4951A Rear Panel Assembly

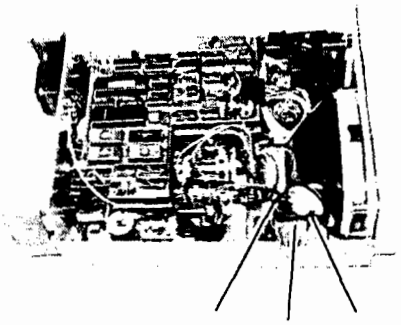
6. Connect the CRT Cables

Move the Front Panel and Keyboard to the front of the case bottom.

Connect the cables from the CRT to the Main Board.

Slide the front panel into the grooves on the front of the case.

Connect the PA cable; check that both prongs are securely inside the CRT.



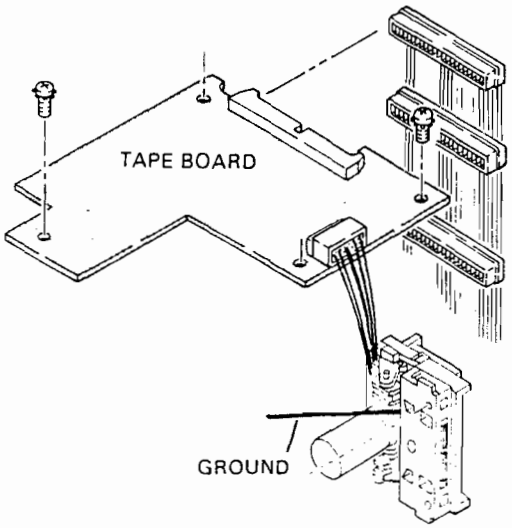
7. Option 001, the Tape Controller Board

Place the A3 Tape Controller Board, circuit side up on the 4 standoffs on the Memory Board.

Insert and tighten the four screws.

Attach the cable to A3J1. Press firmly into place.

Connect the cable from the Tape Transport to A3J2.



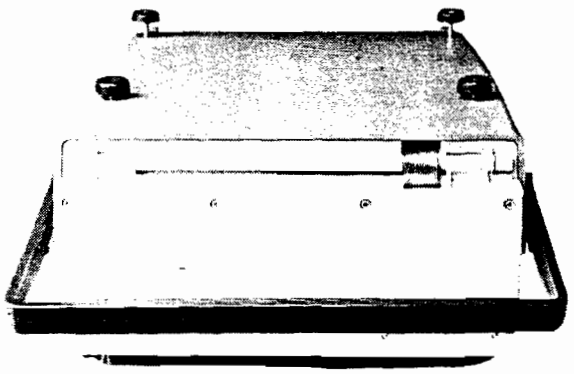
8. Close the Instrument

Place the handle in the bottom half of the case.

Slide the case top into place. All notches and grooves must be correctly seated.

Hold the top and bottom of the instrument together and turn it upside down.

Insert the screws and rubber feet and tighten.



3. Assemble Front Panel

Insert the hinge springs and pins.

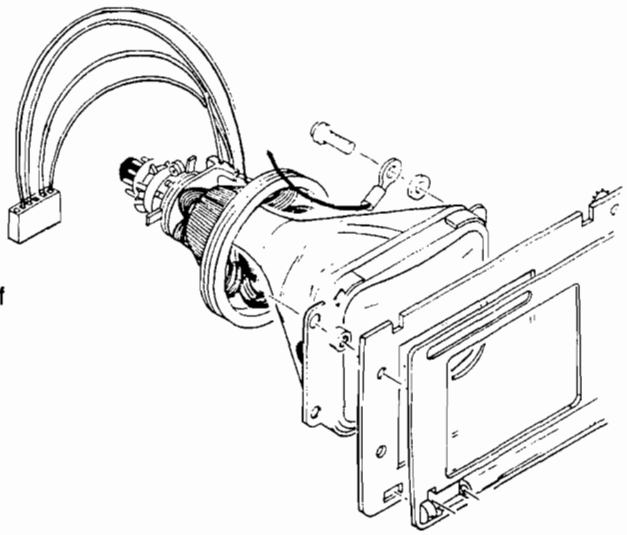
Set the hinges into the slots on the front panel.

Lock into place by wiggling the hinge plate and spring.

4. Mount CRT onto Front Panel

WARNING

Wear safety glasses when handling the CRT.



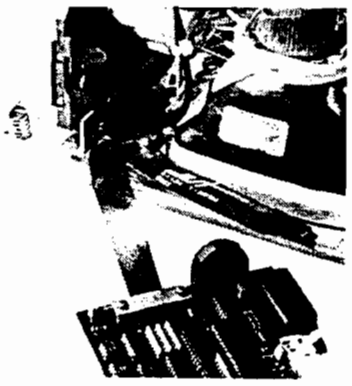
Place assembled Front Panel with the keyboard side down on the bench.

Put the standoffs in place on the CRT. Seat each standoff with the flat side aligned with the cutout for the CRT in the front panel.

Set the CRT on the standoffs with the jack for the PA LEAD to transformer A1T300 facing the side of the case. Attach the ground strap.

Discharge the CRT to ground (see Disassembly, Step 5).

5. Connect the Cable and Mount the Memory Board



Place the Memory Board, circuit side up by the Keyboard cable. Insert the cable into A1J2 on the Memory Board. Insert and tighten the screws.

Place the Memory Board, circuit side down on the standoffs. Fasten the Memory Board into place with the threaded standoffs.

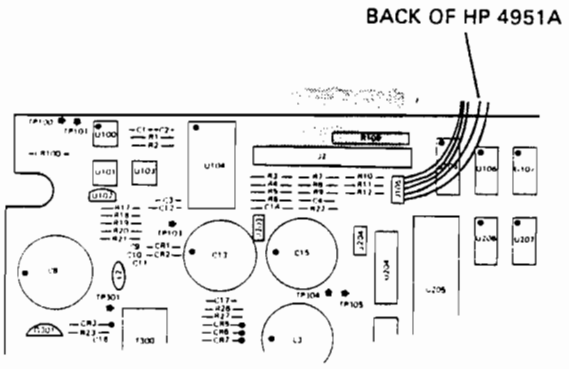
Press the cable into A2J1.

10. Disassemble the Back Panel

Disconnect the cables connected to A1J2 and A1J204.

Disconnect the ground cable attached to the transformer on the back panel.

Slide the Rear Panel up and out of the instrument.



8-9. ASSEMBLY PROCEDURES

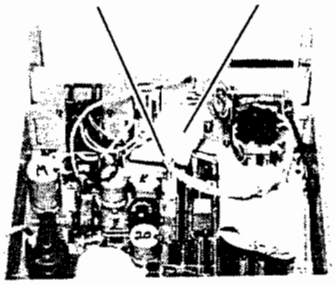
1. Replace A1 Main Board and Back Panel

Seat the Main Board into the case bottom.

Place the Rear Panel against the back of the case bottom.

Connect the cables to A1J2 and A1J204.

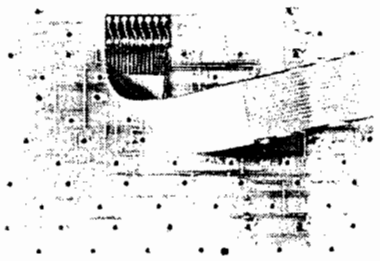
Slide the Rear Panel into place in the grooves on the back of the HP 4951A case bottom.



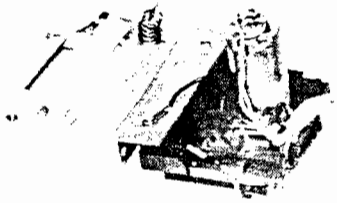
2. Assemble Keyboard Housing

Seat keyboard printed circuit board into keyboard case bottom. Fold the keyboard cable (W6) so that it lies flat against the circuit side of the printed circuit board.

There should be a protective strip attached to the keyboard side of the cable.



7. Remove the Keyboard and Front Panel

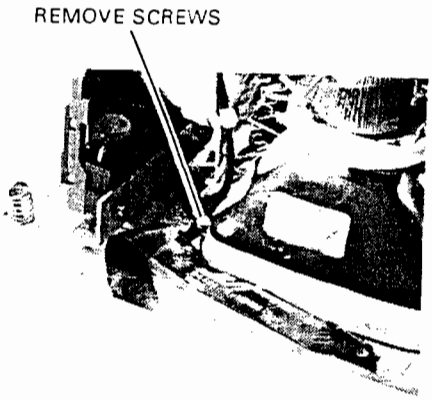


Hold the Keyboard in the closed position. Lift the Front Panel and Keyboard up and out of the case bottom.

Lay the Front Panel face side down on the workbench.

To remove Option 001, remove the two screws holding the Tape Transport in place and lift it off of the Front Panel.

8. Remove the CRT



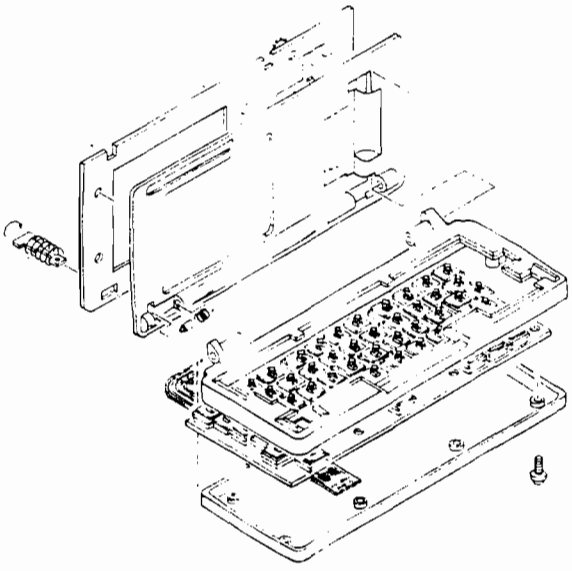
WARNING

Wear safety glasses when handling the CRT.

Disconnect the ground cable attached to the CRT.

Remove the four screws holding the CRT in place.

9. Disassemble the Front Panel and Keyboard



Remove the hinge plates. The CRT and Front Panels will seperate.

Remove the eight screws from the Keyboard case bottom.

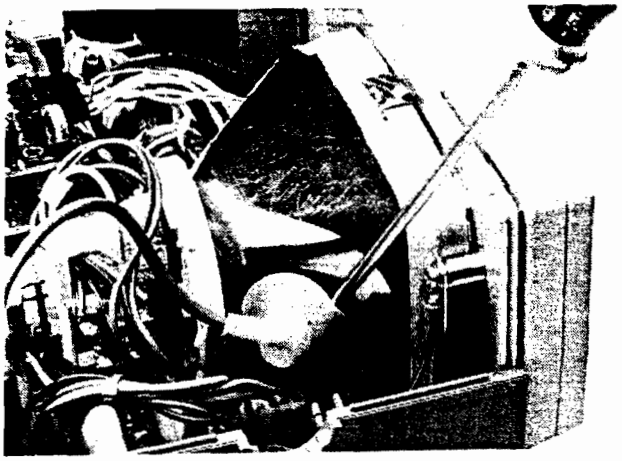
Pull the Keyboard case apart. The Keyboard assembly and Keyboard cable will be exposed.

5. Disconnect the CRT cables

Discharge the CRT to ground. Slide a screwdriver under the PA cable cover. Touch the metal part of the screwdriver to the sheet metal part of the front panel which is ground.

Use the needlenose pliers to squeeze together the two leads in the PA cable and remove the prongs from the CRT.

Remove the cables connected to A1J801 and A1J700.



6. Remove the Keyboard Hinge Pins

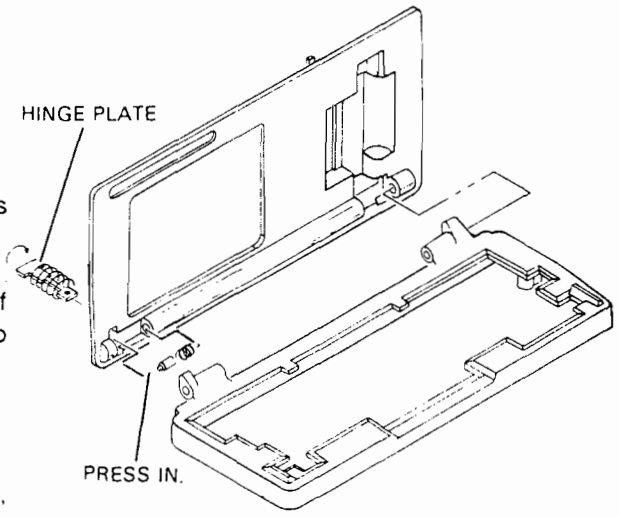
Open the Keyboard.

With one hand, use the needlenose pliers to press in and turn the hinge plate.

Hold the hinge plate in; press in the other end of the hinge plate with the 1/8" screwdriver to release the hinge pin.

Pull the hinge out of the slot on the Front Panel.

BE CAREFUL. catch the hinge pin with your hand, there is a spring behind it.

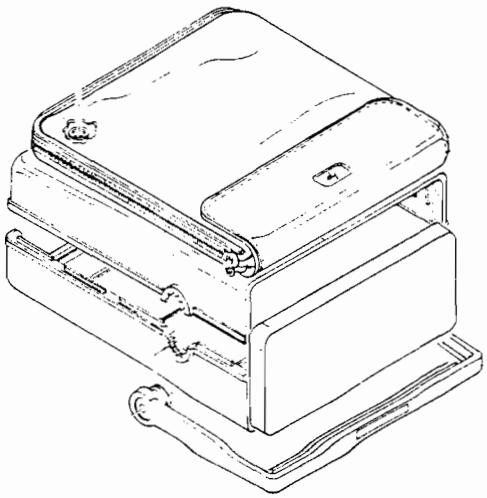


2. Remove the case top.

Hold the halves of the case together and turn the instrument right side up.

CAREFULLY pull the case top up and off.

Remove the handle.



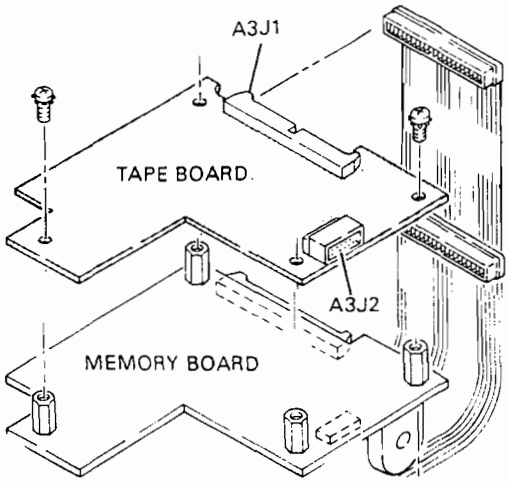
3. Option 001, Tape I/O Board

Disconnect A3J2, the cable between the Tape Board and the Tape Transport.

Remove the cable from A3J1.

Remove the four screws holding the Tape Board in place.

Lift the board off of the standoffs, place the component side up on the static protected work area.



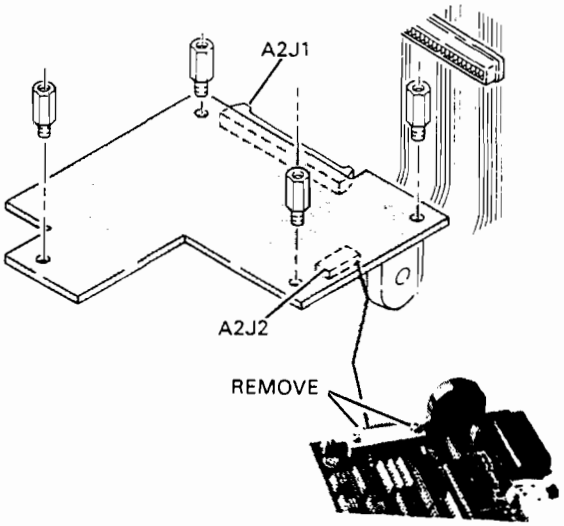
4. Remove the Memory Board

Remove the four threaded standoffs holding the Memory Board in place.

Disconnect the cable at A2J1.

Fold out the Memory Board.

Remove the screws holding the cable to A2J2 and disconnect the cable.



8-7. DISASSEMBLY/ASSEMBLY PROCEDURES

CAUTION

Whenever internal circuits of the HP 4951A are accessed, procedures for handling static sensitive devices must be observed. For correct handling see paragraph 8-6.

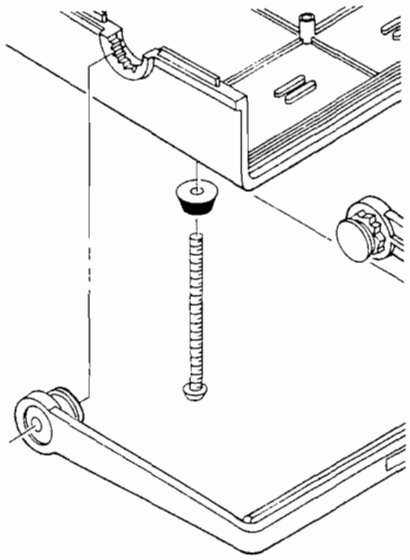
Equipment Needed

#1	posidrive screwdriver
#2	posidrive screwdriver
1/4"	slotted screwdriver
1/8"	slotted screwdriver
	needle nose pliers
	static safe work area

WARNING

8000 volts can be present even when the HP 4951A is turned off.

8-8. DISASSEMBLY PROCEDURES



1. Remove External Fastenings

Lay the instrument upside down on a flat, static protected surface.

Set the handle on the bench.

Remove the four screws which secure the feet and the case halves.

Table 8-1. Recommended Test Equipment for Troubleshooting

INSTRUMENT	CRITICAL SPECIFICATIONS	RECOMMENDED MODEL
Signature Multimeter	DC volts 250V Freq 10 MHz Resistance 10 Mohms	HP 5005A
Oscilloscope	> 20 MHz bandwidth	HP 1740A
Voltmeter	1000 VDC	HP 3466A
Function Generator	Sinewave, 50 KHz	HP 3310B

8-6. GENERAL HANDLING OF STATIC SENSITIVE DEVICES

The HP 4951A has many HCMOS components. Observe the following guidelines when handling static sensitive devices.

1. Wear a wrist strap which contacts the bare skin and is properly grounded.
2. All equipment, such as soldering irons, fixtures, storage containers, and shelving, and so on must be grounded.
3. Work areas must be clear of non-conductive material. No plastics, polyurethane bags, coffee cups, candy wrappers, cigarette packs, or untreated trays should be near the work station.
4. Clothing should never come in contact with components or assemblies. Wear short sleeves, rolled up long sleves, or preferably an antistatic smock.
5. Use antistatic solution on all work benches, table mats, hand tools, storage containers, chair seat, and back rests.
6. Static sensitive devices must be protected at all times. Keep the devices in their antistatic packaging.
7. All work must be performed at a static safe work station. A static safe work station has the following:

   a. Conductive tablemat connected to ground through 1 M resistor.

   b. Wrist strap grounded through 1 M resistor.

   c. All test equipment tied to one common ground.

SECTION VIII
SERVICE

8-1. INTRODUCTION

This section provides information to troubleshoot and repair the HP 4951A Protocol Analyzer. Information includes Disassembly/Assembly procedures, Theory of Operation, Troubleshooting procedures, Signature Analysis tables, Component Locators, and Schematics.

8-2. MAINTENANCE

The HP 4951A Protocol Analyzer does not require regular cleaning or maintenance. It is recommended that the complete Performance Verification tests are performed on a regular basis.

8-3. THEORY OF OPERATION

This manual does not contain a Theory of Operation.

8-4. TROUBLESHOOTING

This manual provides a two part method to isolate a problem to a particular assembly. The results of the Performance Verification tests isolate the problem to an area of the HP 4951A. Once the area is identified, complete the Signature Analysis routines to isolate the problem to a component.

8-5. RECOMMENDED TEST EQUIPMENT

Test equipment recommended to perform the troubleshooting procedures for the Protocol Analyzer is listed in Table 8-1. Equipment with equivalent characteristics may be used.

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SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

This section contains information to backdate this manual for instruments with serial prefix numbers lower than the Serial Prefix shown on the Title Page. It may also contain information about compatibility with other Protocol Analyzer software.

7-2. MANUAL CHANGES

To adapt this manual to your instrument, make changes listed in Table 7-1. Changes are listed by serial prefix number. The sequence of changes should be performed in the order shown.

For instruments with serial prefixes greater than the Serial Prefix shown on the Title Page, any changes are described in a yellow MANUAL CHANGES supplement.

Table 7-1. Manual Changes

Instrument Serial No.	Make Changes
NO CHANGES AT TIME OF PRINTING	

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10U105	1820-3350	0	1	IC MUXR/DATA-SEL CMOS/74HC 4-TO-1-LINE	28480	1820-3350
A10U106	1820-3007	4	2	IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A10U107	1820-2922	0	4	IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A10U204	1820-3082	5	4	IC-MC74HC374N	28480	1820-3082
A10U205	1820-3515	9	1	IC Z8530ACS	28480	1820-3515
A10U206	1820-3298	5	1	IC GATE CMOS/74HC OR QUAD 2-INP	28480	1820-3298
A10U207	1820-3097	2	3	IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A10U208	1820-3191	7	4	IC MUXR/DATA-SEL CMOS/74HC 2-TO-1-LINE	28480	1820-3191
A10U209	1820-3436	3	1	IC-8-BIT MICROPROCESSOR; 4MHZ CLOCK	28480	1820-3436
A10U304	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A10U306	1820-3097	2		IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A10U307	1820-3330	6	1	IC TRANSCEIVER CMOS/74HC BUS OCTL	28480	1820-3330
A10U308	1820-2998	0	1	IC-MC74HC373N	28480	1820-2998
A10U404	1820-3208	7	1	IC CNTR CMOS/74HC BIN ASYNCHRO	28480	1820-3208
A10U405	1820-3081	4	4	IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A10U406	1820-3081	4		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A10U407	1818-3198	9	1	IC CMOS 65536(64K) STAT RAM 150-NS 3-S	28480	1818-3198
A10U408	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC 2-TO-1-LINE	28480	1820-3191
A10U409	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC 2-TO-1-LINE	28480	1820-3191
A10U410	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC 2-TO-1-LINE	28480	1820-3191
A10U503	1820-3373	7	1	IC MV CMOS/74HC MONOSTBL CLEAR DUAL	28480	1820-3373
A10U505	1820-2921	9	3	IC INV CMOS HEX	28480	1820-2921
A10U506	1820-2923	1	1	IC GATE CMOS/74HC NAND TPL 3-INP	28480	1820-2923
A10U508	1820-3297	4	1	IC DRVR CMOS/74HC BUS OCTL	28480	1820-3297
A10U509	1820-2853	6	1	IC-68A45	02037	MC68A45P
A10U604	1826-0753	3	1	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP C	04713	MC34004BL
A10U605	1820-2925	3	1	IC CNTR CMOS/74HC BIN SYNCHRO	28480	1820-2925
A10U606	1820-2922	0		IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A10U607	1818-1738	9	1	IC CMOS 16384 (16K) STAT RAM 200-NS 3-S	S4013	HM6116LP-4
A10U610	1820-2922	0		IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A10U701	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A10U705	04951-10010	7	1	IC MEMORY	28480	04951-10010
A10U707	04951-10011	8	1	IC MEMORY	28480	04951-10011
A10U708	1820-2921	9		IC INV CMOS HEX	28480	1820-2921
A10U709	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A10U803	1820-2924	2	1	IC-MC74HC02N	28480	1820-2924
A10U804	1820-2921	9		IC INV CMOS HEX	28480	1820-2921
A10U805	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A10U806	1820-1922	8	1	IC SHF-RGTR TTL LS PRL-IN SERIAL-OUT	01295	SN74LS166N
A10U807	1820-3081	4		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A10U904	1820-3081	4		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A10U905	1820-3196	2	1	IC GATE CMOS/74HC NOR DUAL 4-INP	28480	1820-3196
A10U906	1820-2922	0		IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A10U907	1820-3097	2		IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A10XJ105	1251-6857	1	15	CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ108	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ203	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ400	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ402	1251-6057	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6057
A10XJ404	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ405	1251-6057	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6057
A10XJ406	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ504	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ509	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ510	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ603	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ703	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ804	1251-6857	1	1	CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A10XJ809	1251-4670	2		CONNECTOR	28480	1251-4670
A10XU205	1200-0654	7	3	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A10XU209	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A10XU509	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A10XU608	1200-0638	7	1	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A10XU609	1200-0796	8	2	SOCKET-IC 8-CONT DIP DIP-SLDR	28480	1200-0796
A10XU705	1200-0567	1	2	SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A10XU707	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A10XU810	1200-0796	8		SOCKET-IC 8-CONT DIP DIP-SLDR	28480	1200-0796
A10Y108	0410-1520	2	1	XTAL 8.064MHZ	28480	0410-1520
A10Y504	0410-0761	1	1	CRYSTAL-QUARTZ 4.915 MHZ HC-18/U-HLDR	28480	0410-0761
A10Y505	0410-1307	7	1	XTAL 3.6864MHZ	28480	0410-1387
	0380-0566	9	4	STANDOFF-RVT-ON 1.5-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	2200-0105	4	2	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2260-0009	3	2	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	4330-0145	7	10	INSULATOR-BEAD GLASS	28480	4330-0145

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10R32	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A10R33	8110-0179	7		WIRE, RESISTIVE- 362 OHM/FT (0.0833 FT)	08696	CUPRON
A10R34	0698-0085	6		RESISTOR 2.61K 1% .125W F TC=0+-100	03292	CT4-1/8-TO-2611-F
A10R35	0757-0145	9	2	RESISTOR 750K 1% .25W F TC=0+-100	19701	MF52C1/4-TO-7503-F
A10R36	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-TO-6192-F
A10R38	0698-3442	9	1	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-TO-237R-F
A10R39	0698-5217	0	2	RESISTOR 28.7K 5% 125W F TC=0+-100	03292	NA4
A10R41	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R42	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R45	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R46	0757-0458	7	2	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A10R47	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R48	0698-3430	5	2	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A10R49	0757-0199	3	2	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A10R50	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A10R51	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A10R52	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R55	0757-0424	7	2	RESISTOR 1.1K 1% .125W F TC=0+-100	03292	CT4-1/8-TO-1101-F
A10R56	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A10R57	0686-1045	9	3	RESISTOR 100K 5% .5W CC TC=0+882	01121	EB1045
A10R58	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A10R59	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A10R60	0698-3389	3	1	RESISTOR 17.8 1% .5W F TC=0+-100	28480	0698-3389
A10R61	0757-0797	7	1	RESISTOR 90.9 1% .5W F TC=0+-100	28480	0757-0797
A10R62	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R63	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A10R64	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R65	0686-1015	3	1	RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A10R66	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R67	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R68	0686-1045	9		RESISTOR 100K 5% .5W CC TC=0+882	01121	EB1045
A10R69	0686-1045	9		RESISTOR 100K 5% .5W CC TC=0+882	01121	EB1045
A10R70	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R71	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R72	0698-3161	9	2	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A10R73	0698-3161	9		RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A10R74	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R75	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A10R76	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R77	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A10R79	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R80	0757-0145	9		RESISTOR 750K 1% .25W F TC=0+-100	19701	MF52C1/4-T0-7503-F
A10R105	1810-0280	8	4	NETWORK-RES 10-SIP 10K OHM X 9	05524	C5C10A01-103G
A10R209	1810-0368	3		NETWORK-RES 10-SIP 10K OHM X 5	02483	750-61-R10K
A10R309	1810-0277	3		NETWORK-RES 10-SIP2.2K OHM X 9	01121	210A222
A10R404	1810-0406	0	1	NETWORK-RES 8-SIP10.0K OHM X 4	01121	208B103
A10R503	2100-3908	9	1	RESISTOR-TRMR 1M 10% CC TOP ADJ 1-TRN	28480	2100-3908
A10R603	2100-3966	9	1	RESISTOR-TRMR 200K 10% C TOP-ADJ 1 TRN	28480	2100-3966
A10R702	2100-3096	6	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 17-TRN	32997	3292W-1-503
A10R703	1810-0369	4		NETWORK-RES 10-SIP 100K OHM X 5	02483	750-61-R100K
A10R704	2100-3089	7	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	32997	3292W-1-502
A10T300	04951-80016	0	1	100KHZ TRANSFORMER	28480	04951-80016
A10T500	9100-0453	0	1	XFMR-FLYBACK	28480	9100-0453
A10TP100	1251-8360	5	18	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP101	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP103	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP301	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP304	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP402	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP403	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP404	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP405	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP406	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP510	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP604	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP704	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP803	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10TP804	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10GND	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SO	28480	1251-8360
A10U100	1826-0412	1	1	IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
A10U101	1826-0544	0	1	V REF 8-DIP-C	04713	MC1403U
A10U102	1826-0275	4	1	IC 78L12A V RGLTR TO-92	04713	MC78L12ACP
A10U103	1826-0468	7	1	IC COMPARATOR GP 8-DIP-P PKG	04713	MC3423P1
A10U104	1826-1066	3	1	IC-VOLTAGE REGULATOR 2A PIN PLASTIC PKG	28480	1826-1066

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR22	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A10CR100	1884-0293	8	1	THYRISTOR-SCR	04713	MCR69-2
A10DS1	2140-0013	5	1	LAMP-GLOW 5AB-A 70/57VDC 300UA T-2-BULB	00806	5AD A(NE-23A)
A10J1	1251-8827	9	1	60 POSITION CONN	28480	1251-8827
A10J2	1251-8828	0	1	40 POSITION CONN	28480	1251-8828
A10J105	1258-0141	8	16	JUMPER-REM	28480	1258-0141
A10J108	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J203	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J204	1251-4246	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A10J400	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J402	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J404	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J405	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J406	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J504	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J509	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J510	1258-0141	8		JUMPER-REM	28480	1258 0141
A10J603	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J608	1251-4292	4	1	SHUNT-DIP 7 POSITIONS	28480	1251-4292
A10J609	1251-4398	1	2	CONNECTOR SHUNT-4 POSITION	28480	1251-4398
A10J700	1251-3825	7		CONNECTOR 5-PIN M POST TYPE	28480	1251-3825
A10J703	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J801	1251-3751	8	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-3751
A10J804	1258-0217	9	1	MULTI-B-JUMP	28480	1258-0217
A10J809	1258-0141	8		JUMPER-REM	28480	1258-0141
A10J810	1251-4398	1		CONNECTOR SHUNT-4 POSITION	28480	1251-4398
A1L1	04951-80017	1		INDUCTOR 2MH +-10%	28480	04951-80017
A1L2	9140-0801	6	1	TOROIDAL CHOKE	28480	9140-0801
A1L3	04951-80015	9	1	COUPLED INDUCTOR	28480	04951-80015
A1L4	9140-0319	1	1	COIL-LINEARITY	28480	9140-0319
A1L5	9140-0407	8	1	CL-V 10UH MIN	28480	9140-0407
A10Q301	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A10Q302	1855-0526	9	1	TRANSISTOR MOSFET P-CHAN E-MODE SI	28480	1855-0526
A10Q400	1855-0525	8	2	TRANSISTOR MOSFET N-CHAN E-MODE SI	28480	1855-0525
A10Q402	1855-0402	0	1	TRANSISTOR J-FET 2N5115 P-CHAN D-MODE	17856	2N5115
A10Q403	1855-0492	8	2	TRANSISTOR MOSFET N-CHAN E-MODE TO-220	28480	1855-0492
A10Q404	1855-0492	8		TRANSISTOR MOSFET N-CHAN E-MODE TO-220	28480	1855-0492
A10Q405	1826-0276	5	1	IC 78L05A V RGLTR TO-92	04713	MC78L05ACP
A10Q601	1855-0524	7	2	TRANSISTOR MOSFET N-CHAN E-MODE TO-220	28480	1855-0524
A10Q602	1855-0524	7		TRANSISTOR MOSFET N-CHAN E-MODE TO-220	28480	1855-0524
A10Q603	1855-0525	0		TRANSISTOR MOSFET N-CHAN E-MODE SI	28480	1855-0525
A10Q703	1854-0659	7	1	TRANSISTOR NPN SI PD=12.5W FT=50MHZ	04713	MJE180
A10Q704	1853-0436	6	1	TRANSISTOR PNP SI PD=12.5W FT=50MHZ	04713	MJE170
A10Q801	1853-0536	7	1	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0536
A10Q803	1854-0730	5	2	TRANSISTOR NPN SI TO-92	04713	MPS6531
A10Q804	1826-0285	6	1	IC V RGLTR TO-92	04713	MC79L05C
A10Q903	1854-0730	5		TRANSISTOR NPN SI TO-92	04713	MPS6531
A10R1	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A10R2	0698-3266	5	2	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A10R3	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R4	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A10R5	0698-7929	5	1	RESISTOR 9.09K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-9091-B
A10R6	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R7	0757-0401	0	4	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R8	0698-8463	4	1	RESISTOR 464.2 .1% .125W F TC=0+-25	28480	0698-8463
A10R9	0699-0589	1	1	RESISTOR 34.334K .1% .125W F TC=0+-25	28480	0699-0589
A10R10	0698-3447	4	1	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A10R11	0757-0442	9	11	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R12	0757-0465	6	9	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R13	0698-0084	9	3	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A10R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R15	0698-8827	4	1	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A10R16	0698-3266	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A10R17	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A10R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R19	0757-0444	1		RESISTOR 12.1K 1% 125W F TC=0+-100	02995	5033R
A10R20	0698-3159	5	1	RESISTOR 26.1K 1% 125W F TC=0+-100	02995	5033R
A10R21	0757-0466	7	1	RESISTOR 110K 1% 125W F TC=0+-100	02995	5033R
A10R22	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A10R23	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A10R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R25	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R26	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A10R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R28	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R29	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R31	0757-0280	3	5	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10	04951-60010	2	1	OPTION 003 KATAKANA BOARD	28480	04951-60010
A10C1	0160-0576	5	13	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C2	0160-3508	9	4	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A10C3	0160-4822	2	2	CAPACITOR-FXD 1000PF + 5% 100VDC CER	28480	0160-4822
A10C4	0160-4832	4	1	CAPACITOR-FXD .01UF + 10% 100VDC CER	28480	0160-4832
A10C5	0160-4789	0	6	CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A10C6	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A10C7	0180-2683	3	1	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	DS10474
A10C8	0180-3374	9	1	CAPACITOR-FXD 4700UF+30-10% 35VDC AL	28480	0180-3374
A10C9	0160-3879	7	5	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A10C7	0180-2683	1	1	CAPACITOR-FXD 4.7UF —10% 35VDC TA	03923	DS10474
A10C11	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A10C12	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A10C13	0180-3376	1	2	CAPACITOR-FXD 2200UF+30-10% 25VDC AL	28480	0180-3376
A10C14	0160-4824	4	1	CAPACITOR-FXD 680PF +-5% 100VDC CER	28480	0160-4824
A10C15	0180-3375	0	1	CAPACITOR-FXD 3300UF+30-10% 16VDC AL	28480	0180-3375
A10C16	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A10C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C19	0160-2055	9		CAPACITOR-FXD 01UF 100VDC	04200	C023F101F103ZS22-CDA
A10C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A10C21	0180-3376	1		CAPACITOR-FXD 2200UF+30-10% 25VDC AL	28480	0180-3376
A10C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C23	0160-0576	3		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C24	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C25	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A10C26	0160-0996	3	1	CAPACITOR-FXD .01UF +-20% 2KVDC CER	72982	805-012-Z5U0 103M
A10C27	0160-4663	7	1	CAPACITOR-FXD 2.2UF -80-20% 100VDC CER	28480	0160-4663
A10C28	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C29	0160-4953	0	1	CAPACITOR-FXD .027UF +-5% 50VDC CER	28480	0160-4953
A10C30	0160-0576	5		CAPACITOR-FXD .1UF + 20% 50VDC CER	28480	0160-0576
A10C31	0160-4663	9	2	CAPACITOR-FXD 2.2UF +80-20% 100VDC CER	28480	0160-4663
A10C32	0180-3377	2	1	CAPACITOR-FXD 47UF+-20% 50VDC AL	28480	0180-3377
A10C33	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A10C34	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A10C35	0160-3071	1	1	CAPACITOR-FXD 10UF +-10% 100VDC	01456	170K106K
A10C36	0170-0040	9	1	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A10C37	0160-4579	6	1	CAPACITOR-FXD .1UF +-5% 160VDC MET-POLYC	28480	0160-4579
A10C38	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C39	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C40	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C41	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C42	0160-4230	6	3	CAPACITOR-FXD .01UF +80-20% 1KVDC CER	71590	GAP-103
A10C43	0160-4663	9		CAPACITOR-FXD 2.2UF +80-20% 100VDC CER	28480	0160-4663
A10C44	0160-4808	4	1	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A10C45	0160-4804	0	2	CAPACITOR-FXD 56PF +-5% 100VDC CER 0+-30	28480	0160-4804
A10C46	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A10C47	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C48	0160-4230	6		CAPACITOR-FXD .01UF +80-20% 1KVDC CER	71590	GAP-103
A10C49	0160-4230	6		CAPACITOR-FXD .01UF +80-20% 1KVDC CER	71590	GAP-103
A10C50	0160-4804	0		CAPACITOR-FXD 56PF +-5% 100VDC CER 0+-30	28480	0160-4804
A10C51	0160-4370	5	1	CAPACITOR-FXD 1000PF + 5% 200VDC CER	51642	200-200-NP0-102J
A10C52	0160-4801	7	1	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A10C53	0160-4709	0		CAPACITOR-FXD 150F +-5% 100VDC CER 0+-30	28480	0160-4709
A10C54	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A10CR1	1901-0704	4	2	DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A10CR2	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A10CR3	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A10CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A10CR5	1901-0871	6	4	DIODE-PWR RECT 150V 2.5A 25NS	12969	UES1103
A10CR6	1901-0871	6		DIODE-PWR RECT 150V 2.5A 25NS	12969	UES1103
A10CR7	1901-0871	6		DIODE-PWR RECT 150V 2.5A 25NS	12969	UES1103
A10CR8	1901-0871	6		DIODE-PWR RECT 150V 2.5A 25NS	12969	UES1103
A10CR9	1901-0992	2	2	DIODE-SCHOTTKY 1N5822 40V 3A	28480	1901-0992
A10CR10	1901-0992	2		DIODE SCHOTTKY 1N5822 40V 3A	28480	1901-0992
A10CR11	1901-0845	4	1	DIODE HV RECT 2KV 50MA 250NS	18546	VG-2X
A10CR12	1901-1105	1	2	DIODE-HV RECTIFIER	28480	1901-1105
A10CR13	1902-3323	1	1	DIODE-ZNR 42.2V 5% DO-35 PD=.4W TC=+.00%	28480	1902-3323
A10CR14	1901-1105	1		DIODE-HV RECTIFIER	28480	1901-1105
A10CR15	1901-0040	1	3	DIODE SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR16	1901-0692	9	1	DIODE-PWR RECT 200V 3A 200NS	04713	MR052
A10CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A10CR19	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A10CR20	1902-0949	1	1	DIODE-ZNR 4.3V 5% DO-35 PD=.4W TC=+.017%	28480	1902-0949

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R26	0698-3260	9	2	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-TO-4641-F
A3R27	0757-3435	6	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3831-F
A3R28	0757-0317	7	1	RESISTOR 1.33K 2W PW TC=0+-25	28480	0698-6360
A3R29	0698-6360	6		RESISTOR 10K 1% .125W F TC=0+-25	28480	0698-6360
A3R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-CMF-55-1, T1
A3R31	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R32	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R32	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2152-F
A3R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R34	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	05524	C4-1/8-TO-CMF-55-1, T1
A3R35	0698-6360	6	1	RESISTOR 10K 1% .125W F TC=0+-100	28480	0698-6360
A3R36	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	02273	5033R
A3R37	0757-0482	7		RESISTOR 511K 1% .125W F TC=0+-100	02273	CEA-993
A3R38	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	03292	CT4-1/8-TO-2151-F
A3R39	0757-0274	5	2	RESISTOR 1.21K 1% .125W F TC=0+-100	03294	CT4-1/8-TO-1211-F
A3R40	0698-3435	6		RESISTOR 38.3 1% .125W F TC=0+-100	03294	L04D
A3R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R43	0757-0442	9		RESISTOR 10K	02273	CEC-993
A3R44	0757-0280	3		RESISTOR 1K 1% .125W	02273	5033R
A3R45	0698-3449	6		RESISTOR 28.7K 1% .125W	03292	CT4-1/8-TO-2872-F
A3R46	0698-3452	1		RESISTOR 147K	03292	CT4-1/8-TO-1472-F
A3R47	0698-3451	0		RESISTOR 133K 1% .125W	03292	CT4-1/8-TO-1331-F
A3R207	1810-0280	8	3	NETWORK-RES 10-SIP 10.0K OHM X 9	01121	210A103
A3R300	1810-0368	3	2	NETWORK-RES 6-SIP 10.0K OHM X 5	01121	206A103
A3R307	1810-0280	8		NETWORK-RES 10-SIP 10.0K OHM X 9	01121	210A103
A3R308	1810-0280	8		NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A3R404	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R505	1810-0368	3		NETWORK-RES 6-SIP10.0K OHM X 5	01121	206A103
A3R506	1810-0374	1	1	NETWORK-RES 8-SIP1.0K OHM X 4	01121	208B102
A3U102	04951-10008	3	1	ST MACH PROM 401	28480	04951-10008
A3U103	04951-10007	2	1	TAPE PROM 404	28480	04951-10007
A3U104	1820-3552	4	1	NSC810AN-I-TEMP	28480	1820-3552
A3U105	1820-3058	5	3	IC FF CMOS/74HC D-M/S POS-EDGE-TRIG COM	28480	1820-3058
A3U106	1820-2970	0	1	MICROPROCESSOR	28480	1820-2970
A3U201	1820-2923	1	1	IC GATE CMOS/74HC NAND TPL 3-INP	28480	1820-2923
A3U205	1820-3058	5		IC FF CMOS/74HC D M/S POS-EDGE-TRIG COM	28480	1820-3058
A3U208	1820-3082	5	3	IC-MC74HC374N	28480	1820-3082
A3U300	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A3U301	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A3U302	04951-10009	4	1	ST MACH PROM 402	28480	04951-10009
A3U303	1820-2232	5	1	IC RGTR CMOS 8-BIT	04713	MC14034BCP
A3U305	1820-3058	5		IC FF CMOS/74HC D-M/S POS EDGE-TRIG COM	28480	1820-3058
A3U306	1820-3185	9	1	IC SCHMITT-TRIG CMOS/74HC INV HEX	28480	1820-3185
A3U307	1820-2922	0	1	IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A3U308	1820-3330	6	1	IC TRANSCEIVER CMOS/74HC BUS OCTL	28480	1820-3330
A3U404	1826-0740	8	1	IC SWITCH ANLG DUAL 16-DIP-C PKG	32293	IH5043CDE
A3U406	1826-0521	3	1	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	01295	TL072CP
A3U407	1820-3081	4	2	IC FF CMOS/74HC D TYPE POS EDGE TRIG	28480	1820-3081
A3U408	1820-3081	4		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A3U504	1820-3377	1	1	IC DRVR CMOS PRPHL HI-CUR GATED QUAD	28480	1820-3377
A3U505	1826-1039	0	1	IC V REGLTR-SWG 1.1/40V 16-CHIP PKG	28480	1826-1039
A3U506	1826-0138	0	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A3U507	1820-1314	2	2	IC MULTIPLXR 4-CHAN-ANLG DUAL 16-DIP-P	3L585	CD4052BE
A3U508	1820-1314	2		IC MULTIPLXR 4-CHAN-ANLG DUAL 16-DIP-P	3L585	CD4052BE
A3U607	1826-0753	3	1	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A3XU102	1200-0541	1	3	SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A3XU103	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A3XU104	1200-0654	7	2	SOCKET-IC 40-CONT DIP DIP SLDR	28480	1200-0654
A3XU106	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A3XU302	1200-0541	1		SOCKET-IC 24-CONT DIP DIP SLDR	28480	1200-0541
A3XU303	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A3XU305	1200-0607	0		IC SOCKET	28480	1200-0607
A3Y107	0410-0726	8	1	CRYSTAL-QUARTZ 6.00000 MHZ	28480	0410-0726
	0624-0336	9	4	SCREW-TPG 4-20 .375-IN-LG PAN-HD-POZI	28480	0624-0336
	2200-0105	4	4	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2260-0039	3	2	NUT-HEX-W/LKWR 4-40 THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	4330-0145	9	2	INSULATOR-BEAD GLASS	28480	4330-0145
	4951A #001	3		OPTION 001 MISCELLANEOUS	28480	4951A #001
	0380-0388	3	4	STANDOFF-HEX .375-IN-LG 6-32THD	28480	0380-0388
	1460-1632	7	1	SPRING-TRSN .103-IN-OD MUW ZN	28480	1460-1632
	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0117	6	2	SCREW MACH 6-32 .375-IN LG PAN-HD POZI	00000	ORDER BY DESCRIPTION
	5041-1523	7	1	EJECT BUTTON	28480	5041-1523
	5061-2246	5	1	TAPE TRANSPORT	28480	5061-2246
	04951-00002	6	1	BRACKET-TP TRANS	28480	04951-00002
	04951-40002	0	1	TAPE COVER	28480	04951-40002
	04951-40006	4	1	TAPE DOOR	28480	04951-40006

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	04951-60003	3	1	OPTION 001 TAPE CONTROLLER BOARD	28480	04951-60003
A3C1	0160-3508	9	7	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C2	0160-4789	0	2	CAPACITOR-FXD 15PF +-10% 200VDC CER	04200	292CCOG150J1008
A3C3	0160-4789	0		CAPACITOR-FXD 15PF +-10% 200VDC CER	04200	292CCOG150J1008
A3C4	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C5	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C6	0160-4833	5	1	CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A3C7	0160-3449	7	1	CAPACITOR-FXD 2000PF +-10% 250VDC CER	28480	0160-3449
A3C8	0160-4567	2	3	CAPACITOR-FXD 3900PF +-1% 100VDC CER	28480	0160-4567
A3C9	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C10	0160-4567	2		CAPACITOR-FXD 3900PF +-1% 100VDC CER	28480	0160-4567
A3C11	0160-4567	2		CAPACITOR-FXD 3900PF +-1% 100VDC CER	28480	0160-4567
A3C12	0160-0576	5	4	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C13	0160-3878	0	2	CAPACITOR-FXD 1000PF +-5% 100VDC CER	02813	CW20A102M3
A3C15	0160-3448	6	1	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3448
A3C16	0180-2683	1	1	CAPACITOR-FXD 4.7UF+-20% 35VDC TA	28480	0180-2683
A3C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C18	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C19	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C20	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C21	0160-5657	3	1	CAPACITOR-FXD 1200PF +-1% 100VDC CER	28480	0160-5657
A3C22	0160-3500	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3500
A3C23	0160-4801	7	1	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A3C24	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C25	0160-4824	4	1	CAPACITOR-FXD 680 +-5% 100VDC CER	02798	CAC03COG681J100A
A3C26	0160-4804	0		CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A3C27	0160-0576	5	1	CAPACITOR-FXD 1UF +-5% 50VDC CER	02010	SR205C104MAA
A3C28	0160-4808	4	1	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A3C29	0160-4808	4		CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A3CR1	1901-0040	1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3E105	1251-4670	2	2	CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
A3E208	1251-4670	2		CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
A3E304	3101-2063	8	1	SWITCH-RKR DIP-RKR-ASSY 4-1A .05A 30VDC	28480	3101-2063
A3J1	1251-8822	4	1	60 POS CONNECTOR	28480	1251-8822
A3J2	1252-0060	8	1	CONN 20 PIN	28480	1252-0060
A3J105	1258-0141	8	2	REMOVABLE JUMPER	28480	1258-0141
A3J208	1258-0141	8		REMOVABLE JUMPER	28480	1258-0141
A3L1	9140-0807	2	2	CHOKE-TOROIDAL	28480	9140-0807
A3L2	9140-0807	2		CHOKE-TOROIDAL	28480	9140-0807
A3Q504	1855-0461	1	2	TRANSISTOR MOSFET N-CHAN	28480	1855-0461
A3Q505	1855-0461	1		TRANSISTOR MOSFET N-CHAN	28480	1855-0461
A3Q508	1826-0285	6	1	IC V RGLTR TO-92	04713	MC79L05C
A3Q604	1855-0509	8	2	TRANSISTOR MOSFET P-CHAN E-MODE TO-220	28480	1855-0509
A3Q605	1855-0509	8		TRANSISTOR MOSFET P-CHAN E-MODE TO-220	28480	1855-0509
A3Q606	1855-0525	8	1	TRANSISTOR MOSFET N-CHAN E-MODE SI	28480	1855-0525
A3R1	0757-0442	9	10	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4 1/8 T0-1002 F
A3R2	0698-6360	6	4	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R3	0698-3435	0	1	RESISTOR 38.3 1% 125W F TC=0+-100	02995	5033R
A3R4	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4 1/8-T0-1001 F
A3R5	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R6	0757-0465	6	3	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4 1/8-T0-1003-F
A3R7	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4 1/8-T0-1003-F
A3R8	0757-0428	1	2	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3R9	0698-3439	4	3	RESISTOR 178 1% .125W F TC=0+-100	24546	C4 1/8-T0-178R-F
A3R10	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4 1/8-T0-178R-F
A3R11	0757-0463	4	1	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4 1/8-T0-8252-F
A3R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4 1/8-T0-1002 F
A3R13	0757-0430	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4 1/8-T0-5111-F
A3R14	0698-3158	4	1	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A3R15	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4 1/8-T0-1002-F
A3R16	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4 1/8-T0-178R-F
A3R17	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R19	0698-3151	7	1	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A3R20	0698-3266	5	1	RESISTOR 237K 1% 125W F TC=0+-100	24546	C4-1 8-T0-2371 F
A3R21	0757-3151	3		RESISTOR 2.87K 1% 125W F TC=0+-100	24546	C4-1 8-T0-2871 F
A3R22	0698-3455	4	1	RESISTOR 237K 1% 125W F TC=0+-100	24546	C4-1 8-T0-2373 F
A3R23	0757-0442	9		RESISTOR 10K 1% 125W F TC=0+-100	24546	C4-1 8-T0-1002 F
A3R24	0757-0442	9		RESISTOR 10K 1% 125W F TC=0+-100	24546	C4-1 8-T0-1002 F
A3R25	0698-3266	5		RESISTOR 237K 1% 125W F TC=0+-100	24546	C4-1 8-T0-2371 F

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	04951-60002	2	1	MEMORY BOARD ASSEMBLY	28480	04951-60002
A2C1	0160-3508	9	8	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C2	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C3	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C4	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C5	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C6	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C7	0180-1846	6		CAPACITOR-FXD 2.2 +80-20% 35V TA	04200	150D225X903582-DYS
A2C8	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A2C9	0160-3878	6	1	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2C10	0160-4426	2	1	CAPACITOR-FXD .01UF +-1% 100VDC CER	28480	0160-4426
A2CR1	1901-1080	1	1	DIODE-SCHOTTKY 1N5817 20V 1A	28480	1901-1080
A2E101	1258-0218	0	4	MULTI-B-JUMP	28480	1258-0218
A2E102	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2E104	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2E105	1258-0218	0		MULTI-B-JUMP	28480	1258-0218
A2J1	1251-8822	4	1	60 POS CONNECTOR	28480	1251-8822
A2J2	1200-0607	0	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A2R1	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2R2	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A2R3	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R4	0698-3150	4	2	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A2R207	0698-3159	5		RESISTOR 26.1K 1% 125W F TC=0+-100	03292	CT4-1/8-TO-2612-F
A2R301	1810-0281	9	1	NETWORK-RES 10-SIP100.0K OHM X 9	01121	210A104
A2R501	1810-0406	0	3	NETWORK-RES 8-SIP10.0K OHM X 4	01121	208B103
A2R502	1810-0406	0		NETWORK-RES 8-SIP10.0K OHM X 4	01121	208B103
A2R503	1810-0406	0		NETWORK-RES 8-SIP10.0K OHM X 4	01121	208B103
A2S301	9164-0235	0	1	AUDIO TRANSDUCER PIEZO CERAMIC TYPE; 50V	28480	9164-0235
A2TP1	1251-8360	5	7	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A2TP2	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A2TP3	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A2TP4	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A2TP300	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A2TP301	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A2TP400	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A2U101	04951-10001	6	1	MEM PROM 01	28480	04951-10001
A2U103	04951-10002	7	1	MEM PROM 23	28480	04951-10002
A2U104	1818-3198	9	6	ICM HM 6264	06347	HM6264P-15
A2U105	1818-3198	9		ICM HM 6264	06347	HM6264P-15
A2U200	04951-10003	8	1	MEM PROM 8FB1	28480	04951-10003
A2U201	1818-3198	9		ICM HM 6264	06347	HM6264P-15
A2U202	1818-3198	9		ICM HM 6264	06347	HM6264P-15
A2U203	1818-3198	9		ICM HM 6264	06347	HM6264P-15
A2U204	1818-3198	9		ICM HM 6264	06347	HM6264P-15
A2U205	04951-10004	9	1	MEM PROM 8FB2	28480	04951-10004
A2U206	1820-3014	3	2	IC DCDR CMOS 2-TO-4-LINE DUAL	28480	1820-3014
A2U207	1820-3014	3		IC DCDR CMOS 2-TO-4 LINE DUAL	28480	1820-3014
A2U300	1820-3552	4	1	NSC810AN-I-TEMP	28480	1820-3552
A2U301	1820-2998	3	1	IC-MC74HC373N	28480	1820-2998
A2U302	1820-3079	0	1	IC DCDT CMOS/74HC 3-TO-8-LINE	28480	1820-3079
A2U303	1820-2924	3	1	IC-MC74HC02N	28480	1820-2924
A2U304	1820-3082	5	2	IC-MC74HC374N	28480	1820-3082
A2U401	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A2U402	1820-3081	4	2	IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A2U403	1820-3298	5	1	IC GATE CMOS/74HC OR QUAD 2-INP	28480	1820-3298
A2U404	1820-3208	7	1	IC CNTR CMOS/74HC BIN ASYNCHRO	28480	1820-3208
A2U500	1820-3196	2	1	IC GATE CMOS/74HC NOR DUAL 4-INP	28480	1820-3196
A2U503	1820-3081	4		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A2U504	1820-2466	7	1	IC TIMER CMOS	32293	ICM7555IPA
A2XE100	1251-4670	2	2	CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
A2XE101	1251-8702	9	4	CONN POST TYPE .100-PIN-SPCG 16-CONT	28480	1251-8702
A2XE102	1251-8702	9		CONN POST TYPE .100-PIN-SPCG 16-CONT	28480	1251-8702
A2XE103	1251-4670	2		CONNECTOR 3-PIN M POST TYPE	28480	1251-4670
A2XE104	1251-8702	9		CONN POST TYPE .100-PIN-SPCG 16-CONT	28480	1251-8702
A2XE105	1251-8702	9		CONN POST TYPE .100-PIN-SPCG 16-CONT	28480	1251-8702
A2XU100	1200-0567	1	5	SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A2XU101	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A2XU103	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A2XU200	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A2XU205	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
	04951-61601	9	1	MAIN/MEMORY CBL	28480	04951-61601
	04951-61602	3	1	MA, MC, MO, TP, CBL	28480	04951-61602

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A1U105	1820-3350	0	1	IC MUXR/DATA-SEL CMOS/74HC 4-TO-1-LINE	28480	1820-3350
A1U106	1820-3007	4	2	IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U107	1820-2922	0	4	IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A1U204	1820-3082	5	4	IC-MC74HC374N	28480	1820-3082
A1U205	1020-3515	9	1	IC Z8530ACS	28480	1820-3515
A1U206	1820-3298	5	1	IC GATE CMOS/74HC OR QUAD 2-INP	20480	1820-3298
A1U207	1820-3097	2	3	IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A1U208	1820-3191	7	4	IC MUXR/DATA-SEL CMOS/74HC 2-TO-1-LINE	28480	1820-3191
A1U209	1820-3436	3	1	IC-8-BIT MICROPROCESSOR; 4MHZ CLOCK	28480	1820-3436
A1U304	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A1U306	1820-3097	2		IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A1U307	1820-3330	6	1	IC TRANSCEIVER CMOS/74HC BUS OCTL	28480	1820-3330
A1U308	1820-2998	0	1	IC-MC74HC373N	28480	1820-2998
A1U404	1820-3208	7	1	IC CNTR CMOS/74HC BIN ASYNCHRO	28480	1820-3208
A1U405	1820-3081	4	4	IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A1U406	1820-3081	4		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A1U407	1818-3198	9	1	IC CMOS 65536(64K) STAT RAM 150-NS 3-S	28480	1818-3198
A1U408	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC 2-TO-1-LINE	28480	1820-3191
A1U409	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC 2-TO-1-LINE	28480	1820-3191
A1U410	1820-3191	7		IC MUXR/DATA-SEL CMOS/74HC 2-TO-1-LINE	28480	1820-3191
A1U503	1820-3373	7	1	IC MV CMOS/74HC MONOSTBL CLEAR DUAL	28480	1820-3373
A1U505	1820-2921	9	3	IC INV CMOS HEX	28480	1820-2921
A1U506	1820-2923	1	1	IC GATE CMOS/74HC NAND TPL 3-INP	28480	1820-2923
A1U508	1820-3297	4	1	IC DRVR CMOS/74HC BUS OCTL	28480	1820-3297
A1U509	1820-2853	6	1	IC-68A45	02037	MC68A45P
A1U604	1826-0753	3	1	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A1U605	1820-2925	3	1	IC CNTR CMOS/74HC BIN SYNCHRO	28480	1820-2925
A1U606	1820-2922	0		IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A1U607	1818-1738	9	1	IC CMOS 16384 (16K) STAT RAM 200-NS 3-S	54013	HM6116LP-4
A1U610	1820-2922	0		IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A1U701	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A1U705	04951-10005	0	1	CHAR PROM 111	28480	04951-10005
A1U707	04951-10006	1	1	CHAR PROM 112	28480	04951-10006
A1U708	1820-2921	9		IC INV CMOS HEX	28480	1820-2921
A1U709	1820-3082	5		IC-MC74HC374N	28480	1820-3082
A1U803	1820-2924	2	1	IC-MC74HC02N	28480	1820-2924
A1U804	1820-2921	9		IC INV CMOS HEX	28480	1820-2921
A1U805	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U806	1820-1922	8	1	IC SHF-RGTR TTL LS PRL-IN SERIAL-OUT	01295	SN74LS166N
A1U807	1820-3081	4		IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A1U904	1820-3081	4		IC FF CMOS/74HC D TYPE POS-EDGE-TRIG	28480	1820-3081
A1U905	1820-3196	2	1	IC GATE CMOS/74HC NOR DUAL 4-INP	28480	1820-3196
A1U906	1820-2922	0		IC GATE CMOS/74HC NAND QUAD 2-INP	28480	1820-2922
A1U907	1820-3097	2		IC GATE CMOS AND QUAD 2-INP	28480	1820-3097
A1XJ105	1251-6857	1	15	CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ108	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ203	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ400	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ402	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ404	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ405	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ406	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ504	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ509	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ510	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ603	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ703	1251-6857	1		CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ804	1251-6857	1	1	CONNECTOR 2-PIN M POST TYPE	28480	1251-6857
A1XJ809	1251-4670	2		CONNECTOR	28480	1251-4670
A1XU205	1200-0654	7	3	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A1XU209	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A1XU509	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A1XU608	1200-0638	7	1	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A1XU609	1200-0796	8	2	SOCKET-IC 8-CONT DIP DIP SLDR	28480	1200-0796
A1XU705	1200-0567	1	2	SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A1XU707	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A1XU810	1200-0796	8		SOCKET-IC 8-CONT DIP DIP-SLDR	28480	1200-0796
A1Y108	0410-1520	2	1	XTAL 8.064MHZ	28480	0410-1520
A1Y504	0410-0761	1	1	CRYSTAL-QUARTZ 4.915 MHZ HC-18/U-HLDR	28480	0410-0761
A1Y505	0410-1387	9	1	XTAL 3.6864MHZ	28480	0410-1387
	0380-0566	9	4	STANDOFF-RVT-ON 1.5-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	2200-0105	4	2	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2260-0009	3	2	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	4330-0145	9	10	INSULATOR-BEAD GLASS	28480	4330-0145

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R32	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A1R33	8110-0179	7		WIRE, RESISTIVE .362 OHM/FT (0.0833FT)	08696	CUPRON
A1R34	0698-0085	6		RESISTOR 2.61K 1% .125W F TC=0+-100	03292	CT4-1/8-TO-2611-F
A1R35	0757-0145	9	2	RESISTOR 750K 1% .25W F TC=0+-100	19701	MF52C1/4-TO-7503-F
A1R36	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-TO-6192-F
A1R38	0698-3442	9	1	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-TO-237R-F
A1R39	0698-5217	0	2	RESISTOR 28.7K 5% .125W F TC=0+-100	03292	NA4
A1R41	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A1R42	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A1R43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A1R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A1R45	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A1R46	0757-0458	7	2	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5112-F
A1R47	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A1R48	0698-3430	5	2	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-TO-21R5-F
A1R49	0757-0199	3	2	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2152-F
A1R50	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5112-F
A1R51	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2152-F
A1R52	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A1R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A1R55	0757-0424	7	2	RESISTOR 1.1K 1% .125W F TC=0+-100	03292	CT4-V8-TO-1101-F
A1R56	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1R57	0686-1045	9	3	RESISTOR 100K 5% .5W CC TC=0+802	01121	EB1045
A1R58	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1R59	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1R60	0698-3389	3	1	RESISTOR 17.8 1% .5W F TC=0+-100	20480	0698-3389
A1R61	0757-0797	7	1	RESISTOR 90.9 1% .5W F TC=0+-100	20480	0757-0797
A1R62	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R63	0698-0004	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A1R64	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R65	0686-1015	3	1	RESISTOR 100 5% .5W CC TC=0+529	01121	EB1015
A1R66	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R67	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R68	0686-1045	9		RESISTOR 100K 5% .5W CC TC=0+802	01121	EB1045
A1R69	0686-1045	9		RESISTOR 100K 5% .5W CC TC=0+802	01121	EB1045
A1R70	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R71	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R72	0698-3161	9	2	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A1R73	0698-3161	9		RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A1R74	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R75	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A1R76	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A1R77	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-TO-21R5-F
A1R79	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A1R80	0757-0145	9		RESISTOR 750K 1% .25W F TC=0+-100	19701	MF52C1/4-TO-7503-F
A1R105	1810-0280	8	4	NETWORK-RES 10-SIP 10K OHM X 9	05524	CSC10A01-103G
A1R209	1810-0368	3		NETWORK-RES 10-SIP 10K OHM X 5	02483	750-61-R10K
A1R309	1810-0277	3		NETWORK-RES 10-SIP 2.2K OHM X 9	01121	210A222
A1R404	1810-0406	C	1	NETWORK-RES 8-SIP 10.0K OHM X 4	01121	2088103
A1R503	2100-3908	9	1	RESISTOR-TRMR 1M 10% CC TOP-ADJ 1-TRN	28480	2100-3908
A1R603	2100-3966	9	1	RESISTOR-TRMR 200K 10% C TOP-ADJ 1-TRN	28480	2100-3966
A1R702	2100-3096	6	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 17-TRN	32997	3292W-1-503
A1R703	1810-0363	4		NETWORK-RES 10-SIP 100K OHM X 5	02483	750-61-R100K
A1R704	2100-3089	7	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	32997	3292W-1-502
A1T300	04951-80016	C	1	100KHZ TRANSFORMER	28480	04951-80016
A1T500	9100-0453	C	1	XFMR-FLYBACK	28480	9100-0453
A1TP100	1251-8360	5	18	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP101	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP103	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP301	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP304	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP402	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP403	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP404	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP405	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP406	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP510	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP604	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP704	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP803	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1TP804	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1GND	1251-8360	5		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-8360
A1U100	1826-0412	*	1	IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
A1U101	1826-0544	C	1	V REF 8-DIP-C	04713	MC1403U
A1U102	1826-0275	4	1	IC 78L12A V RGLTR TO-92	04713	MC78L12ACP
A1U103	1826-0468	7	1	IC COMPARATOR GP 8-DIP-P PKG	04713	MC3423P1
A1U104	1826-1066	3	1	IC-VOLTAGE REGULATOR 2A PIN PLASTIC PKG	28480	1826-1066

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR22	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A1CR100	1884-0293	8	1	THYRISTOR-SCR	04713	MCR69-2
A1DS1	2140-0013	5	1	LAMP-GLOW 5AB-A 70/57VDC 300UA T-2-BULB	08806	5AB-A(NE-23A)
A1J1	1251-8827	9	1	60 POSITION CONN	28480	1251-8827
A1J2	1251-8828	0	1	40 POSITION CONN	28480	1251-8828
A1J105	1258-0141	8	16	JUMPER-REM	28480	1258-0141
A1J108	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J203	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J204	1251-4246	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A1J400	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J402	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J404	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J405	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J406	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J504	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J509	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J510	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J603	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J608	1251-4292	4	1	SHUNT-DIP 7 POSITIONS	28480	1251-4292
A1J609	1251-4398	1	2	CONNECTOR SHUNT-4 POSITION	28480	1251-4398
A1J700	1251-3825	7		CONNECTOR-POST-TP-HDC	03418	09-65-1051
A1J703	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J801	1251-3751	0	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-3751
A1J804	1258-0217	9	1	MULTI-B-JUMP	28480	1258-0217
A1J809	1258-0141	8		JUMPER-REM	28480	1258-0141
A1J810	1251-4398	1		CONNECTOR SHUNT-4 POSITION	28480	1251-4398
A1L1	04951-80017	1		INDUCTOR 2MH +-10%	28480	04951-80017
A1L2	9140-0801	6	1	TOROIDAL CHOKE	28480	9140-0801
A1L3	04951-80015	9	1	COUPLED INDUCTOR	28480	04951-80015
A1L4	9140-0319	1	1	COIL-LINEARITY	28480	9140-0319
A1L5	9140-0407	8	1	CL-V 10UH MIN	28480	9140-0407
A1Q301	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A1Q302	1855-0526	7	1	TRANSISTOR MOSFET P-CHAN E-MODE SI	28480	1855-0526
A1Q400	1855-0525	8	2	TRANSISTOR MOSFET N-CHAN E-MODE SI	28480	1855-0525
A1Q402	1855-0402	0	1	TRANSISTOR J FET 2N5115 P-CHAN D-MODE	17856	2N5115
A1Q403	1855-0492	8	2	TRANSISTOR MOSFET N-CHAN E-MODE TO-220	28480	1855-0492
A1Q404	1855-0492	8		TRANSISTOR MOSFET N-CHAN E-MODE TO-220	28480	1855-0492
A1Q405	1826-0276	5	1	IC 78L05A V RGLTR TO-92	04713	MC78L05ACP
A1Q601	1855-0524	7	2	TRANSISTOR MOSFET N-CHAN E-MODE TO-220	28480	1855-0524
A1Q602	1855-0524	7		TRANSISTOR MOSFET N-CHAN E-MODE TO-220	28480	1855-0524
A1Q603	1855-0525	8		TRANSISTOR MOSFET N-CHAN E-MODE SI	28480	1855-0525
A1Q703	1854-0659	7	1	TRANSISTOR NPN SI PD=12.5W FT=50MHZ	04713	MJE180
A1Q704	1853-0436	6	1	TRANSISTOR PNP SI PD=1.5W FT=50MHZ	04713	MJE170
A1Q801	1853-0536	7	1	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0536
A1Q803	1854-0730	5	2	TRANSISTOR NPN SI TO-92	04713	MPS6531
A1Q804	1826-0285	6	1	IC V RGLTR TO-92	04713	MC79L05C
A1Q903	1854-0730	5		TRANSISTOR NPN SI TO-92	04713	MPS6531
A1R1	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A1R2	0698-3266	5	2	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R3	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1R4	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A1R5	0698-7929	5	1	RESISTOR 9.09K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-9091-B
A1R6	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R7	0757-0401	0	4	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R8	0698-8463	4	1	RESISTOR 464.2 .1% .125W F TC=0+-25	28480	0698-8463
A1R9	0699-0589	1	1	RESISTOR 34.334K .1% .125W F TC=0+-25	28480	0699-0589
A1R10	0698-3447	4	1	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A1R11	0757-0442	9	11	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R12	0757-0465	6	9	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R13	0698-0084	9	3	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A1R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R15	0698-8827	4	1	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A1R16	0698-3266	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R17	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R19	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	02995	5033R
A1R20	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0+-100	02995	5033R
A1R21	0757-0466	7	1	RESISTOR 110K 1% .125W F TC=0+-100	02995	5033R
A1R22	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A1R23	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R25	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R26	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1R28	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R29	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R31	0757-0280	3	5	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

Table 6-7. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	04951-60001	1	1	MAIN BOARD (ALL UNITS EXCEPT OPTION 003)	28480	04951-60001
A1BT1	1420-0264	1	1	BATTERY 3.6V 065A-HR NI-CD PIN	19209	41B013AD00201 (DS3GT)
A1C1	0160-0576	5	12	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C2	0160-3508	9	4	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C3	0160-4822	2	2	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A1C4	0160-4832	4	1	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C5	0160-4789	0	6	CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A1C6	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A1C7	0180-2683	1	1	CAPACITOR-FXD 4.7 UF+-10% 35VDC TA	03923	DS10474
A1C8	0180-3374	9	1	CAPACITOR-FXD 4700UF+30-10% 35VDC AL	28480	0180-3374
A1C9	0160-3879	7	5	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C11	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C12	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A1C13	0180-3376	1	2	CAPACITOR-FXD 2200UF+30-10% 25VDC AL	28480	0180-3376
A1C14	0160-4824	4	1	CAPACITOR-FXD 680PF +-5% 100VDC CER	28480	0160-4824
A1C15	0180-3375	0	1	CAPACITOR-FXD 3300UF+30-10% 16VDC AL	28480	0180-3375
A1C16	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C19	0160-2055	9		CAPACITOR-FXD 01UF 100VDC	04200	CO23F101F103ZS22-COA
A1C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C21	0180-3376	1		CAPACITOR-FXD 2200UF+30-10% 25VDC AL	28480	0180-3376
A1C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C23	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C24	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C25	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C26	0160-0996	3	1	CAPACITOR-FXD .01UF +-20% 2KVDC CER	72982	828-012-Z5U0-103M
A1C27	0160-4663	7	1	CAPACITOR-FXD 2.2UF +80-20% 100VDC CER	28480	0160-4663
A1C28	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C29	0160-4953	0	1	CAPACITOR-FXD .027UF +-5% 50VDC CER	28480	0160-4953
A1C30	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C31	0160-4663	9	2	CAPACITOR-FXD 2.2UF +80-20% 100VDC CER	28480	0160-4663
A1C32	0180-3377	2	1	CAPACITOR-FXD 47UF+-20% 50VDC AL	28480	0180-3377
A1C33	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A1C34	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A1C35	0160-3071	1	1	CAPACITOR-FXD 10UF +-10% 100VDC	01456	17U8106K
A1C36	0170-0040	9	1	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A1C37	0160-4579	6	1	CAPACITOR-FXD .1UF +-5% 160VDC MET-POLYC	28480	0160-4579
A1C38	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C39	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C40	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C41	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C42	0160-4230	6	3	CAPACITOR-FXD .01UF +80-20% 1KVDC CER	71590	GAP-103
A1C43	0160-4663	9		CAPACITOR-FXD 2.2UF +80-20% 100VDC CER	28480	0160-4663
A1C44	0160-4808	4	1	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4808
A1C45	0160-4804	0	2	CAPACITOR-FXD 56PF +-5% 100VDC CER 0+-30	28480	0160-4804
A1C46	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C47	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C48	0160-4230	6		CAPACITOR-FXD .01UF +80-20% 1KVDC CER	71590	GAP-103
A1C49	0160-4230	6		CAPACITOR-FXD .01UF +80-20% 1KVDC CER	71590	GAP-103
A1C50	0160-4804	0		CAPACITOR-FXD 56PF +-5% 100VDC CER 0+-30	28480	0160-4804
A1C51	0160-4370	5	1	CAPACITOR-FXD 1000PF +-5% 200VDC CER	51642	200-200-NP0-102J
A1C52	0160-4801	7	1	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A1C53	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A1C54	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A1CR1	1901-0704	4	2	DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR2	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR3	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR5	1901-0871	6	4	DIODE-PWR RECT 150V 2.5A 25NS	12969	UES1103
A1CR6	1901-0871	6		DIODE-PWR RECT 150V 2.5A 25NS	12969	UES1103
A1CR7	1901-0871	6		DIODE-PWR RECT 150V 2.5A 25NS	12969	UES1103
A1CR8	1901-0871	6		DIODE-PWR RECT 150V 2.5A 25NS	12969	UES1103
A1CR9	1901-0992	2	2	DIODE-SCHOTTKY 1N5822 40V 3A	28480	1901-0992
A1CR10	1901-0992	2		DIODE-SCHOTTKY 1N5822 40V 3A	28480	1901-0992
A1CR11	1901-0845	4	1	DIODE-HV RECT 2KV 50MA 250NS	18546	VG-2X
A1CR12	1901-1105	1	2	DIODE-HV RECTIFIER	28480	1901-1105
A1CR13	1902-3323	1	1	DIODE ZNR 42.2V 5% DO-35 PD=.4W TC=+.00%	28480	1902-3323
A1CR14	1901-1105	1		DIODE-HV RECTIFIER	28480	1901-1105
A1CR15	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR16	1901-0692	9	1	DIODE-PWR RECT 200V 3A 200NS	04713	MR052
A1CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR19	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A1CR20	1902-0949	1	1	DIODE-ZNR 4.3V 5% DO-35 PD=.4W TC=+.017%	28480	1902-0949

Ref. Desig.	PN	CD	Qty	Description	Mfg Code	Mfg PN
1 , !	5041-6701	3	1	Key cap, pearl gray	28480	5041-6701
2 , "	5041-6702	4	1	Key cap, pearl gray	28480	5041-6702
3 , #	5041-6703	5	1	Key cap, pearl gray	28480	5041-6703
4 , $	5041-6704	6	1	Key cap, pearl gray	28480	5441-6704
5 , %	5041-6705	7	1	Key cap, pearl gray	28480	5041-6705
6 , &	5041-6706	8	1	Key cap, pearl gray	28480	5041-6706
7 , '	5041-6707	9	1	Key cap, pearl gray	28480	5041-6707
8 , (	5041-6708	0	1	Key cap, pearl gray	28480	5041-6708
9 ,)	5041-6709	1	1	Key cap, pearl gray	28480	5041-6709
0 , DEL,-	5041-6710	4	1	Key cap, pearl gray	28480	5041-6710
A , SOH	5041-6711	5	1	Key cap, pearl gray	28480	5041-6711
B , STX	5041-6712	6	1	Key cap, pearl gray	28480	5041-6712
C , ETX	5041-6713	7	1	Key cap, pearl gray	28480	5041-6713
D , EOT	5041-6714	8	1	Key cap, pearl gray	28480	5041-6714
E , ENQ	5041-6715	9	1	Key cap, pearl gray	28480	5041-6715
F , ACK	5041-6716	0	1	Key cap, pearl gray	28480	5041-6716
G , BEL	5041-6717	1	1	Key cap, pearl gray	28480	5041-6717
H , BS	5041-6718	2	1	Key cap, pearl gray	28480	5041-6718
I , HT	5041-6719	3	1	Key cap, pearl gray	28480	5041-6719
J , LF	5041-6720	6	1	Key cap, pearl gray	28480	5041-6720
K , VT	5041-6721	7	1	Key cap, pearl gray	28480	5041-6721
L , FF	5041-6522	8	1	Key cap, pearl gray	28480	5041-6722
M , CR	5041-6523	9	1	Key cap, pearl gray	28480	5041-6723
N , SO	5041-6524	0	1	Key cap, pearl gray	28480	5041-6724
O , SI	5041-6525	1	1	Key cap, pearl gray	28480	5041-6725
P , DLE	5041-6726	2	1	Key cap, pearl gray	28480	5041-6726
Q , DC1	5041-6727	3	1	Key cap, pearl gray	28480	5041-6727
R , DC2	5041-6728	4	1	Key cap, pearl gray	28480	5041-6728
S , DC3	5041-6729	5	1	Key cap, pearl gray	28480	5041-6729
T , DC4	5041-6730	6	1	Key cap, pearl gray	28480	5041-6730
U , NAK	5041-6731	7	1	Key cap, pearl gray	28480	5041-6731
V , SYN	5041-6732	8	1	Key cap, pearl gray	28480	5041-6732
W , ETB	5041-6733	9	1	Key cap, pearl gray	28480	5041-6733
X , CAN	5041-6734	0	1	Key cap, pearl gray	28480	5041-6734
Y , EM	5041-6735	3	1	Key cap, pearl gray	28480	5041-6735
Z , SUB	5041-6736	4	1	Key cap, pearl gray	28480	5041-6736
__ , =	5041-6737	5	1	Key cap, pearl gray	28480	5041-6737
^ , RS , ~	5041-6738	6	1	Key cap, pearl gray	28480	5041-6738
@ , NUL,`	5041-6739	7	1	Key cap, pearl gray	28480	5041-6739
RTN	5041-6740	0	1	Key cap, pearl gray	28480	5041-6740
; , +	5041-6741	1	1	Key cap, pearl gray	28480	5041-6741
: , *	5041-6742	2	1	Key cap, pearl gray	28480	5041-6742
shift	5041-6743	3	2	Key cap, moss gray	28480	5041-6743
, , <	5041-6744	4	1	Key cap, pearl gray	28480	5041-6744
. , >	5041-6745	5	1	Key cap, pearl gray	28480	5041-6745
/ , US , ?	5041-6746	6	1	Key cap, pearl gray	28480	5041-6746
EXIT(HALT)	5040-4482	1	1	Key cap, pearl gray	28480	5040-4482
MORE	5040-4483	2	1	Key cap, pearl gray	28480	5040-4483
(up arrow)	5040-4484	3	1	Key cap, pearl gray	28480	5040-4484
(down arrow)	5040-4485	4	1	Key cap, pearl gray	28480	5040-4485
(left arrow)	5040-4486	5	1	Key cap, pearl gray	28480	5040-4486
(right arrow)	5040-4487	6	1	Key cap, pearl gray	28480	5040-4487
[, ESC , {	5040-4488	7	1	Key cap, pearl gray	28480	5040-4488
] , GS , }	5040-4489	8	1	Key cap, pearl gray	28480	5040-4489
\ , FS , :	5040-4490	9	1	Key cap, pearl gray	28480	5040-4490
CNTL	5040-4491	2	1	Key cap, pearl gray	28480	5040-4491
(BLANK)	5040-4492	3	6	Key cap, moss gray	28480	5040-4492

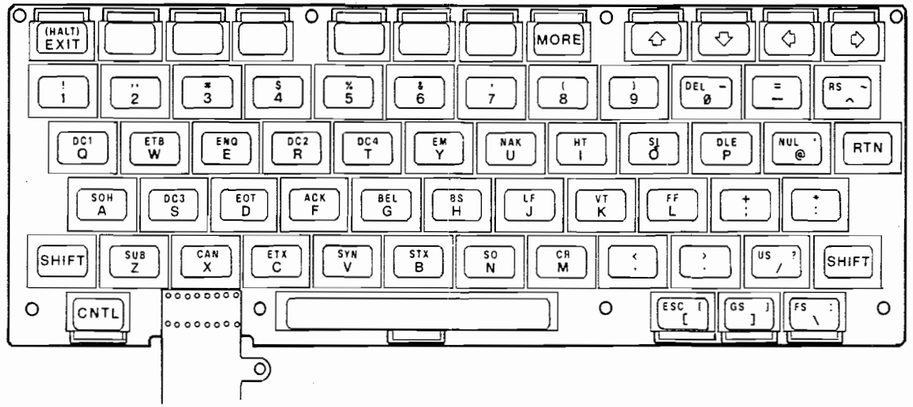

Figure 6-5. HP 4951A Keyboard Assembly

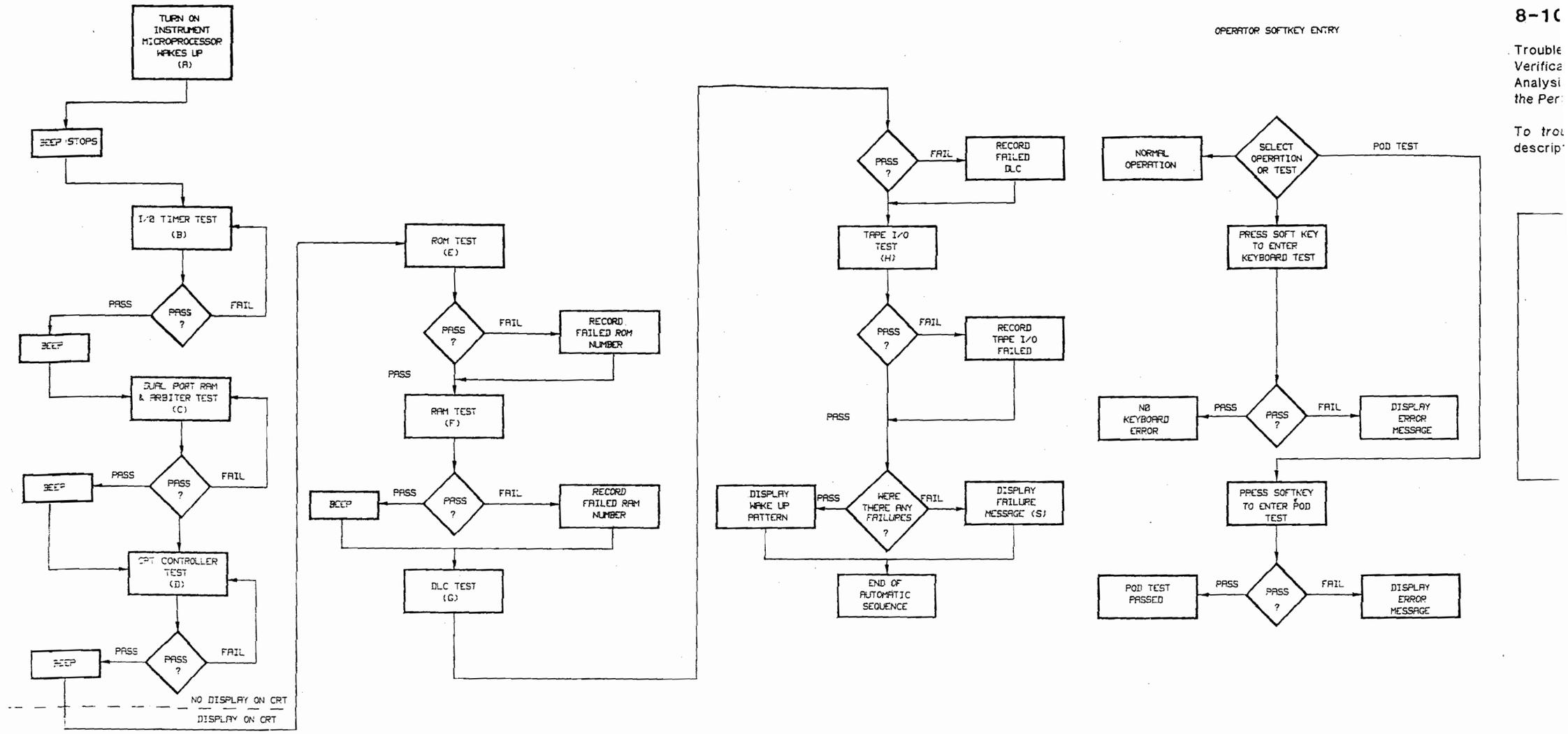

Figure 8-1. Performance Verification Flowchart

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8-10. TROUBLESHOOTING

Troubleshooting the HP 4951A is a two part process. Use the results of the Performance Verification tests to identify the circuit with problems. Once the circuit is identified, use the Signature Analysis routines to isolate the problem component level. Table 8-2 illustrates the failure table for the Performance Verification test sequence. Figure 8-1 is the Performance Verification flowchart.

To troubleshoot, perform the Performance Verification tests and note any failures. The test descriptions contain the test failure code, description and troubleshooting procedure.

Table 8-2. Test Failures

TEST	FAILURES
ROM 2	00
ROM 8-1	00
ROM 8-2	00
RAM 2	00
RAM 6	00
RAM 8	00
RAM A	00
RAM C	00
RAM E	00
DLC	00
TAPE	00

Number of tests = (total number of tests performed)

8-11. TROUBLESHOOTING PROCEDURES

A. TURN ON INSTRUMENT/MICROPROCESSOR WAKES UP

Test Failure Code

continuous beep

Description

When the beep stops the microprocessor and the power supply are working.

Failure Troubleshooting

1. Perform the No Op signature analysis on the microprocessor, Table 8-3.

B. I/O TIMER

Test Failure Code

no beep

Description

Tests the operation of the Dual Port RAM and the arbiter circuits.

Failure Troubleshooting

1. Perform the signature analysis routine for the I/O Timer, Table 8-4.

C. DUAL PORT RAM AND ARBITER

Test Failure Code

no beep

Description

Tests operation of Dual Port RAM and Arbiter circuit.

Failure Troubleshooting

1. Perform the signature analysis routine for the Dual Port RAM, Tables 8-12 and 8-13.

2. Perform the signature analysis routine for the Arbiter, Tables 8-5, 8-6, 8-7, and 8-8.

D. CRT CONTROLLER

Test Failure Code

no beep
no CRT display

Description

Checks operation of the deflection circuits.

Failure Troubleshooting

1. Perform the signature analysis routine for the CRT Controller, Tables 8-15 through 8-19.

2. If the CRT display does not turn on, perform the Signature Analysis routine and analog troubleshooting procedures for the Deflection Circuitry, Table 8-20.

E. ROM

Test Failure Code

The ROM test is performed once at turn on. ROM failures are displayed under FAILURES by the appropriate ROM on the CRT.

Description

The microprocessor checks all ROMs (except ROM 0000) and places pass/fail information in memory. If any ROM device fails after the test sequence is performed, the Test Failure Table is displayed. Press EXIT(HALT) to access the Top Level menu.

Failure Troubleshooting

1. Perform signature analysis routine for the Memory Decoder, Table 8-11.

F. RAM

Test Failure Code

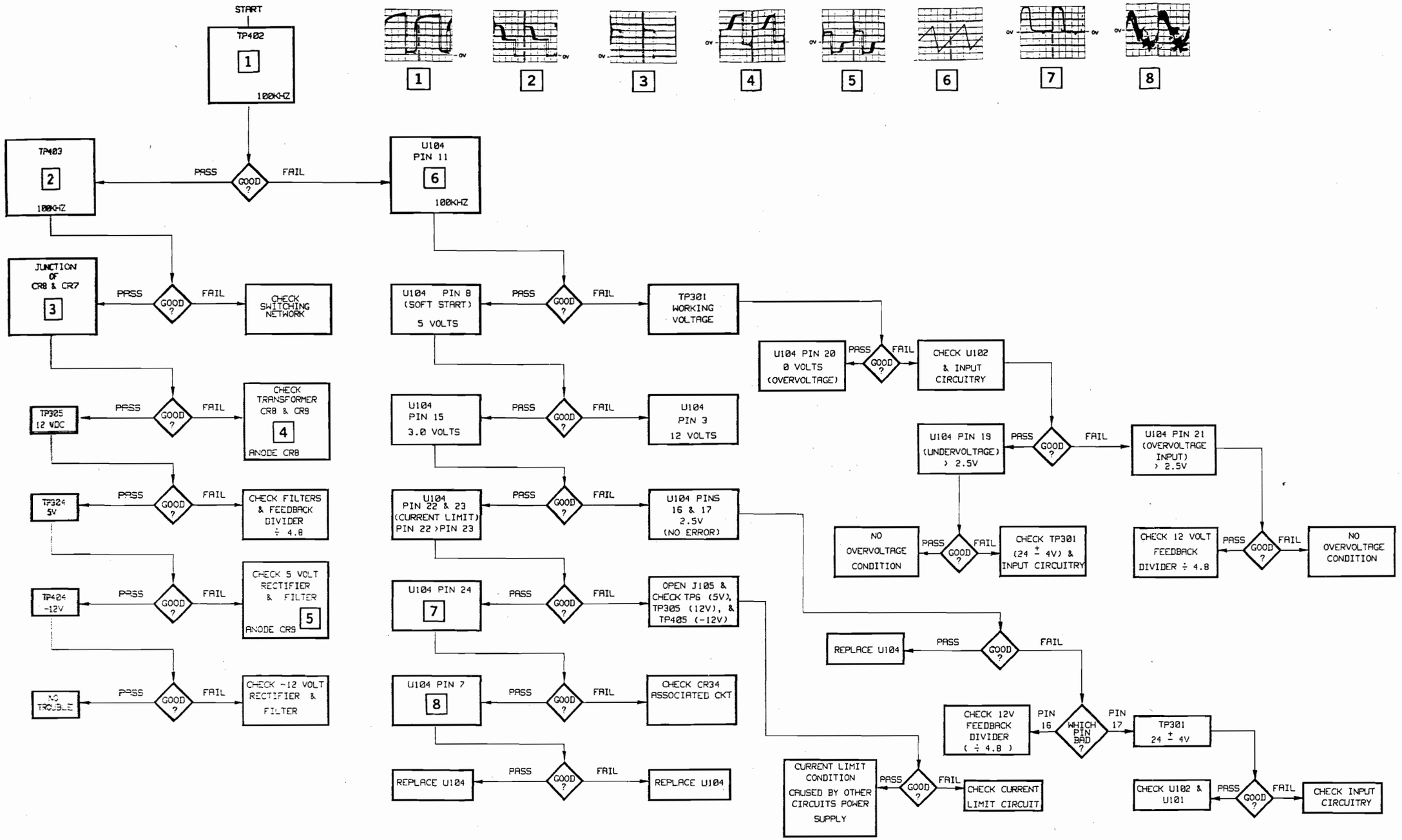
The RAM test is performed once at turn on. RAM failures are displayed under FAILURES by the appropriate RAM on the CRT.

Description

The microprocessor checks all RAM and places pass/fail information in memory. If any RAM device fails after the test sequence is performed, the Test Failure Table is displayed. Press EXIT(HALT) to access the Top Level menu.

Failure Troubleshooting

1. Perform signature analysis routine for the Memory Decoder, Table 8-11.



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G. DATA LINK CONTROL CIRCUITRY (DLC)

Test Failure Code

Number of times failed displayed under FAILURES column.

Description

Microprocessor checks the DLC for proper operation.

Failure Troubleshooting

1. Perform the signature analysis routine for the DLC, Table 8-21.

H. TAPE I/O

Test Failure Code

Number of times failed displayed under FAILURES column.

Description

Checks digital circuitry.

Failure Troubleshooting

1. The Tape I/O troubleshooting procedures begin paragraph 8-19. Start at the beginning and complete all procedures.

8-12. POWER SUPPLY TROUBLESHOOTING

To troubleshoot the Power Supply, work through the flowchart in Figure 8-2.

8-13. TAPE I/O ANALOG TROUBLESHOOTING

If the Signature Analysis for the Tape I/O passes, then the problem can be found in the Analog Section of the Tape Board. To determine the part of the circuitry where the problem is located. Enter the program in step 3.

Set Up

1. Insert a cassette tape.

2. Turn on the HP 4951A.

3. Enter the simulate program in Table 8-2.

Table 8-2. Simulate Test for Option 001

Select	SIMULATE
	DTE
	SEND
Type in	SOME MESSAGE
Press	RTN
	EXIT
	MORE
Select	MASS STORE
	TENSION

Wait for the tape drive to stop

Select	INIT

A warning should appear on the CRT

Select	EXECUTE

Wait until the tape drive stops

Select	STORE

Insert a file name

Select	EXECUTE

Wait until the tape drive stops

Press	EXIT
Select	LOAD

Insert the file name input during store operation

Select	EXECUTE

Wait until the tape drive stops

4. If no error messages are displayed in any of the steps in procedure 3, then the analog circuit is 100% tested and working.

8-14. READ AMPLIFIER TROUBLESHOOTING

Description

Troubleshooting procedure for the Read Amplifier circuitry.

Equipment

3310B Function Generator

Procedure

1. Turn off the HP 4951A.
2. For A3E304, set switches 1,2, and 4 closed and 3 open.
3. Turn on the HP 4951A.
4. The wake up menu should be on the display.
5. Check pin 6 of A3U507 and A3U508, they should be high and low respectively.
6. Pin 10 of A3U507 and A3U508 should be high.
7. Pin 9 of A3U507 and A3U508 should be low.
8. Connect a Function Generator to A3U508 pins 3 and 13. The low side of the Function Generator should be connected to pin 3. Check the signals at A3U506 and A3U607 against the waveforms shown on the Tape Board Schematic.

   a. Set up the Function Generator as follows:

      Function = sine wave
      Frequency = 33kHz at 50 mVp-p

8-15. MOTOR SPEED CONTROL TROUBLESHOOTING

Procedure

1. Turn off the HP 4951A.
2. Set all switches of A3E304 to closed (DMA).
3. Turn on the HP 4951A.
4. The waveforms shown on the schematic should be displayed.

Table 8-3. Microprocessor No Op Signatures

LOOP: Microprocessor No Ops PCA: A1 Main Board
SET UP: Remove A1J108, move A1J809 to T, and on PC board, open A2E101 and A2E102. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge.

SIGNATURE	NORM	
START/STOP	+	A1U209 pin 8 (A15)
QUAL		
CLOCK	-	A1U209 pin 32
GROUND		A1U209 pin 20

Vh = 0001 (+5 V)

U209 1 = HC89 (A8)
2 = 2H70 (A9)
3 = HPP0 (A10)
4 = 1293 (A11)
5 = HAP7 (A12)
6 = 3C96 (A13)
7 = 3827 (A14)
8 = 755P (A15)
12 = UUUU (D0)
13 = 5555 (D1)
14 = CCCC (D2)
15 = 7F7F (D3)
16 = 5H21 (D4)
17 = 0AFA (D5)
18 = UPFH (D6)
19 = 52F8 (D7)

A2U101 pin 20 - 6H49

NOTE: Replace A1J108, A1J809, A2E101 and A2E102 at end of test

Table 8-5. Arbiter Signature Analysis

LOOP: Arbiter PCA: A1 Main Board
SET UP: Connect A1J406 and A1J405 to T on PC board for turn on condition. To disable beeper, place a jumper from ground on the A2 board to A2R207 nearest board edge)

SIGNATURE	NORM	
START/STOP	+	A1U605 pin 12
QUAL		
CLOCK	+	1U605 pin 2

Vh = 00UP

U306 1 = 00U1
2 = 00F2
3 = 00F1

U405 2 = 00U1
3 = 0033
5 = 003F
6 = 00F2
8 = 000U
9 = 00U1
11 = 00UP
12 = 00U1

U406 2 = 003F
3 = 00FH
5 = 000U
9 = 00UP (high)
11 = 00FH
12 = 00UP (high)

U505 10 = 00FH
11 = 0033
12 = 00UP
13 = 0000

Table 8-4. I/O Timer Signature Analysis

LOOP: I/O Timer PCA: A2 Memory Board
SET UP: Pull A1U304 pin 3 low. Disconnect the Interface Pod. (To disable beeper, place a jumper from ground on the A2 board to A2R207, end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
CLOCK	+	A2TP4
GROUND		A2TP GND

Vh = A803 (+5 V)

U300
2 = 45C5
4 = 0000 (low)
5 = 0000 (low)
6 = A803 (high)
7 = 0000
8 = 0000
10 = A803
11 = 45C5
12 = 2F56
13 = 90AA
14 = A9UU
15 = 3F27
16 = 73HH
17 = CU86
18 = 35HC
19 = P3PP
21 = F1PF
22 = 7769
23 = 15H9
24 = H5HC
25 = 95H1
26 = 8A31
27 = C163
28 = UU94
29 = U07C
30 = HHHA
31 = 4576
32 = U576
33 = 6574
34 = 228F
35 = AF58
36 = UUP5
37 = 6783
38 = 16PP
39 = H22C

Table 8-6. Arbiter Signature Analysis

LOOP: Arbiter PCA: A 1 Main Board
SET UP: Jumper A 1J406 and A 1J405 to T on the PC board, the turn on condition. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A 1U605 pin 12
QUAL		
CLOCK	+	A 1U605 pin 2

Vh = 00UP

U506 1 = 00U1
2 = 0055
3 = 00UP (high)
4 = 000U
5 = 00F2
6 = 00UH
12 = 00PP
13 = 0033

U605 12 = 00U1
13 = 0033
14 = 0055

U606 1 = 00UP (high)
2 = 000U
3 = 00U1
4 = 00F1
5 = 0000 (high)
6 = 00UP

After test return AlJ406 and AlJ405 to normal positions.

Table 8-7. Arbiter Signature Analysis

LOOP: Arbiter PCA: A1 Main Board
SET UP: A1J108 open, set A1J809 to T.
Pull down A1R54 (the leg nearest the edge of the PC board). Remove jumpers A2E101 and A2E102. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U308 pin 18
QUAL		
CLOCK	-	A1U209 pin 32
GROUND		A1U209 pin 20

Vh = CC34

U308
2 = 96PF
3 = 96PF
4 = 725C
5 = 725C
6 = P5PH
7 = P5PH
8 = 5CP0
9 = 5CP0
11 = 0000
12 = 7P25
13 = 7P25
14 = 85PA
15 = 85PA
16 = 77F7
17 = 77F7
18 = H58A
19 = H58A

After the test replace jumpers A1J108, AIJ809, A2E101 and A2E102.

Table 8-8. CRTC RAM Signature Analysis

LOOP: Arbiter PCA: A1 Main Board

SET UP: A1J108 open, set A1J809 to T. Tests address muxes to see if they select and pass on AO-A11. Pulldown A1R54 (the leg nearest the edge of the PC board). Remove jumpers A2E101 and A2E102. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U410 pin 13
QUAL		
CLOCK	+	A1U209 pin 32
GROUND		A1U209 pin 20

Vh = 826P

U408
3 = 7P25
4 = 7P25
6 = 2A1F
7 = 2A1F
9 = A206
10 = A206
12 = C133
13 = C133

U409
3 = 8P3U
4 = 8P3U
6 = 3319
7 = 3319
9 = 7C47
10 = 7C47
12 = C25F
13 = C25F

U410
3 = 5H21
4 = 5H21
6 = 19H6
7 = 19H6
9 = HP66
10 = HP66
12 = U81P
13 = U81P

After the test replace jumpers to normal position.

Table 8-9. CRTC RAM Signature Analysis

LOOP: CRT RAM PCA: A1 Main Board
SET UP: A1J108 open, set A1J809 to T. Remove jumpers A2E and A2E102. Pull down AIR54, the leg nearest the edge of the PC board). To disabale beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A1U410 pin 13
QUAL		
CLOCK	+	A1U209 pin 32

Vh = 826P

U407
2 = 7A70
3 = C25F
4 = 7C47
5 = 3319
6 = 8P3U
7 = C133
8 = A206
9 = 2A1F
10 = 7P25
21 = HP66
22 = 826P (high)
23 = U81P
24 = 19H6
25 = 5H21
26 = 826P (high)
27 = 826P (high)

Table 8-10. CRT Controller Signature Analysis

LOOP: CRT Controller PCA: A1 Main Board
SET UP: Pull A1U304 pin 4 low. A1U509 Pin 21 (CCLK) frequency = 614.400 kHz +-100 Hz. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
QUAL		
CLOCK	+	A1U509 pin 23

Vh = 4106 (+5 V)

U509 22 = UUCU
24 = 42UP
25 = 0P8A
26 = HF17
27 = 2U99
28 = 2415
29 = CP73
30 = HF57
31 = 2U30
32 = 099F
33 = 05A3

Table 8-11. Memory Decoder Signature Analysis

LOOP: Memory Decoder PCA: A2 Memory Board
SET UP: Pull A1U304 pin 7 low. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP QUAL	+	A2U401 pin 2
CLOCK	+	TP300

Vh = U973

U101 20 = 1F34

U103 20 = FH93

U104 20 = CAH9

U105 20 = 22CF

U200 20 = 26H0

U201 20 = 4PA6

U202 20 = 4818

U203 20 = 81F4

U204 20 = 0187

U205 20 = C6U3

U206 1 = C0C1
2 = 63P7
3 = 6C5C
4 = 1F34 ROM enable
5 = 8P39
6 = U973 (high)
7 = 22CF RAM enable
11 = CAH9 RAM enable
12 = FH93 ROM enable
14 = 18H7
15 = 8P39

Table 8-11. Memory Decoder Signature Analysis (cont)

LOOP: Memory Decoder PCA: A2 Memory Board
SET UP: Pull A1U304 pin 7 low. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
QUAL		
CLOCK	+	TP300

Vh = U973

U207
1 = PUAH
2 = 1UC0
3 = P696
5 = 26H0 ROM enable
6 = C6U3 ROM enable
7 = 7U8P
9 = 4PA6 ROM enable
10 = 4818 RAM enable
11 = 81F4 RAM enable
12 = 0187 RAM enable
13 = 6C5C
14 = 63P7
15 = 7U8P

U302
1 = 07P6
2 = C1FF
3 = 63P7
4 = 6C5C
5 = 16HP
6 = A66U
12 = P936

U303
9 = 16HP
10 = PUAH

U403
4 = 16HP
5 = A66U
6 = COC1
11 = PUAH
12 = PUAH
13 = A66U

Table 8-12. CRTC RAM Signature Analysis

LOOP: Dual Port RAM PCA: A1 Main Board
SET UP: Normal operation, wake up menu. To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge)

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U509 pin 21

Vh = 80F6

U407
2 = 0000 (low)
3 = UHF2
4 = 9FF9
5 = AF72
6 = HPF5
7 = 4FF0
8 = 7UF1
9 = 8042
10 = 0000
11 = C84U
12 = 7F05
13 = 3FPH
15 = 7C24
16 = AH74
17 = 2336
18 = PU98
19 = 63P2
22 = 0000 (low)
23 = 0000 (low)
24 = 62C4
25 = 1799
26 = 80F6 (high)
27 = 80F6 (high)

Table 8-13. CRTC RAM Signature Analysis

LOOP: Dual Port RAM PCA: A 1 Main Board
SET UP: Normal operation, wake up menu. To disable beeper, pleace a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A 1U509 pin40
QUAL		
CLOCK	+	A 1U509 pin 21

Vh = FP96

U408
1 = 0000 (low)
2 = 0000
4 = 0000
5 = 458H
7 = 458H
9 = 3F84
11 = 3F84
12 = 597P
14 = 597P

U409
1 = 0000 (low)
2 = 7605
4 = 7605
5 = 3543
7 = 3543
9 = C28P
11 = C28P
12 = 3CUF
14 = 3CUF

U410
1 = 0000 (low)
2 = 2F0C
4 = 2F0C
5 = P049
7 = P049
9 = 106H
11 = 106H
12 = 0000 (low)
14 = 0000 (low)

Table 8-14. CRT RAM Signature Analysis

LOOP: CRTC RAM PCA: A1 Main Board
SET UP: Normal operation, wake up menu. To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U509 pin 21

Vh = 80F6

U508
1 = 0000 (low)
2 = C84U
3 = 63P2
4 = 7F05
5 = PU98
6 = 3FPH
7 = 2336
8 = 7C24
9 = AH74
11 = AH74
12 = 7C24
13 = 2336
14 = 3FPH
15 = PU98
16 = 7FO5
17 = 63P2
18 = C84U
19 = 0000 (low)

Table 8-14. CRTC RAM Signature Analysis (cont)

LOOP: CRTC RAM PCA: A1 Main Board
SET UP: Normal operation, wake up menu. To disable beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U509 pin 21

Vh = 80F6

U607
1 = UHF2
2 = 9FF9
3 = AF72
4 = HPF5
5 = 4FF0
6 = 7UF1
7 = 8042
8 = 0000
9 = C84U
10 = 7F05
11 = 3FPH
13 = 7C24
14 = AH74
15 = 2336
16 = PU98
17 = 63P2
19 = 0000
20 = 80F6 (high)
21 = 0000
22 = 62C4
23 = 1799

8-16. Set up procedure using Self Test.

1. Turn on HP 4951A.
2. Press MORE.
3. Select <SELF TEST>.
4. Select <CRT TSTS>.
5. Selct <CHAR SET 2>.using Self Test.

8-17. Set up procedure using Self Test

1. Turn on HP 4951A.
2. Press MORE.
3. Select <SELF TEST>.
4. Select <CRT TSTS>.
5. Select <TEST PTRN>.

Table 8-15. CRT Controller Signature Analysis

LOOP: CRT Controller PCA: A1 Main Board
SET UP: Follow procedure in paragraph 8-16.

SIGNATURE	NORM	
START/STOP	+	A1U509 pin 40
QUAL		
CLOCK	+	A1U509 pin 21

Vh = FP96

U509
4 = 458H (MA0)
5 = 3F84 (MA1)
6 = 597P (MA2)
7 = 7605 (MA3)
8 = 3543 (MA4)
9 = C28P (MA5)
10 = 3CUF (MA6)
11 = 2F0C (MA7)
12 = P049 (MA8)
13 = 106H (MA9)
14 = 0000 (MA10)
18 = 04F5 (DE)
35 = F278 (CR3)
36 = 2ACA (R2)
37 = P398 (R1)
38 = 51PF (R0)
39 = 3FA9 (HS)
40 = H169 (VS)

Table 8-16. CRT Controller Signature Analysis

LOOP: CRT Controller PCA: A1 Main Board
SET UP: Follow procedure in paragraph 8-16.

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	+	A1U509 PIN 18
CLOCK	-	A1U509 pin 21

Vh = 879F

U709
2 = 09UH
3 = C556
4 = 54F7
5 = 024C
6 = 22PU
7 = HP87
8 = A713
9 = 7P95
11 = 879F
12 = 6627
13 = 1857
14 = 76U1
15 = P45C
16 = AH21
17 = 0000
18 = 879F
19 = FPP6

U710
2 = UO57
3 = C556
4 = 54F7
5 = 2234
6 = 1UFP
7 = HP89
8 = A713
9 = 3444
11 = 0000
12 = 0F26
13 = 1857
14 = 76U1
15 = HA2C
17 = 0000
18 = 879F

Table 8-17. CRT Controller Signature Analysis

LOOP: CRT Controller PCA: A1 Main Board
SET UP: Follow procedure in paragraph 8-16.

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	+	A1U509 pin 18
CLOCK	-	A1U509 pin 21

Vh = 879F

U705
2 = 0000
3 = 7P95
4 = 22PU
5 = 024C
6 = 09UH
7 = 2288
8 = 3U4F
9 = A569
10 = CCHF
11 = AC40
12 = 281H
13 = FC12
15 = 3F22
16 = 6PC1
17 = AA93
18 = 85PF
19 = H421
21 = AH21
22 = 0000
23 = FPP6
24 = P456

U806
2 = AC40
3 = 281H
4 = FC12
5 = 3F22
7 = 879F
10 = 6PC1
11 = AA93
12 = 85PF
13 = H421
14 = H421
15 = 0000

Table 8-18. CRT Controller Signature Analysis

LOOP: CRT Controller PCA: A1 Main Board
SET UP: Follow procedure in paragraph 8-17.

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	AIU509 pin 18
CLOCK	-	A1U509 pin 21

Vh = 879F

U905 1 = IFC0
2 = 2288
3 = 3U4F
4 = A569
5 = 3FH0
9 = CC4F
13 = 3FH0

U906 1 = U057
2 = IFC0
3 = 7F4H
4 = 2234
5 = A738
6 = 9U81
9 = IUFP
11 = 2H9H (change qual to -)
13 = A524

U907 1 = 2288
2 = 3U4F
3 = A738
4 = 7F4H
5 = 9U81
6 = 6450
9 = 6450

Table 8-19. CRT Controller Signature Analysis

LOOP: CRT Controller PCA: A1 Main Board
SET UP: Follow procedure in Paragraph 8-P15. To disable beeper, place a ground from the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	+	A1U509 pin 40
QUAL	-	A1U509 pin 13
CLOCK	+	A1U509 pin 3

Vh = 0291

U904 2 = H499
5 = F72U
6 = F5CP
8 = H2FA
9 = H05C

U807 2 = 29A9
3 = 46UP
5 = 4F5H
8 = H05C
10 = H2FA
11 = F72U

Table 8-20. Deflection Signature Analysis

LOOP: Deflection PCA: A1 Main Board
SET UP: Normal operation, wake up menu. To disable beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	NORM	
START/STOP	+	A1U509 pin 40
QUAL		
CLOCK	+	A1U509 pin 21

Vh = FP96

TP804 = FP96 (PU) (high)
TP803 = 6838

U503 2 = H169
10 = 3FA9
11 = FP96 (high)

Table 8-20. Deflection Signature Analysis (cont)

LOOP: Deflection PCA: A1 Main Board
SET UP: Nornal operaion, wake up menu. To disable beeper, place a jumper from gound on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	QUAL	
START/STOP	+	A1U509 Pin 40
QUAL	-	A1U509 Pin 13
CLOCK	+	ALU904 PIN 3

VH = FP96

U803 4 = AHC1
5 = F72U
6 = H05C
11 = FSCP
13 = 7U7C

Table 8-21. DLC Signature Analysis

LOOP: DLC PCA A1 Main Board
SET UP: Self Test menu, do not connect an Interface Pod.
Pull A1U304 pins 3 and 4 low.
To disable the beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	QUAL	
START/STOP	+/-	A2U401 pin 2
QUAL	+	A1U205 pin 32 (D/C)
CLOCK	+	A1U205 pin 36 (RD)

Vh = 3696

U205
1 = P742
2 = 43F2
3 = 9PUF
4 = P2P5
5 = 3696 (high)
8 = 3696 (high)
15 = 3696 (high)
19 = 0000 (low)
25 = 3696 (high)
33 = 3696
34 = 0000
35 = 3696
37 = 2UA4
38 = UHH3
39 = 7FP6
40 = 8652

Table 8-23. Tic Clock Signature Analysis

LOOP: RST B PCA: A2 Memory Board
SET UP: Pull A1U304 pin 3 low.
To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	NORM	
START/STOP	+	A2U401 pin 2
GROUND		A2U300 pin 20
CLOCK	+	A2U300 pin 9

Vh = A803

U402 2 = 0000 (low)
3 = 45C5
5 = 0000 (low)
6 = A803 (high)
9 = A803 (high)
10 = 16PP
11 = 0000 (low)
13 = A803 (high)

U500 1 = O4P8
2 = UUP5
3 = HHHA
4 = 228F
5 = AF58
10 = A803 (high)
13 = 0000 (low)

8-18. A2 Memory Board Troubleshooting Procedure

Table 8-22. Tic Clock Signature Analysis

LOOP: Tic Clock PCA: A2 Memory Board

SET UP: Wake up menu. To disable. To disable beeper, place a jumper from ground on the A2 board to S2R207 (the end nearest the board edge).

SIGNATURE	NORM	
START/STOP	+	A2U404 pin 9
QUAL		
CLOCK	-	TP300

Vh = 48CF

U404 1 = 0A3C
3 = 513C
4 = CH89
5 = 745P
6 = 8PA4
10 = 7103
11 = C2A1

8-19. SIGNATURE ANALYSIS FOR A3 TAPE CONTROLLER, OPTION 001.

Before performing any Signature Analysis on the A3 Tape Controller Board, read the A3E304 switch position and A3E208 function descriptions.

NOTE: Make sure there is no tape in tape drive assembly.

A3E304

Switch 1 closed = external ROM open = 8048 internal ROM

Switch 2 closed = normal open = no ops

Switch 3 closed = run motor at 40 ips open = normal

Switch 4 closed = run motor at 40 ips open = normal

A3E208

A \ system bus acknowledge
B /
B \ stand alone bus acknowledge
C /

A3E105

A \ 27C32 4K EPROM
B /
B \ 27C16 2K EPROM
C /

Table 8-24. Microprocessor No Ops

LOOP: Microprocessor No Op PCA: A3 Tape Controller
SET UP: Wake up menu.
S304 switch 1 closed and 2,3, and 4 open. To disable beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	NORM	
START/STOP	+	A3U106 pin 23
QUAL		
CLOCK	-	A3U106 pin 11
GND		A3U106 pin 20

Vh = 7A70

U106 1 = 7A70
3 = 0000
4 = 7A70 (high)
5 = 7A70 (high)
6 = 0000 (low)
7 = 7A70 (high)
12 = H62U
13 = C21A
14 = HA07
15 = H0AA
16 = P030
17 = 4442
18 = 4U2A
19 = 0772
21 = 9635
22 = 1734
23 = U424
24 = 0000

Table 8-25. Microprocessor No Ops

LOOP: Microprocessor No Ops PCA: A3 Tape Controller
SET UP: Wake up menu.
Switch 1 of A3E304 is closed and 2,3, and 4 are open.
To disable beeper, place a jumper from ground on the A2 board to A2R207 (end nearest board edge).

SIGNATURE	NORM	
START/STOP	+	A3U106 pin 23
QUAL		
CLOCK	-	A3U106 pin 11
GND		A3U106 pin 20

Vh = 7A70

U105
2 = AF5U
3 = H62U
4 = C21A
5 = 1P45
6 = HA07
7 = AA4C
9 = 0000
10 = 2U1H
11 = HOAA
12 = 3750
13 = P030
14 = 4442
15 = 6569

U205
2 = P0HH
3 = 4U2A
4 = 0772
5 = F4U1
6 = 9635
7 = 8F52
9 = 0000
10 = 4FH2
11 = 1734
12 = UA12
13 = U424
14 = 0000
15 = 0000 (low)

Table 8-26. I/O Timer Signature Analysis

LOOP: I/O Timer PCA: A3 Tape Controller
SET UP: Switch A3E304 set switch 3 open, and 1, 2, and 4 closed. To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

NOTE: Use ground indicated below, otherwise signatures will be unstable.

SIGNATURE	NORM	
START/STOP	+/-	A3U104 pin 10
QUAL		
CLOCK	-	A3U104 pin 3
GND		A3U104 pin 20

Vh = 99FA

U104
4 = 0000 (low)
7 = 7347
8 = 99FA (high)
11 = 0H45
12 = 7466
13 = 0425
14 = 7ACF
15 = P72U
16 = 7487
17 = P0PU
18 = 9031
19 = 7347
21 = P672
22 = 7UC8
23 = P672
24 = 7UC8
25 = P672
26 = 7UC8
27 = P672
28 = 7UC8
36 = 99FA

Table 8-27. State Machine/Bit Timer Signature Analysis

LOOP: State Machine/Bit Timer PCA: A3 Tape Controller
SET UP: Close switches 1, 2, and 3 of A3E304, open switch 4
To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	-/+	A3U106 pin 31
QUAL	+	A3U106 pin 39
CLOCK	+	A3U106 pin 1
GND		A3U106 pin 20

Vh = 2016

U305 3 = 5818
4 = 2016
5 = 1HF7
6 = 2016 (high)
7 = 2016 (high)
9 = 0000
10 = 0000
11 = 0000

Table 28. State Machine/Bit Timer Signature Analysis

LOOP: State Machine/Bit Timer (RD) PCA: A3 Tape Controller
SET UP: Close switches 1, 2, and 3 of A3E304, openswitch 4.
Pull U300 pins 1 and 16 to +5V.
To disable the beeper, place a jumper from gound on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	+	A3U106 pin 31
QUAL	+	A3U106 pin 39
CLOCK	+	A3U106 pin 1

Vh = F013

U104
1 = 0000
2 = 7UP2
6 = F013 (high)
9 = F013 (high)
21 = 46C5
22 = 7C4U
23 = 6AUH
24 = 8UPP
25 = HHCF
26 = 8U8H
27 = P402
28 = CUPP
39 = F013

U302
1 = F013
2 = CUU1
3 = 3004
4 = F013 (high)
5 = 0000
8 = CUU1
9 = 0000 (low)
10 = CUU1
11 = 3004
13 = CUU1
14 = 7UP2
15 = 8UU5
16 = 7UP2
17 = F013

Table 29. State Machine/Bit Timer Signature Analysis

LOOP: State Machine/Bit Timer (RD) PCA: A3 Tape Controller
SET UP: Close switches 1, 2, and 3 of A3E304, open switch 4.
Pull U300 pins I and 16 to +5V.
To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	+	A3U106 pin 31
QUAL	+	A3U106 pin 39
CLOCK	+	A3U106 pin 1

Vh = F013

U301 2 = 0000 (low)
5 = 0000
6 = 4UP6
9 = 0000
12 = CUU1
15 = 3004
16 = CUU1
19 = F013

U303 1 = CUPP
2 = P402
11 = F013 (high)
13 = 0000
15 = 0000 (low)
16 = 46C5
17 = 7C4U
18 = 6AUH
19 = 8UPP
20 = HHCF
21 = 8U8H
22 = P402
23 = CUPP

Table 8-30. State Machine/Bit Timer Signature Analysis

LOOP: State Machine/Bit Timer PCA: A3 Tape Controller
SET UP: Close switches 1, 2, and 3 of A3E304, open switch 4.
To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	+	A3U106 pin 31
QUAL	+	A3U106 pin 39
CLOCK	+	A3U106 pin 1

Vh = 2016

U102
1 = 1HF7
2 = 2648
3 = 7CCU
4 = 7P18
5 = 4C19
6 = C8PF
8 = 88HP
9 = 7187
10 = 611P
11 = 71H9
13 = 9632
14 = UF31
15 = U77P
16 = 2FAC
19 = 2016 (high)
23 = OU5P

U300
2 = 88HP
3 = 7187
4 = 611P
5 = 308U
6 = C8PF
7 = 71H9
8 = 9632
9 = 4C19
12 = 7P18
13 = UF31
14 = U77P
15 = 7CCU
16 = 2648
17 = 2FAC
18 = 985H
19 = OU5P

Table 8-31. State Machine/Bit Timer Signature Analysis

LOOP: Shift Register (WR) PCA: A3 Tape Controller
SET UP: Close switches 1, 2, and 4 of A3E304, open switch 3. Pull U300 pins 1 and 16 to +5V.
To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

SIGNATURE	QUAL	
START/STOP	+	A3U302 pin 8
QUAL	-	A3U302 pin 5
CLOCK	+	A3U104 pin 3

Vh = A310

U302
1 = 3F1P
2 = P0H9
3 = 4H16
4 = 0000 (low)
7 = F4UP
9 = 2681
10 = 3P1H
11 = 0000 (low)
13 = 0000 (low)
14 = 1A9U
15 = 9A2F
16 = 2482
17 = 9H0H

U301
2 = 9340
5 = 9U0P
6 = 0000 (low)
9 = 0000 (low)
12 = 7UH7
15 = 4H16
16 = P0H9
19 = 3F1P

U303
1 = A310 (high)
2 = A31U (high)
11 = 0000 (low)
13 = 0000 (low)
15 = 9340
16 thru 23 = A310 (high)

Table 8-32. DMA Signature Analysis

LOOP: DMA PCA: A3 Tape Controller
SET UP: Close switches 1, 2, 3, and 4 of A3E304.
To disable the beeper, place a jumper from ground on the A2 board to A2R207 (the end nearest the board edge).

NOTE: Wait approximately 15 seconds for start/stop to toggle, this gives Vh time to set the correct signature.

SIGNATURE	QUAL	
START/STOP	+/-	A3U106 pin 34
QUAL	+	A3U106 pin 33
CLOCK	+	A3U106 pin 1

Vh = 03U9

U307
2 = 03U9
3 = 0000
4 = 03U9
5 = 03U9
6 = 0000
8 = 03U9
10 = 0000 (high)
11 = 03U9
12 = 0000
13 = 03U9

U407
3 = 0000
4 = 03U9
5 = 03U9
6 = 0000
8 = 03U9
10 = 03U9
11 = 03U9
13 = 0000

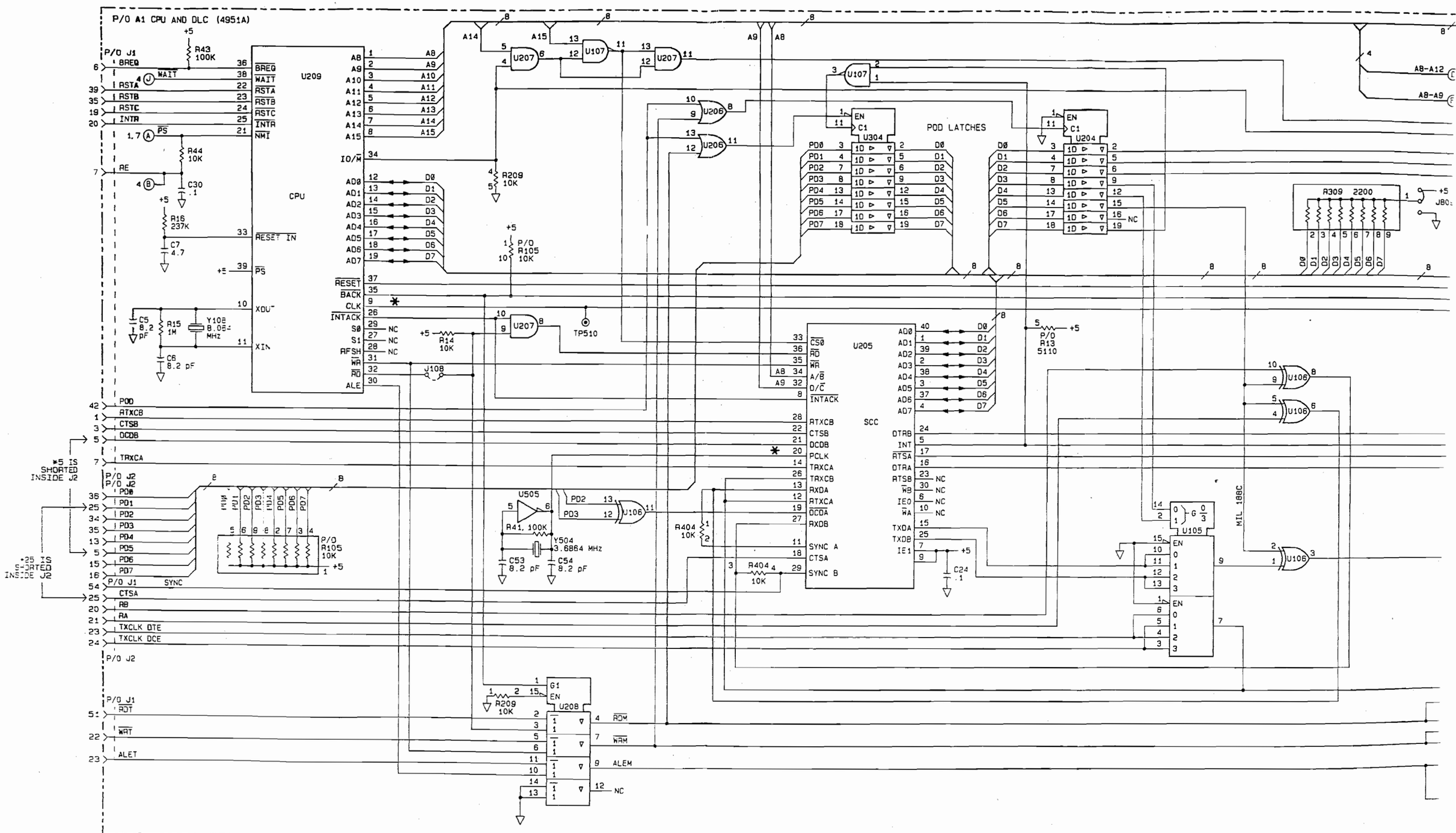

P/O A1 CPU AND DLC (4951A)
P/O J1
BREQ
WAIT
RSTA
RSTB
RSTC
INTR
PS
AE
R43 100K
R44 10K
C30 .1
R16 237K
C7 4.7
C5 8.2 pF
R15 1M
Y108 8.064 MHz
C6 8.2 pF
U209
CPU
BREQ
WAIT
RSTA
RSTB
RSTC
INTR
NMI
RESET IN
PS
XOUT
XIN
IO/M
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
RESET
BACK
CLK
INTACK
S0
S1
RFSH
WR
RD
ALE
NC
R209 10K
P/O R105 10K
R14 10K
U108
TP510
U207
U107
U206
A14
A15
A9
A8
A8-A12
A8-A9
POD LATCHES
U304
U204
EN
C1
PD0
PD1
PD2
PD3
PD4
PD5
PD6
PD7
D0
D1
D2
D3
D4
D5
D6
D7
NC
R309 2200
J80
U205
SCC
CS0
RD
WR
A/B
D/C
INTACK
RTXCB
CTSB
DCDB
PCLK
TRXCA
TRXCB
RXDA
RTXCA
DCDA
RXDB
SYNC A
CTSA
SYNC B
DTRB
INT
RTSA
DTRA
RTSB
WB
IE0
WA
TXDA
TXDB
IE1
C24 .1
P/O R13 5110
U106
U505
R41 100K
Y504 3.6864 MHz
C53 8.2 pF
C54 8.2 pF
R404 10K
U105
U108
MIL 188C
U208
G1
R209 10K
RDT
WRT
ALET
RDM
WRM
ALEM
POD
RTXCB
CTSB
DCDB
TRXCA
P/O J2
SYNC
TXCLK DTE
TXCLK DCE
CTSA
RB
RA
*5 IS SHORTED INSIDE J2
*25 IS SHORTED INSIDE J2

Figure 8-

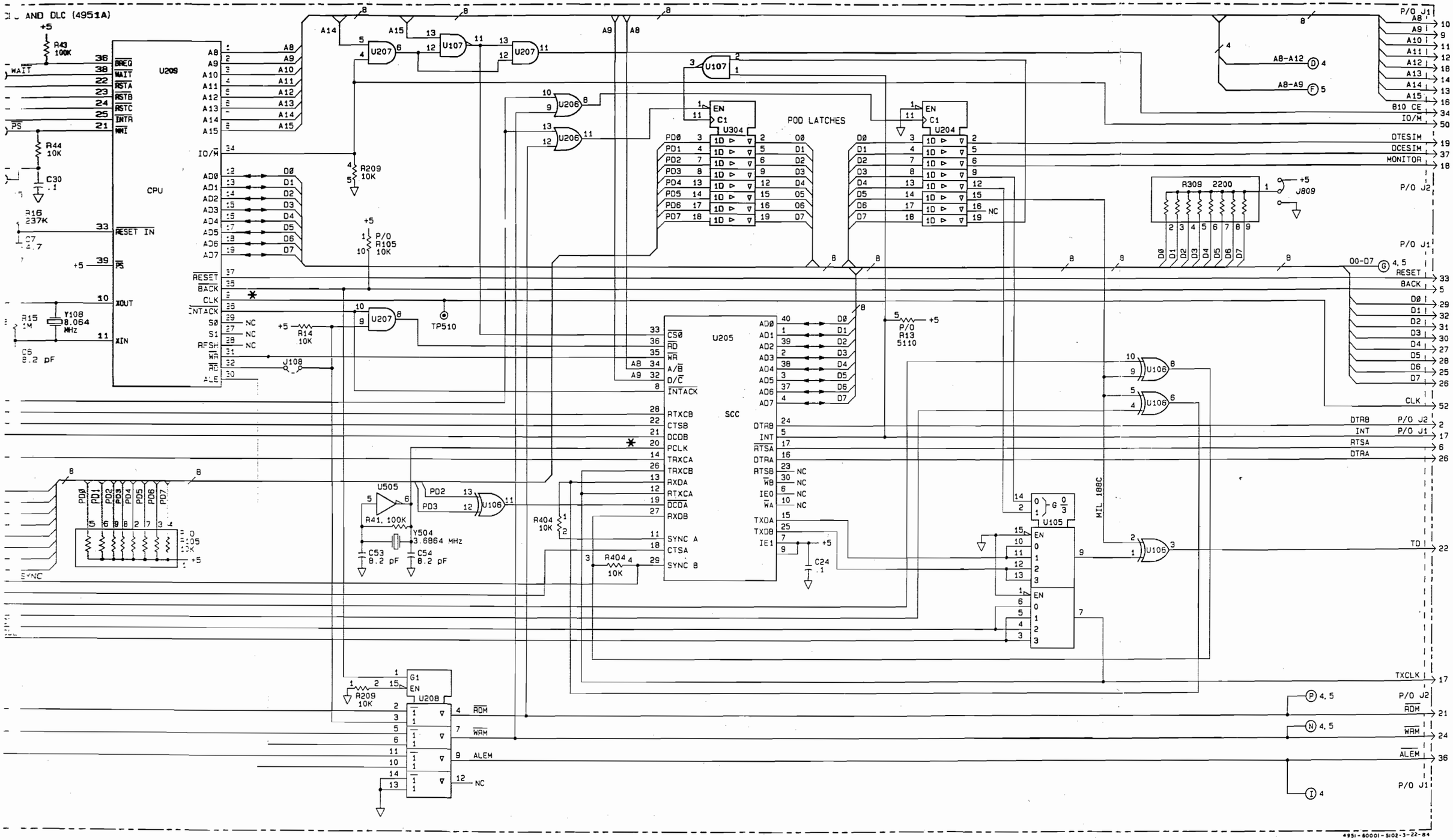
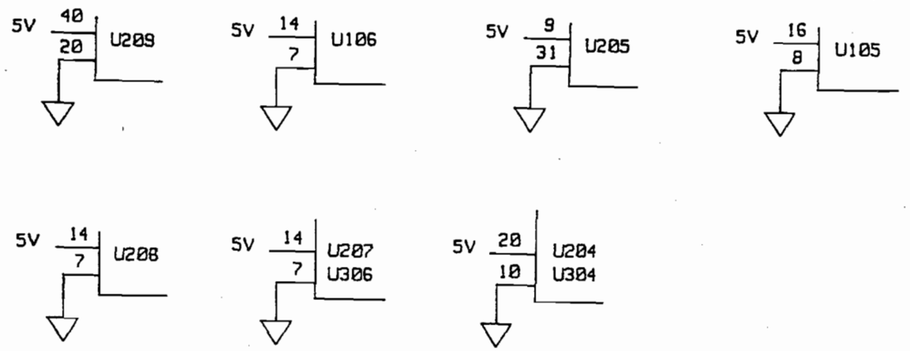
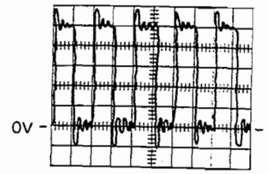


Figure 8-6. A1 CPU and DLC Schema

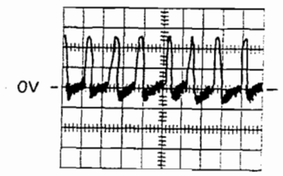
POWER AND GROUNDS



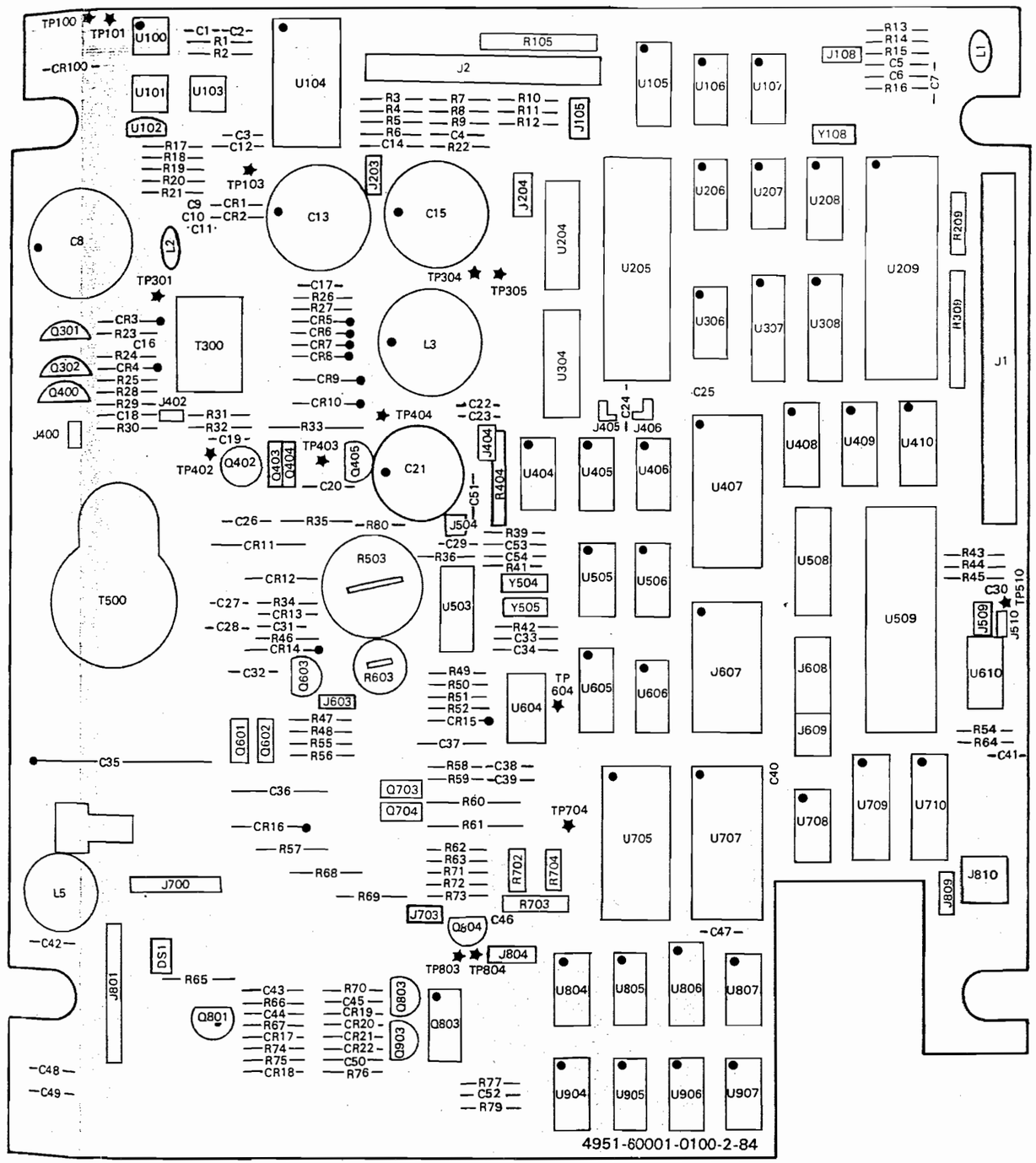
CPU CLOCKS



U205 pin 20, P Clock
.1 μsec/Div
1 V/Div, DC coupled



U209 pin 9, Clock
50 μsec/Div
.1 V/Div, DC coupled



A1 Main Board Component Locator

P/O A1 POWER SUPPLY (4951A)

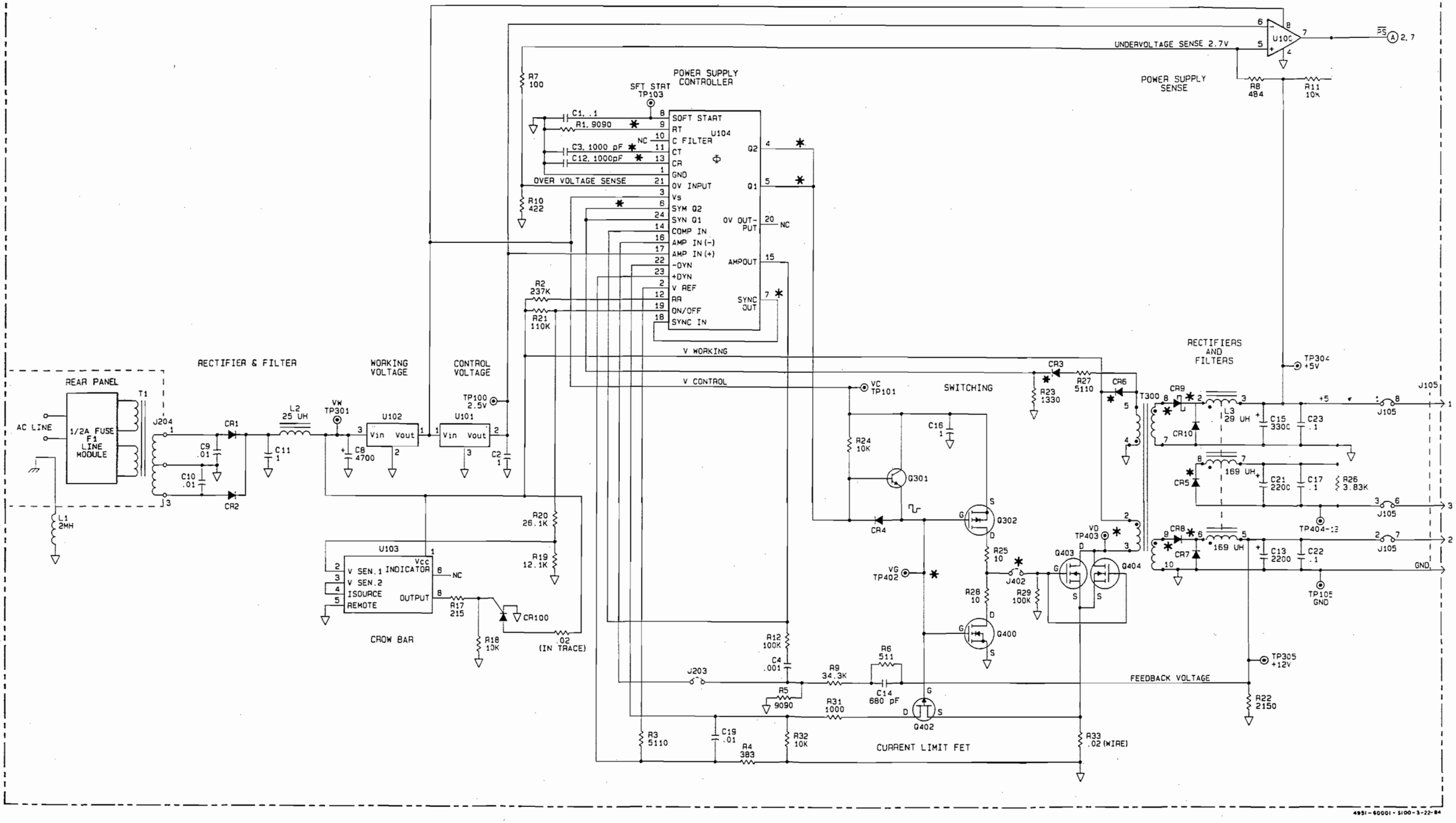


Figure 8-5. A1 Power Supply Schemat

P/O A1 POWER SUPPLY (4951A)

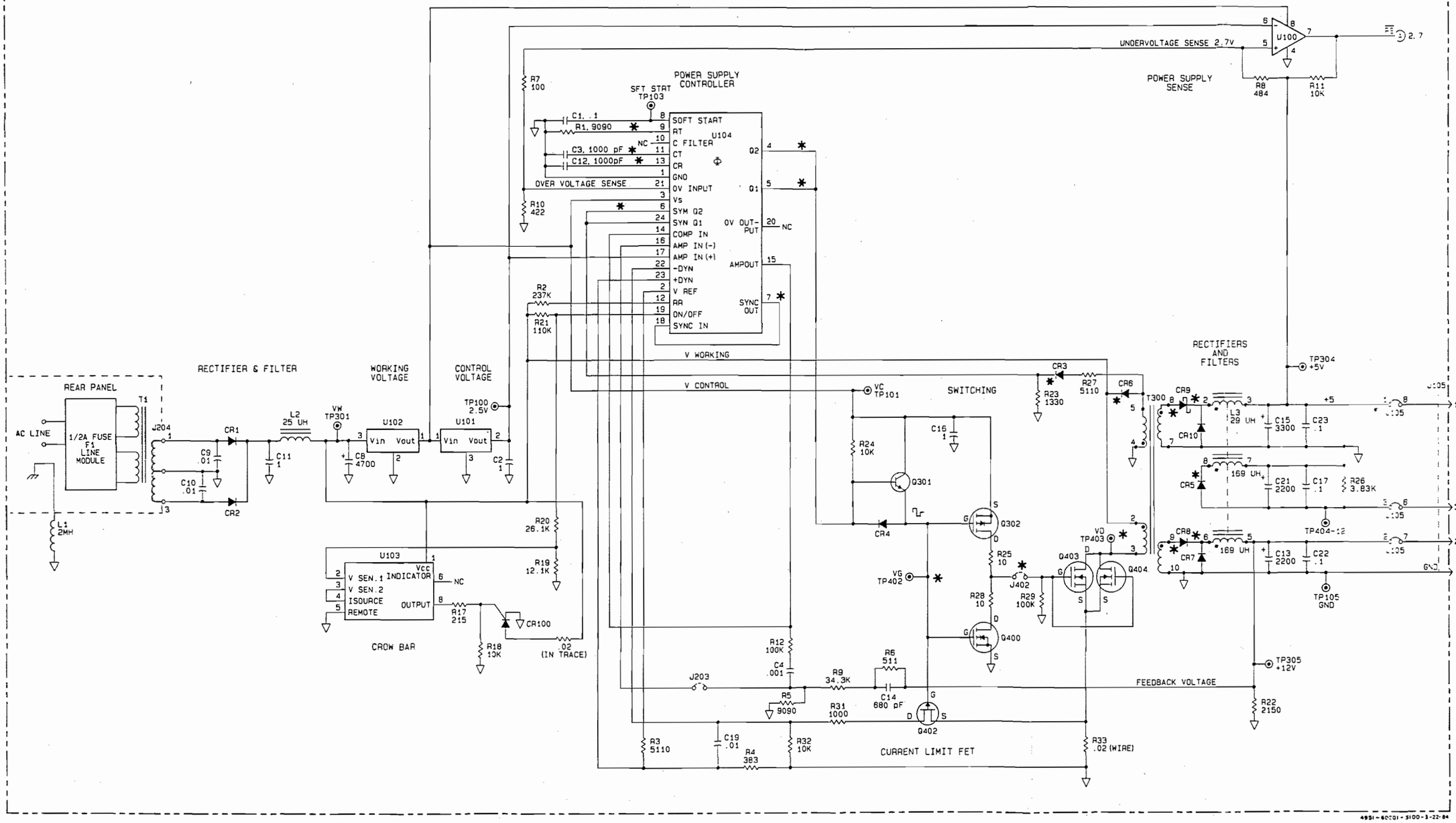
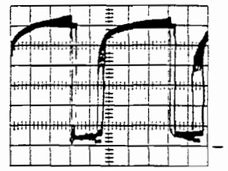


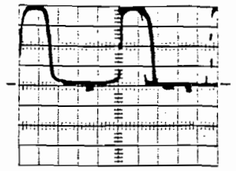
Figure 8-5. A1 Power Supply Schematic

POWER AND GROUNDS

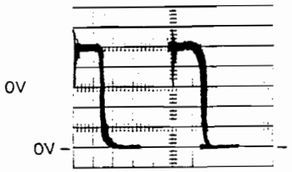
POWER SUPPLY



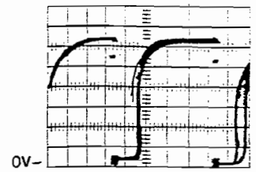
TP402
2 µsec/Div
2 V/Div, DC coupled



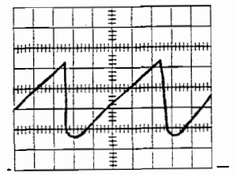
U104 pin 6
2 µsec/Div
1 V/Div, DC coupled



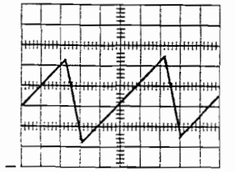
CR6 anode
2 µsec Div
5 V Div, DC coupled



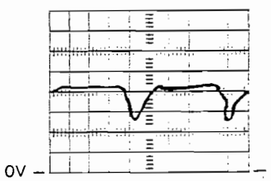
U104 pins 4 & 5
2 µsec/Div
2 V/Div, DC coupled



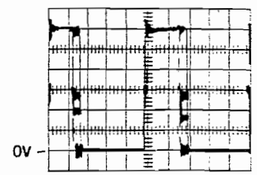
U104 pin 13
2 µsec/Div
1 V/Div, DC coupled



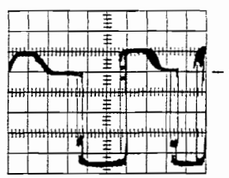
U104 pin 11
2 µsec/Div
1 V/Div, DC coupled



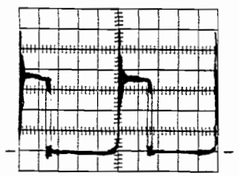
U104 pin 9
2 µsec Div
1 V/Div, DC coupled



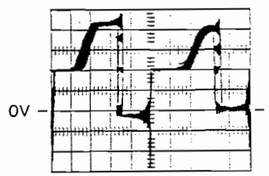
J402
2 µsec/Div
2 V/Div, DC coupled



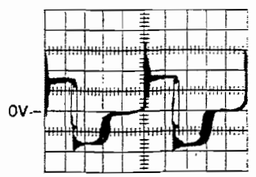
CR3 (anode)
2 µsec/Div
5 V/Div, DC coupled



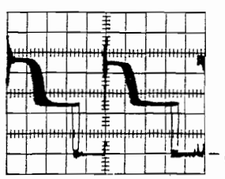
CR9 (cathode)
2 µsec/Div
5 V/Div, DC coupled



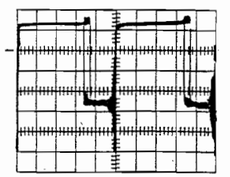
CR8 (anode)
2 µsec Div
V/cm 20, DC coupled



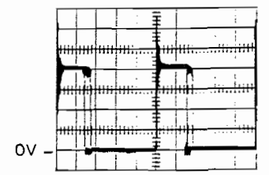
CR9 (anode)
2 µsec/Div
10 V/Div, DC coupled



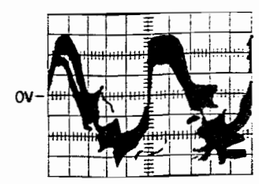
TP403
2 µsec/Div
10 V/Div, DC coupled



CR5 (cathode)
2 µsec/Div
10 V/Div, DC coupled



CR8 (cathode)
2 µsec/Div
10 V/Div, DC coupled



U104 pin 7
2 µsec/Div
.1 V/Div, DC coupled

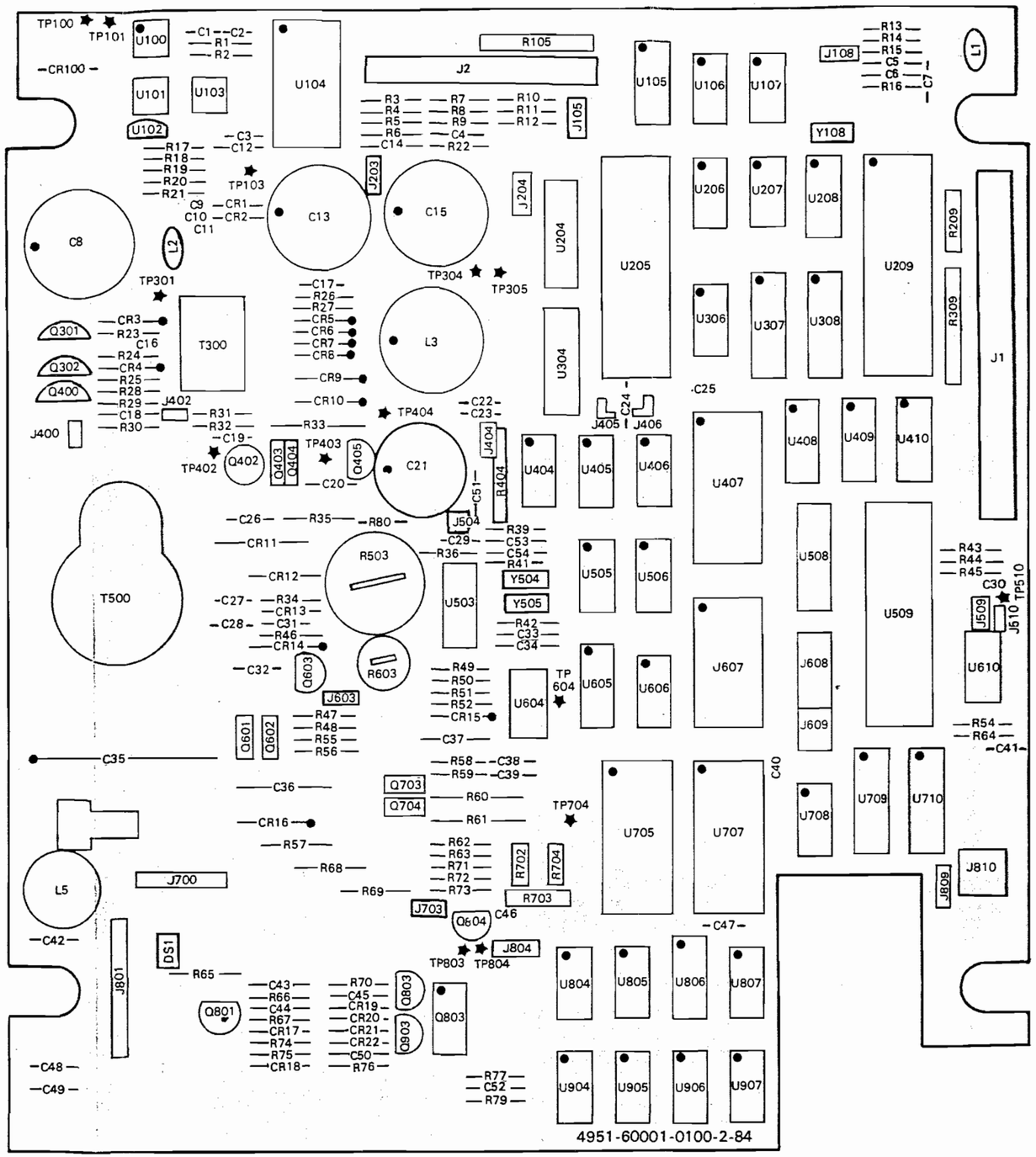


Figure 8-4. A1 Main Board Component Locator

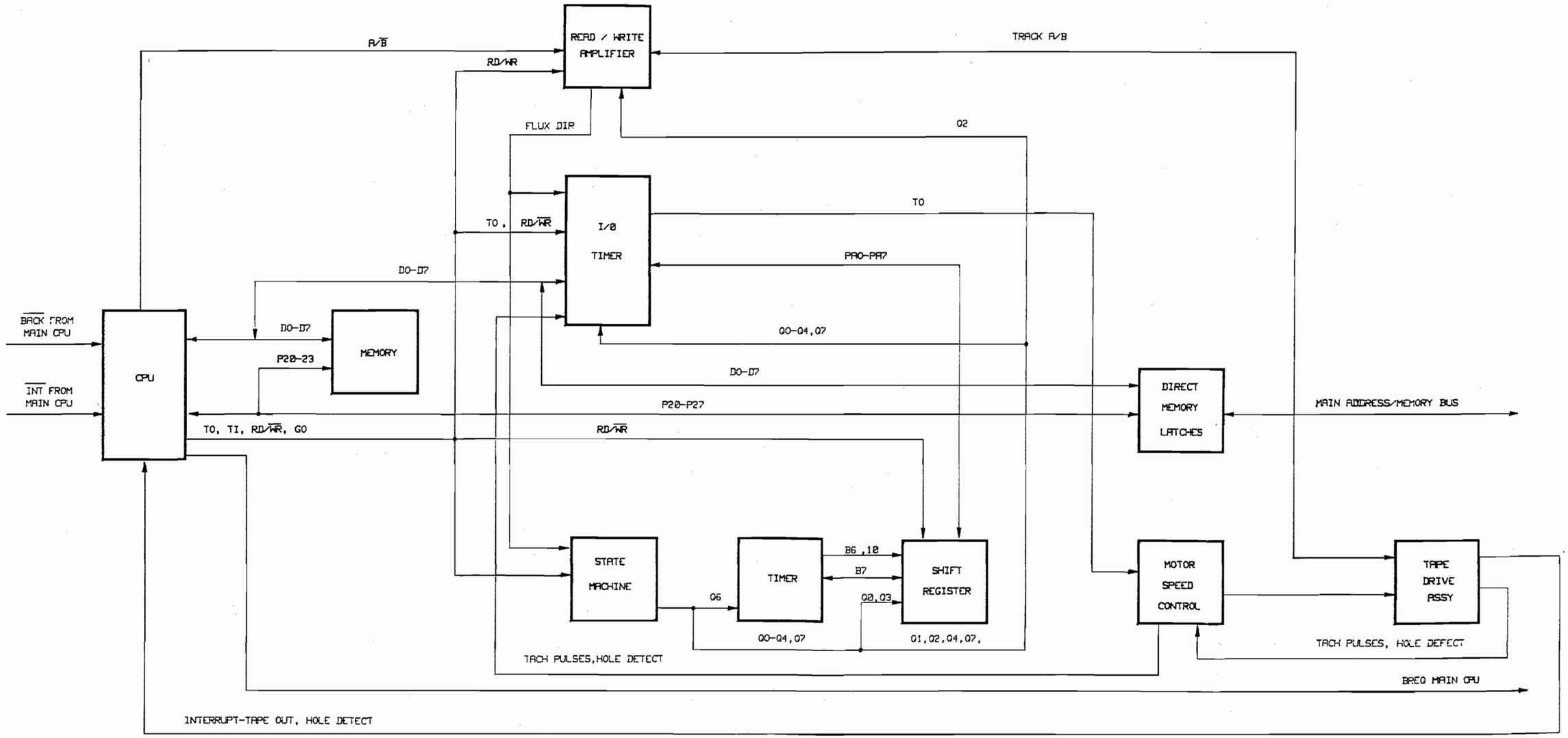


Figure 8-3. HP 4951A Overall Block Diagram

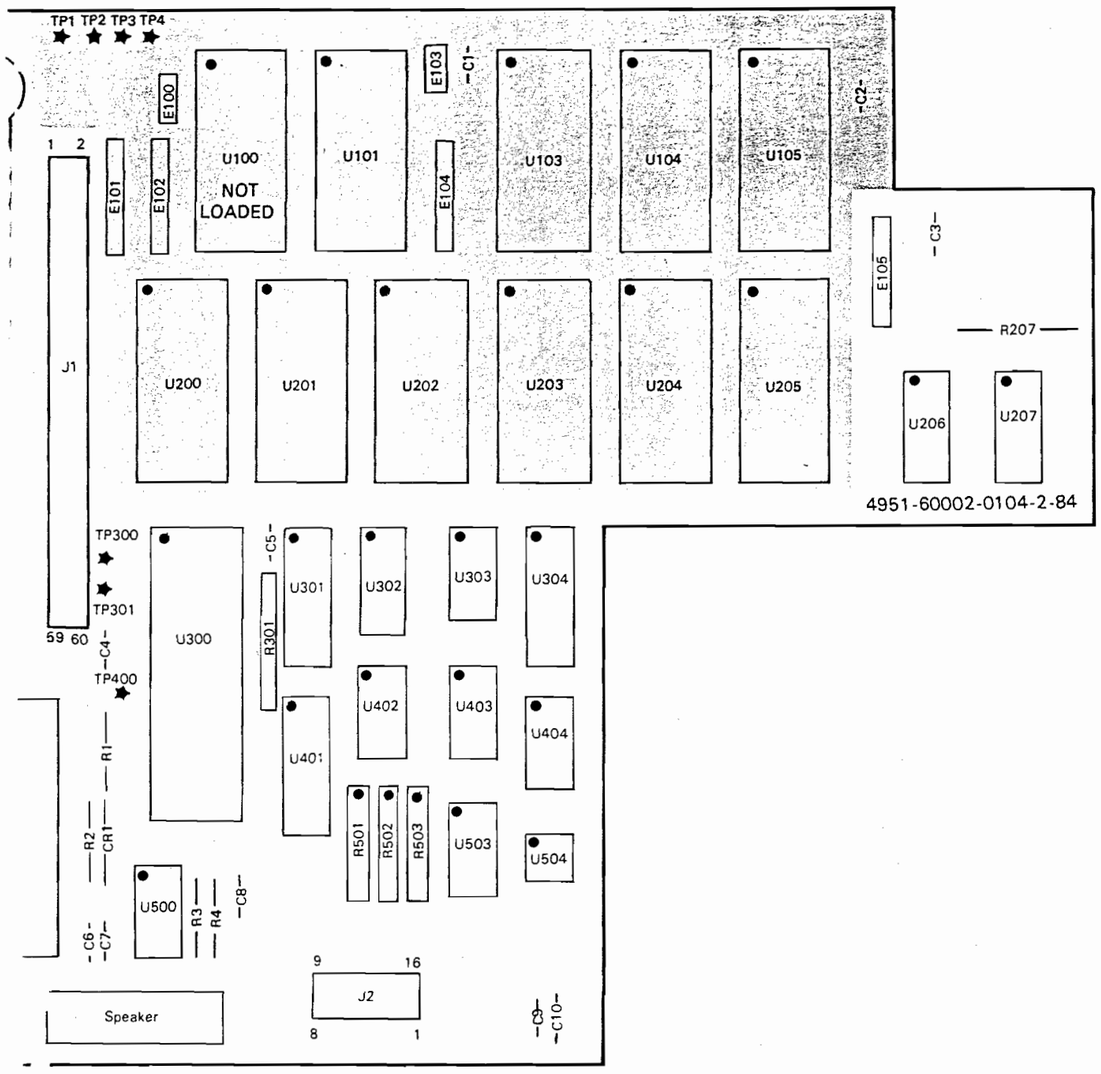
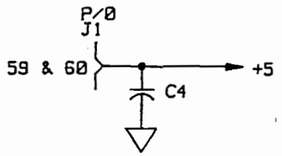
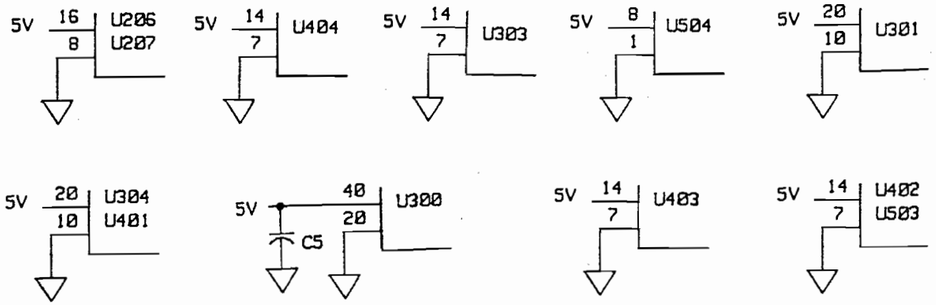
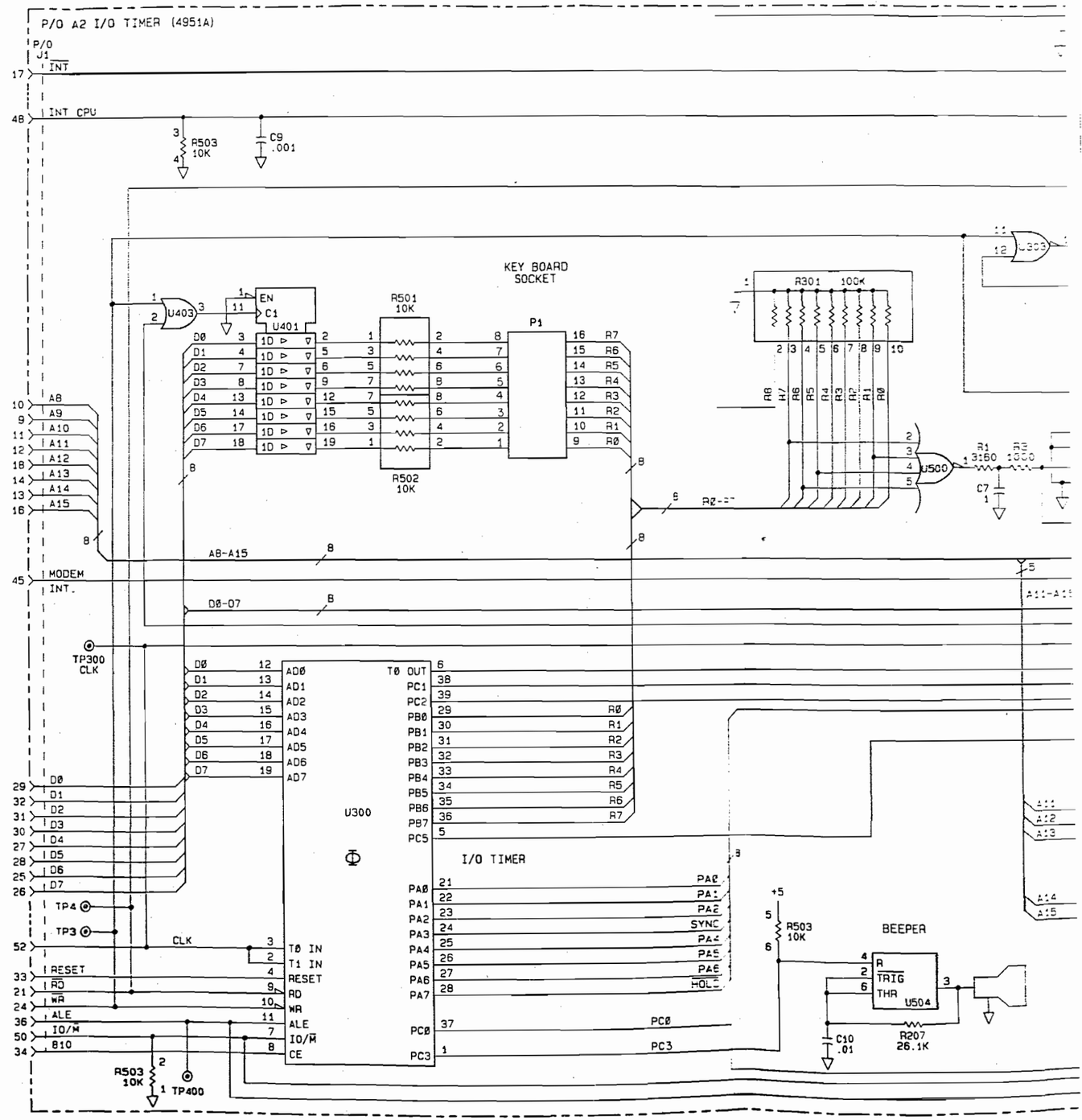


Figure 8-7. A2 Memory Board Component Locator

POWER AND GROUNDS







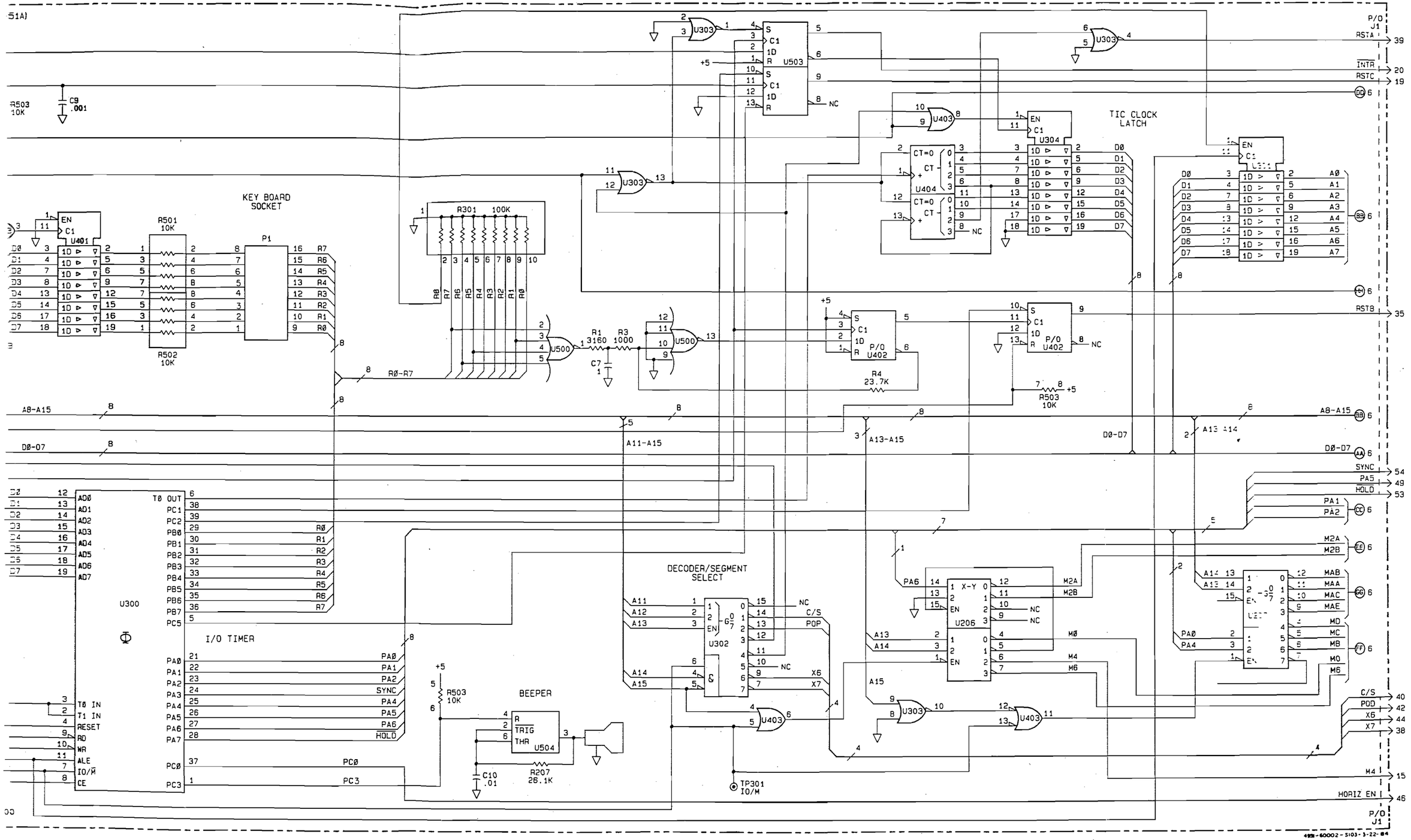
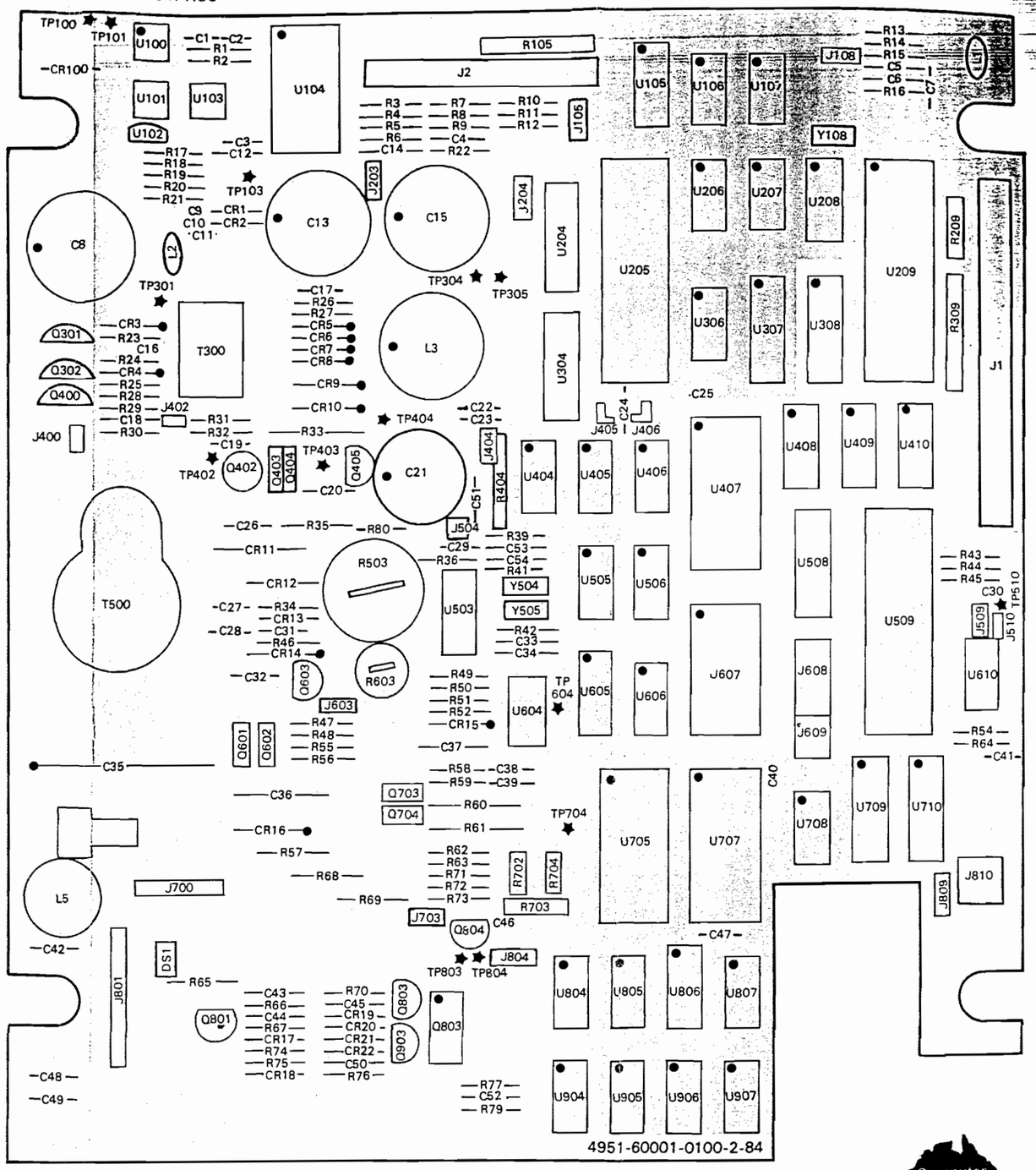
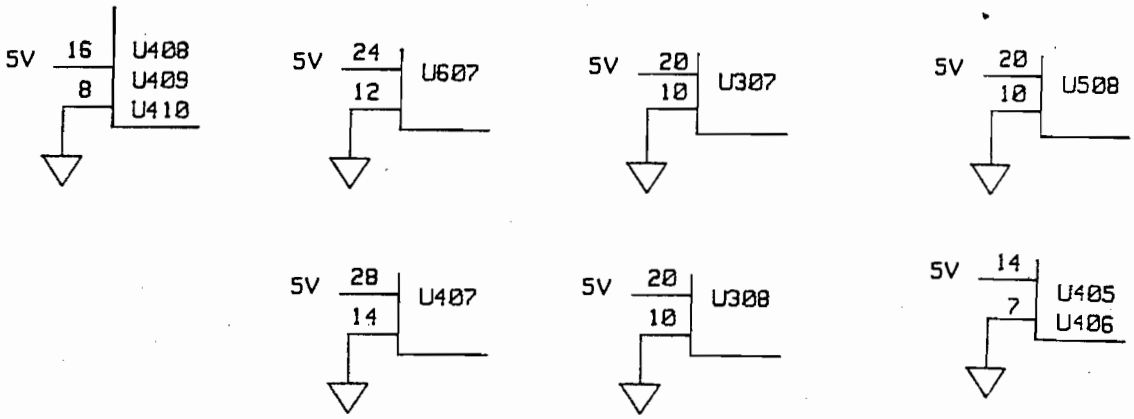


Figure 8-8. A2 I/O Timer Schematic

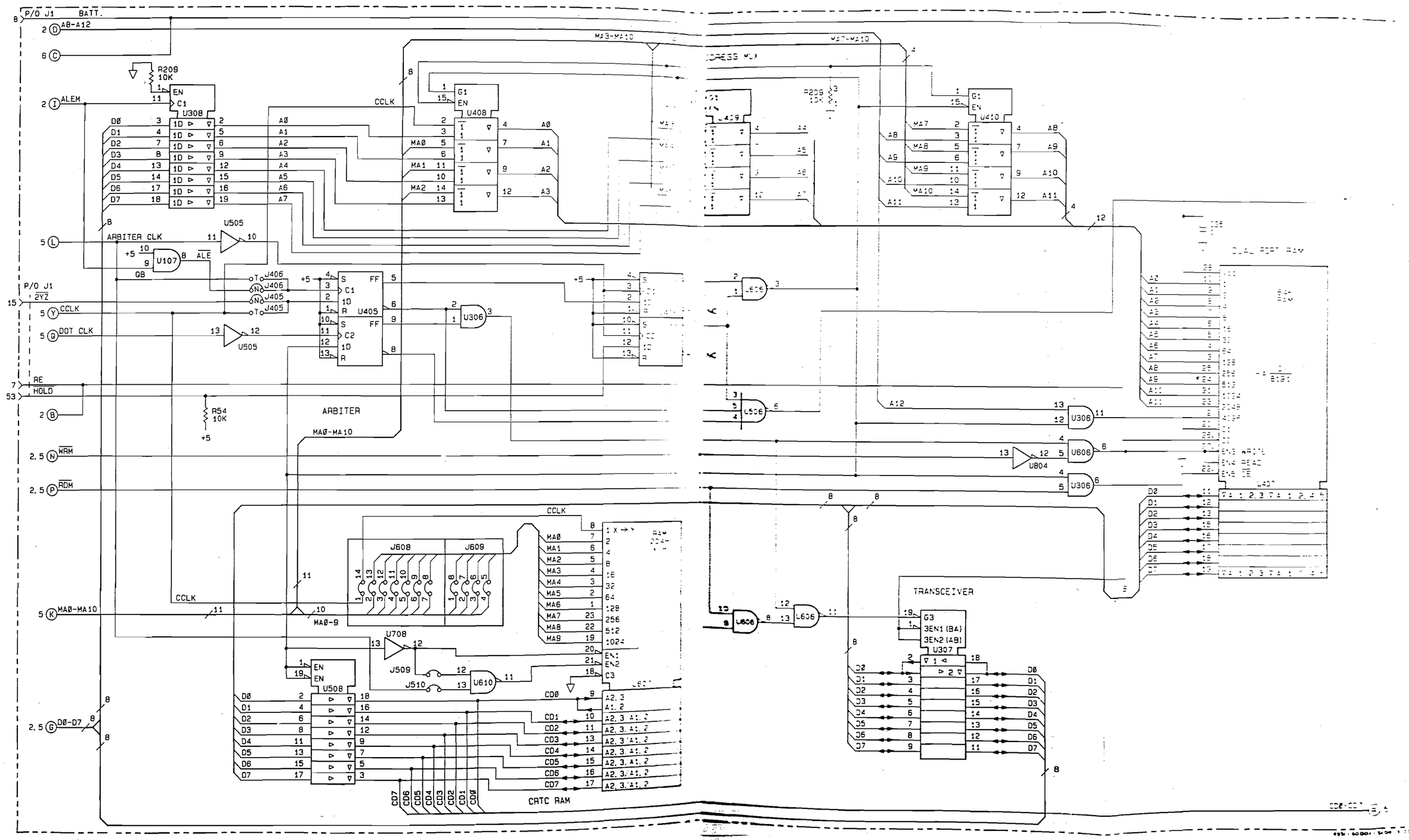


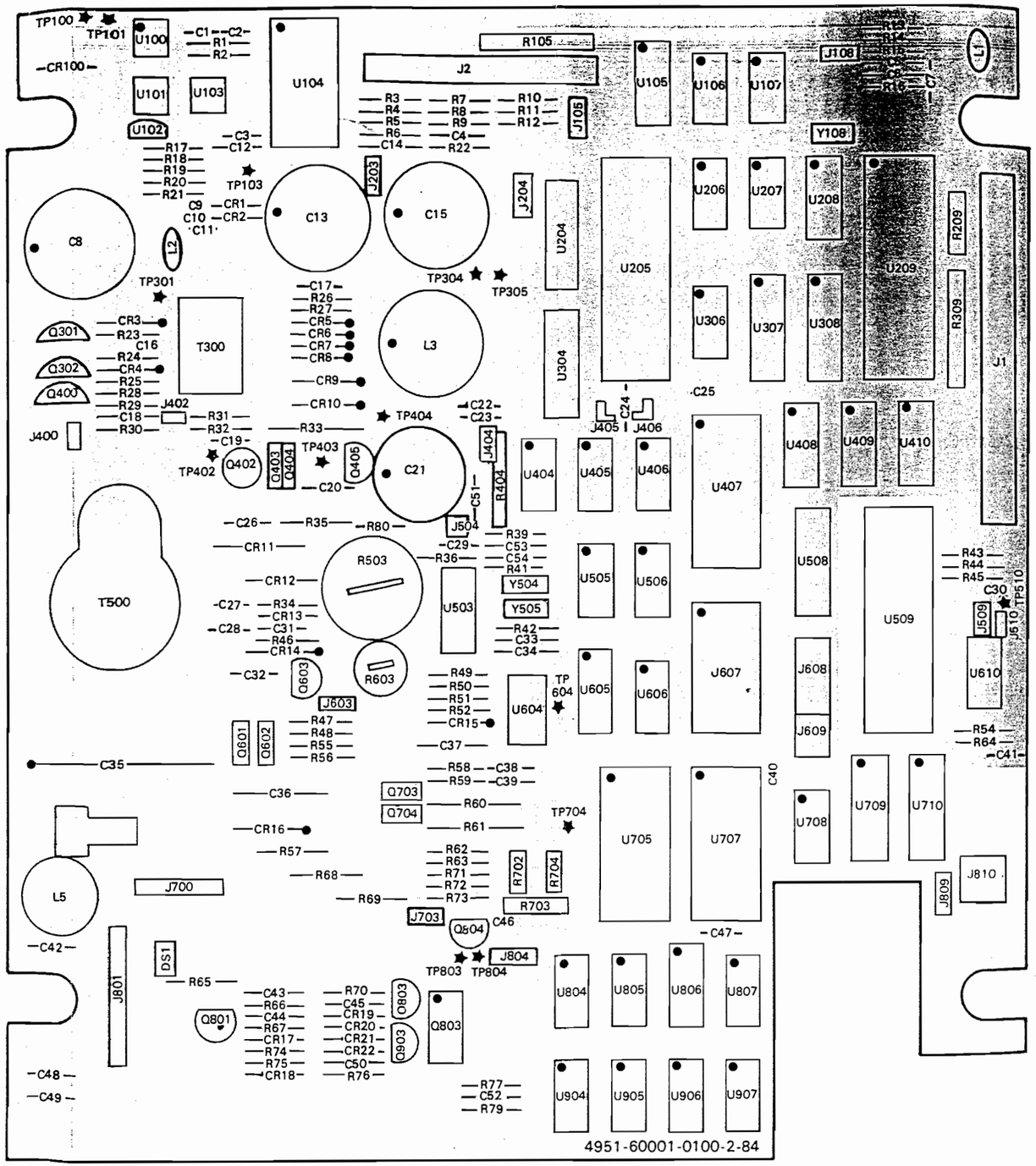
A1 Main Board Component Locator

POWER AND GROUNDS



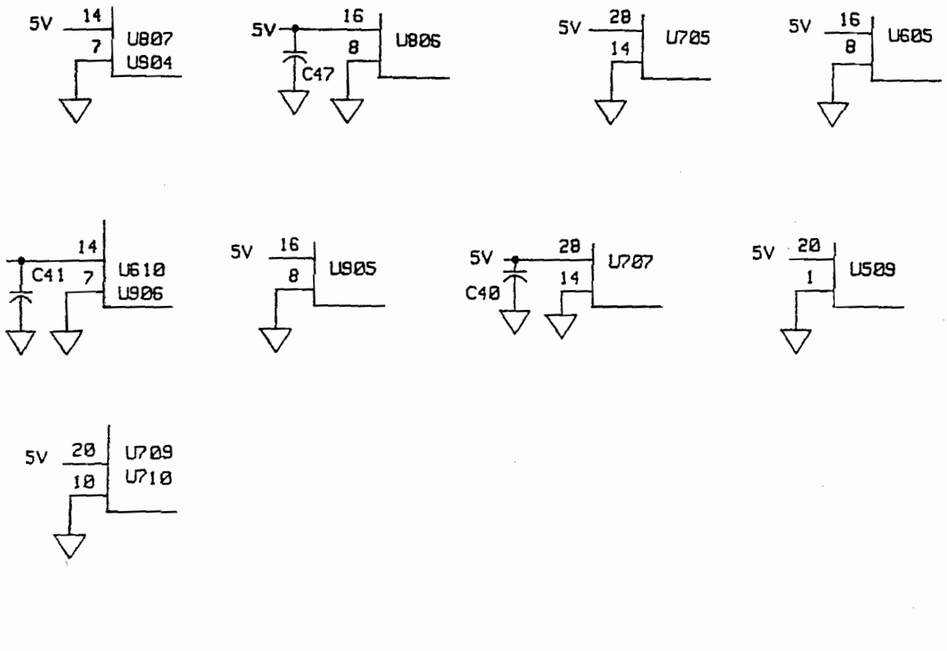
P/O A1 DUAL PORT RAM & ARBITER (4951A)



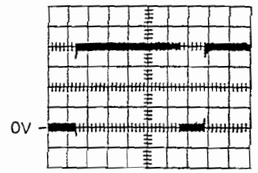


A1 Main Board Component Locator

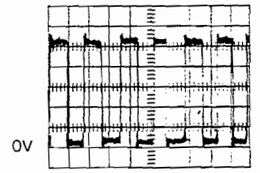
POWER AND GROUNDS



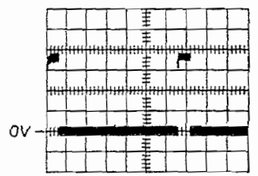
CRTC CONTROLLER



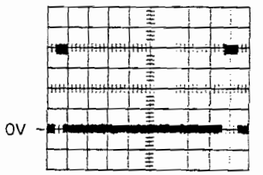
U509 pin 18, Display Enable
10 µsec/Div
1 V/Div, DC coupled



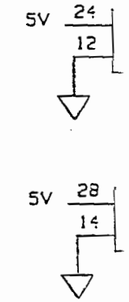
U509 pin 21, Character Clock
1 µsec/Div
1 V/Div, DC coupled



U509 pin 39, H Sync
10 µsec/Div
1 V/Div, DC coupled



U509 pin 40 VSYNC
2 msec/Div
1 V/Div, DC coupled



P/O A1 CRT CONTROLLER (4951A)

5V

CHARACTER LATCH

ATTRIBUTE LATCH

CHARACTER ROM

PARALLEL TO SERIAL SHIFT REGISTER

DIVIDE BY 8

LATCH DECODE 4.9152 MHz

DOT CLOCK

CLOCK

CRTC CONTROLLER

OVERBAR

UNDER LINE

INVERSE VIDEO

BLINK

CURSOR

HALFBRIGHT

RESYNC

Figure

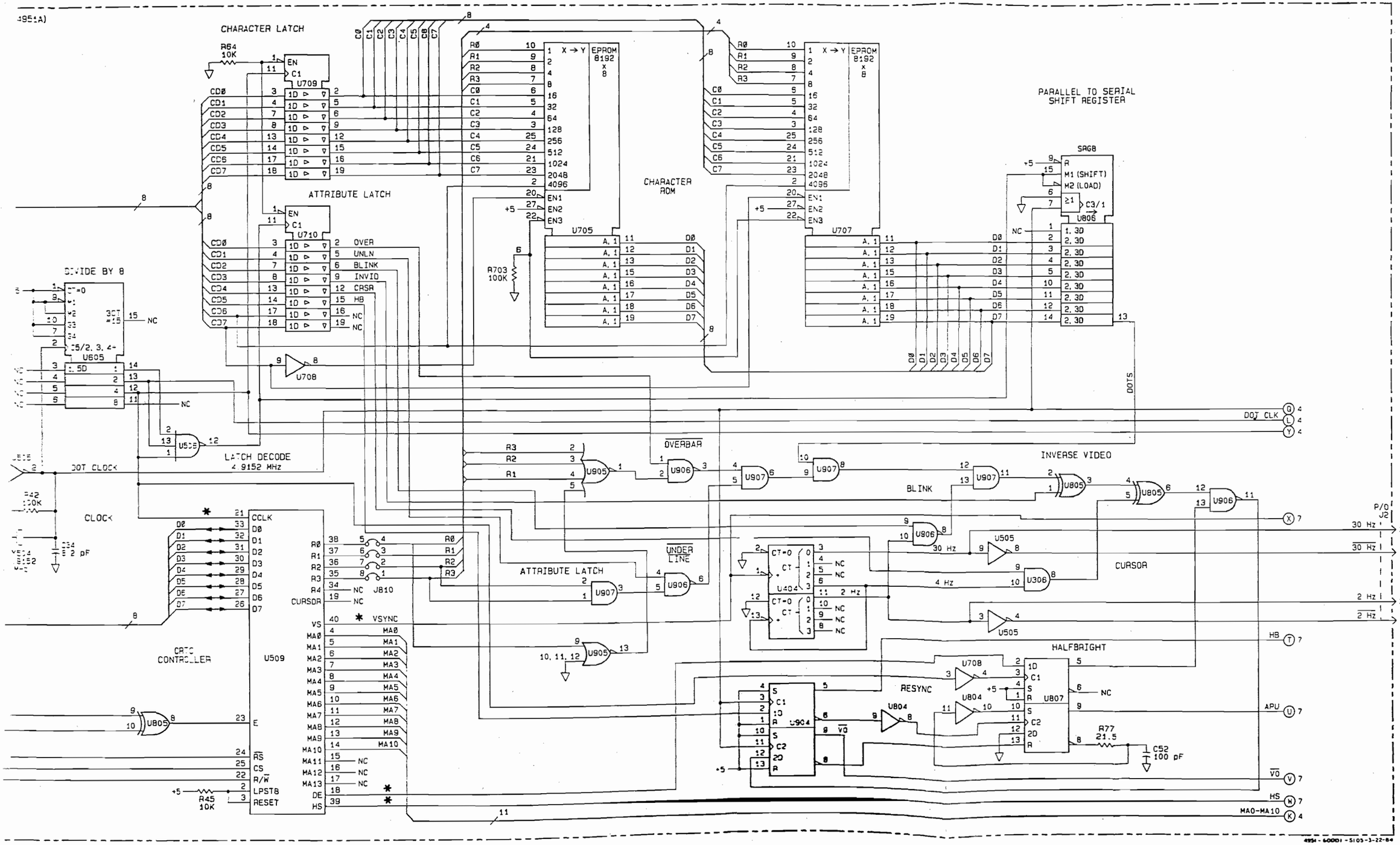
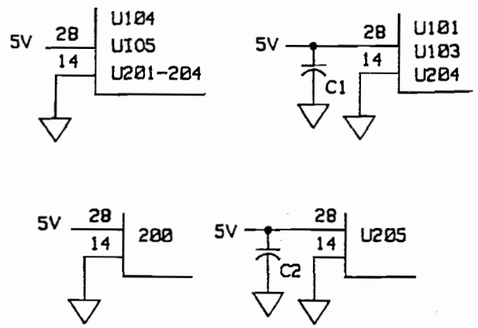
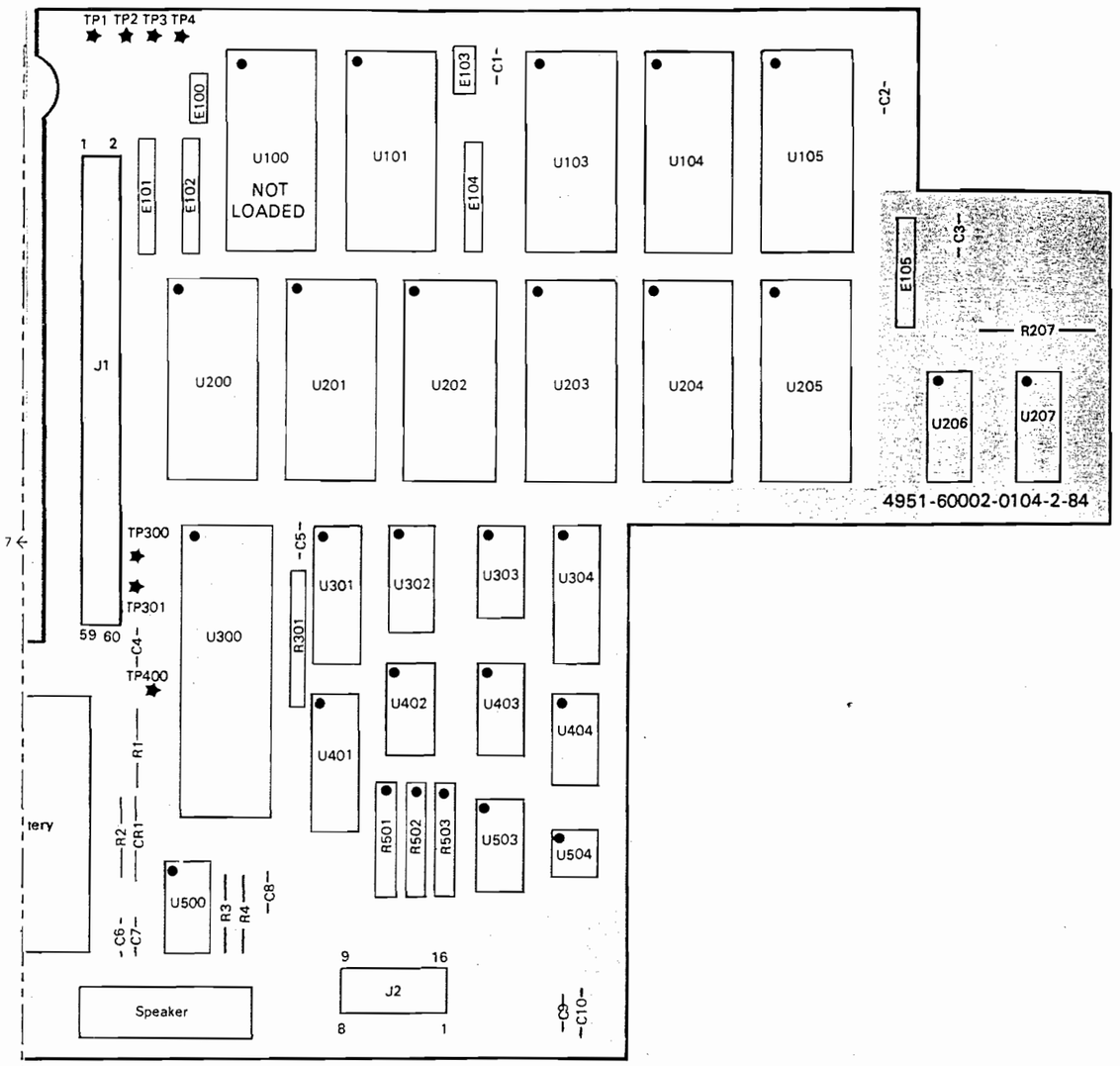


Figure 8-10. A1 CRT Controller Schematic

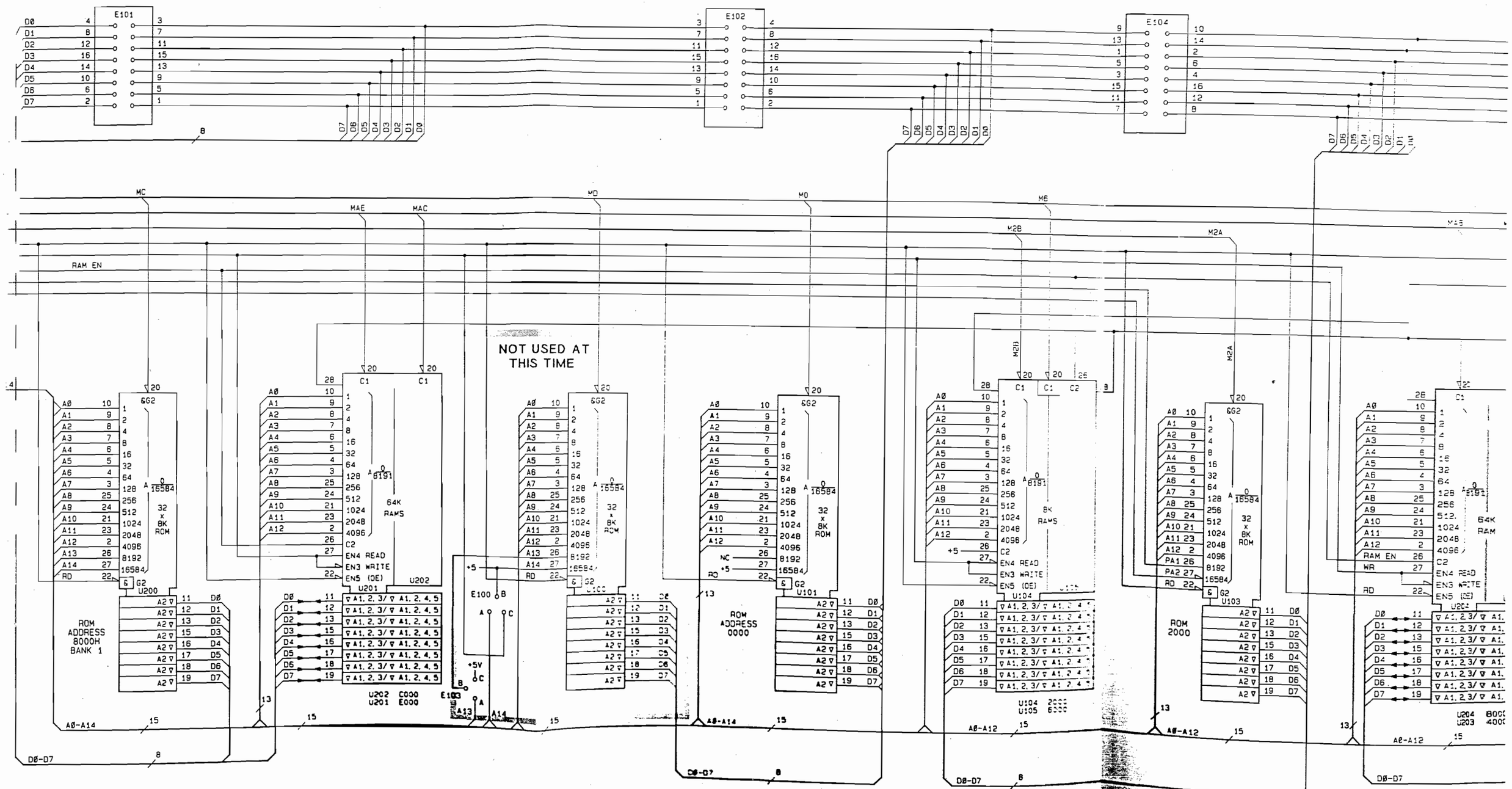
POWER AND GROUNDS





A2 Memory Board Component Locator

AND RAM (4951A)



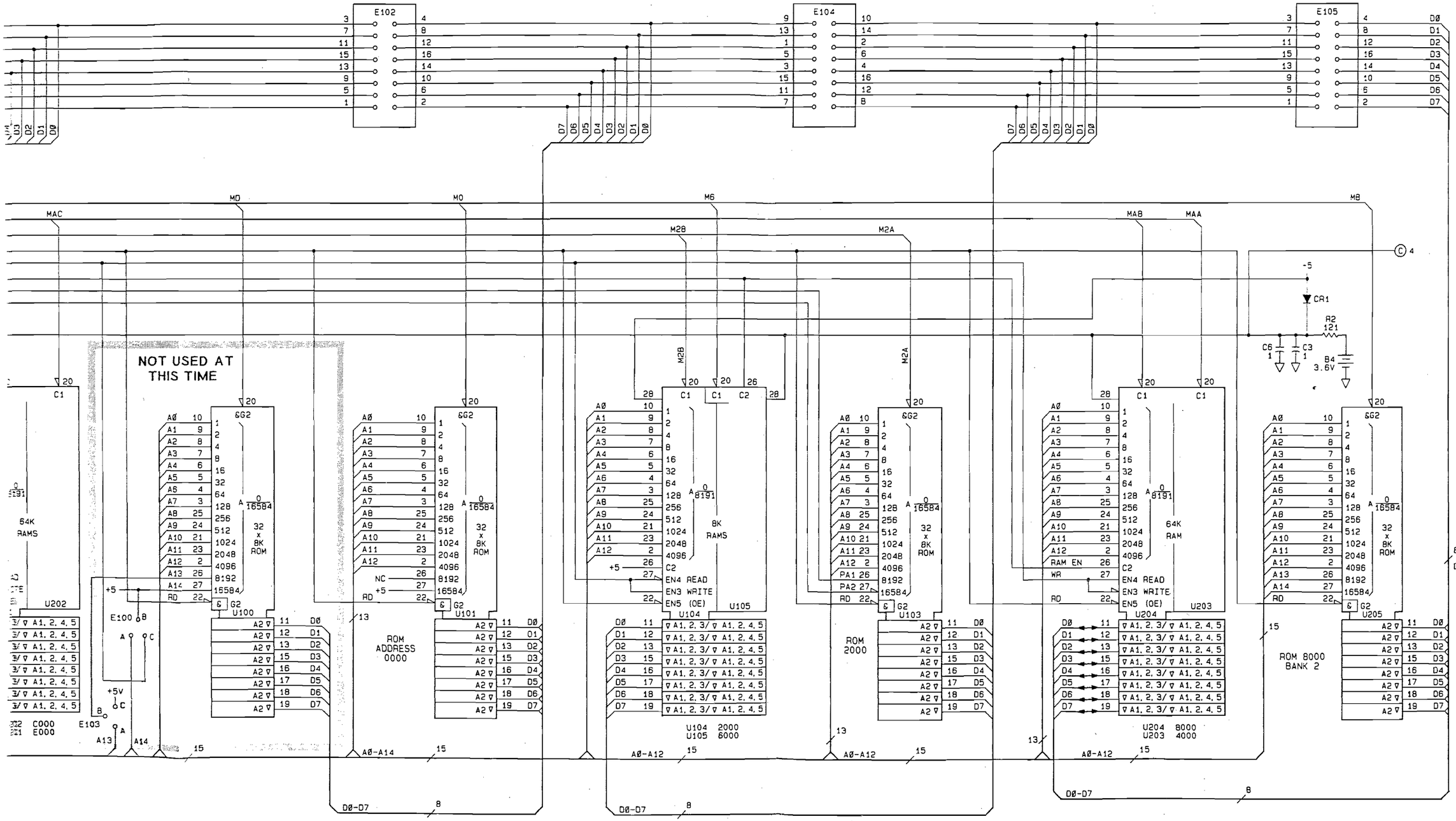
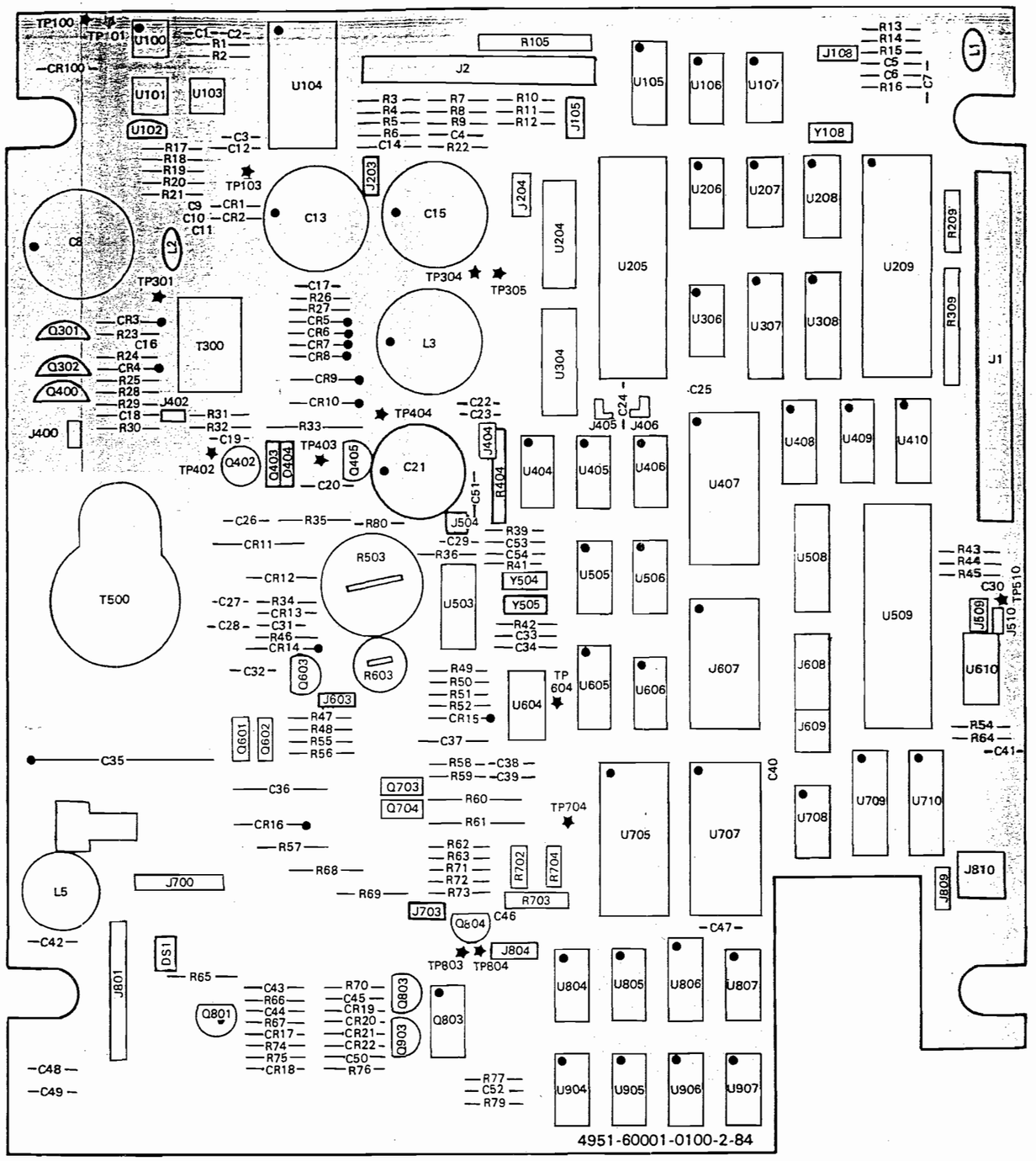
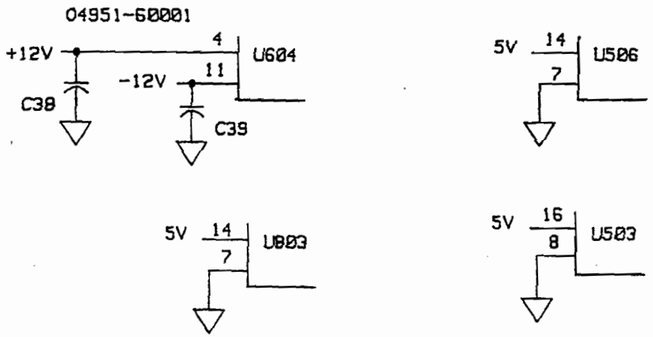


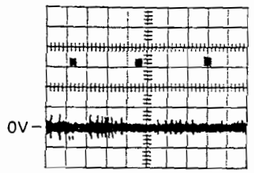
Figure 8-11. A2 ROM and RAM Schema



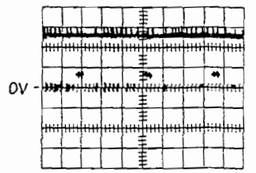
A1 Main Board Component Locator

POWER AND GROUNDS



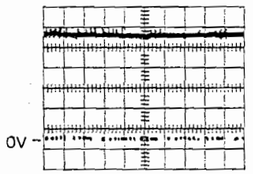


Q803 (base), Wake Up Conditions
5 msec/Div
.5 V/Div, DC coupled

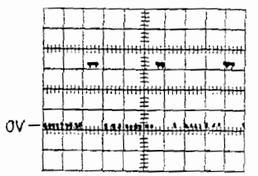


Q803 (collector), Wake Up Conditions
2 msec/Div
10 V/Div, DC coupled

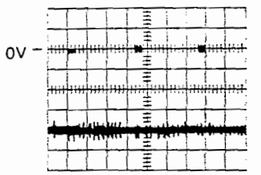
Q903 (base), Wake Up Conditic
5 msec/Div
.2 V/cm, DC coupled



Q903 (collector), Wake Up Conditions
5 msec/Div
5 V/Div, DC coupled



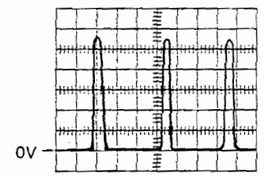
TP803, Wake Up Conditions
5 msec/Div
5 V/Div, DC coupled



Wake Up Conditions

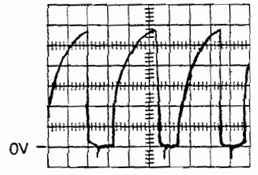
J804 (pin 12 of U803),
5 msec/Div
2 V/Div, DC coupled

HORIZONTAL AMPLIFIER

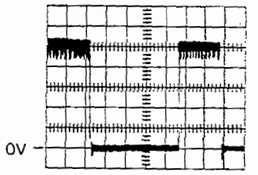


Wake Up Conditions

Q601-Q602 (drain) pin 3 (T300),
20 µsec/Div
20 V/Div, DC coupled

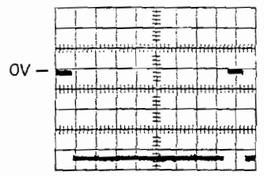


J603, Wake Up Conditions
20 µsec/Div
2 V/Div, DC coupled

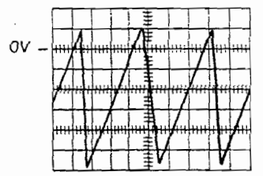


U506 pin 8, Wake Up Conditions
10 µsec/Div
1 V/Div, DC coupled

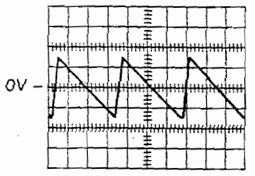
VERTICAL AMPLIFIER



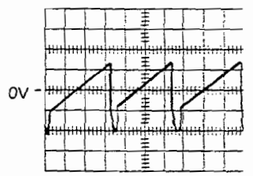
TP704
5 msec/Div
5 V/Div, DC coupled



TP604 pin 1
5 msec/cm
5 V/cm, DC coupled



TP604 pin 2
5 msec/Div
.5 V/cm, DC coupled



TP604 pin 3
2 msec/cm
.5 V/cm, DC coupled

P/O A1 DEFLECTION CIRCUIT (4951A)

HEIGHT & CENTER

VERT. HEIGHT ADJ

VOLTAGE TO CURRENT CONVERTER

V DAV

VERT. CENTERING ADJ

HIGH VOLTAGE

VIDEO AMPLIFIER

NORMAL TEST

APU TP804

HORIZONTAL AMPLIFIER

H DAV

INT. ADJ

HORIZ. WIDTH ADJ

INTERNAL CONNECTION

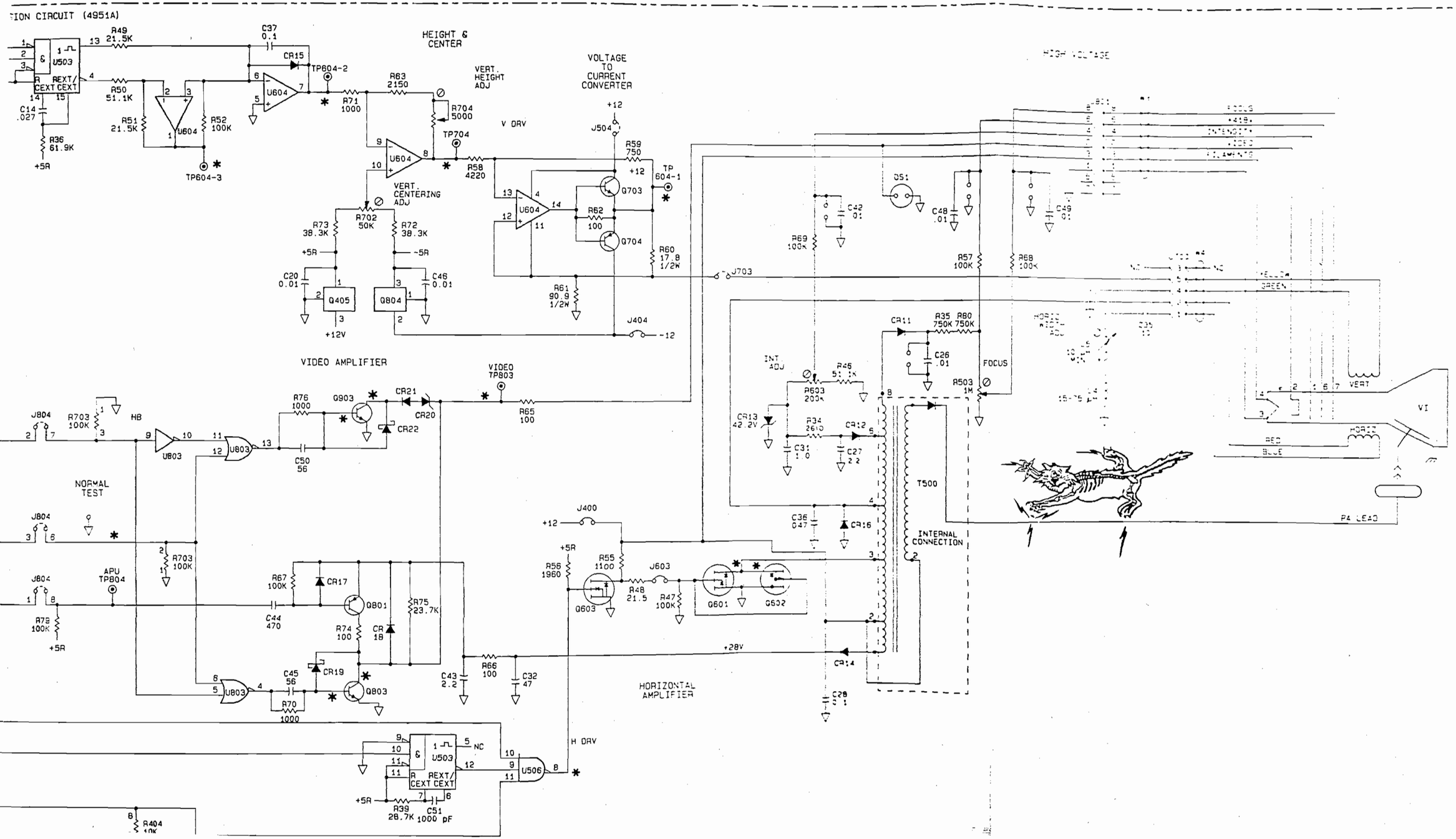
FOCUS

INTENSITY

VIDEO

FILAMENTS

HORIZEN


TION CIRCUIT (4951A)
R49 21.5K
C37 0.1
CR15
TP604-2
HEIGHT & CENTER
VERT. HEIGHT ADJ
VOLTAGE TO CURRENT CONVERTER
U503
REXT/ CEXT CEXT
R50 51.1K
R51 21.5K
R52 100K
C14 .027
R36 61.9K
+5R
TP604-3
U604
R63 2150
R704 5000
TP704
R58 4220
V DRV
J504
+12
R59 750
TP 604-1
Q703
Q704
R62 100
R60 17.8 1/2W
R61 90.9 1/2W
J703
J404
-12
VERT. CENTERING ADJ
R702 50K
R73 38.3K
R72 38.3K
-5R
C20 0.01
C46 0.01
Q405
Q804
+12V
VIDEO AMPLIFIER
VIDEO TP803
R76 1000
Q903
CR21
CR20
CR22
R65 100
C50 56
J804
R703 100K
HB
U803
NORMAL TEST
APU TP804
R73 100K
R67 100K
CR17
Q801
R74 100
CR 18
R75 23.7K
C44 470
C45 56
CR19
Q803
R70 1000
C43 2.2
R66 100
C32 47
J400
R56 1960
R55 1100
J603
R48 21.5
R47 100K
Q603
Q601
Q602
+28V
HORIZONTAL AMPLIFIER
H DRV
U506
R404 10K
R39 28.7K
C51 1000 pF
HIGH VOLTAGE
C42 01
C48 .01
C49 01
R69 100K
R57 100K
R68 100K
CR11
R35 R80 750K 750K
C26 .01
FOCUS
R503 1M
INT ADJ
R46 51.1K
R503 200K
CR13 42.2V
R34 2610
CR12
C31 1.0
C27 2.2
C36 047
CR16
CR14
C28 0.1
T500
INTERNAL CONNECTION
P4 LEAD
VERT
HORIZ
RED
BLUE
VI

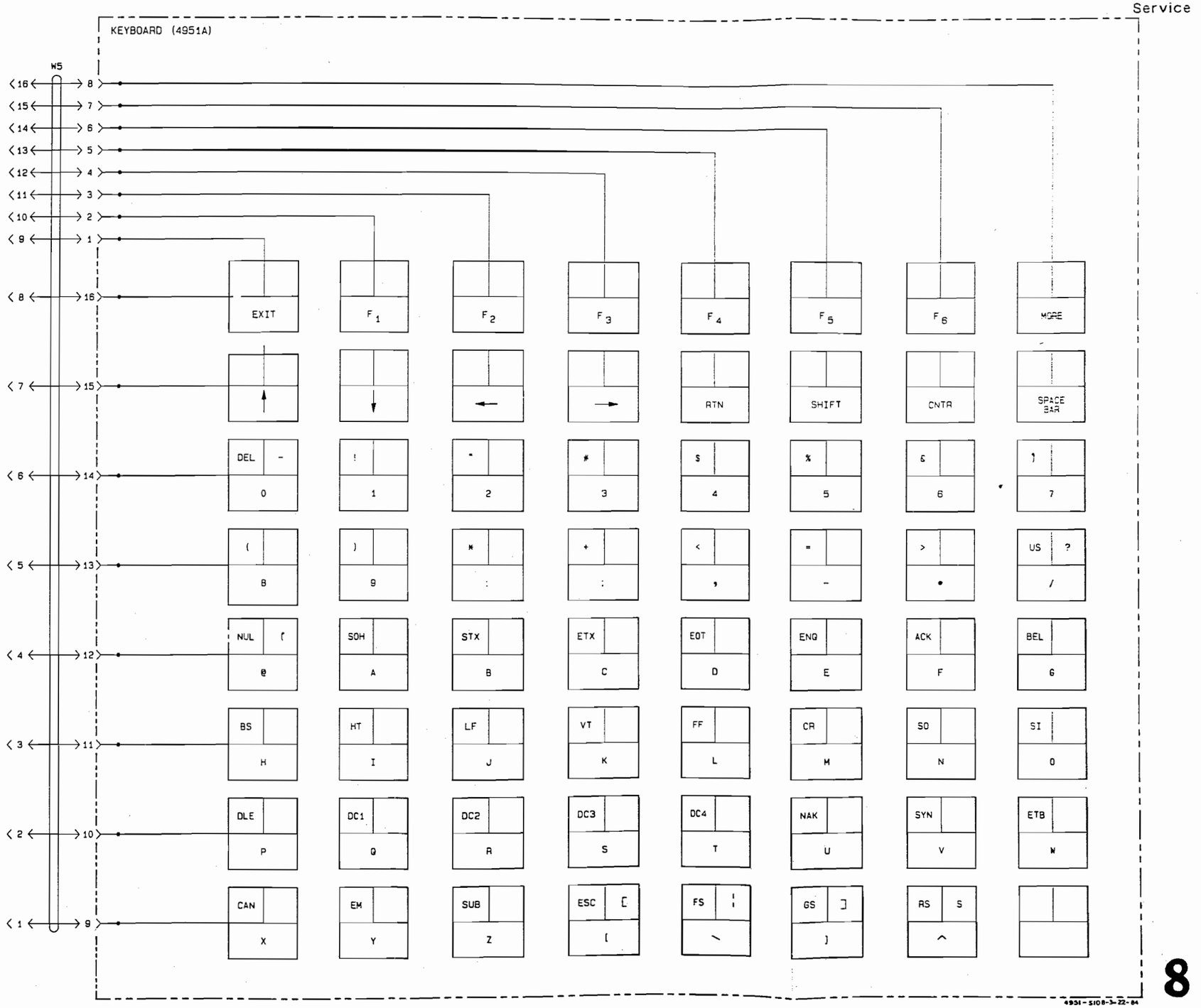


Figure 8-18. Keyboard Diagram

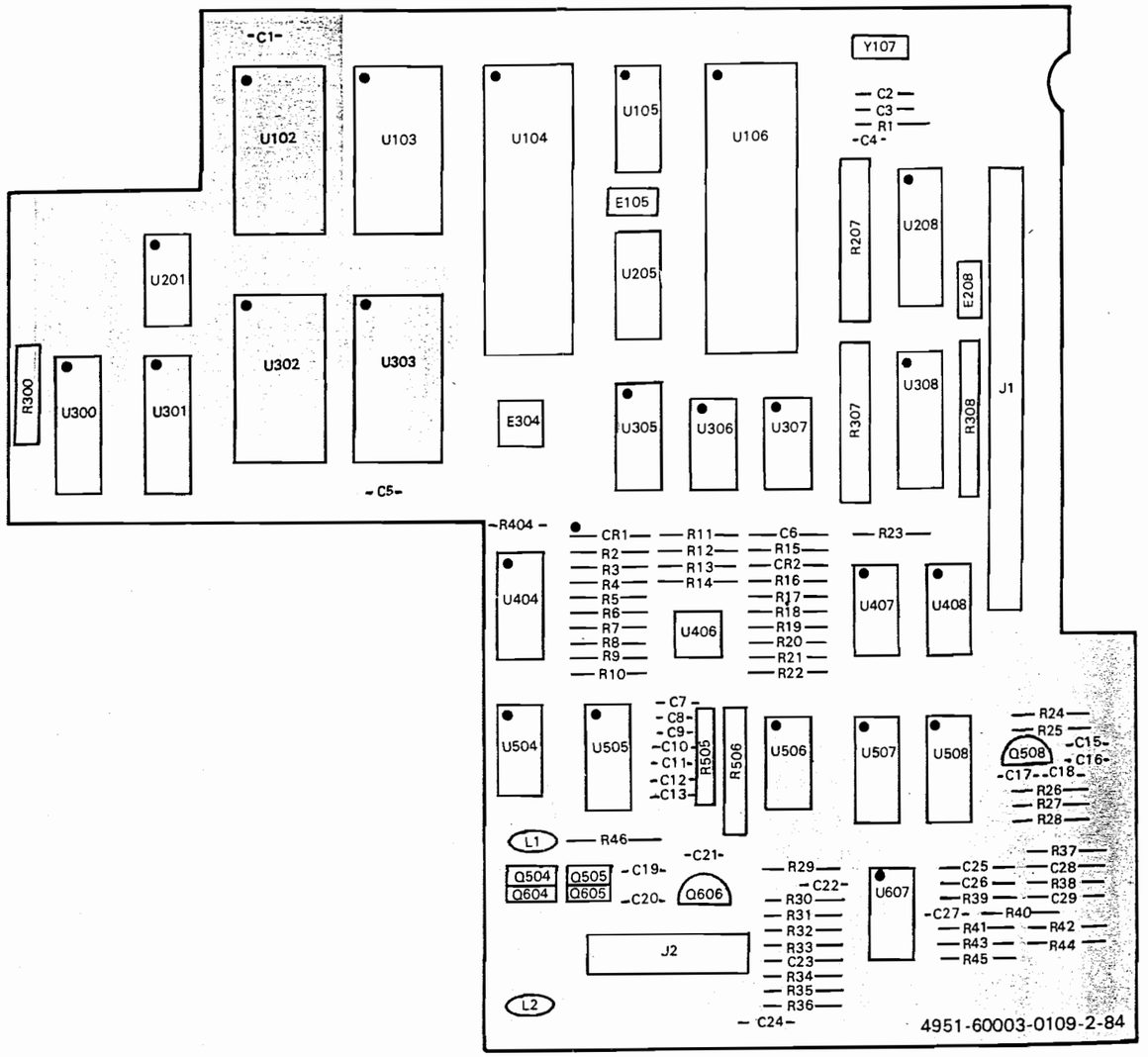
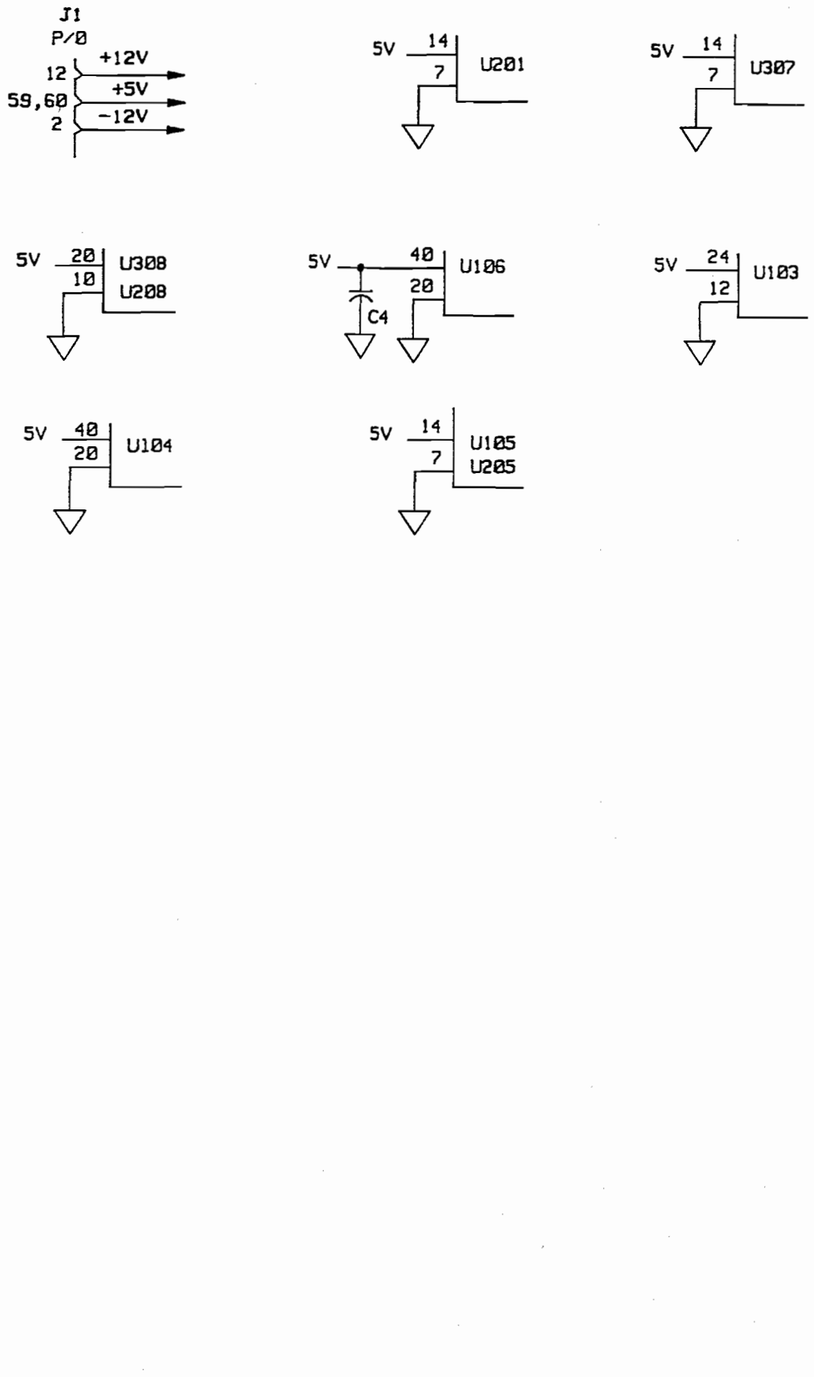
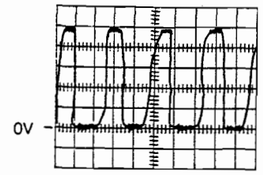


Figure 8-14. A3 Tape Board Component Locator

POWER AND GROUNDS



I/O SYSTEM CLOCK



A3U106 pin 1
.2 μsec/Div
1 V/Div, DC coupled

P/O A3 CPU TAPE (4951A)

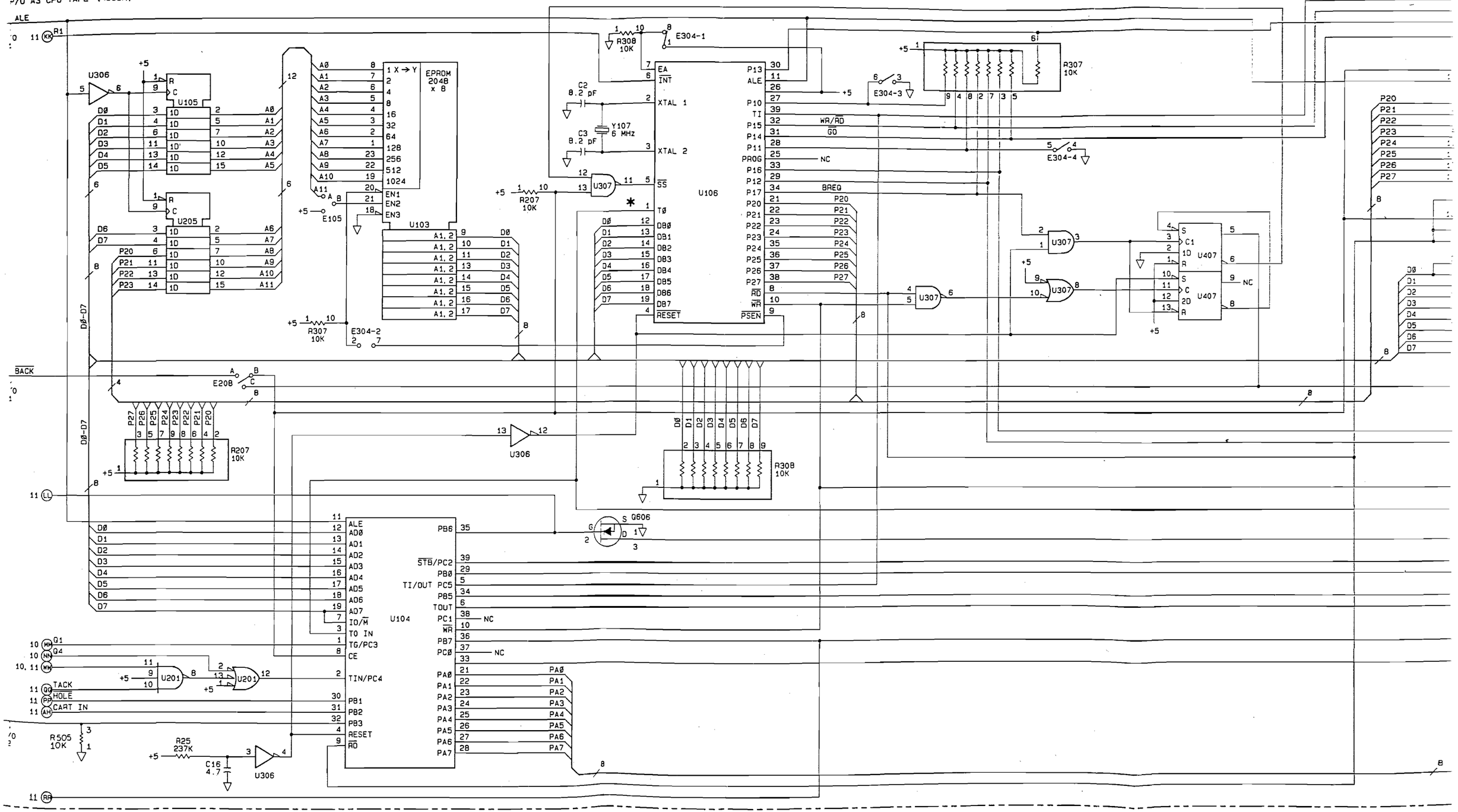
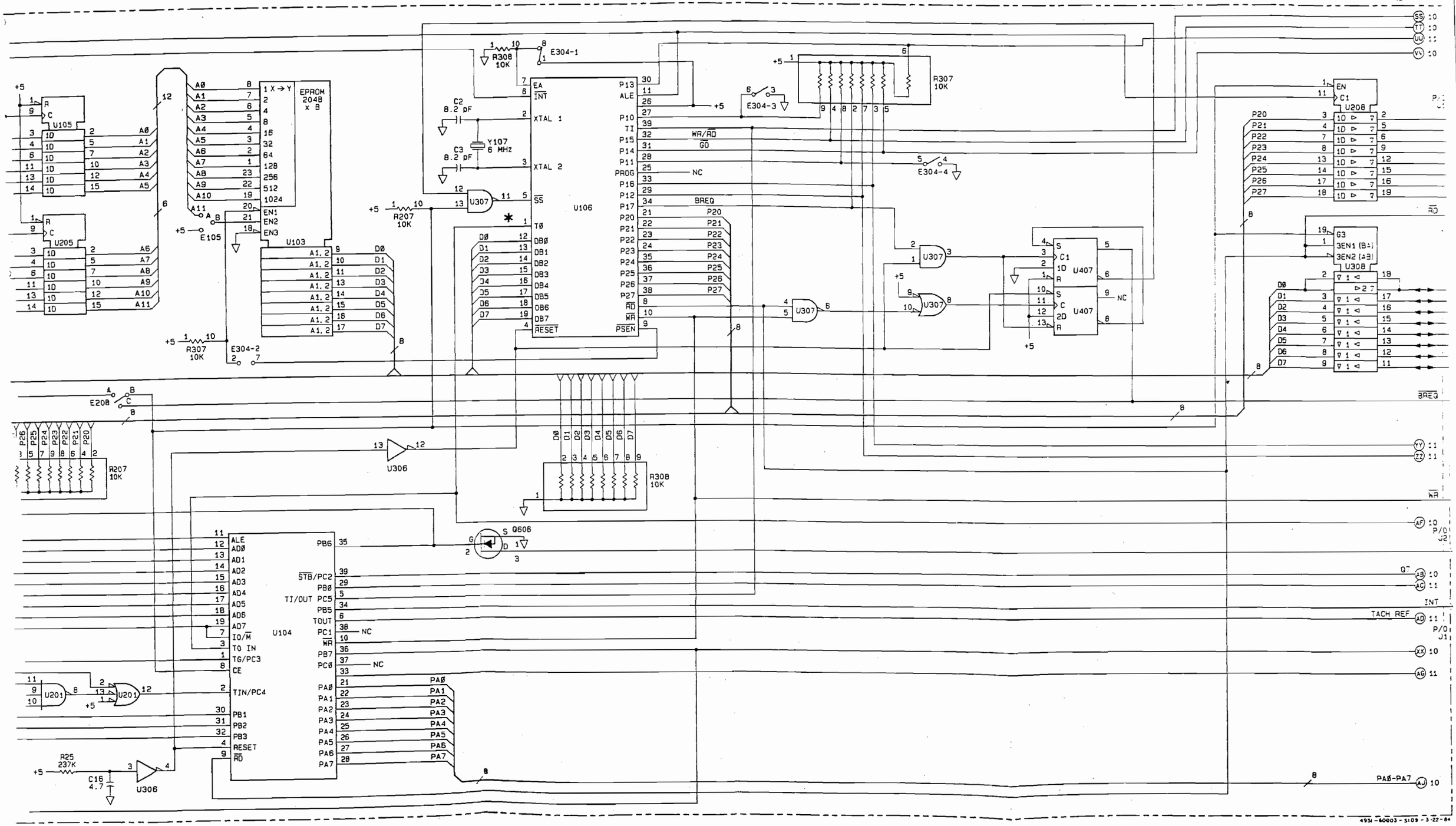
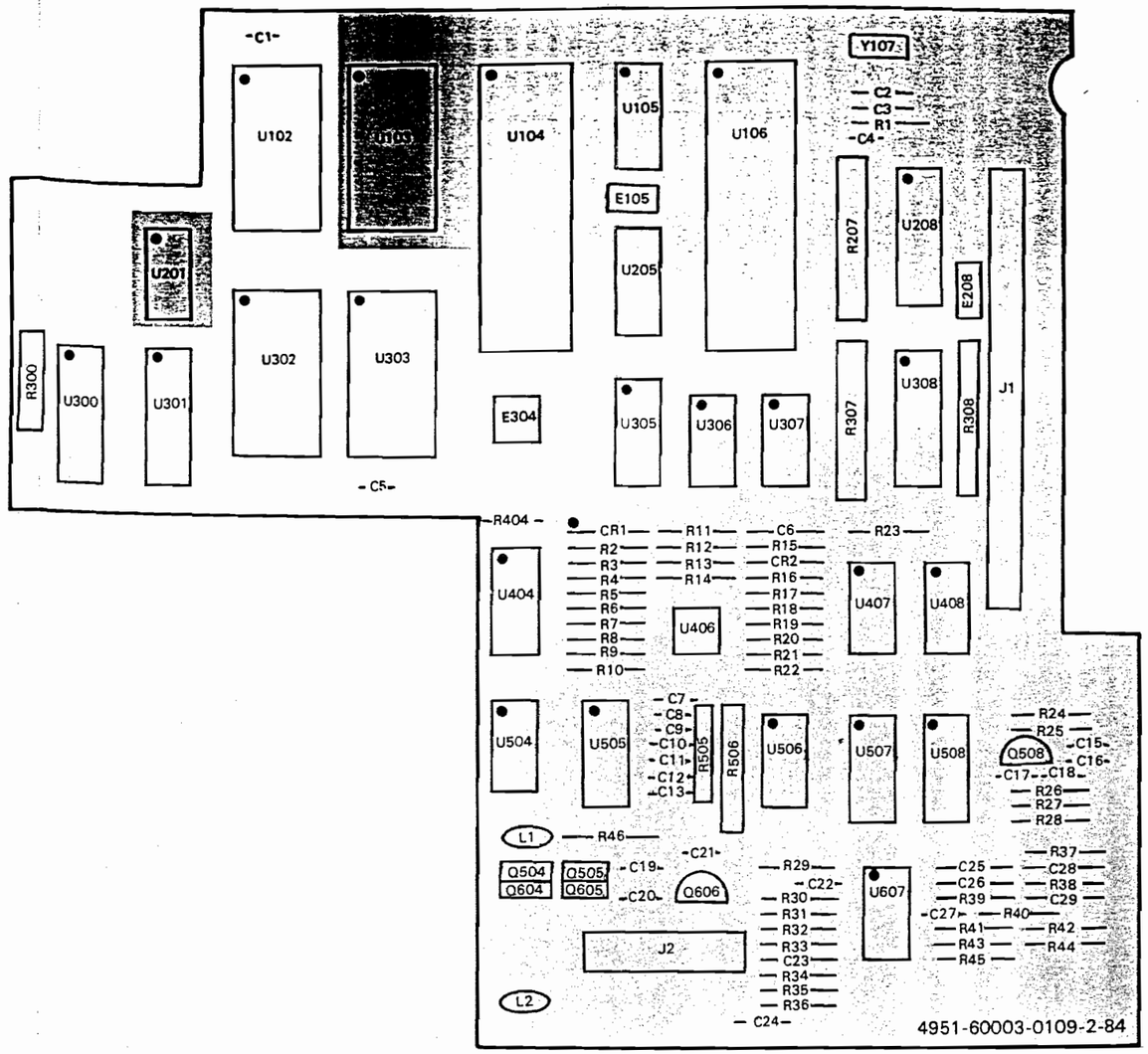


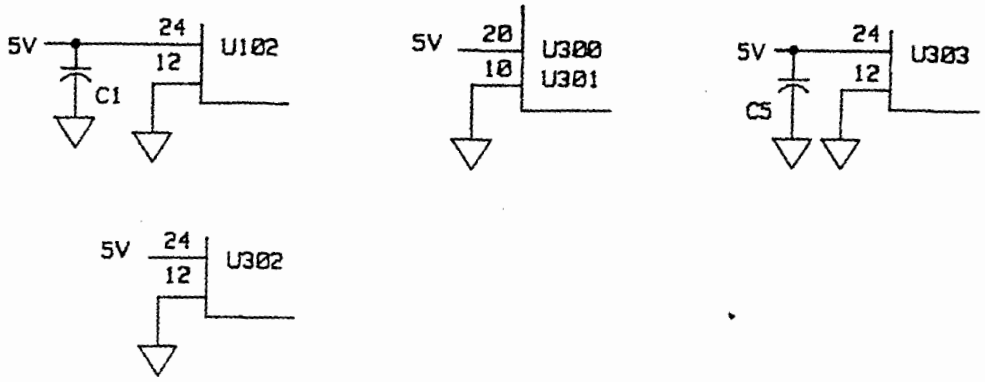
Figure 8-15. A3 Ta

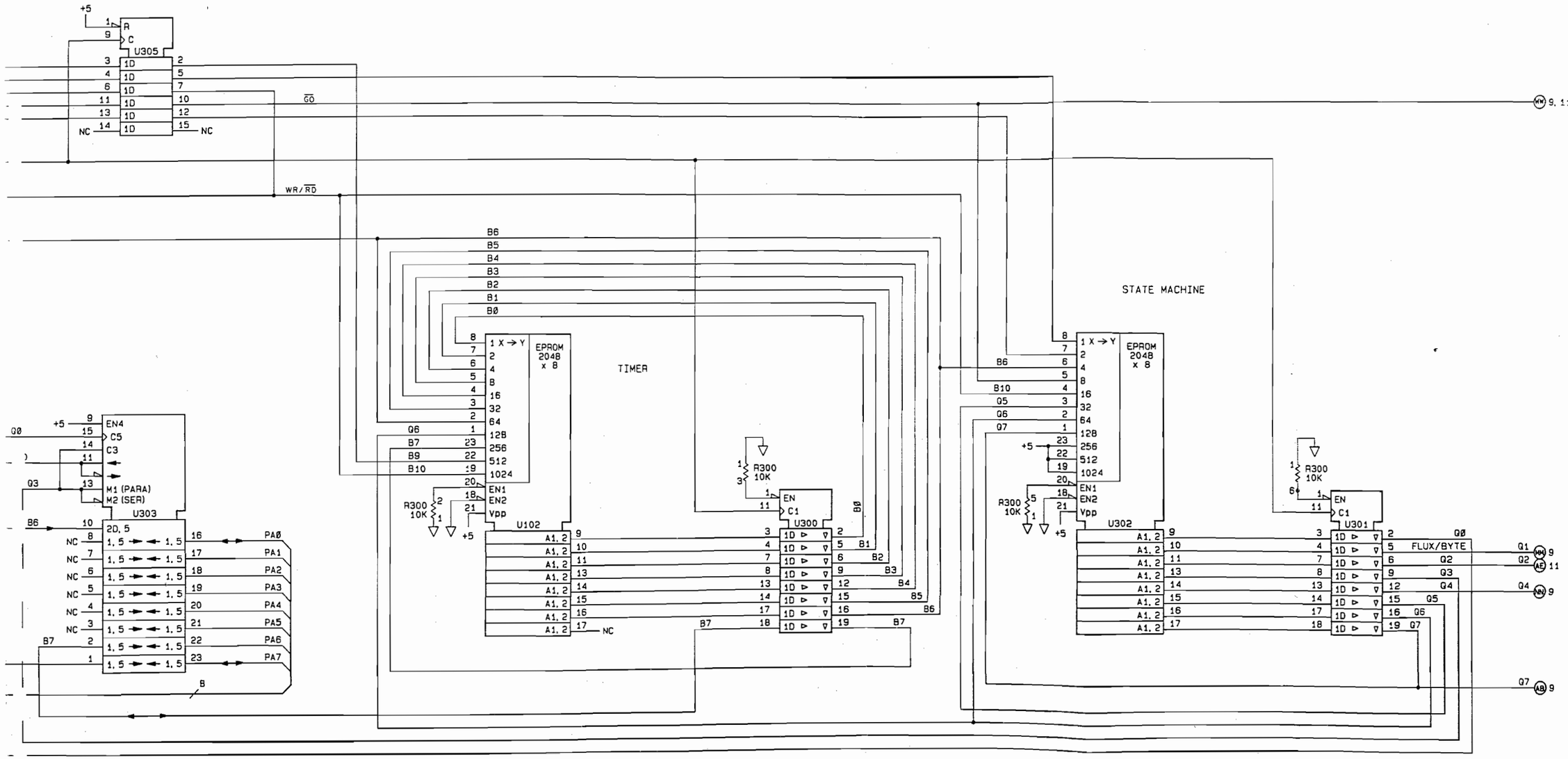

U105
U205
EPROM 204B x B
U103
E105
R307 10K
R207 10K
E304-2
R308 10K
E304-1
C2 8.2 pF
C3 8.2 pF
Y107 6 MHz
U106
R207 10K
U307
E304-3
R307 10K
E304-4
U407
U208
U308
E208
R207 10K
U306
R308 10K
Q606
U104
R25 237K
C16 4.7
U201
U306
PA0-PA7
WR
RD
BREQ
INT
TACH REF

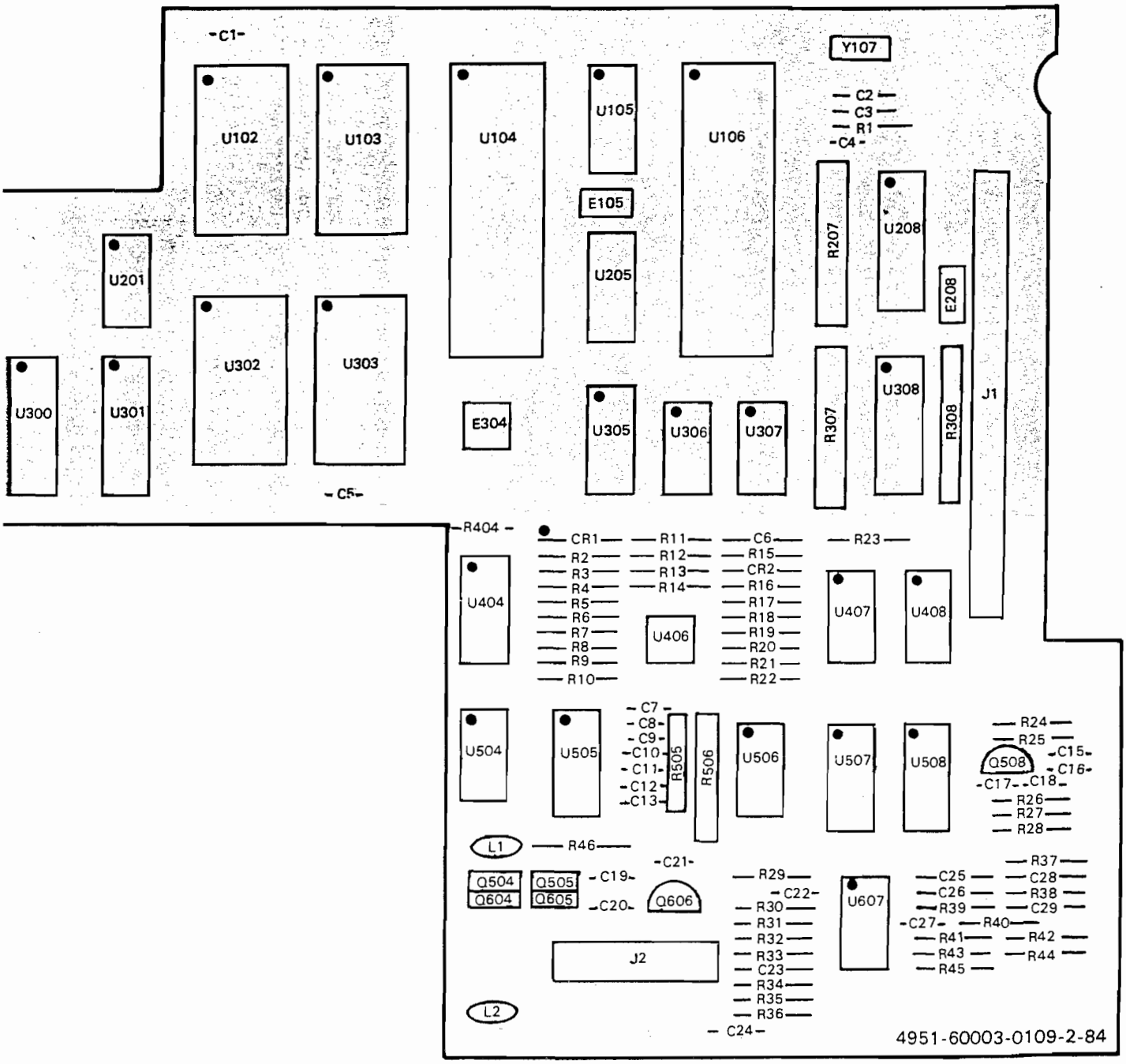


A3 Tape Board Component Locator

POWER AND GROUNDS

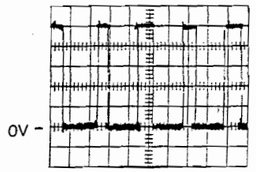



+5
U305
1D
NC
GO
WR/RD
B6
B5
B4
B3
B2
B1
B0
1 X → Y
EPROM
2048
x 8
TIMER
R300
10K
U102
U300
B0
B1
B2
B3
B4
B5
B6
B7
NC
STATE MACHINE
B10
Q5
Q6
Q7
U302
U301
FLUX/BYTE
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
EN4
C5
C3
M1 (PARA)
M2 (SER)
U303
2D, 5
1, 5
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
EN
C1
EN1
EN2
Vpp
A1, 2
9, 11

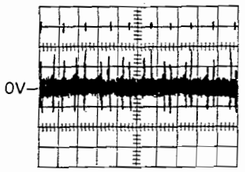


A3 Tape Board Component Locator

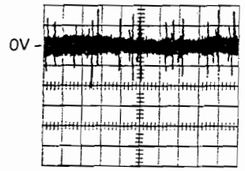
MOTOR SPEED CONTROL



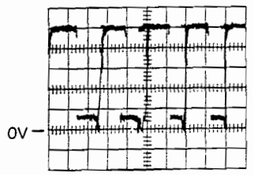
A3U504 pin 12
5 μsec/Div
2 V/Div, DC coupled



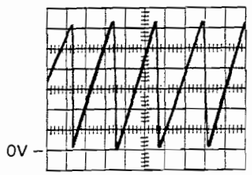
A3U504 pin 10
10 μsec/Div
.2 V/Div, DC coupled



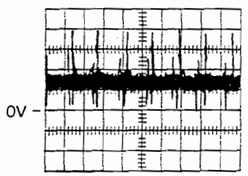
A3U504 pin 3
5 μsec/Div
.5 V/Div, DC coupled



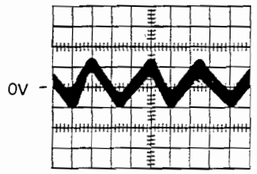
A3U505 pin 8
5 μsec/Div
1 V/Div, DC coupled



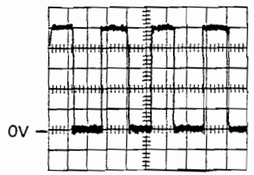
A3U505 pin 5
5 μsec/Div
.5 V/Div, DC coupled



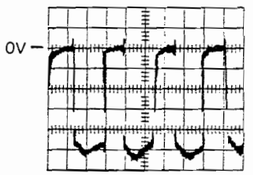
Junction of A3R13 & A3CR2
10 μsec/Div
1 V/Div, DC coupled



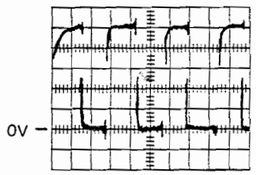
A3U506 pin 6
10 μsec/Div
.05 V/Div, DC coupled



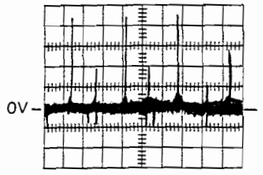
A3U404 pin 10
10 μsec/Div
1 V/Div, DC coupled



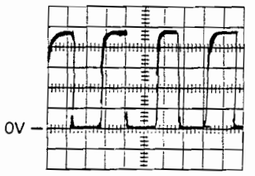
A3U404 pin 9
10 μsec/Div
1 V/cm, DC coupled



A3U404 pin 16
10 μsec/Div
1 V/Div

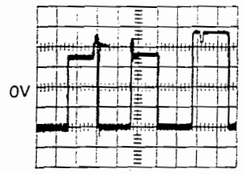


A3U404 pin 1
10 μsec/Div
.5 V/Div, DC coupled

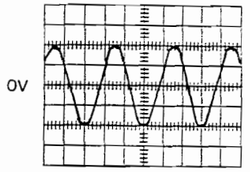


A3U506 pin 1
10 μsec/Div
1 V/Div, DC coupled

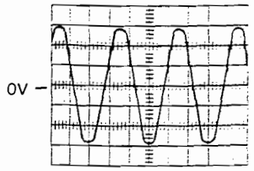
READ AMPLIFIER



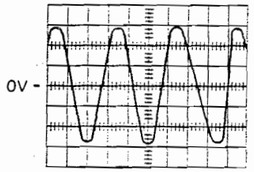
A3U506 pin 14
10 μsec/Div
1 V/Div, DC coupled
HF Rej depressed



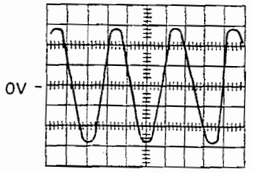
A3U506 pin 8
10 μsec/Div
.1 V/Div, Dc coupled



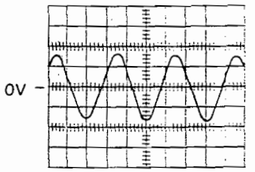
A3U607 pin 14
10 μsec/Div
.5 V/Div, DC coupled



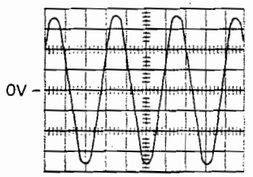
A3U607 pin 12
10 μsec/Div
.5 V/Div, DC coupled



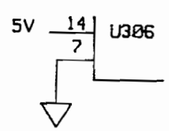
A3U607 pin 8
10 μsec/Div
.5 V/Div, DC coupled

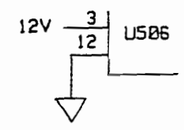


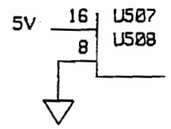
A3U607 pins 9 & 10
10 μsec/Div
.1 V/Div, DC coupled

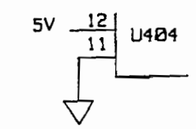


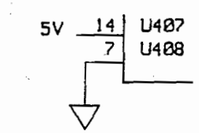
A3U607 pins 1 & 7
10 μsec/cm
.2 V/cm, DC coupled

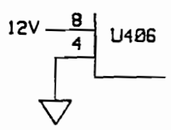


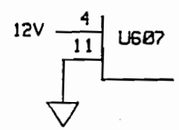


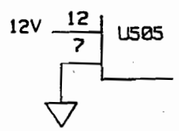


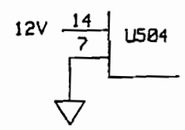


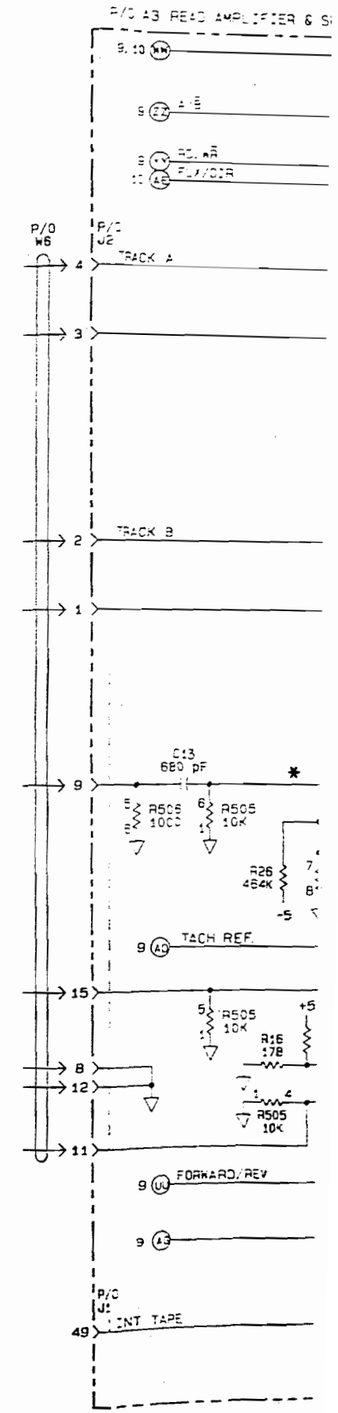


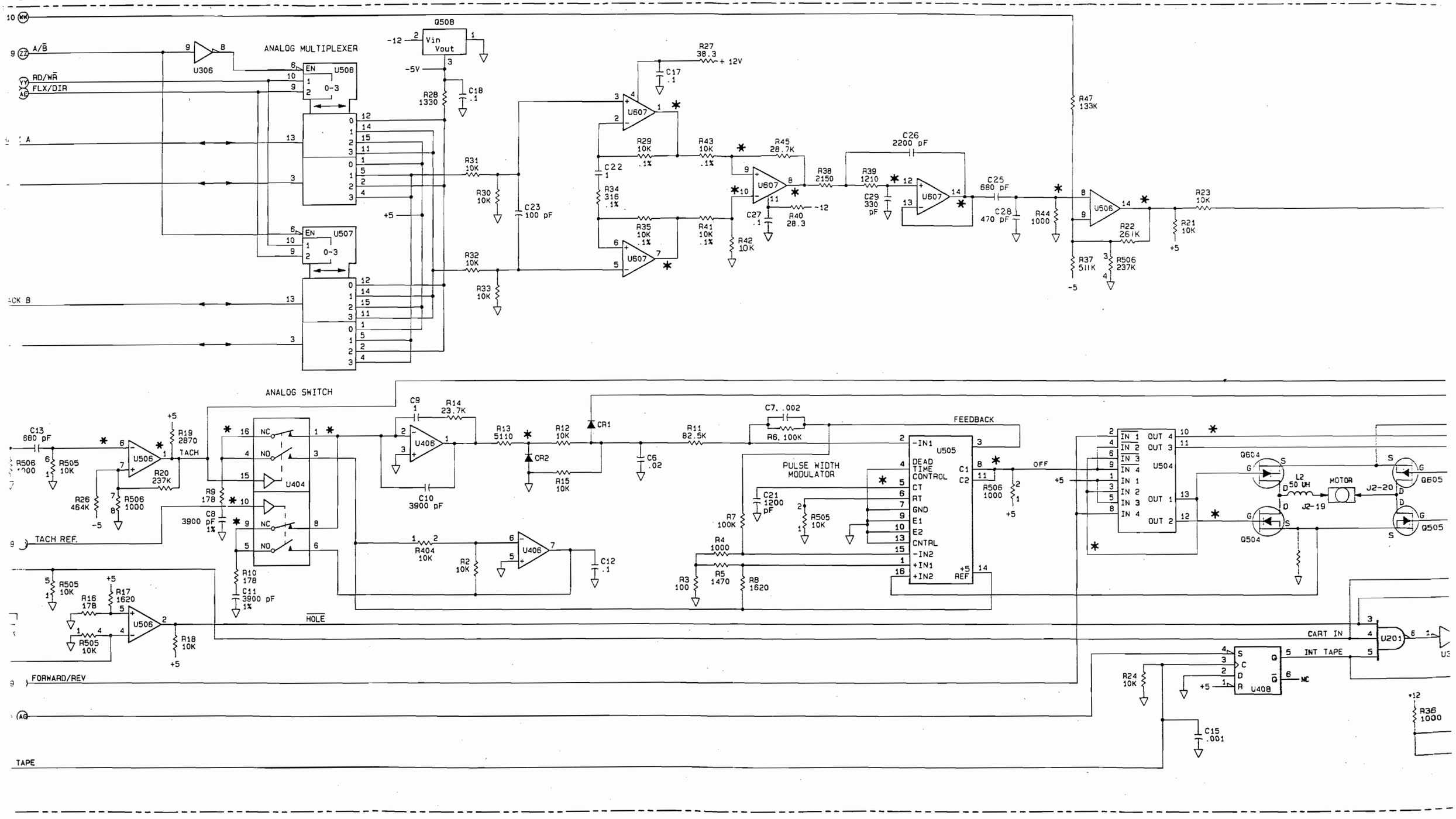











10 NW
9 ZZ A/B
YY RD/WR
AE FLX/DIR
U306
ANALOG MULTIPLEXER
U508
U507
EN
0-3
Q508
Vin
Vout
-12
-5V
+5
R28 1330
C18 .1
R31 10K
R30 10K
C23 100 pF
R32 10K
R33 10K
C17 .1
R27 38.3
+ 12V
U607
R29 10K .1%
R43 10K .1%
R45 28.7K
C22 1
R34 316 .1%
R35 10K .1%
R41 10K .1%
R42 10K
C27 .1
R40 28.3
-12
R38 2150
R39 1210
C29 330 pF
C26 2200 pF
C25 680 pF
C28 470 pF
R44 1000
R47 133K
U506
R22 26.1K
R23 10K
R21 10K
R37 511K
R506 237K
-5
C13 680 pF
R506 1000
R505 10K
R19 2870
TACH
R20 237K
R26 464K
R9 178
C8 3900 pF 1%
TACH REF.
R10 178
C11 3900 pF 1%
R16 178
R17 1620
R18 10K
HOLE
FORWARD/REV
AG
TAPE
ANALOG SWITCH
U404
U406
C9 1
R14 23.7K
C10 3900 pF
R13 5110
R12 10K
R15 10K
CR1
CR2
C6 .02
R11 82.5K
C7, .002
R6, 100K
R404 10K
R2 10K
C12 .1
FEEDBACK
PULSE WIDTH MODULATOR
U505
-IN1
DEAD TIME CONTROL
CT
RT
GND
E1
E2
CNTRL
-IN2
+IN1
+IN2
REF
C21 1200 pF
R7 100K
R4 1000
R5 1470
R3 100
R8 1620
R505 10K
R506 1000
OFF
U504
IN 1
IN 2
IN 3
IN 4
OUT 4
OUT 3
OUT 1
OUT 2
Q604
Q605
Q504
Q505
L2 .50 UH
MOTOR
J2-20
J2-19
CART IN
INT TAPE
U201
U408
R24 10K
C15 .001
R36 1000
+12

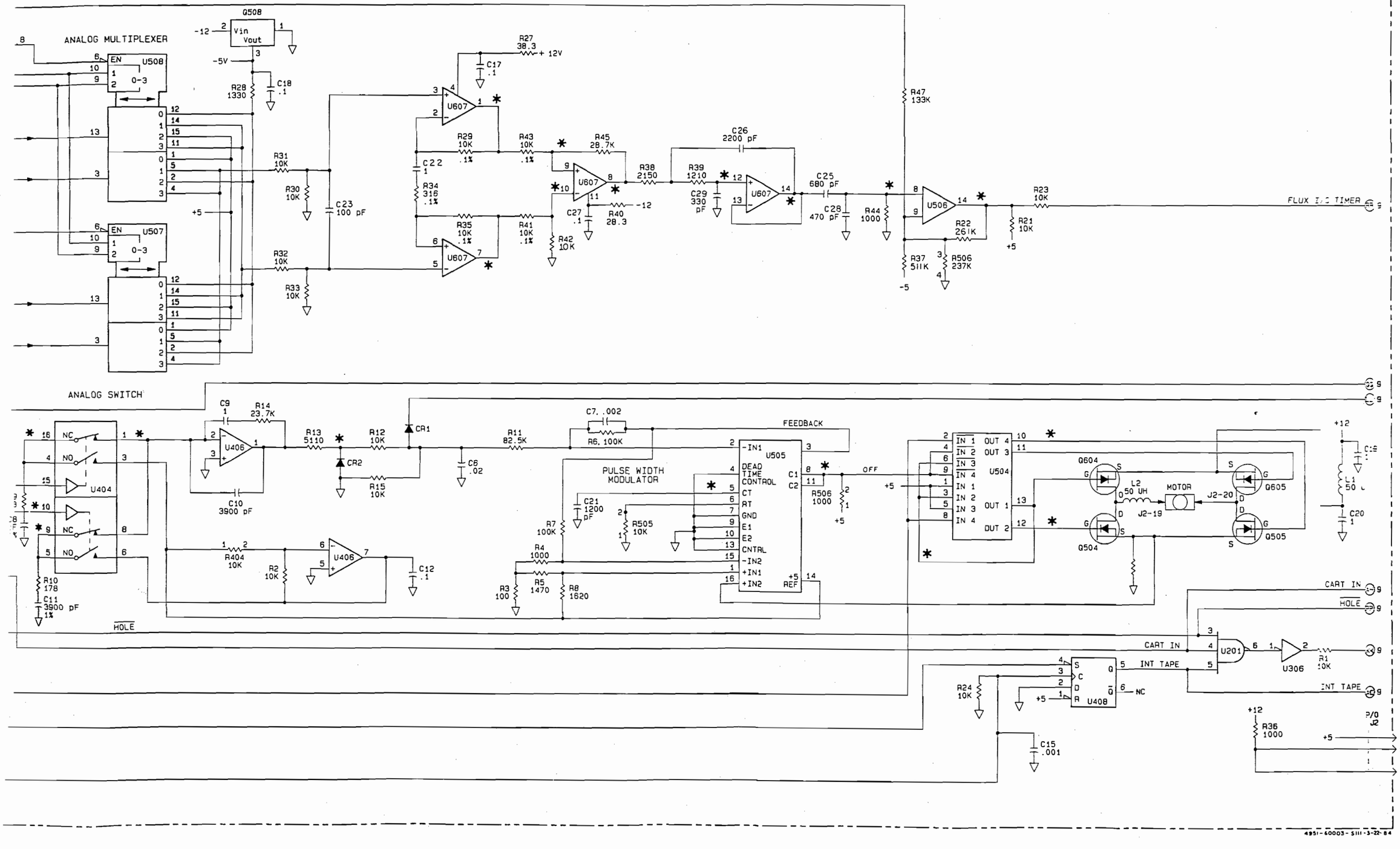


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Figure 8-17. A3 Read Amplifier and Speed Control Schematic

APPENDIX A
GUIDE TO INTERPRETING ANSI

1. INTRODUCTION.

The Institute of Electrical and Electronics Engineers (IEEE) is developing ANSI symbol notation. The symbols used in this manual's schematics are designed according to IEEE Draft 91PR79-16 N. Some basic elements are similar to conventional symbology, inputs on left and outputs on the right. Where conventional symbology gives a signal mnemonic, ANSI describes the functional behavior of the logic circuit, and the signal's relationship to other signals. The interpretation of this effort in our schematics is to describe the truth table of each component using the ANSI symbology. Including this information reduces need for component data and other support documents. Definitions of mnemonics and symbols, as well as illustrations are provided. Table 3 located after the symbol descriptions is a quick reference for ANSI symbols and notation.

2. SYMBOL OUTLINE

The physical layout of each symbol is simple, Figure 1 shows two variations. The style used depends on the function of the component. The difference between 1(a) and 1(b) is the control block. The control block visually emphasizes the difference between control and data inputs.

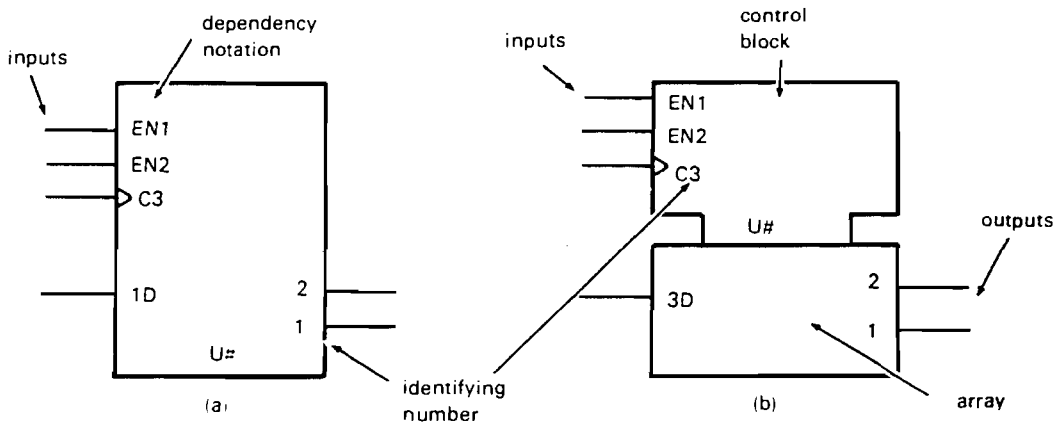


Figure 1. ANSI Symbol Outline

3. General Rules:

1. Inputs enter from the left side of the symbol. Elements modifying the inputs are shown with input notation.
2. Outputs leave from the right side of the symbol. Elements modifying the outputs are shown with output notation.
3. A symbol may have input or output notation, or both.
4. Symbols contain two essential ingredients: data and signals which modify the data.
   a. Data is shown coming into or leaving from the lower part of the symbol.
   b. Signals modifying data or other signals are described with DEPENDENCY NOTATION. These signals are input to the control block when symbol outline shown in Figure 1(b) is used.

DEPENDENCY NOTATION

endency notation defines relationships between internal logic states. It does not show all elements or c nections and is written in alphanumberic form, A2 for example. The letter is a dependency notation symbol and n nber is used for identification. There are two types of dependency notation.

1 Dependency notation at inputs describes conditions which permit action.

2. Dependency notation at outputs describes conditions which cause the outputs to be active.

General Rules

1 The component's truth table is described as accurately as possible through the combination of dependency notation used.

2 If input or output dependency notation is not present, then all inputs must be at their active state for the output to be active.

3 When an output has no label, its normally defined state is dependent on the inputs (low outputs will have low or negation symbol on the output line).

4 Labels describing the function of inputs or outputs are prefixed by identifying number(s) of any affecting input.

5. When an input or output is affected by more than one input, the identifying numbers of each affecting input will be in the label, separated by commas. The notation is read left to right.

6. The complement of an internal logic state which affects an input or output has a bar placed over the identifying numbers at the affected inputs or outputs.

When two or more combinations of inputs make an output or input valid, they are separated by a slanted line (/, solidi).

Labels may be factored using algebraic techniques.

$$A + B = A \text{ or } B$$
$$A \cdot B = A \text{ and } B$$

NOTE

For explanation and illustration in this text, the normally defined state of components in this Appendix follows positive logic conventions.

SEQUENCE OF INPUT LABELS

Labels are written left-to-right, in order (left has the first affect) according to their order of effect on the input.

If an input with a single function is affected by other inputs, the qualifying symbol is preceded by the identifying number(s) of the affecting inputs.

If an input performs several different functions, each may be described on separate input lines or on the same line with each effect separated by a slanted line (/). Figure 2 illustrates these two formats. In Figure 2(a) input C,

Figure 2. Dependency Notation Layout

a reset line is active when input a is high or (/) when inputs a and b are high. Figure 2(b) illustrates the same idea, but separates the two conditions showing them as separate inputs rather than combining them.

4. All affecting inputs must be in their respective active state for output or input notation to be valid.

5. Each condition imposed on an input by dependency notation must be valid for that input to be active. When an input is disabled, its contents are not changed and the respective outputs remain at their existing internal logic states.

6. Two adjacent identifying number notations not separated by a non-numeric character should be separated by a comma.

7. Sequence Of Output Labels

1. Outputs with several different labels, are shown in the following order (left to right):

   a. the postponed output symbol, when used,

   b. labels which indicate when the internal logic state of the output is affected, in left-to-right order,

   c. labels which indicate an effect of the output on inputs or other outputs of the element,

   d. finally, symbols for open circuit or tristate outputs are placed just inside the boundary.

2. If an output symbol has several sets of labels representing different functions (i.e., dependent on mode) these sets may be shown on different output lines connected outside the symbol outline (similar to the input examples shown in Figure B-2, only placed on the outputs).

   a. In cases when this method of presentation is not advantageous, the output may be shown once and each different set of labels should be separated by a slanted line (/).

3. Two adjacent identifying number notations not separated by a nonnumeric character should be separated by a comma.

8. DEPENDENCY NOTATION DESCRIPTION

To date IEEE has defined ten types of dependency notations. Table 1 gives a brief description of each type.

Table 1. ANSI Dependency Notation

Type of Dependency	Letter Symbol	Affecting Input At Its 1-State	Affecting Input At Its 0-State
Address	A	Permits action (address selected)	Prevents action (address not selected)
Control	C	Permits action	Prevents action
Enable	EN	Permits action	Prevents action of inputs outputs off outputs at external high impedance, no change in internal logic state Other outputs at internal 0 state
AND	G	Permits action	Imposes 0 state
Mode	M	Permits action (mode selected)	Prevents action (mode not selected)
Negate (X-OR)	N	Complements state	No effect
RESET	R	Affected output reacts as it would to S=0, R=1	No effect
SET	S	Affected output reacts as it would to S=1, R=0	No effect
OR	V	Imposes 1 state	Permits action
Inter-connection	Z	Imposes 1 state	Imposes 0 state

I. ADDRESS (A)

Represents address inputs of a device. In particular, memories and similar devices which use addresses to select specified sections of a multidimensional array. Each address input is labeled with an A, followed by an identifying number which corresponds to the address selected by the input. Figure 3 illustrates address dependency notation.

Figure 3. Address Dependency

INPUTS: In example (a) inputs b and c illustrate address lines which form a binary code address to select an output.

NOTE

Anytime that the form 3 or A0-3 is used in an ANSI symbol, it refers to the binary truth table. This means that there are four possible conditions (0-3) dependent on the state of the line. For example, if line a is high and line b is low, then address two (10) will be active. In other cases, with different dependency notation, it could be mode 2.

	a	b
0	0	0
1	0	1
2	1	0
3	1	1

The c input is a clock. The d input is a data input. Read the dependency notation as follows: mode 2 (10) and (,) the clock (4) must be active for data to enter the component.

Example (b) has three separate address lines. Each address is followed by an identifying number. Input e shows that when input b (identifying number 2) and input d, the clock (4) are active, data can be clocked into the component.

OUTPUTS: In this example there are no output dependencies. When the appropriate input lines are addressed, data will appear at the respective output.

10. CONTROL (C)

Control dependency identifies inputs that initiate actions, for example, an edge-triggered clock. These inputs can enable or disable data inputs of stored elements. An internal 1 state enables the affected inputs.

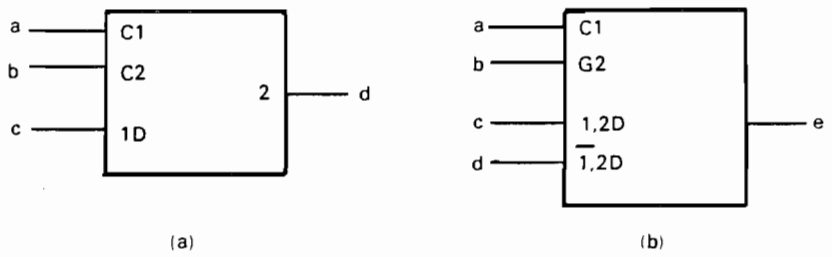


Figure 4. Control Dependency

Inputs: In example (a), both a and b are control inputs. They have different identifying numbers to show that they control different functions of the component. Thus input c is controlled by only input a.

In example (b), input c or d will be enabled dependent on the state of input a. When a is a 1, input c will be enabled; when it is a 0, input d will be enabled. The 2D shows that the affected input will be ANDed with input b (input b shows AND function).

Outputs: In example (a) for output d to be active, input b must be enabled (1 state).

In example (b), since no dependency notation is shown, the output is dependent on the inputs. When the inputs are active, the output is enabled.

1.. ENABLE (EN)

lc ɪtifies enable inputs. When the EN input is at an internal 1 state, the inputs affected are enabled. When the EN input is at it_ .nternal 0 state, the inputs and outputs affected are disabled, open collector outputs are turned off, three-state outputs are at their normally defined internal logic states but externally exhibit high impedance, and all other outputs (e.g., totem pole o ɔuts) stand at their internal 0 states.

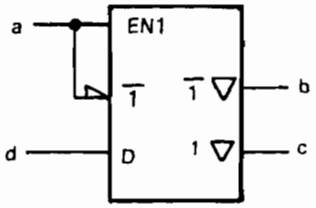


Figure 5. Enable Dependency

INPUT: Input a enables an output in either state. To emphasize this aspect, the signal is shown as two enable inputs. The second input has the identifying number 1 to show that it is dependent and in this case a part of EN1. Input d is a data input with dependencies.

OUTPUTS: When input a is low (0), output c is disabled and output b is enabled. When input a is high (1), output b is disabled and output c is enabled. The inverted triangle by the output indicates that it is a tri-state output.

2 AND (G)

ʌo inputs or outputs ANDed together is a common relationship. Traditionally AND gates are drawn as a part of the ɔonent outline with the signal input connected to the gate. G dependency notation describes this relationship as ɔown in Figure 6. When an input or output stands at its internal 1 state, all inputs and outputs affected are enabled.

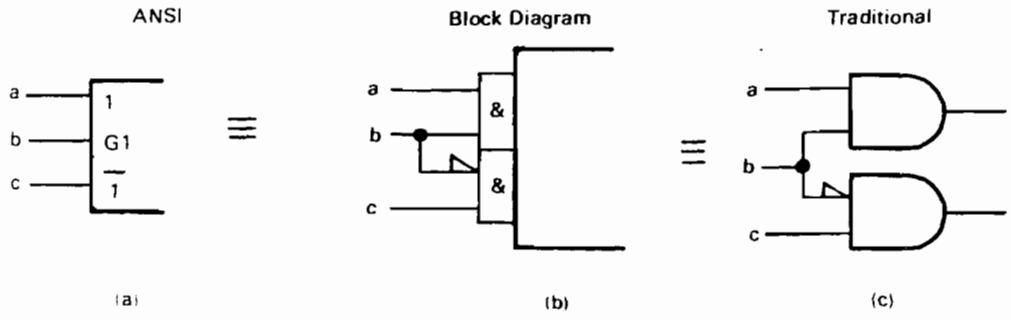


Figure 6. AND Dependency

INPUTS: Example (a) describes a component with two 2-input AND gate. Inputs a and c are dependent on input b. To show this dependency inputs a and c are labeled with a "1", which refers to the 1 of input b. To make input a active, input b must be at a 1 state (high); for input c to be active, input b must be at a 0 state (low).

OUTPUTS: Although no outputs are shown in the above examples, when a G dependency appears, they should be read the same way as inputs.

13. MODE (M)

Mode dependency identifies one or more inputs which select the operation mode of a component. When an M dependency identifies several modes or functions, the appropriate identifying number is placed in the label of the affected input or output. Each function applying to an input is seperated by a slanted line (/). When the M input or output is at its internal 1 state, the affected inputs or outputs are enabled.

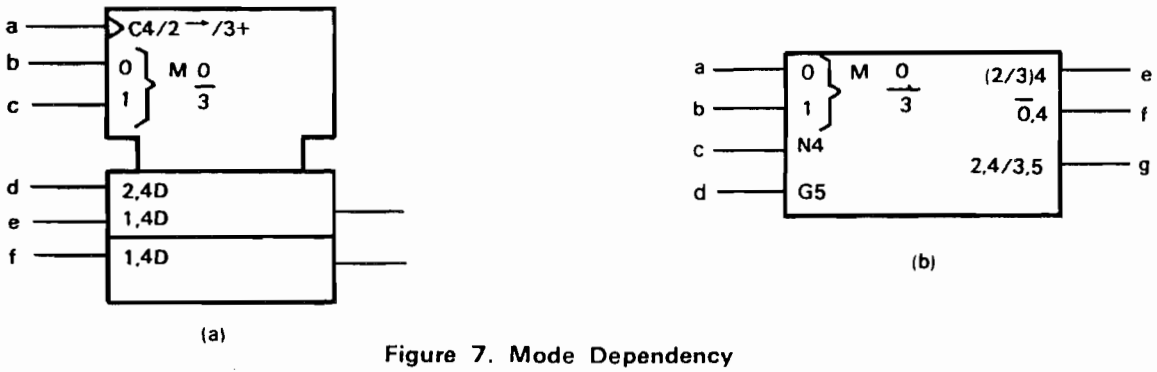


Figure 7. Mode Dependency

INPUTS: In example (a), input a is the control input. It controls three functions. It is a clock for entering data. In mode 2 it causes data to shift right once and in mode 3 the contents of the register are incremented by 1 count. Inputs b and c form a binary number. The mode or state which is created identifies the operation mode of the component. In this case:

Mode 0 (b=0,c=0), inputs do not affect outputs, so the outputs remain at their existing state
Mode 1 (b=1,c=0), inputs e and f are active, data enters the component
Mode 2 (b-0,c=1), shifting down and serial loading through input d takes place
Mode 3 (b=c=1), counts up by 1 count per clock pulse

NOTE

Any time that the form 3 or M0-3 is used in an ANSI symbol, it refers to the binary truth table. This means that there are four possible conditions (0-3) dependent on the state of the line. For example, if line a is high and line b is low then mode 2 (10) will be active.

	a	b
0	0	0
1	0	1
2	1	0
3	1	1

Input d is enabled in mode 2 when the control (4) is active.
Input e is enabled in mode 1 when the control (4) is active.
Input f is enabled in mode 1 when the control (4) is active.
In example (b), inputs a and b should be combined to represent a binary number. Each binary number enables a different mode. Input c forms an exclusive OR relationship with any input or output it modifies. Input d forms an AND relationship with anything it modifies.

OUTPUTS: In example (a) the outputs are determined by the inputs, so no further dependency notation is needed.

In example (b), output e may also be read 2,4/3,4. When mode 2 or mode 3 is negated by input c, this output will be active. Output f is active whenever the mode is not 0 and negated by input c. When output g is active, mode 2 is negated by input c or mode 3 is ANDed with input d.

4 NEGATE (N)

An input or output affected by N inputs or outputs has an exclusive OR relationship with that input or output. When an input or output stands at its internal 1 state, the internal logic state of each input and output stands at its internal 0 state.

Figure 8. Negate Dependency

INPUT: The a input indicates that there is an exclusive OR relationship.

OUTPUTS: Output b is not affected by input a. Output c has an exclusive OR relationship with input a. If a = 0, then c = b; if a = 1, then c = b.

Table 8. Exclusive OR Truth Table

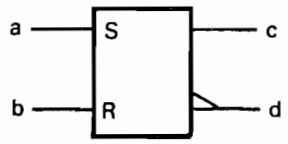
A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

15. RESET (R) and SET (S)

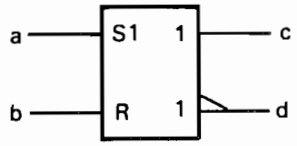
SET AND RESET dependencies specify the effect of a combination of R and S elements in a bistable component. R and S dependencies affect outputs only.

When S input stands at its internal 1 state, the outputs will take on the internal logic states for the combination S=1 and R=0, regardless of the state of any R input. At an internal 0 state the S dependency has no effect.

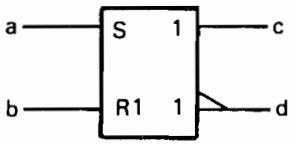
An R input at its internal 1 state causes the outputs to take on the internal logic state for the combination S=0 and R=1, regardless of any S state input.



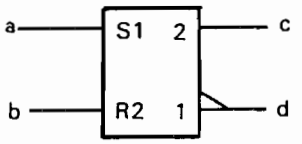
a	b	c	d
0	0	no change	
0	1	0	1
1	0	1	0
1	1	not specified	



a	b	c	d
0	0	no change	
0	1	0	1
1	0	1	0
1	1	1	0



a	b	c	d
0	0	no change	
0	1	0	1
1	0	1	0
1	1	c	c



a	b	c	d
0	0	no change	
0	1	0	1
1	0	1	0
1	1	0	0

NOTE

0 = external 0 state
1 = external 1 state

Figure 9. RESET/SET Dependency

6. OR (V)

' c ɔendency shows a Boolean relationship between inputs and outputs. When a V input or output is at an internal 1 tate, all inputs and outputs affected are at their internal 1 state. When a V input or output is at an internal 0 state, all ɲputs and outputs affected are at their normally defined internal logic states.

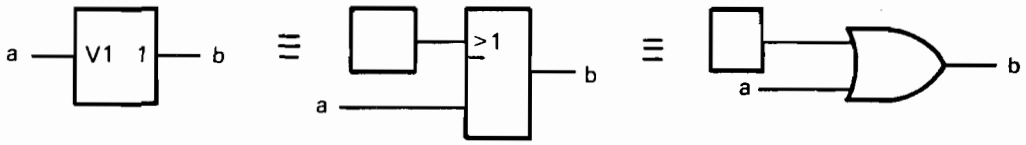


Figure 10. Or Dependency

INPUT: The a input indicates that there is an OR relationship to the output.

OUTPUT: The a input is ORed with internal state of the b output.

: TRANSMISSION (X)

ransmission dependency indicates controlled bidirectional connections between affected input and output ports. When r (input or output is at its internal 1 state, all input and output ports affected are bidirectionally connected and are at ɲc same internal logic state or analog signal level. When an X input or output is at its internal 0 state, the connection ssociated with this dependency notation is broken.

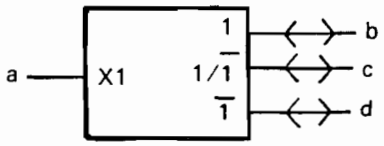


Figure 11. Transmission Dependency

INPUT: Input a indicates that a transmission dependency exists between outputs.

OUTPUT: When input a is at a 1 state, there is a bidirectional internal connection between outputs b and c. If input a is at a 0 state there is a bidirectional connection between outputs c and d.

1 . INTERCONNECTION (Z)

Indicates connections between inputs, outputs, internal inputs, and internal outputs in any combination inside the s ɲbol. The internal logic state of an input or output affected by a Z input or output remains the same, unless modified by additional dependency notation.

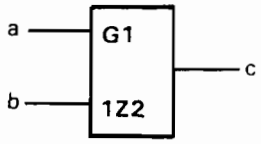


Figure 12. Interconnection Dependency

INPUTS: Input a indicates an AND relationship. When input a is ANDed with input b there is an internal connection which will not affect the output state.

OUTPUT: Notice that there is no output dependency, this means that any output is dependent on the inputs. Output *c* is active if input *b* makes the internal connection. The output state is the same as the internal logic state.

19. BISTABLE ELEMENTS

The four types of bistable elements use the dynamic input symbol, the postponed symbol, and dependency notation.

1. Transparent latch inputs are level-operated. The D input is active while the C input is at its internal 1 state.

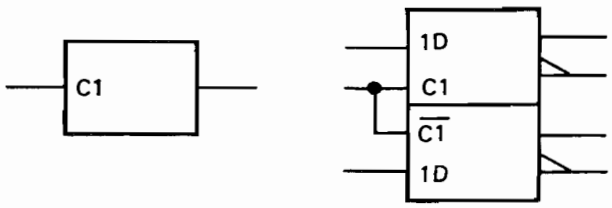
2. Edge-triggered components accept data from D, J, K, R, or S inputs on the active transition of the C input.

3. Pulse-triggered components require data to be setup before the control pulse starts. The C input is static since the output is postponed

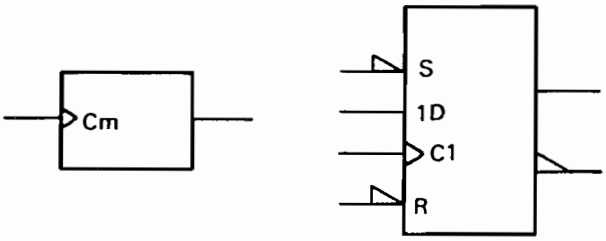
4. The data-lock-out component is similar to the pulse triggered. The C input is dynamic since after input C goes through its active transition, the data inputs are disabled and data is not held. The output is postponed until the C input returns to its initial external level.

Synchronous inputs are identified by their dependency labels (1D, 1J, 1K, 1S, 1R), whereas asynchronous inputs (S,R) are not dependent on C inputs.

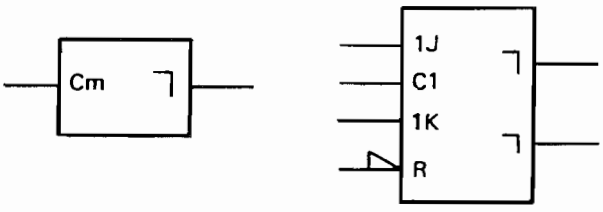
Transparent Latches



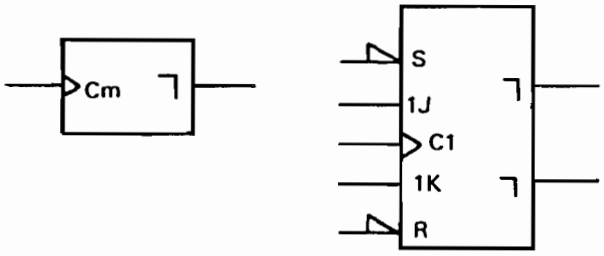
Edge Triggered Bistable



Pulse Triggered Bistable



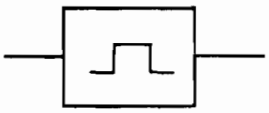
at. .ock-Out
istable



0. MONOSTABLE ELEMENTS

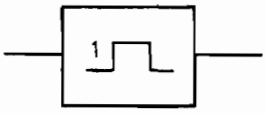
1e are two types of monostable elements: retriggerable and non-retriggerable. The first retriggers during the output ulse. The second can not be retriggered during the output pulse.

1 Retriggerable Monostable



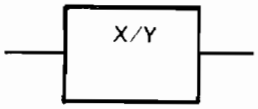
/h-n the input changes to a 1 state the output changes to or remains at a 1 state. After a period of time characteristic to u device, the output returns to 0 state.

2 Non-retriggerable Monostable



When the input changes to 1 state, the output changes to 1 state. The output returns to 0 state after a period of time characteristic of the device, regardless of any input variable changes.

25. CODERS



X nd Y may be replaced by appropriate indications of the code used to represent the information at the inputs and outputs respectively.

F each input code, the internal input logic state determines an internal value. This value is reproduced by the internal logic states of the outputs, depending on the output code.

F ationships between internal logic states of inputs and the internal value is indicated one of two ways.

1. Labeling the inputs with numbers, the internal value equals the sum of the weights associated with the inputs at their internal 1 state.

2. Replacing X with an appropriate indication of the input code and labeling the inputs with characters that refer to this code.

Relationships between the internal value and the internal logic states of the output are indicated in one of two ways.

1. The output label is a list of numbers which represent the internal values leading to the internal 1-state of the output. Each number in the list is separated by a slanted line (/). This labeling may be used when Y is replaced by a letter denoting a type of dependency. If a continuous range of internal values produces the internal 1 state of an output, this is indicated by two numbers. The beginning and the end of the range are separated by three dots.

2. Replace Y with an appropriate indication of the output code and label the outputs with characters that refer to this code.

Table 3. General Qualifying Symbols

Symbol	Description
&	And gate or function.
>1	OR gate or function. The symbol was chosen to indicate that at least one active input is needed to activate the output.
=1	Exclusive OR. One and only one input must be active to activate the output.
=	Logic identity. All inputs must stand at same state.
2k	An even number of inputs must be active.
2k+1	An odd number of inputs must be active.
1	The one input must be active.
▷ or ◁	A buffer or element with more than usual output capability (symbol is oriented in the direction of signal flow).
⎍	Schmitt trigger; element with hysteresis.
X/Y	Coder, code converter (DEC/BCD, BIN/OUT, BIN/7-SEG, etc.).
MUX	Multiplexer/data selector.
DMUX or DX	Demultiplexer.
Σ	Adder.
P−Q	Subtracter.
CPG	Look-ahead carry generator.
π	Multiplier.
COMP	Magnitude comparator.
ALU	Arithmetic logic unit.
⎍	Retriggerable monostable.
1 ⎍	Non-retriggerable monostable (one-shot).
G ⎍	Astable element. Showing waveform is optional.
!G ⎍	Synchronously starting astable.
G! ⎍	Astable element that stops with a completed pulse.
SRGm	Shift register. m = number of bits.
CTRm	Counter. m = number of bits; cycle length = 2m.
CTR DIVm	Counter with cycle length = m.
ROM	Read-only memory.
RAM	Random-access read/write memory.
FIFO	First-in, first-out memory.

*Not all of the general qualifying symbols have been used in this manual but they are included here for the sake of completeness.

Table 3. General Qualifying Symbols (cont'd.)

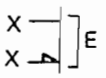
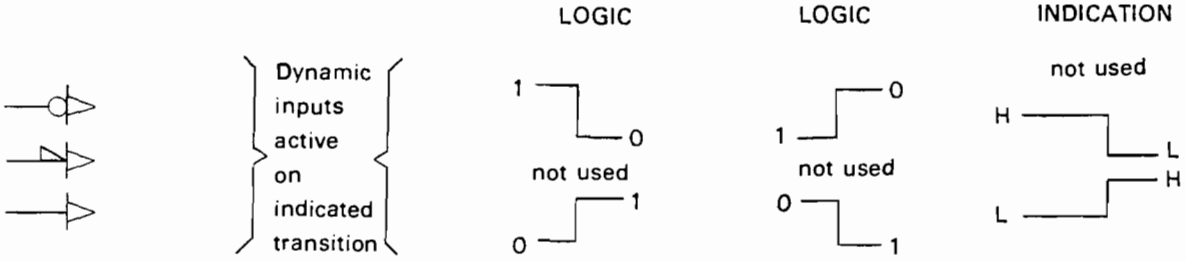
Symbol	Description
¬|	Postponed output (of a pulse-triggered flip-flop). The output changes when input initiating change (e.g., a C input) returns to its initial external state or level.
|⊓	Bi-threshold input (input with hysteresis).
◇|	NPN open-collector or similar output that can supply a relatively low-impedance L level when not turned off. Requires external pull-up. Capable of positive-logic wired-AND connection.
◇|	Passive-pull-up output is similar to NPN open-collector output but is supplemented with a built-in passive pull-up.
◇|	NPN pen-emitter or similar output that can supply a relatively low-impedance H level when not turned off. Requires external pull-down. Capable of positive-logic wired-OR connection.
◇|	Passive-pull-down output is similar to NPN open-emitter output but is supplemented with a built-in passive pull-down.
▽|	3-state output.
|	Enable input When at its internal 1-state, all outputs are enabled. When at its internal 0-state, open-collector and open-emitter outputs are off. Three-state outputs are at normally defined internal logic states and at external high-impedance state, and all other outputs (e.g., totem poles) are at the internal 0-state.
	Usual meanings associated with flip-flops (e.g., R = reset, T = toggle)
D|	Data input to a storage element equivalent to: 
|→ m |← m	Shift right (left) inputs, m = 1, 2, 3 etc. If m = 1, it is usually not shown.
|+m |−m	Counting up (down) inputs, m = 1, 2, 3 etc. If m = 1, it is usually not shown.
o m	Binary grouping. m is highest power of 2.
| CT = 15	The contents-setting input, when active, causes the content of a register to take on the indicated value.
CT = 9 |	The content output is active if the content of the register is as indicated.
⌐⌐	Input line grouping. . . indicates two or more terminals used to implement a single logic input.
	e.g., The paired expander inputs of SN7450. 
"1" |	Fixed-state output always stands at its internal 1 state.

Table 3. General Qualifying Symbols (cont'd.)

Symbol	Description
	Logic negation at input. External 0 produces internal 1.
	Logic negation at output. Internal 1 produces external 0.
	Active-low input. Equivalent to  in positive logic.
	Active-low output. Equivalent to  in positive logic.
	Active-low input in the case of right-to-left signal flow.
	Active-low output in the case of right-to-left signal flow.
	Signal flow from right to left. If not otherwise indicated, signal flow is from left to right.
	Bidirectional signal flow.
	POSITIVE LOGIC / NEGATIVE LOGIC / POLARITY INDICATION Dynamic inputs active on indicated transition 1 → 0 not used 0 → 1 1 → 0 not used 0 → 1 not used H → L L → H
	Nonlogic connection. A label inside the symbol will usually define the nature of this pin.
	Input for analog signals.
	Internal connection. 1 state on left produces 1 state on right.
	Negated internal connection. 1 state on left produces 0 state on right.
	Dynamic internal connection. Transition from 0 to 1 on left produces transitory 1 state on right.
	Internal input (virtual input). It always stands at its internal 1 state unless affected by an overriding dependency relationship.
	Internal output (virtual output). Its effect on an internal input to which it is connected is indicated by dependency notation.

The internal connections between logic elements abutted together may be indicated by the symbols shown. Each logic connection may be shown by the presence of qualifying symbols at one or both sides of the common line and if confusion can arise about the numbers of connections, use can be made of one of the internal connection symbols.

The internal (virtual) input is an input originating somewhere else in the circuit and is not connected directly to a terminal. The internal (virtual) output is likewise not connected directly to a terminal.

APPENDIX B
HP 18173A
RS-232C/V.24/INTERFACE POD

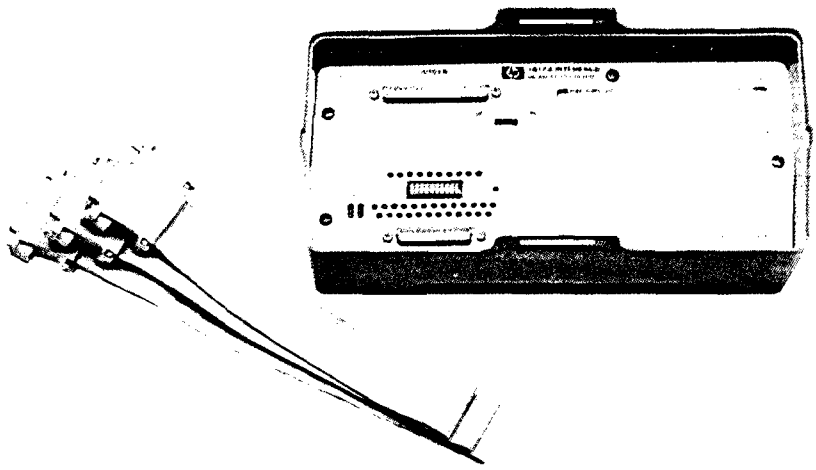


Figure B-1. HP 18173A Interface Pod

B-1. INTRODUCTION

The HP 18173A is an RS-232C/V.24 Interface Pod designed to provide the connection between the HP 4951A Protocol Analyzer and the Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). The HP 18173A is compatible with CCITT V.24 and EIA RS-232C electrical, mechanical, functional, and procedural specifications.

This appendix includes information to install, operate, and service the HP 18173A.

-2. INSTALLATION

ı connect the Interface Pod to the HP 4951A Protocol Analyzer, turn off the power and attach the ' pin connector to the port on the back of the Protocol Analyzer. Tighten the hex screws to ensure at he cable will not pull off during operation.

CAUTION

Turn off the Protocol Analyzer before
connecting or disconnecting any Interface Pod.

-3. OPERATION

ıce the Interface Pod cable is installed, all operations are performed from the keyboard. See the ıe·rating Manual (HP 04951-90003) for procedures.

- 1. PERFORMANCE VERIFICATION

(Performance Verification test is performed by the operator. Follow the procedure described in ar graph B-5.

5- . HP 18173A Self Test

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the data lines work.

Set Up

1. Turn on the HP 4951A.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <POD TEST>.

Procedure

1. When the <POD TEST> softkey is pressed, the Interface Pod test will be automatically performed.

2. If there are no failures, POD TEST PASSED is displayed.

B-6. ADJUSTMENTS

There are no adjustments for the HP 18173A.

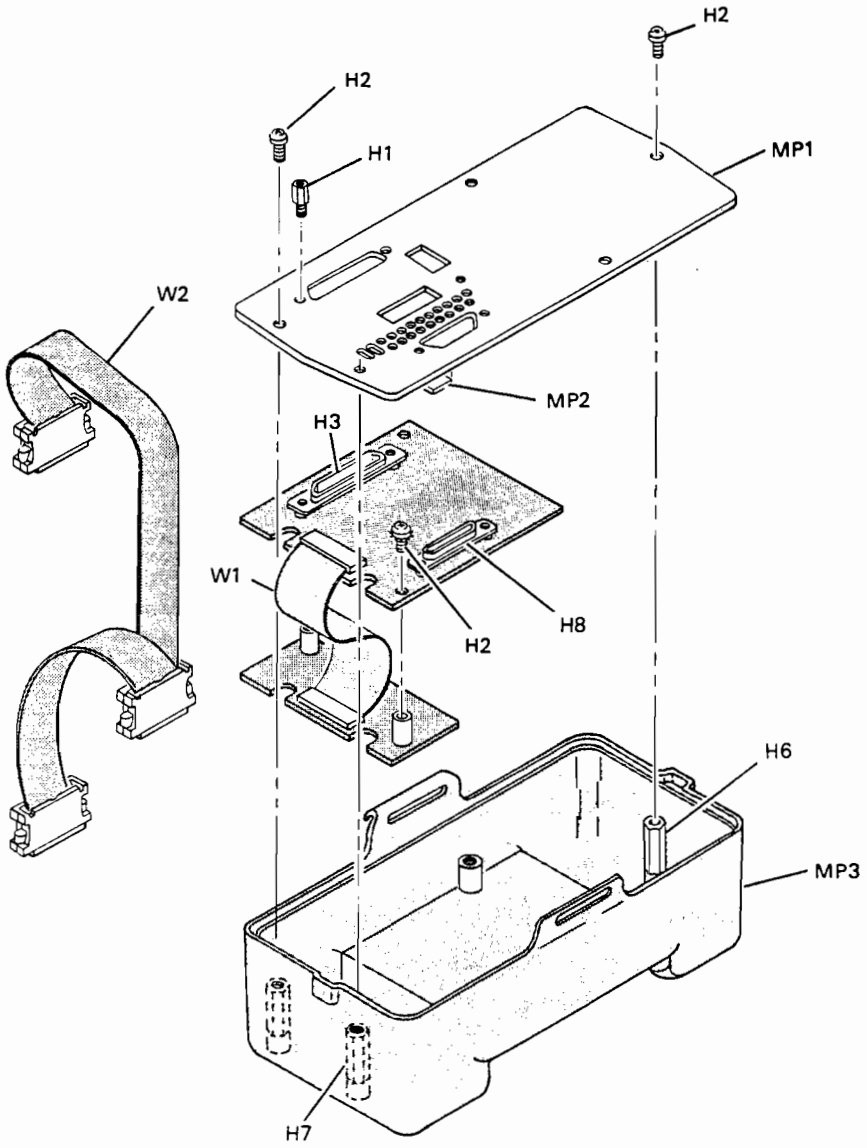
B-7. REPLACEABLE PARTS

The following tables and figure give information for ordering replacement parts. Table B-1 is the Manufacturer's Code List. Table B-2 lists the replaceable parts in alphanumeric order. Information is given for the Description, Quantity, HP Part Number, and Manufacturers Part Number. Chassis and mechanical parts are listed in Figure B-2. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table B-1. HP 18173A Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
11236	CTS OF BERNE INC	BERNE	IN	46711
13606	SPRAGUE ELECT CO SEMICONDUCTOR DIV	CONCORD	NH	03301
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247



Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
H1	1251-2942	7	4	SCR POST LOCK	04486	D2D4-18-2
H2	2200-0112	3	3	SCR. MCH. 4-40. .5IN	04771	ORDER BY DESCRIPTION
H3	1251-6074	4	1	CONNECTOR-37 PIN	04486	DC375V
H6	0380-T39625		1	STANDOFF	28480	0380-T39625
H7	1251-4946	5	1	CONNECTOR-25 PIN	04486	DB-255V
H8	0380-T39626		2	STANDOFF	28480	0380-T39626
MP1	18173-00001		1	RS-232C PANEL	28480	18173-00001
MP2	5040-4478	5	1	LENS	28480	5040-4478
MP3	4040-2171	0	1	HOUSING	28480	4040-2171
W1	18173-61601	3	1	CABLE, INTERCONNECT	28480	18173-61601
W2	18173-61602	5	1	CABLE, RS-232C	28480	18173-61602

Figure B-2. HP 18173A Exploded View

Table B-2. HP 18173A Replaceable Parts List

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	18173-60001	8	1	RS-232C INTERFACE POD	28480	18173-60001
A1C1	0180-1746	5	3	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A1C2	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A1C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A1C4	0160-5299	9		CAPACITOR-FXD 022UF+-20% 50VDC	02010	MD011C223MAA
A1C5	0160-5299	9		CAPACITOR-FXD 022UF+-20% 50VDC	02010	MD011C223MAA
A1C6	0160-5299	9		CAPACITOR-FXD 022UF+-20% 50VDC	02010	MD011C223MAA
A1C7	0160-5299	9		CAPACITOR-FXD 022UF+-20% 50VDC	02010	MD011C223MAA
A1C8	0160-5299	9		CAPACITOR-FXD 022UF+-20% 50VDC	02010	MD011C223MAA
A1C9	0180-1846	6	2	CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A1C10	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A1C11	0160-0576	5	9	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C12	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C15	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C18	0180-3050	8	1	CAPACITOR-FXD 330UF+50-10% 16VDC AL	28480	0180-3050
A1C19	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C20	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1E105	1260-0445	0	2	CONNECTOR 3-PIN M POST TYPE	03206	65500-109
A1E208	1810-0206	0		CONNECTOR 3-PIN M POST TYPE	02483	750-81-R10K
A1J1	1251-6074	4	1	CONNECTOR 37-PIN F D SUBMINIATURE	28480	1251-6074
A1J2	1251-4946	5	1	CONNECTOR 25-PIN F D SUBMIN	28480	1251-4946
A1K1	0490-1354	8	1	RELAY 2C 5VDC-COIL 2A 250VAC	28480	0490-1354
A1K2	0490-1383	3	2	RELAY 4C 5VDC-COIL 2A 250VAC	28480	0490-1383
A1K3	0490-1383	3		RELAY 4C 5VDC-COIL 2A 250VAC	28480	0490-1383
A1R1	0699-0556	2	3	RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R2	0699-0556	2		RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R3	0699-0556	2		RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R4	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1R5	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A1R6	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1R7	0698-3453	2	1	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A1R8	0698-3158	4	1	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A1R9	0698-3266	5	2	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R10	0698-3266	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R11	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A1R12	0757-0461	2	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A1R13	0683-1025	9	2	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A1R14	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A1R15	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A1R16	0698-8820	7	1	RESISTOR 4.64 1% .125W F TC=0+-100	28480	0698-8020
A1R100	1810-0292	2	1	NETWORK-RES 14-DIP220.0 OHM X 7	01121	314B221
A1R200	1810-0679	9	10	RES NETWK SIP 4	28480	1010-0679
A1R201	1810-0679	9		RES NETWK SIP 4	28480	1010-0679
A1R202	1810-0679	9		RES NETWK SIP 4	28480	1010-0679
A1R300	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R301	1010-0679	9		RES NETWK SIP 4	28480	1010-0679
A1R302	1010-0679	9		RES NETWK SIP 4	28480	1010-0679
A1R400	1810-0679	9		RES NETWK SIP 4	28480	1010-0679
A1R401	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R402	1810-0206	8	2	NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
A1R500	1810-0679	9		RES NETWK SIP 4	28480	1010-0679
A1R501	1810-0679	9		RES NETWK SIP 4	28480	1810-0679
A1R601	1810-0368	3	1	NETWORK-RES 6-SIP10.0K OHM X 5	01121	206A103
A1R602	1810-0206	8		NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
A1U103	1820-3007	4	3	IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1020-3007
A1U201	1826-0759	9	3	IC COMPARATOR GP QUAD 14 DIP-C PKG	04713	LM339J
A1U301	1826-0759	9		IC COMPARATOR GP QUAD 14 DIP-C PKG	04713	LM339J
A1U302	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U303	1990-0883	7	1	DISPLAY-LIQ-XTAL	28480	1990-0883
A1U400	1858-0047	5	1	TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A1U401	1826-0759	9		IC COMPARATOR GP QUAD 14 DIP-C PKG	04713	LM339J
A1U402	1820-3081	4	1	IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A1U503	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U600	1826-0753	3	2	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A1U603	1820-3373	7	1	IC MV CMOS/74HC MONOSTBL CLEAR DUAL	28480	1820-3373
A1U700	1826-0753	3		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A1U703	1820-3396	4	1	IC GATE CMOS/74HC AND-OR-INV DUAL 2-INP	28480	1820-3396
	0380-0162	1	2	STANDOFF-RVT-ON 75 IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	0380-0332	7	4	STANDOFF-RVT-ON 187-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A1XJ400	1251-8360	5	36	CONNECTOR-SGL CONT PIN 025-IN-BSC-SZ SQ	28480	1251-8360
A1XJ503	1251-8360	5		CONNECTOR-SGL CONT PIN 025-IN-BSC-SZ SQ	28480	1251-8360
A1XJ504	1251-8360	5		CONNECTOR-SGL CONT PIN 025-IN-BSC-SZ SQ	28480	1251-8360
A1S501	3101-2732	8	1	DIP SWITCH	28480	3101-2732
	18173-61601	6	1	8D INTERCONN CBL	28480	18173-61601
	1251-7642	4	1	KEYING PLUG	01380	206509-1
	1260-0445	0	2	SQUARE PINS .425 IN LONG	03206	65500-109
	1251-2942	7		SCREW LOCK POST	04507	318-15-99-011

3. SERVICE

The following paragraphs contain service information for the HP 18173A. Included is the Theory of Operation, RS-232C/V.24 Signal Mnemonics, Troubleshooting, Component Locators, and Schematics.

3. THEORY OF OPERATION

The Interface Pod has the following capabilities:

1. It translates voltages to and from RS-232C and HP 4951A logic levels.
2. It displays EIA line signal status (of selected lines only).
3. The HP 4951A can program the HP 18173A to monitor data lines and simulate DTE or DCE equipment.
4. The HP 18173A automatically identifies itself to the HP 4951A.
5. The breakout box is a part of the Interface Pod.

The HP 18173A is connected to the HP 4951A by a 37 pin connector. Connection to the device under is through a Y-cable. There are three circuits which control the Interface Pod: the SCC (on HP 1A Main Board), the Receivers, and the Drivers.

0. SCC. The SCC is an I/O device located on the HP 4951A Main Board that controls all communications between the HP 4951A and the Interface Pods. The HP 4951A operates in three modes.

1. Monitor mode, the HP 4951A monitors traffic on a communication line.
2. DTE simulate, the HP 4951A drives the data lines and acts as a terminal.
3. DCE simulate, the HP 4951A drives the data lines and acts as the digital side of a modem or another piece of Data Circuit-Terminating Equipment.

Interface Pod latch A1U204 and an output signal from A1J1 pins 18, 19, and 37 configure the Interface Pod for the correct mode of operation.

B-11. Receivers. Receivers A1U201, A1U301, and A1U401 translate voltage levels from RS-232C to HP 4951A Protocol Analyzer logic levels. The mark and space thresholds are +0.25 and +2.75 volts respectively. These thresholds also provide 2.5 volts of hysteresis at the physical interface lines. The receivers operate correctly over an input voltage range of -15 volts to +25 volts and are protected against voltages between -60 and +90 volts by an input voltage divider network.

B-12. Drivers. RS-232C drivers A1U600 and A1U700 translate the voltage from HP 4951A logic levels to RS-232C levels. The outputs are current limited with a series resistor to protect against driver contentions or unintentional shorts to ground in the power supply. The drivers are connected to the RS-232C interface via latching relays A1K1, A1K2, and A1K3. The relays are software controlled through the Interface Pod output latch.

Status of the EIA lines is shown on an LCD display on the Interface Pod. Control Line bar indicators are turned on when the control line is ON. The transmit and receive clock and data indicators flash at a 2 Hz rate when edge transitions are detected.

Two of the LCD indicators provide valid mark and space threshold information. RS-232C mark and space thresholds are 3 and -3 volts respectively. A mark/space LCD detect can be connected to any incoming EIA line. When the voltage applied to this input is a valid mark or space, the appropriate indicator turns on. If the voltage is between the two thresholds, neither indicator turns on.

B-13. RS-232C SIGNAL MNEMONICS

The HP 18173A is designed to accomodate two similar interface standards, the RS-232C and the V.24. Table B-3 describes RS-232C/V.24 signal mnemonics.

Table B-3. RS-232C/V.24 Signal Mnemonics

CON-NECTOR PIN NO	SIGNAL MNEMONICS EIA	CCITT	HP DISPLAY	DESCRIPTION
1	AA	101P		Protective Ground
2	BA	103	TD	Transmitted Data
3	BB	104	RD	Received Data
4	CA	105	RTS	Request To Send
5	CB	106	CTS	Clear To Send
6	CC	107	DSR	Data Set Ready
7	AB	102	GND	Signal Ground
8	CF	109	CD	Carrier Detect (Received Line Signal Detector
9				unassigned
10				unassigned
11				unassigned
12	SCF	122	SCD	Secondary Carrier Detect
13	SCB	121	SCS	Secondary Clear to Send
14	SBA	118	STX	Secondary Transmitted Data
15	DB	114	TC	Transmit Signal Elements Timing (transmit clock)
16	SBB	119	SRX(SRD)	Secondary Received Data
17	DD	115	RC	Receiver Signal Element (Receive Clock)
18				unassigned
19	SCA	120	SRS	Secondary Request to Send
20	CD	108.2	DTR	Data Terminal Ready
21	CG	110	SQ	Signal Quality
22	CE	125	RI	Ring Indicator
23	CH/CI	111/112	DSR	CH=Data Signal Rate Selector, DTE CI=Data Signal Rate Selector, DCE
24	DA	113	XTC	Transmit Signal Element Timing (DTE source)
25				unassigned

B-14. TROUBLESHOOTING

Before troubleshooting the HP 18173 Interface Pod, verify that the HP 4951A is functioning correctly. To verify operation follow the procedure below.

1. Turn on the HP 4951A.
2. Press MORE.
3. Select <SELF TEST>.
4. Select <LOOP>.
5. If there are any failures, repair then repeat the test. If there are no failures, proceed to step 6.
6. Select <POD> and look for failures.
7. Turn off HP 4951A and connect the following jumpers for the DCE test:

   RD to TD
   DSR to DTR
   CTS to RTS

   a. For the DTE test connect the following jumpers:

   CTS to RTS and CD

8. If the POD test has any failures, enter the following program to isolate the part of the circuit needing repair.

B-15. SET UP

1. Press EXIT twice to return to the Top Level Menu.
2. Input the program in Table B-4. Press indicates that the key is on the keyboard and select indicates a softkey.

Table B-4. DCE Test Program

Select	RESET
	SIMULATE
	DCE
Press	MORE
Select	SET LEAD
	CTS
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	DSR
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	CD
	OFF
	AND THEN
	SEND
Type in	CTS OFF
Press	RTN
Select	NEXT BLOCK
Press	MORE
Select	SET LEAD
	CTS
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	DSR
	ON
	AND THEN
Press	MORE
	SET LEAD
	CD
	ON
	AND THEN
	SEND
Type in	CTS ON
Press	RTN

Table B-4. DCE Test Program (continued)

Press	RTN
Select	AND THEN
Press	MORE
Select	WAIT
Type in	500
Press	RTN
Select	NEXT BLOCK
	WHEN TRIG
	LEAD
	CTS
	ON
	THEN GOTO
Type in	Block 1
Press	RTN

B-16. PROCEDURE

1. Press EXIT/Halt.
2. Select <RUN MENU>.
3. Select <SIMULATE>.

B-17. TROUBLESHOOTING

1. All of the lines on the CRT should be active.
2. Check the LCD display. All of the segments should be active except --, ON, and OFF. (-- is never active).
   a. If there are any segments not turned on, troubleshoot that part of the HP 18173A circuitry.
3. If a DTE problem is suspected, enter the program for DTE troubleshooting.
   a. All of the lines on the CRT should be active except CD, ON & OFF.
   b. All LCDs should turn on except DCE.
   c. If there are any other segments not turned on, troubleshoot that part of the HP 18173A circuitry (except --, on, and off).

B-18. SET UP

1. Press EXIT twice to return to the Top Level menu.
2. Enter the program in Table B-5.

Table B-5. DTE Test Program

Select	RESET
	SET UP
	SIMULATE

Use the Cursor Up key to scroll to the DTE clock setup

Select	DTE
Press	EXIT/(Halt)
Press	MORE
Select	SET LEAD
	RTS
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	DTR
	OFF
	AND THEN
	SEND
Type in	RTS OFF
Press	RTN
Select	NEXT BLOCK
Press	MORE
Select	SET LEAD
	AND THEN
	RTS
	ON
Press	MORE
Select	SET LEAD
	AND THEN
	DTR
	ON
	SEND
Type in	RTS ON
Press	RTN
Select	AND THEN
Press	MORE
Select	WAIT
Type in	500
Press	RTN

Table B-5. DTE Test Program (Continued)

Select	NEXT BLOCK
	WHEN TRIG
	LEAD
	RTS
	ON
	THEN GOTO
Type in	block 1
Press	RTN

B-19. PROCEDURE

1. PRESS EXIT/Halt.
2. Select <RUN MENU>.
3. Select <SIMULATE>.

B-20. TROUBLESHOOTING

1. The inputs to A1U600 and A1U700 should be at TTL levels (between 0 and +5 volts).
2. The outputs from A1U600 and A1U700 should be RS-232C levels (+-12 V).
3. The inputs and outputs of all other circuits should be at TTL levels. Check for correct amplitudes and pulsing signals in all cases.
4. To check the OFF LCD, connect -12VTP to the MARK/SPACE TP. The off LCDsegment should turn on.
5. To check the ON LCD, short ground pin 7 on the Breakout Box to pin 11, A1U401. The ON LCD segment should turn on.
6. A1U400, the relay circuit pulses only once, indicating that the entered program is latched in.
7. If the problem is in the Monitor program, ignore A1U600 and A1U700.

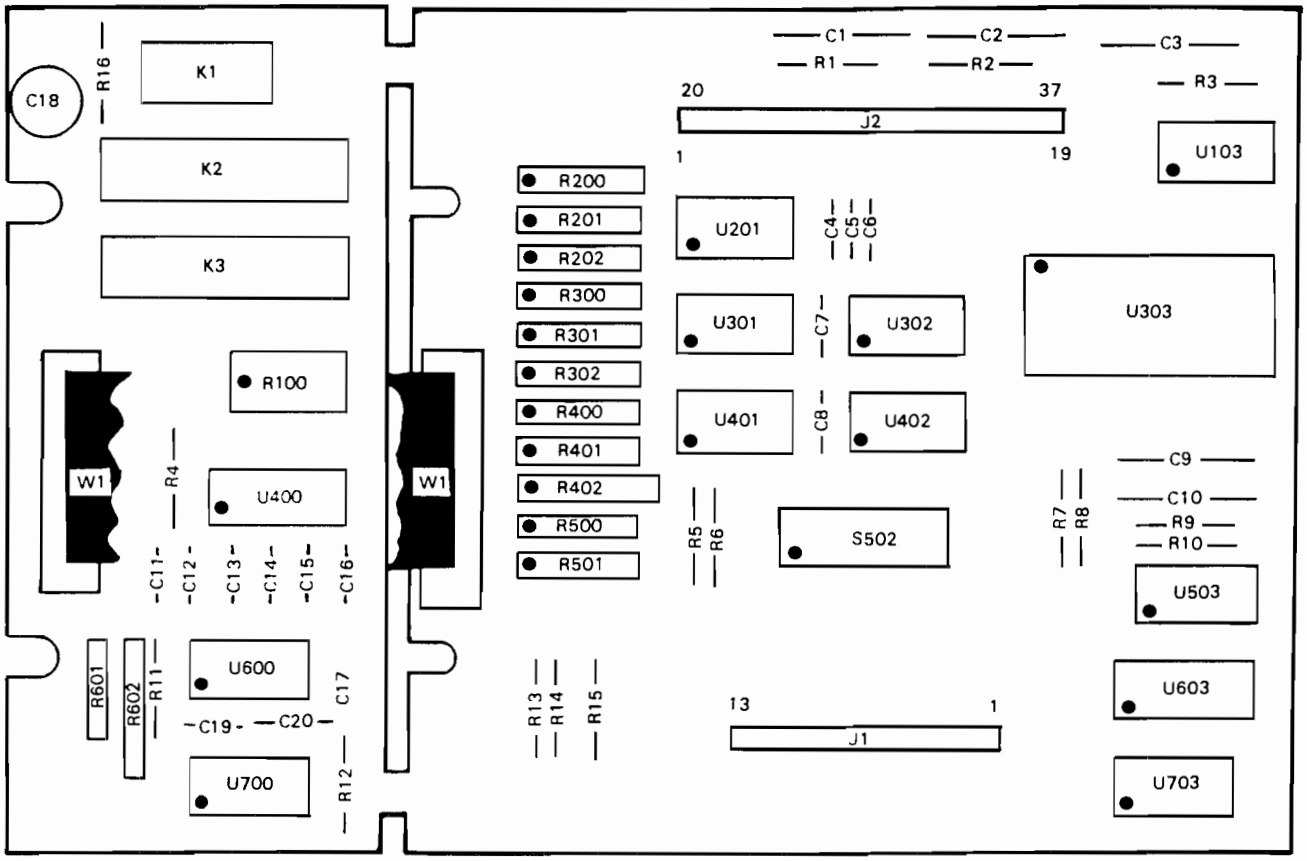


Figure B-3. HP 18173A Component Locator

ANALOG MULTIPLEXER
U508
U507
EN
0-3
Q508
Vin
Vout
-12
-5V
+5
+12
R28 1330
C18 .1
R31 10K
R30 10K
R32 10K
R33 10K
C23 100 pF
U607
R27 38.3
C17 .1
R29 10K .1%
R43 10K .1%
R45 28.7K
C22 1
R34 316 .1%
R35 10K .1%
R41 10K .1%
R42 10K
C27 .1
R40 28.3
R38 2150
C26 2200 pF
R39 1210
C29 330 pF
C25 680 pF
C28 470 pF
R44 1000
R47 133K
U506
R22 261K
R37 511K
R506 237K
R23 10K
R21 10K
FLUX I/O TIMER
ANALOG SWITCH
U404
U406
C9 1
R14 23.7K
C10 3900 pF
R13 5110
R12 10K
CR1
CR2
R15 10K
C6 .02
R11 82.5K
C7, .002
R6, 100K
PULSE WIDTH MODULATOR
U505
DEAD TIME CONTROL
CT
RT
GND
E1
E2
CNTRL
-IN1
-IN2
+IN1
+IN2
C1
C2
+5 REF
FEEDBACK
OFF
R506 1000
C21 1200 pF
R505 10K
R7 100K
R4 1000
R5 1470
R3 100
R8 1620
R404 10K
R2 10K
C12 .1
R10 178
C11 3900 pF 1%
HOLE
U504
IN 1
IN 2
IN 3
IN 4
OUT 1
OUT 2
OUT 3
OUT 4
Q604
Q605
Q504
Q505
L2 50 uH
MOTOR
J2-19
J2-20
L1 50 uH
C20 1
C19
CART IN
HOLE
INT TAPE
U201
U306
R1 10K
U408
R24 10K
C15 .001
R36 1000
P/O J2
P/O W6
4951-60003-S111-3-22-84

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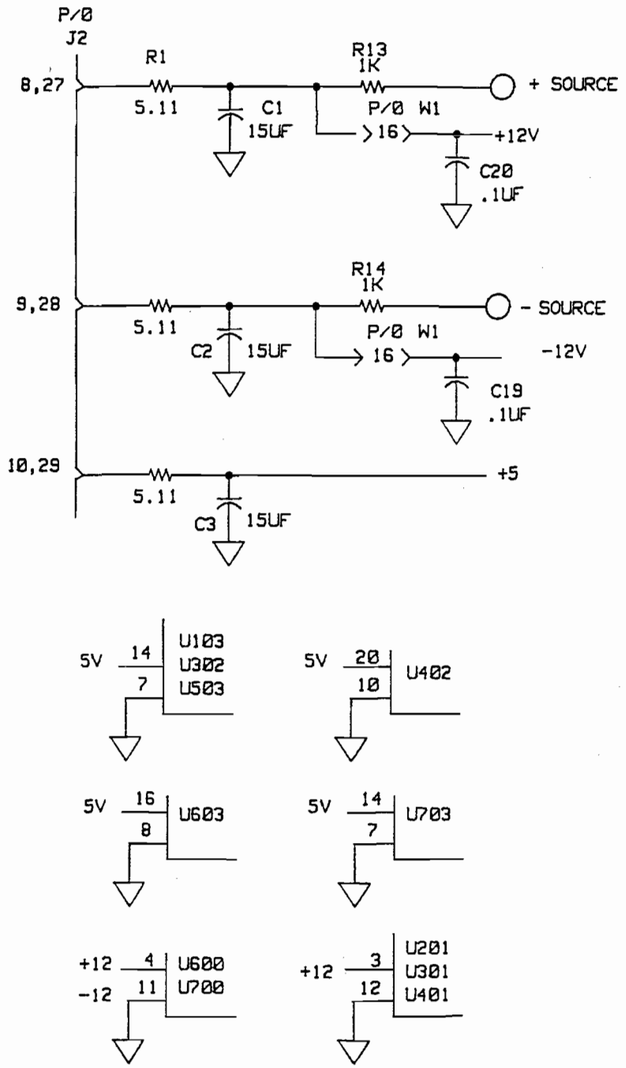
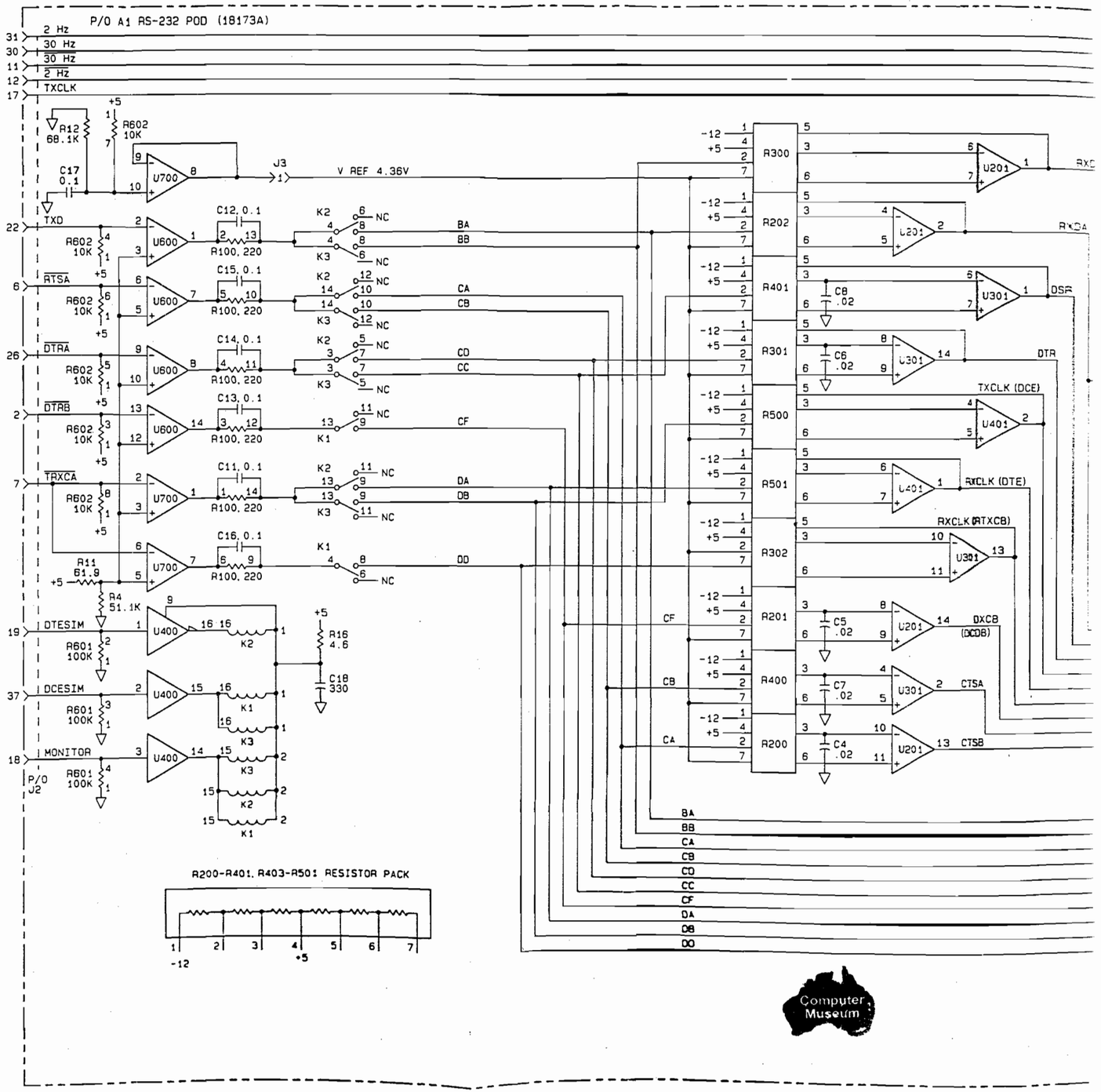
Figure 8-17. A3 Read Amplifier and Speed Control Schematic

HP 18173A Power and Grounds





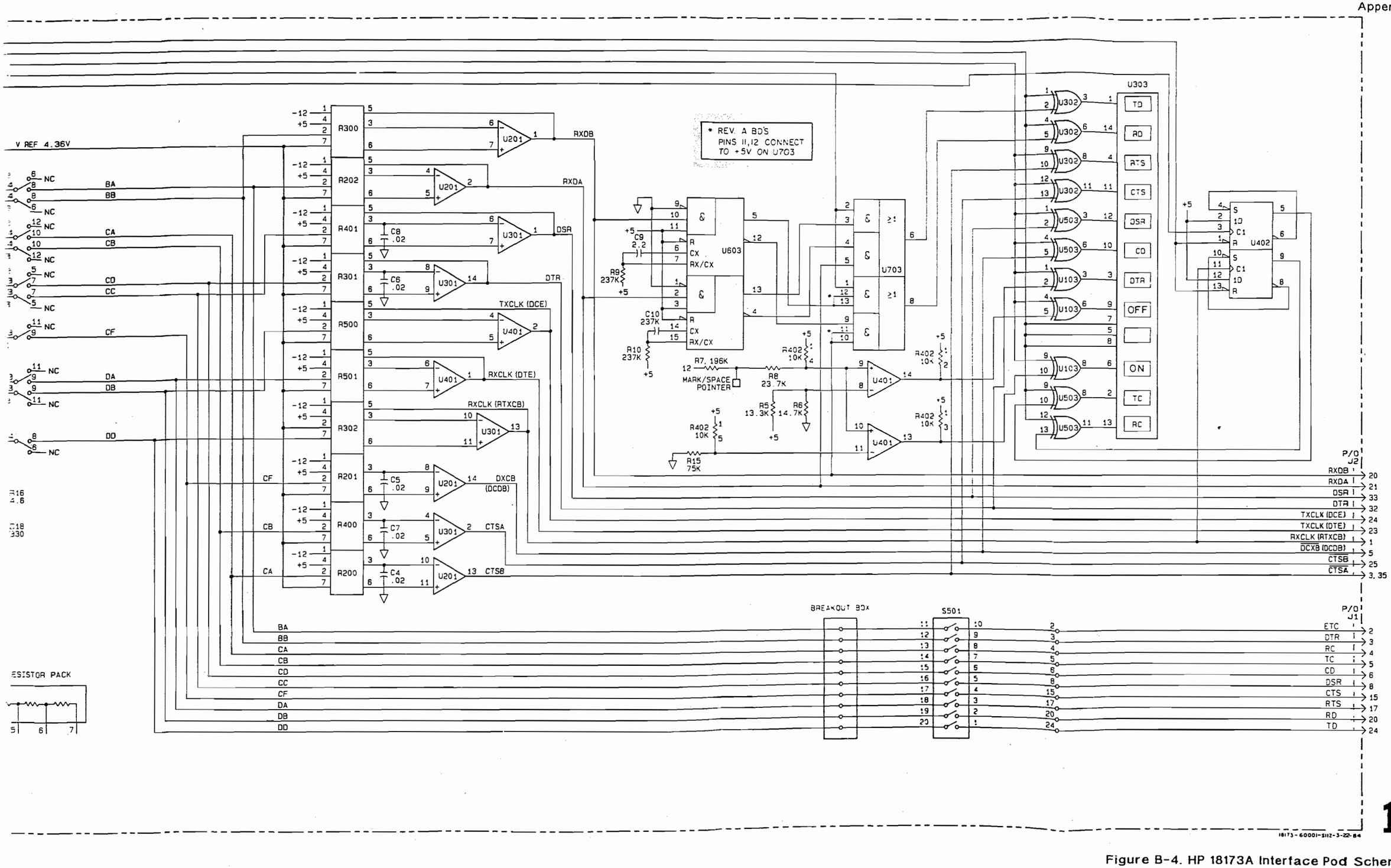


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Figure B-4. HP 18173A Interface Pod Schematic

APPENDIX C
HP 18174A
RS-449 INTERFACE POD

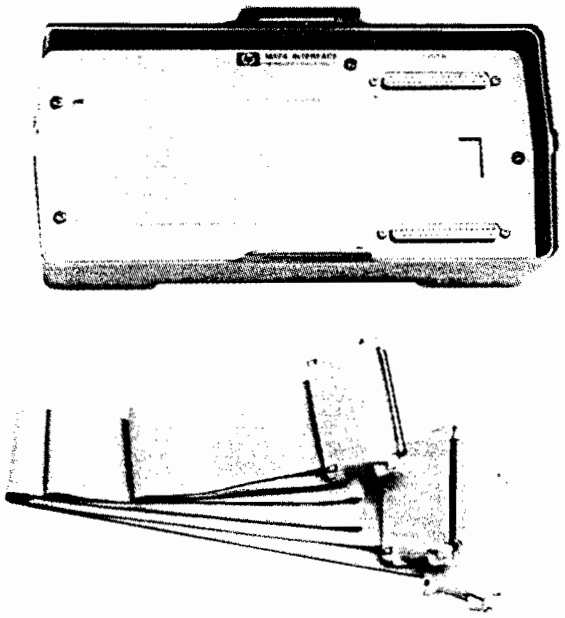


Figure C-1. HP 18174A Interface Pod

C-1. INTRODUCTION

The HP 18174A is an RS-449 Interface Pod designed to provide the connection between the HP 4951A Protocol Analyzer and Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). The HP 18174A is compatible with EIA RS-449/422A/423A electrical, mechanical, functional, and procedural specifications.

This appendix includes information to install, operate, and service the HP 18174A.

-2 INSTALLATON

cc nect the Interface Pod to the HP 4951A Protocol Analyzer, turn the power off and attach the oir connector to the port on the back of the Protocol Analyzer. Tighten the hex screws to ensure t the cable will not pull off during operation.

CAUTION

Turn off the Probed Analyzer before
connecting or disconnecting any Interface Pod.

-3. OPERATION

:e the Interface Pod is installed, all operations are performed from the keyboard. See the :r^ting Manual (HP 04951-90003) for procedures.

-4 PERFORMANCE VERIFICATION

erformance Verification test is performed by the operator. Follow the procedure described in a aph C-5.

5 HP 18174A SELF TEST

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the lines work.

Set Up

1. Turn on the HP 4951A.
2. Press MORE.
3. Select <SELFTEST>.
4. Select <PODTEST>.

Procedure

1. When the <POD TEST> softkey is pressed, the Interface Pod test is automatically performed.

2. If there are no failures POD TEST PASSED will be displayed.

C-6. ADJUSTMENTS

There are no adjustments for the HP 18174A.

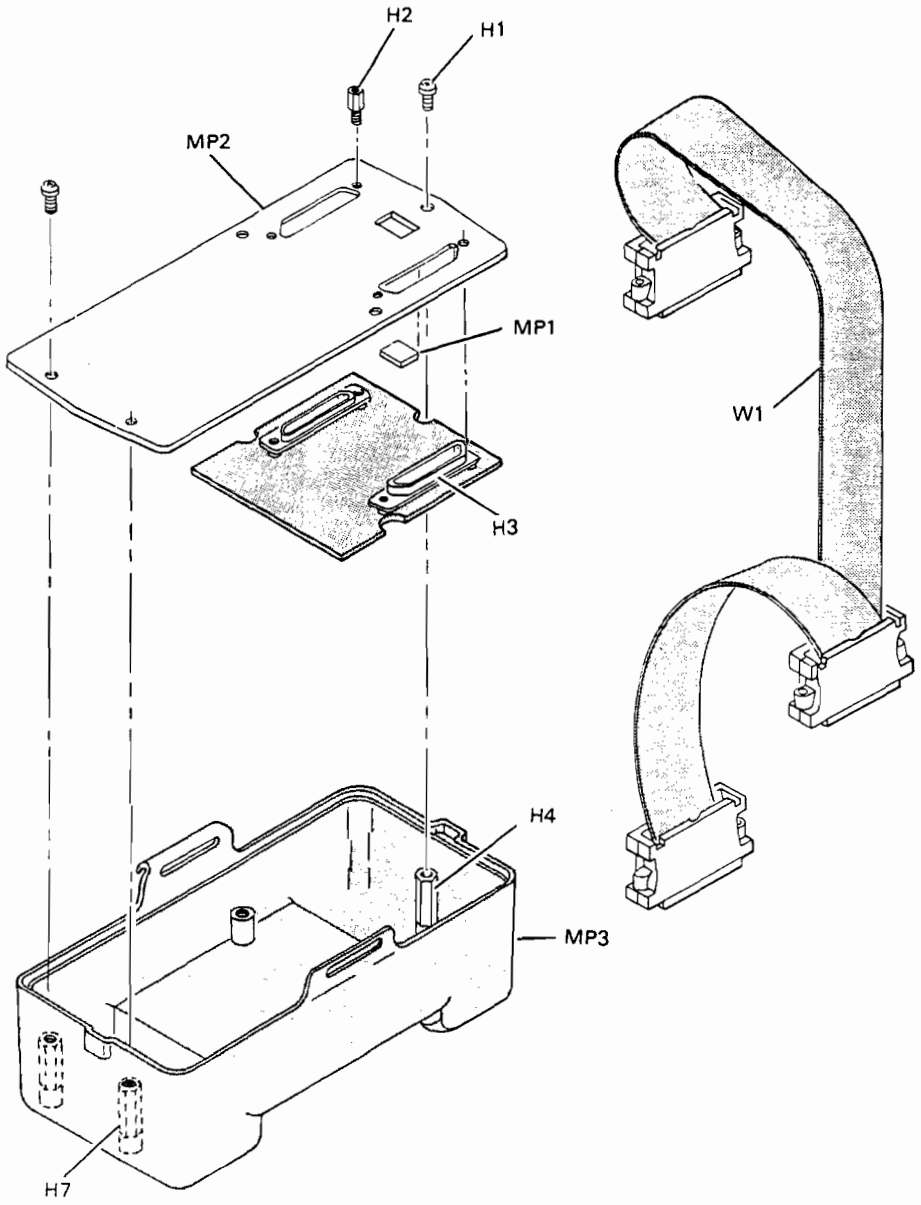
C-7. REPLACEABLE PARTS

The following tables and figure give information for ordering replacement parts. Table C-1 is the Manufacturer's Code List. Table C-2 lists the replaceable parts in alphanumeric order. Information is given for the description, Quantity, HP Part Number, and Manufacturers Part Number. Chassis and mechanical parts are listed in Figure C-2. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table C-1. HP 18174A Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
11236	CTS OF BERNE INC	BERNE	IN	46711
13606	SPRAGUE ELECT CO SEMICONDUCTOR DIV	CONCORD	NH	03301
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247



eference gnation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
-1	2200-0112	3	1	SCR-MCH, 4-40, .5IN	04771	ORDER BY DESCRIPTION
-2	1251-2942	7	4	SCREW POST LOCK	04486	020418-2
-3	1251-6074	4	2	CONNECTOR-37 PIN	04486	DC37SV
-4	0380-T39625		1	STANDOFFS	28480	0380-T39625
-7	0380-T39626		2	STANDOFF	28480	0380-T39626
MP1	5040-4478	5	1	LENS	28480	5040-4478
MP2	18174-00001	3	1	RS-449 PANEL	28480	18174-00001
MP3	4040-2171	0	1	HOUSING	28480	4040-2171
W1	18174-61601	8	1	RS-449 CABLE	28480	18174-61601

Figure C-2. HP 18174A Exploded View

Table C-2. HP 18174A Replaceable Parts List

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	18174-60001	9	1	RS-449 INTERFACE POD	28480	18174-60001
A1C1	0180-1846	6	2	CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A1C2	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A1C3	0180-1746	5	2	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C4	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C5	0160-0576	5	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C6	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1DS1	1990-0883	7	1	DISPLAY-LIQ-XTAL	28480	1990-0883
A1J1	1251-6074	4	2	CONNECTOR 37-PIN F D SUBMINIATURE	28480	1251-6074
A1J2	1251-6074	4		CONNECTOR 37-PIN F D SUBMINIATURE	28480	1251-6074
A1R1	0698-3266	5	2	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R2	0698-3266	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A1R3	0699-0556	2	2	RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R4	0699-0556	2		RESISTOR 5.11 1% .125W F TC=0+-100	28480	0699-0556
A1R5	0757-0442	9	2	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R201	1810-0680	2	10	RES NETWK SIP 2	28480	1810-0680
A1R202	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R203	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R204	1810-0368	3	1	NETWORK-RES 6-SIP10.0K OHM X 5	01121	206A103
A1R301	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R302	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R303	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R304	1810-0369	4	2	NETWORK-RES 6-SIP100.0K OHM X 5	11236	750-61-R100K
A1R401	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R402	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R403	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R404	1810-0680	2		RES NETWK SIP 2	28480	1810-0680
A1R405	1810-0369	4		NETWORK-RES 6-SIP100.0K OHM X 5	11236	750-61-R100K
A1U100	1820-3373	7	1	IC MV CMOS/74HC MONOSTBL CLEAR DUAL	28480	1820-3373
A1U101	1820-3396	4	1	IC GATE CMOS/74HC AND-OR-INV DUAL 2-INP	28480	1820-3396
A1U103	1820-3081	4	1	IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG	28480	1820-3081
A1U104	1820-3007	4	3	IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U200	1826-0759	9	3	IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A1U202	1820-2831	0	3	ICD 75174 DRIVER	28480	1820-2831
A1U300	1826-0759	9		IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A1U302	1820-2831	0		ICD 75174 DRIVER	28480	1820-2831
A1U400	1826-0759	9		IC COMPARATOR GP QUAD 14 DIP-C PKG	04713	LM339J
A1U402	1820-2831	0		ICD 75174 DRIVER	28480	1820-2831
A1U403	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
A1U404	1820-3007	4		IC GATE CMOS/74HC EXCL-OR QUAD 2-INP	28480	1820-3007
	0380-0332	7	4	STANDOFF-RVT-CN .187-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
	1251-2942	7	4	SCREW POST LOCK	28480	1251-2942

C- 3. SERVICE

The following paragraphs contain service information for the HP 18174A. Included is Theory of Operation, RS-449 Signal Mnemonics, Troubleshooting, Component Locators, and Schematics.

C- 9. THEORY OF OPERATION

The HP 4951A operates in three modes.

1. Monitor mode: The HP 4951A monitors traffic on a communication line.
2. DTE simulate: The HP 4951A drives the data lines and acts as a terminal.
3. DCE simulate: The HP 4951A drives the data lines and acts as the digital side of a modem or another piece of Data Circuit-Terminating Equipment.

The Interface Pod is configured for the correct mode of operation by Interface Pod latch A1U204 and output signals from pins 18, 19, and 37 of the connector between the Interrface Pod and the Protocol Analyzer.

The RS-449 Interface Pod has the following capabilities.

1. Translates voltages to and from RS-449 and HP 4951A logic levels.
2. Displays EIA line signal status (of selected lines only)
3. Programmable for monitoring and DTE or DCE simulation.
4. Identifies the type of Interface Pod connected to the HP 4951A.
5. Supports differentially driven category I circuits.

-10. SCC. The SCC is an I/O device located on the HP 4951A Main Board that controls all communications between the HP 4951A and the Interface Pods.

Drivers A1U1 and A1U2 convert the signal from single ended logic levels to a differential voltage waveform. These drivers are tristate devices and need no relays to isolate them from the interface lines in the monitor mode.

Receivers A1U10 and A1U11 operate over a common mode voltage range from -7 to +7 volts and require a minumum differential of 200 mvolts to change states. They maintain operation over a differential voltage range from 200 mvolts to 6 volts; however, the positive common mode signal voltage cannot exceed the RS-449 specification of 10 volts. A1U10 and A1U11 are protected by divider resistors from signal levels up to 12 volts.

The EIA status of the selected interface lines is displayed on a bargraph LCD. Clock and data indicators are flashed at a 2Hz rate when line state transitions are detected. Table C-3 lists these RS-449 lines.

Table C-3. RS-449 Description

TR	Terminal Ready
DM	Data Mode
RS	Request to Send
CS	Clear to Send
RR	Receiver Ready
SD	Send Data
RD	Receive Data
RT	Receive Timing

Table C-4. RS-449 Signal Mnemonics

	CON-NECTOR PIN NO.	RS-449 4951A DISPLAY MNEMONICS		DESCRIPTION
	1		open	open
	2	SI	SI	Signaling-rate Indicator
	3		open	open
*	4	DTE	SDa	Send Data (a)
	5	ST	STa	Send Timing (a)
*	6	DCE	RDa	Receive Data (a)
*	7	RS	RSa	Request to Send (a)
	8	RT	RTa	Receive Timing (a)
*	9	CS	CSa	Clear to Send (a)
	10		open	open
*	11	DM	DMa	Data Mode (a)
	12	TR	TRa	Terminal Ready (a)
*	13	RR	RRa	Receiver Ready (a)
	14	RL	RL	Remote Loopback
	15	IC	IC	Incoming Call
	16	SF	SF/SR	Select Frequency/ Signaling-rate Selector
	17	TT	TTa	Terminal Timing (a)
	18		open	open
	19		SG	Signal Ground
	20		RC	Receive Common
	21		open	open
	22	DTE	SDb	Send Data (b)
	23	ST	STb	Send Timing (b)
	24	DCE	RDb	Receive Data (b)
	25	RS	RSb	Request to Send (b)
	26	RT	RTb	Receive Timing (b)
	27	CS	CSb	Clear to Send (b)
	28	IS	IS	Terminal in Service
	29	DM	DMb	Data Mode (b)
	30	TR	TRb	Terminal Ready (b)
	31	RR	RRb	Receiver Ready (b)
	32	SS	SS	Select Standby
	33	SQ	SQ	Signal Quality
	34		open	open
	35	TT	TTb	Terminal Timing (b)
	36		open	open
	37		SC	Send Common

*Indicates lines which parameters can be selected from HP 4951A screen.

C-10. TROUBLESHOOTING

Before troubleshooting the HP 18174A Interface Pod, verify that the HP 4951A is functioning correctly. To verify operation follow the procedure below.

1. Turn on the HP 4951A.
2. Press MORE.
3. Select <SELF TEST>.
4. Select <LOOP>.
5. If there are any failures, repair then repeat the test. If there are no failures, proceed to step 6.
6. Select <POD> and look for failures.
7. If the POD test shows any failures, enter the program in paragraph C-11 under SET UP to isolate the part of the circuit needing repair.

C-11. SET UP

1. Press EXIT twice to return to the Top Level Menu.
2. Input the program in Table C-5. Press indicates that the key is on the keyboard and select indicates a softkey.

Table C-5. DCE Test Program

Select	RESET
	SIMULATE
	DCE
Press	MORE
Select	SET LEAD
	CS
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	DM
	OFF
	AND THEN
Press	MORE
Select	SET LEAD
	RR
	OFF
	SEND
Type in	CS OFF
Press	RTN
Select	NEXT BLOCK
Press	MORE
	SET LEAD
	CS
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	DM
	ON
	AND THEN
Press	MORE
	SET LEAD ON
	RR
	ON
	AND THEN
	SEND
Type in	CS ON
Press	RTN

Table C-5. DCE Test Program (Continued)

Select	AND THEN
Press	MORE
Select	WAIT
Type in	500
Press	RTN
Select	NEXT BLOCK
	WHEN TRIG
	LEAD
	CS
	ON
	THEN GOTO BLOCK
Type in	1
Press	RTN

C-12. PROCEDURE

1. Press EXIT.
2. Select <RUN MENU>.
3. Select <SIMULATE>.

C-13. TROUBLESHOOTING

1. All of the lines on CRT should be active except DTE & RS.
2. Check the LCD display. All of the segments should be active except SD, RS, and TR (--- is never active).
   a. If there are any other segments not lit, troubleshoot that part of the HP 18174A circuitry.
3. If a DTE problem is suspected, enter the program for DTE.
   a. All of the lines on the CRT should be active except DCE, CS, DM, and RR.
   b. All LCDs should turn on except RD, RT, CS, DM, and RR.
   c. If there are any other segments not turned on, troubleshoot that part of the HP 18174A circuitry (except SD, RS, TR and ---).

C-14. SET UP

1. Press EXIT twice to return to the Top Level Menu.
2. Select the following sequence of softkeys to load the DTE test program in Table C-6.

Table C-6. DTE Test Program

Select	MORE
	RESET
	SIMULATE

Use the Cursor Up key to scroll to the DTE clock setup

Select	DTE
Press	EXIT/(Halt)
Select	SIMULATE
	DTE
Press	MORE
Select	SET LEAD
	RS
	OFF
	AND THEN
	MORE
	SET LEAD
	TR
	OFF
	AND THEN
	SEND
Type in	RS OFF
Press	RTN
Select	NEXT BLOCK
Press	MORE
Select	SET LEAD
	RS
	ON
	AND THEN
Press	MORE
Select	SET LEAD
	TR
	ON
	AND THEN
	SEND
Type in	RS ON
Press	RTN
Select	AND THEN
Press	MORE
Select	WAIT
Type in	500
Press	RTN

Table C-5. DCE Test Program (Continued)

```
                Select      NEXT BLOCK
                            WHEN TRIG
                            LEAD
                            RS
                            ON
                            THEN GOTO
                Type in     block 1
                Press       RTN
                Press       EXIT/(Halt)
```

C-15. PROCEDURE

1. Press EXIT/(Halt).
2. Select <RUN MENU>.
3. Select <SIMULATE>.

C-16. TROUBLESHOOTING

1. Only DTE and RS lines are active on the CRT.
2. LCD segments RD, RT, CS, DM, and RR are not active on display.
3. The inputs to A1U202, A1U302, and A1U402 should be at TTL levels (between 0 and 5 volts).
4. The outputs to A1U202, A1U302, and A1U402 should be RS-449 levels (+- 12V).
5. The inputs and outputs of all other circuits should be at TTL levels. Check for correct amplitudes and pulsing signals.
6. If the problem is in the Monitor program, ignore A1U202, A1U302, and A1U700.

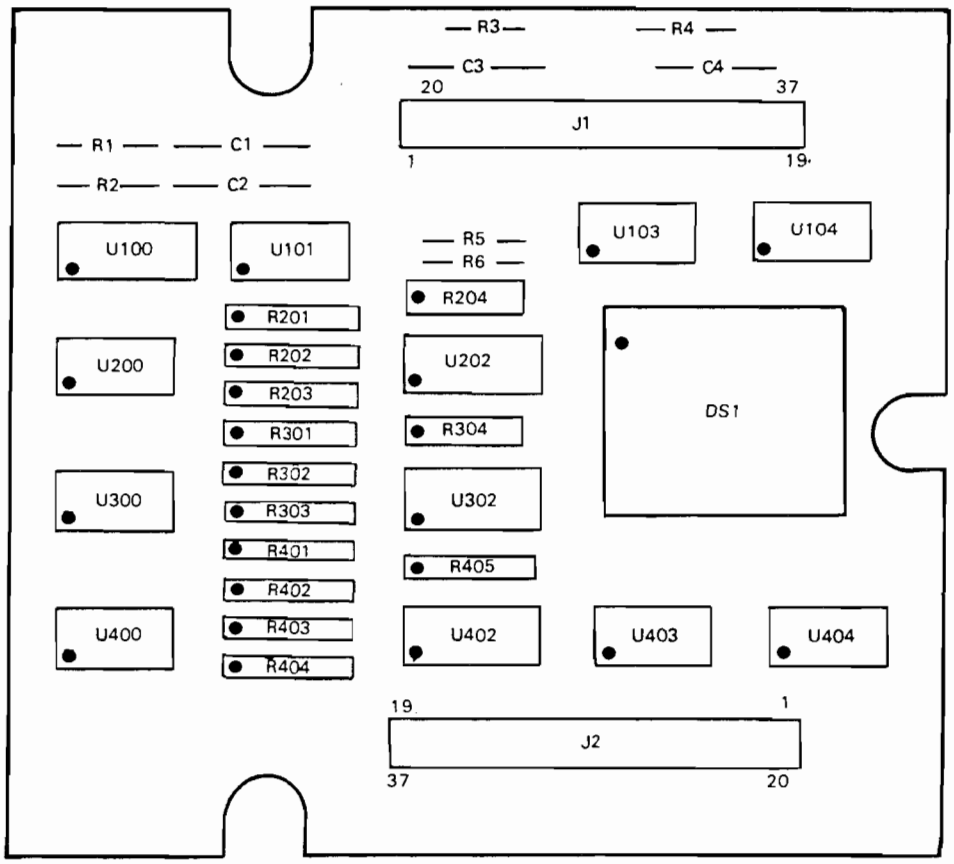
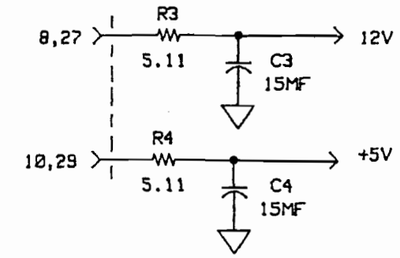
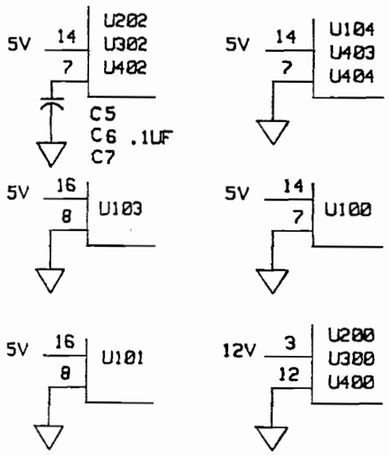
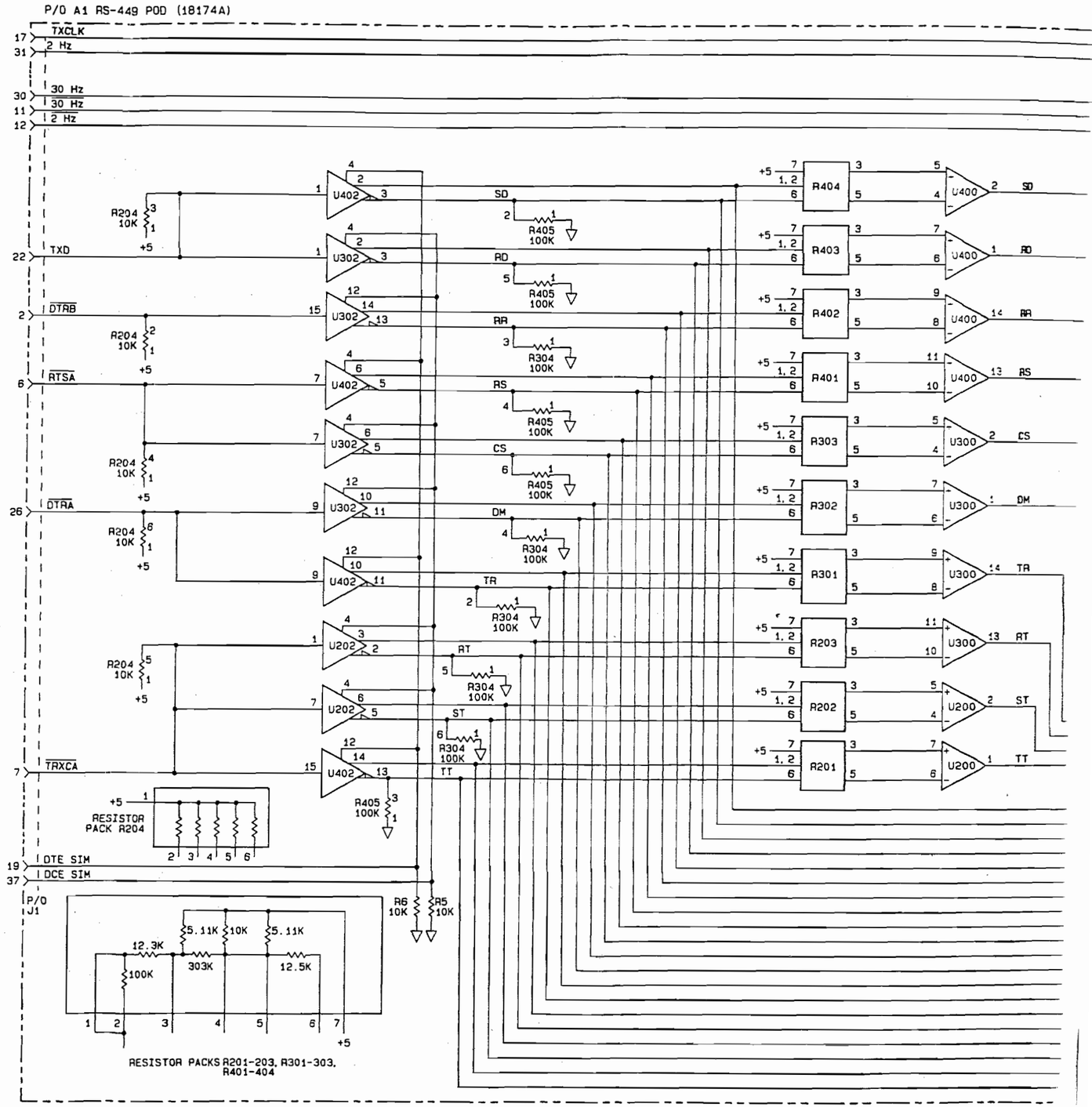


Figure C-3. HP 18174A Component Locator

HP 18174A. Power and Grounds







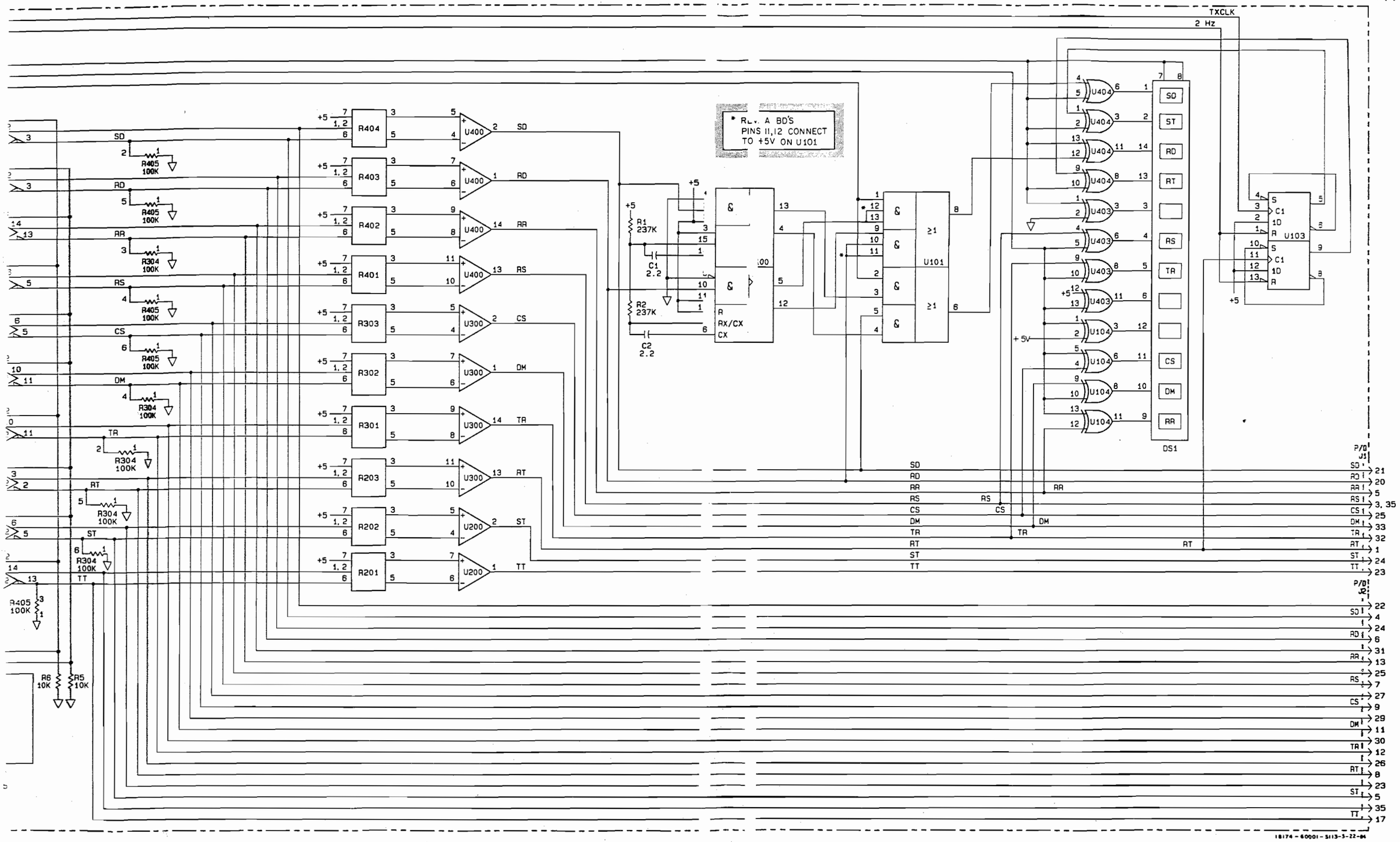


Figure C-4. HP 18174A Interface Pod Schematic

APPENDIX D
HP 18180A
RS-232C/V.24/RS-449 INTERFACE POD

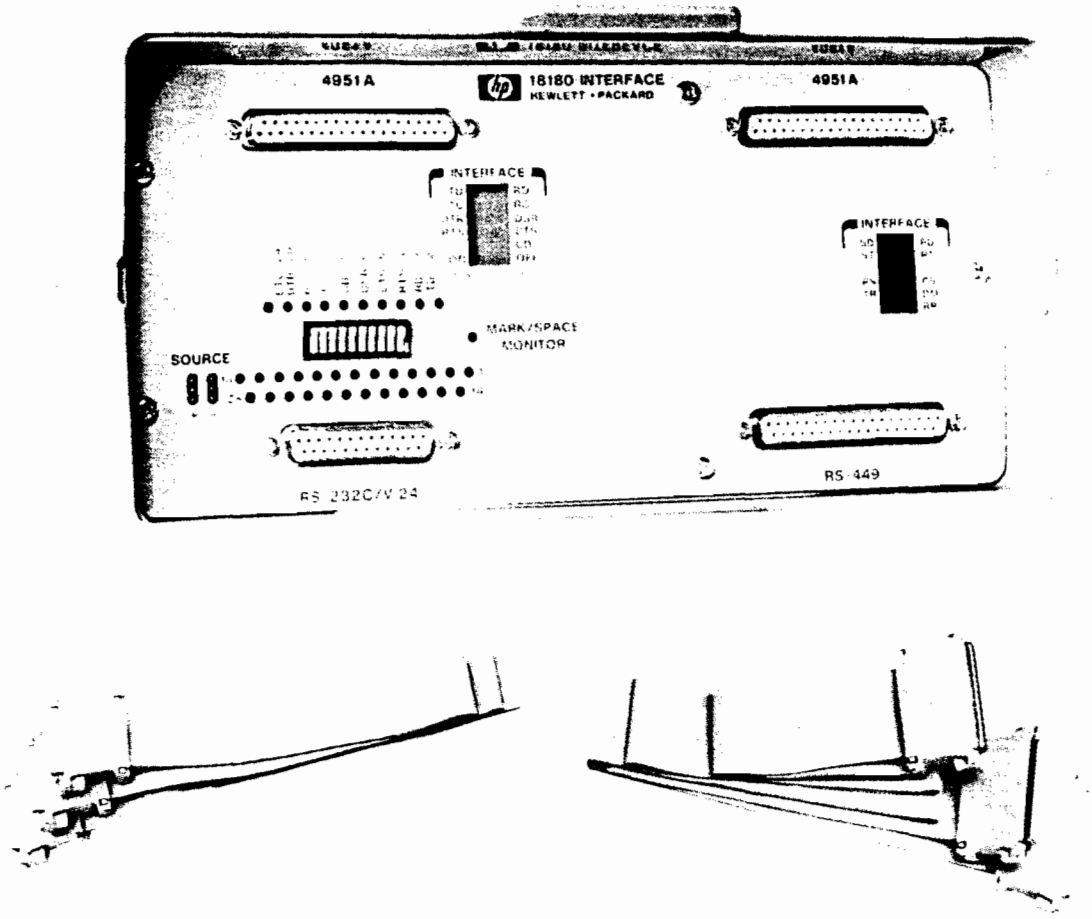


Figure D-1. HP 18180A Interface Pod

D-1. INTRODUCTION

The HP 18180A is an RS-232C/V.24/RS-449 Interface Pod designed to provide the connection between the HP 4951A Protocol Analyzer and the Data Terminal Equipment (DTE) and/or Data Circuit-Terminating Equipment (DCE). The HP 18180A contains both the HP 18173A and the HP 18174A Interface Pods. For descriptions, refer to Appendixes B and C.

This appendix includes information to install, operate, and service the HP 18180A.

D-6. ADJUSTMENTS

The HP 18180A needs no adjustments.

D-7. REPLACEABLE PARTS

To order replacement parts refer to Appendix B for RS-232C/V.24 components and to Appendix C for RS-449 components. Chassis and mechanical parts are listed in Figure D-2. To order a listed part, quote the HP Part Number, indicate the quantity needed and send the order to the nearest Hewlett-Packard office.

When ordering a part not listed, include the instrument model number, serial number, and a physical and functional description of the part. Send the order to the nearest Hewlett-Packard office.

Table D-1. Replaceable Parts List

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
	18180	4	1	RS-232C/RS-449 INTERFACE POD	28480	18180
	4040-2171	0	1	HOUSING	28480	4040-2171
	18173-60001	8	1	RS232 POD ASSY	28480	18173-60001
	18173-61602	7	1	RS232 CBL	28480	18173-61602
	18174-60001	9	1	RS449 PC ASSY	28480	18174-60001
	18174-61601	7	1	RS449 CBL	28480	18174-61601
	18180-00001	1	1	RS232/449 PANEL	28480	18180-00001

D-8. SERVICE

The HP 18180A contains both the RS-232C/V.24 and the RS-449 Interface Pods. Service information and schematics are located in Appendix B for RS-232C/V.24 side of the Interface Pod and Appendix C for the RS-449 side of the Interface Pod.

-2. INSTALLATION

) connect the Interface Pod to the HP 4951A Protocol Analyzer, turn the power off and attach the ' pin connector to the port on the back of the Protocol Analyzer. Tighten the hex screws to ensure at the cable will not pull off during operation.

CAUTION

Turn off the Protocol Analyzer before
connecting or disconnecting any Interface Pod.

)-3. OPERATION

nce the Interface Pod is installed, all operations are performed from the keyboard. See the perating Manual (HP 04951-90003) for procedures.

)-4. PERFORMANCE VERIFICATION

he Performance Verification test is performed by the operator. Follow the procedure described in aragraph D-5.

)-5. HP 18180A SELF TEST

Description

This test has two parts: a check that there is an Interface Pod connected to the Protocol Analyzer and verification that the data lines work.

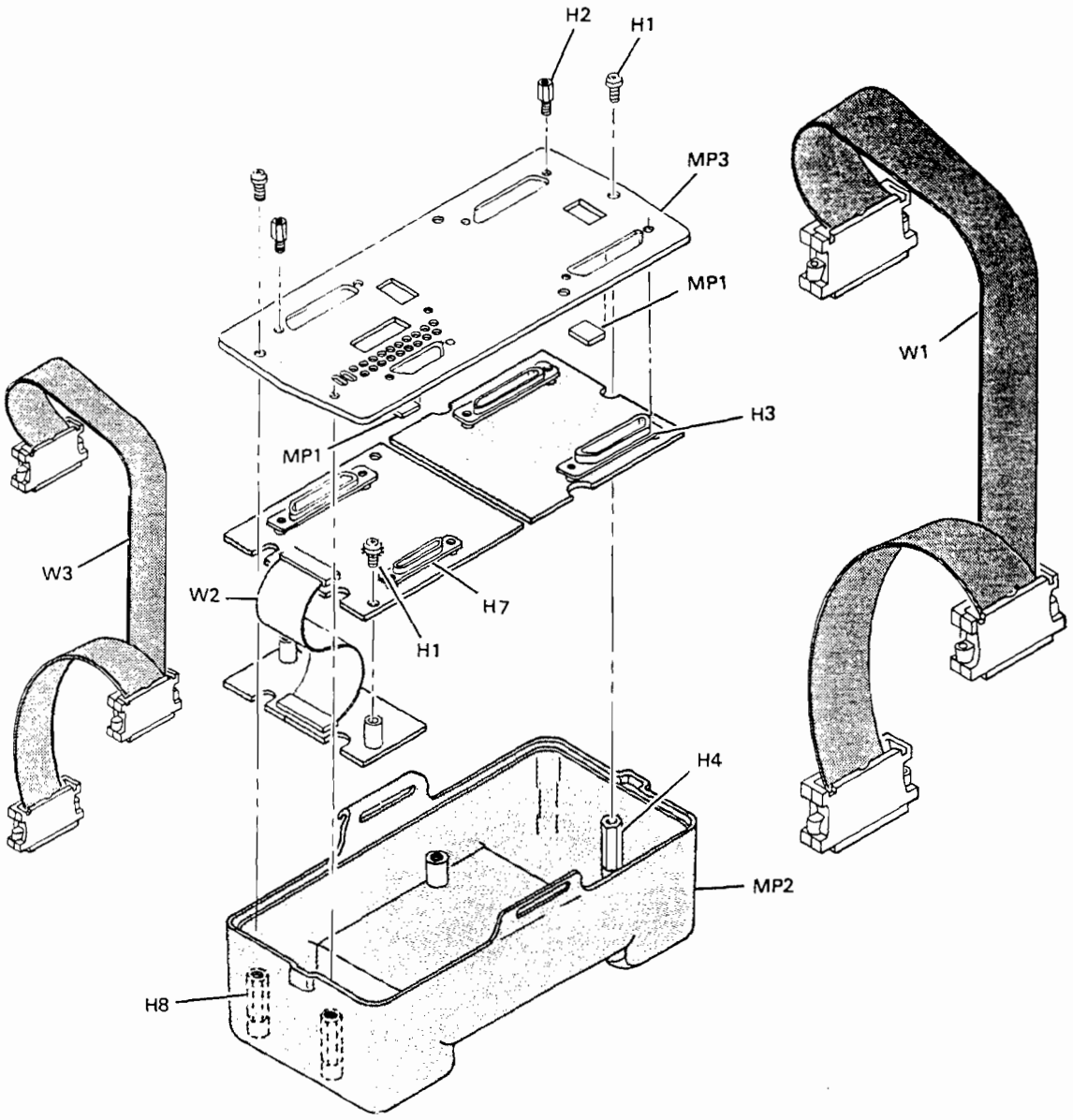
Set Up

1. Turn on the HP 4951A.
2. Press MORE>.
3. Select <SELFTEST>.
4. Select <PODTEST>.

Procedure

1. When the <POD TEST> softkey is pressed, the Interface Pod test is automatically performed.

2. If there are no failures, POD PASSED is displayed.



Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
H1	2200-0112	3	3	SCR-MCH, 4-40, 5IN	04771	ORDER BY DESCRIPTION
H2	1251-2942	7	8	SCR POST LOCK	04486	10204-18-2
H3	1251-6074	4	3	CONNECTOR-37 PIN	04486	DC375V
H4	0380-T39625		1	STANDOFF	28480	0380-T39625
H7	1251-4946	5	1	CONNECTOR-25 PIN	04486	DB-255V
H8	0380-T39626		2	STANDOFF	28480	0380-T39626
MP1	5040-4478	5	2	LENS	28480	5040-4478
MP2	4040-2171	0	1	HOUSING	28480	4040-2171
MP3	18180-00001	5	1	RS-232C/RS-449 PANEL	28480	18180-00001
W1	18174-61601	8	1	CABLE, RS-449	28480	18174-61601
W2	18173-61601	3	1	CABLE, INTERCONNECT	28480	18173-61601
W3	18173-61602	5	1	CABLE, RS-232C/V.24	28480	18173-61602

Figure D-2. HP 18180A Exploded View