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Support for Your Product

Agilent no longer sells or supports this product. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available. You will find any other available product information on the Agilent Test & Measurement website, www.tm.agilent.com.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. In other documentation, to reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product number/name was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

HEWLETT PACKARD

SERVICE MANUAL

HP 16500A/16501A

Logic Analysis System

SERIAL NUMBERS

This manual applies directly to instruments
prefixed with serial number:

HP 16500A - 3048A and below
HP 16501A - 3050A

For additional information about serial numbers see
INSTRUMENTS COVERED BY THIS MANUAL
in Section 1.

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SECTION I
General Information

1-1. Introduction

This service manual explains how to test, adjust, and service the Hewlett-Packard 16500A/16501A Logic Analysis System. This manual is divided into six sections as follows:

I - General Information

II - Installation

III - Performance Tests

IV - Adjustments

V - Replaceable Parts

VI- Service

The General Information Section includes a description of the HP 16500A/16501A, its specifications, options, available accessories, and recommended test equipment for maintaining the instrument.

Information for operating, programming, and interfacing with the HP 16500A/16501A is contained in the Operating and Programming manual set supplied with each instrument.

Shipped with this manual are service manuals for each module ordered with the HP 16500A/16501A. To complete the service documentation for your system, unpack the module service manuals and place them in the 3-ring binder of this manual.

1-2. Instruments Covered by This Manual

The instrument serial number is on the rear panel of the instrument. Hewlett-Packard uses a two-part serial number consisting of a four-digit prefix and a five-digit suffix separated by a letter (for example, 0000A00000). The prefix is the same for all identical instruments and the suffix is different for each instrument. Prefix changes are for parts compatibility and for instrument tracking. The only time the manual will be updated to reflect a new prefix is for parts compatibility. This manual applies directly to instruments with the serial prefix shown on the title page.

1-3. Safety Considerations

Review the instrument and manual for safety markings and instructions before operating it. Specific warnings, cautions, and instructions are placed wherever applicable throughout the manual. These precautions must be observed during all phases of operation, service, and repair of the instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of this instrument. Hewlett-Packard assumes no liability for the customer's failure to comply with these safety requirements.

1-4. Product Description

The HP 16500A is the mainframe of the HP Logic Analysis System. The HP 16501A is an expansion frame of the HP Logic Analysis System. The HP 16500A/16501A is of modular structure using plug-in cards with a wide range of data acquisition and stimulus capabilities.

This allows the user to configure the system with only the necessary modules for a particular application.

Some of the key features of the HP 16500A/16501A include the following:

- Modular mainframe with five card slots.
- Nine-inch color monitor.
- The touchscreen user interface.
- Dual 3.5-inch disk drives.
- Intermodule triggering and time correlation of acquired data.
- HP-IB and RS-232C interfaces for hardcopy output to a printer or controller interface.
- Expansion frame, which expands the total system card slots to nine.

1-5. Accessories Supplied

The following accessories are supplied with the HP 16500A/16501A:

- One power cord. See section 2, "Installation," for the available power cords.
- One *HP 16500A/16501A Logic Analysis System Operation Reference Manual*.
- One *HP 16500A/16501A Logic Analysis System Programming Reference Manual*.
- One *HP 16500A/16501A Logic Analysis System Service Manual*.
- One *Feeling Comfortable With Logic Analyzers* guide.
- One *Feeling Comfortable With Digitizing Oscilloscopes* guide.
- Rear panel filler panels. The quantity of filler panels depends on how many modules are ordered with the HP 16500A/16501A.
- Disk pouch containing composite software.
- Disk pouch containing systemized operating system software.
- One RS-232C loopback connector.
- One blank disk.

1-6. Accessories Available

The accessories available for the HP 16500A/16501A include the following:

- HP 46060A Mouse.
- HP E2427A Keyboard.
- HP-IB Cables: HP 10833A, 10833B, 10833C, 10833D.
- Hewlett-Packard Printers (see table 1-1).
- Extra Operating and Programming Manual (Option 910).
- HP 1008A Testmobile.
  Option 006 Power Strip and Cabinet.
- Extended Repair Service (Option W30).
- RS-232C DTE to DTE Cable. Used for connecting the HP 16500A to printers and controllers. HP Part Number 13242-60010.
- RS-232C DTE to DCE Cable. Used for connecting the HP 16500A to modems and data switch. HP Part Number 13242-60001.
- HP 74240A/74240B CAE Software.
- Rackmount Kit HP Part Number 5061-9679.
- Transit Case HP Part Number 9211-2658.
- Hewlett-Packard Plug-In Modules with data acquisition, stimulus, pattern generator, and oscilloscope capabilities.
- Blank 3.5-inch disks (box of 10) HP Part Number 92192A.

For more information about plug-in modules or accessories, contact the nearest Hewlett-Packard Sales Office.

1-7. Operating Characteristics

Table 1-1 is a listing of the instrument's operating characteristics. These are not specifications, but are typical operating characteristics included as additional information for you.

1-8. Recommended Test Equipment

The equipment required to test and maintain the HP 16500A/16501A is listed in table 1-2.

Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-1. HP 16500A/16501A Operating Characteristics

Built-in Disk Drives

File Types: System software; performance verification; configuration (contains instrument configuration, data, pointer to inverse assembler file); inverse assembler; auto-configuration, calibration.

Autoload Designation: A predefined configuration file can be loaded at power-up.

Disk Operations: Store, load, copy, duplicate disk, pack disk, rename, purge, and format disk.

Programmability

Instrument settings and operating modes, including automatic measurements, may be remotely programmed via RS-232C or HP-IB (IEEE-488).

Hardcopy Output

Printers Supported: HP ThinkJet, HP QuietJet, HP LaserJet, HP PaintJet, HP Deskjet, Epson and Epson-compatible (e. g. Epson FX-80) via RS-232C or HP-IB.

RS-232C Configurations: Protocols: XON/XOFF, Hardware; Data bits: 8; Stop bits: 1, 1 1/2, 2; Parity: none, odd, or even; Baud rates: 110, 300, 600, 1200, 2400, 4800, 9600, 19200.

Input/Output Rear Panel BNCs:

Input BNC: Labeled Port-in. Input signal must drive four LS TTL loads, active high.

Output BNC: Labeled Port-out. Output signal is active high, TTL output level: high $\geq$ 2V into 50 Ohms, low $\leq$ 0.4V into 50 Ohms.

Table 1-1. HP 16500A/16501A Operating Characteristics (Continued)

Operating Environment

Temperature:

Instrument: 0 °C to 55 °C (+32 °F to 131 °F).

Disk Media: 10 °C to 50 °C (+50 °F to 122 °F).

Probes and Cables: 0 °C to 65 °C (+32 °F to 149 °F).

Humidity:

Instrument: up to 95% relative humidity at 40 °C (104 °F).

Disk media: 8% to 80% relative humidity at 40 °C (104 °F).

Altitude:

Up to 4600 m (15 000 ft).

Vibration:

Operating: Random vibration 5-500Hz, 10 minutes per axis, ~ 0.3g (rms).

Non-operating: Random vibration 5-500Hz, 10 minutes per axis, ~ 2.4 g (rms);
and swept sine resonant search, 5-500Hz, 0.75g (0-peak),
5 minute dwell at 4 resonances per axis.

Weight

HP 16500A

Net: 18.1 kg (40 lbs) + (0.7 kg (1.6 lbs) x number of optional cards installed).

Shipping: 25.9 kg (57 lbs) + (3.6 kg (8 lbs) x number of optional cards installed).

HP 16501A

Net: 12.2 kg (27 lbs) + (0.7 kg (1.6 lbs) x number of optional cards installed).

Shipping: 19.9 kg (44 lbs) + (3.6 kg (8 lbs) x number of optional cards installed).

Power Requirements:

115 V/230 V, 48 to 66 Hz, 475 W max.

Dimensions:

Refer to figure 1-1 for dimensional detail.

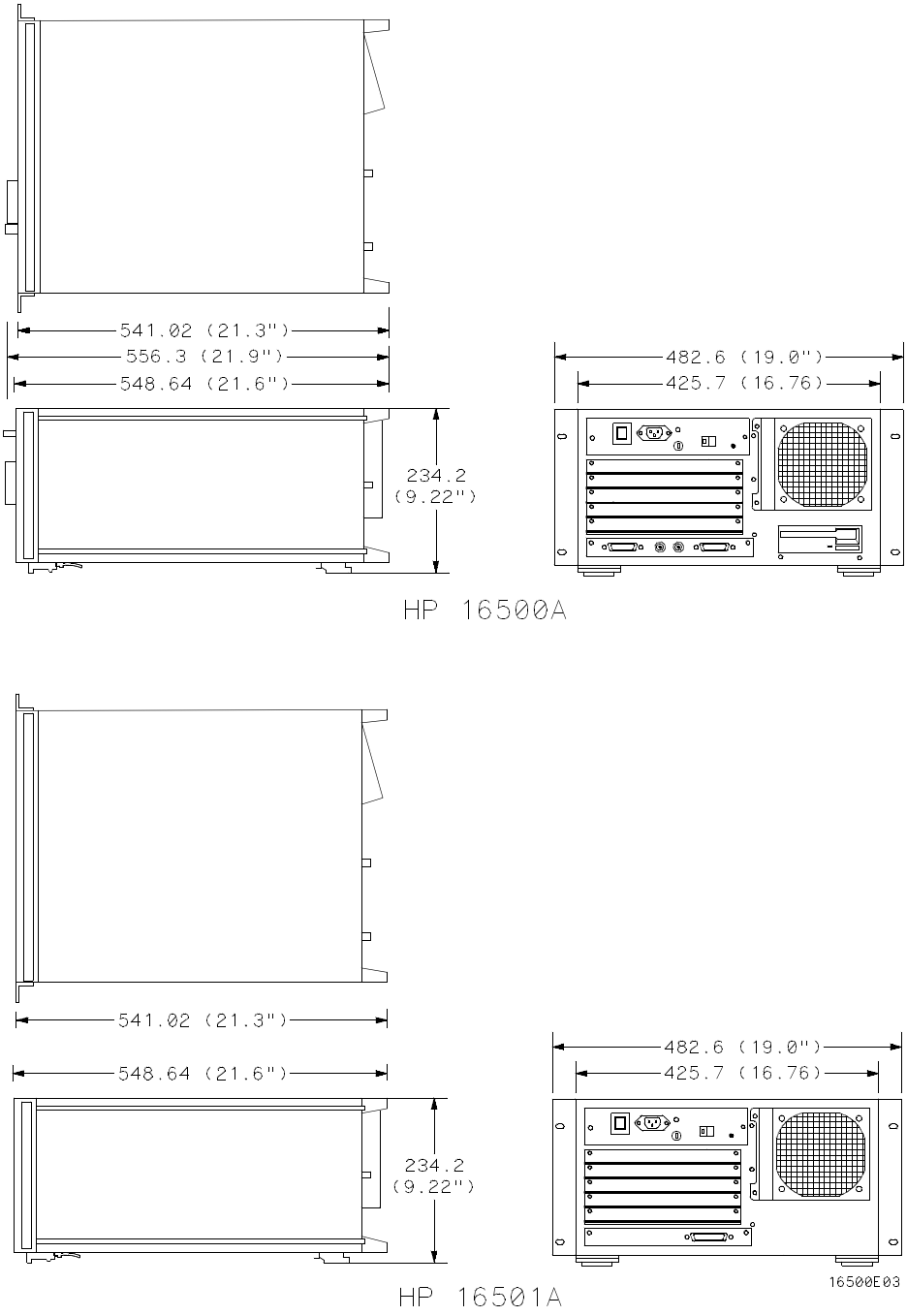


Figure 1-1. Dimensional Detail

Table 1-2. Recommended Test Equipment

Instrument	Critical Specification	Recommended Model	Use*
State Analyzer	10 MHz Acquisition Speed 22 Channels	HP 1651B	T
Oscilloscope	100 MHz Bandwidth	HP 54501A	T
RS-232C Loopback Connector		HP Part No. 01650-63202	T
Voltmeter	3 1/2 Digit Resolution	HP 3468A	T

* A=Adjustments P=Performance Tests T=Troubleshooting

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SECTION II
Installation

2-1. Introduction

This section contains information and instructions necessary for setting up the HP 16500A/16501A Logic Analysis System. This includes inspection procedures, power requirements, hardware connections and configurations, and packaging information.

2-2. Safety Considerations

The safety symbols used with Hewlett-Packard instruments are illustrated in the front of this manual. WARNING and CAUTION symbols and instructions should be reviewed before operating the instrument. These warnings and cautions must be followed for your own protection and to avoid damage to the instrument.

2-3. Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as listed in "Accessories Supplied" in section 1. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not operate properly, notify the nearest Hewlett-Packard Sales Office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard Sales Office. Keep the shipping material for carrier's inspection. The Hewlett-Packard Sales Office will arrange for repair or replacement at Hewlett-Packard's option without waiting for a claim settlement.

2-4. Operating Disk Installation

The HP 16500A is shipped with yellow protective disks in each disk drive. Before applying power to the mainframe, remove the protective disks from the front and rear disk drives, then install the operating disk in one of the disk drives. Reinstall the protective disks whenever the instrument is transported.

2-5. Power Requirements

The HP 16500A and the HP 16501A each require a power source of 115 Vac or 230 Vac, 48 to 66 Hz, 475 W maximum.

2-6. Line Voltage Selection

CAUTION

The instrument may be damaged if the Line Voltage Select switch is not properly set.

When shipped from Hewlett-Packard, the Line Select switch is set and an appropriate fuse is installed for operating the instrument in the country of destination.

To operate the instrument from a power source other than the one set at Hewlett-Packard, proceed as follows:

1. Turn the front panel switch to STBY and turn the rear panel power switch to OFF. Remove the power cord from the instrument.

2. Replace the main fuse with a 5 A/250 V fuse for 230 V operation, or a 10 A/125 V fuse for 115 V operation.

3. Set the rear panel Line Select switch for the desired line voltage. See figure 2-1.

4. Reconnect the power cord, turn on the rear panel power switch, then continue normal operation.

2-7. Power Cable

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power outlet, this cable grounds the instrument cabinet. The type of power cable plug shipped with the instrument depends on the country of destination. See figure 2-2 for option numbers of available power cables and plug configurations.

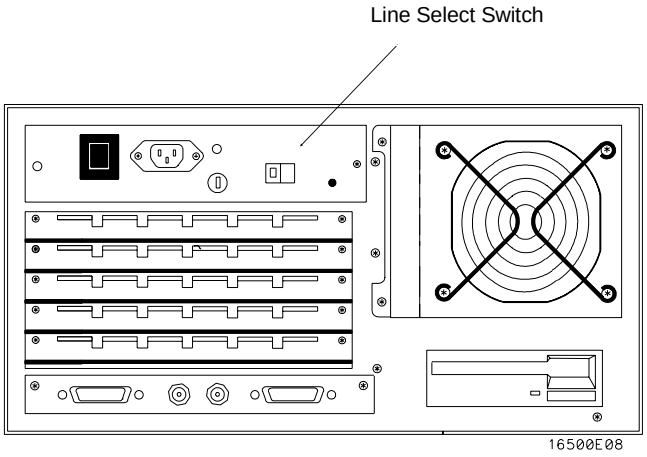
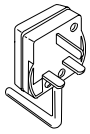
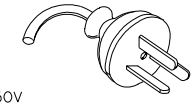
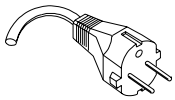
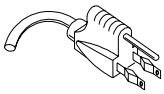
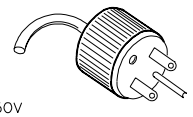
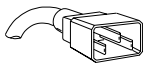
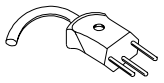
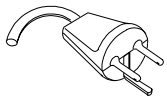
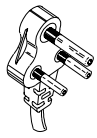
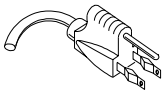


Figure 2-1. Line Voltage Selection

Figure 2-2. Power Cord Configurations

PLUG TYPE	CABLE PART NO.	PLUG DESCRIPTION	LENGTH IN/CM	COLOR	COUNTRY
OPT 900  250V	8120-1351 8120-1703	Straight *BS1363A 90°	90/228 90/228	Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
OPT 901  250V	8120-1369 8120-0696	Straight *NZSS198/ASC 90°	79/200 87/221	Gray Mint Gray	Australia New Zealand
OPT 902  250V	8120-1689 8120-1692 8120-2857	Straight *CEE7-Y11 90° Straight (Shielded)	79/200 79/200 79/200	Mint Gray Mint Gray Coco Brown	East and West Europe, Saudi Arabia, So. Africa, India (Unpolarized in many nations)
OPT 903**  125V	8120-1378 8120-1521 8120-1992	Straight *NEMA5-15P 90° Straight (Medical) UL544	90/228 90/228 96/244	Jade Gray Jade Gray Black	United States, Canada, Mexico, Phillipines, Taiwan
OPT 904**  250V	8120-0698	Straight *NEMA6-15P	90/228	Black	United States, Canada
OPT 905  250V	8120-1396 8120-1625	CEE22-V1 (System Cabinet Use) 250V	30/76 96/244	Jade Gray	For interconnecting system components and peripherals. United States and Canada only
OPT 906  250V	8120-2104 8120-2296	Straight *SEV1011 1959-24507 Type 12 90°	79/200 79/200	Mint Gray Mint Gray	Switzerland
OPT 912  220V	8120-2956 8120-2957	Straight *DHCK107 90°	79/200 79/200	Mint Gray Mint Gray	Denmark
OPT 917  250V	8120-4211 8120-4600	Straight SABS164 90°	79/200 79/200	Jade Gray	Republic of South Africa India
OPT 918  100V	8120-4753 8120-4754	Straight Miti 90°	90/230 90/230	Dark Gray	Japan

Rev. 11NOV88 ART00019

*Part number shown for plug is industry identifier for plug only. Number shown for cable is HP part number for complete cable including plug.

**These cords are included in the CSA certification approval of the equipment.

E=Earth Ground
L=Line
N=Neutral

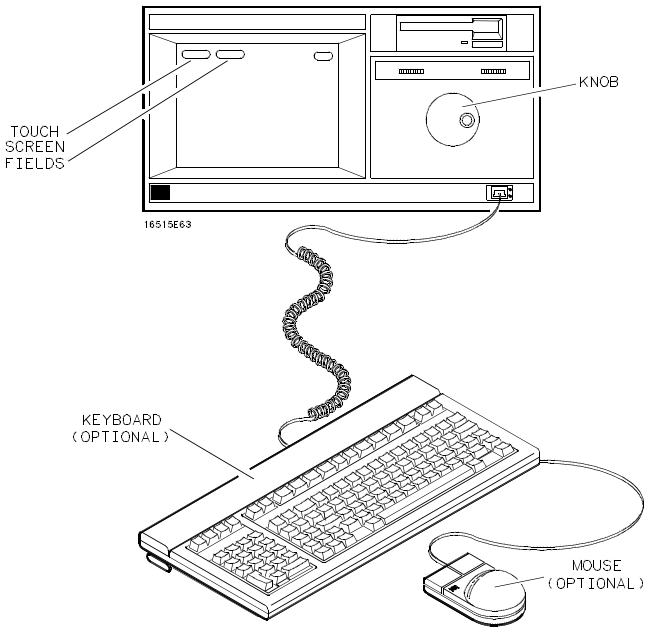


Figure 2-3. HP 16500A User Interface Devices

2-8. User Interface

Four devices may be used to interface with the HP 16500A and all installed modules, the touchscreen, the front panel knob, the optional keyboard, and the optional mouse. See figure 2-3.

For complete operating information refer to the *HP 16500A/16501A Logic Analysis System Operation Reference Manual* and the Operating Manual for each module installed.

The Touchscreen.

The touchscreen interface provides the main front panel control or access to the menus. By touching the appropriate field, you can access other menus, configure the HP 16500A for making measurements, and enter or change alphanumeric data.

The Front Panel Knob

The front panel knob is used to increment or decrement numeric fields and to roll the display. Rolling the display means scrolling through information on screen.

The Optional Mouse

The mouse is an optional user interface accessory (HP 46060A). The mouse functions in the same way as the touchscreen and the knob. Moving it about on a hard, flat surface will move the cursor over the entire screen. To select a field, connect the mouse to the front panel HIL connector and move the mouse until the cursor rests in the desired field. Press the left button of the mouse to complete the selection of the field. To duplicate the knob function, press and hold the right button of the mouse and move it over the desktop. When the correct numerical value or the correct function has been selected, stop moving the mouse and release the right button.

The Optional Keyboard

The keyboard is an optional user interface accessory (HP E2427A). The keyboard can be used interchangeably with the knob, the touchscreen, and the mouse for all menu applications.

2-9. HP-IB Interfacing

The Hewlett-Packard Interface Bus (HP-IB) is Hewlett-Packard's implementation of IEEE Standard 488-1978, "Standard Digital Interface for Programmable Instrumentation." HP-IB is a carefully defined interface that simplifies the integration of various instruments and computers into systems. The interface makes it possible to transfer messages between two or more HP-IB compatible devices. HP-IB is a parallel bus of 16 active signal lines divided into three functional groups according to function.

Eight signal lines, called data lines, are in the first functional group. The data lines are used to transmit data in coded messages. These messages are used to program the instrument function, to transfer measurement data, and to coordinate instrument operation. Input and output of all messages, in bit parallel-byte serial form, are also transferred on the data lines. A 7-bit ASCII code normally represents each piece of data.

Data is transferred by means of an interlocking "handshake" technique, which permits data transfer (asynchronously) at the rate of the slowest active device used in that transfer. The data byte control lines coordinate the handshaking and form the second functional group.

The remaining five general interface management lines (third functional group) are used to manage the devices connected to the HP-IB. This includes activating all connected devices at once and clearing the interface.

The connections to the HP-IB connector on the rear panel are shown in figure 2-4.

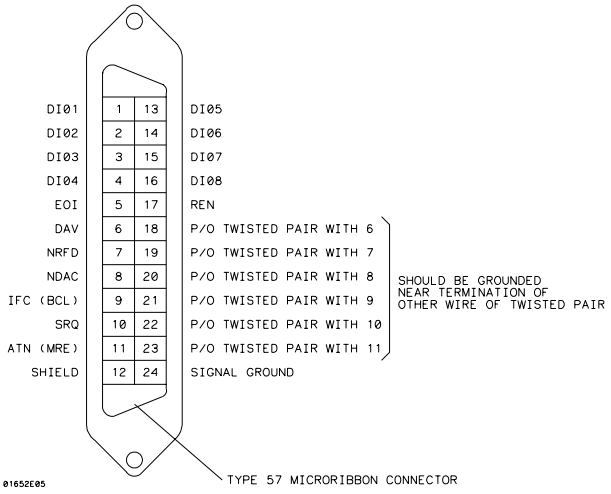


Figure 2-4. HP-IB Interface Connector

2-10. HP-IB Address Selection

Each instrument connected to the HP-IB interface bus requires a unique address. The address provides a method for the system computer to select individual instruments on the bus. The address of the HP 16500A defaults at power-on to decimal "07". The corresponding ASCII code is a listen address of "'" and a talk address of "G".

To change the address of the HP 16500A, proceed as follows:

1. With the operating system disk in one of the disk drives, turn the instrument on to obtain the System Configuration menu. See figure 2-5.

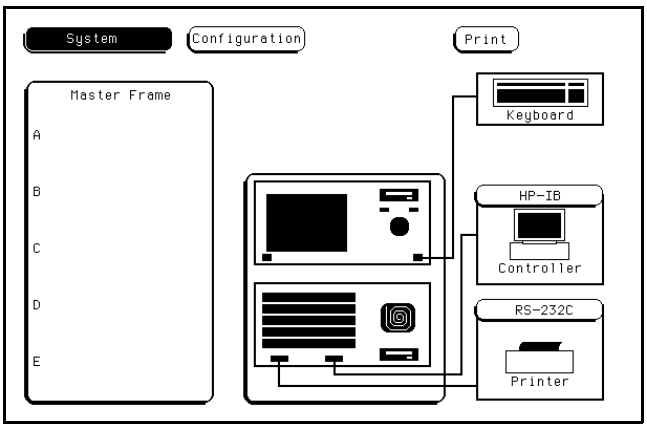


Figure 2-5. System Configuration Menu

2. Touch the **HP-IB** field to obtain the HP-IB Configuration Menu. See figure 2-6.

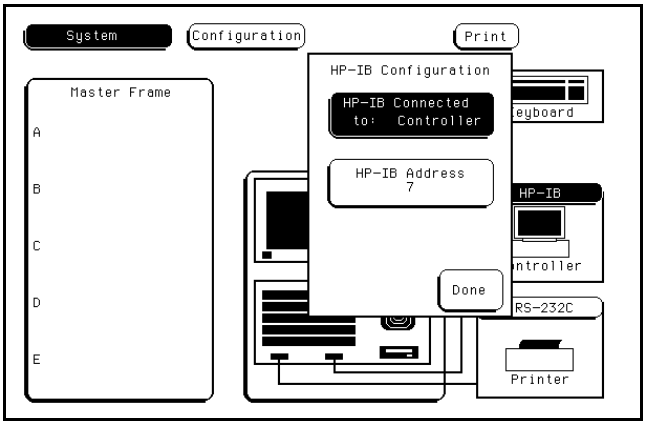


Figure 2-6. HP-IB Configuration Menu

3. Rotate the knob to select the desired HP-IB address. The address number is shown in the HP-IB Address field. The address number may also be entered via the keypad. Touch the **HP-IB** field again to bring up the keypad. Select the new number using the keypad, then touch **Done** to enter

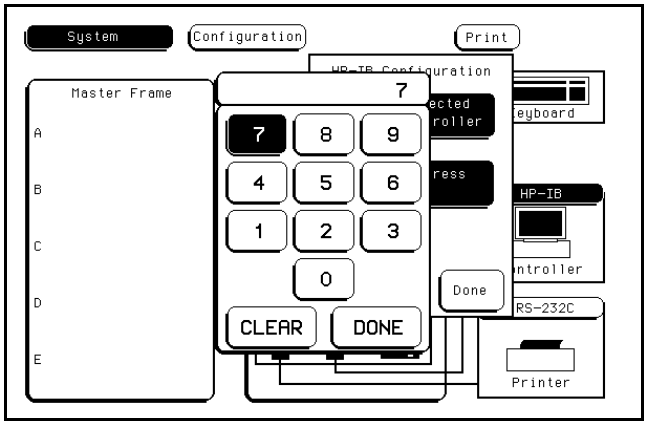


Figure 2-7. HP-IB Configuration with Keypad

the new selected address. See figure 2-7.

4. Touch **Done** to exit the HP-IB Configuration menu.

2-11. HP-IB Interface Functions

The HP-IB interface offers 10 functions to support communications. Table 2-1 lists the HP-IB functions that the HP 16500A uses.

Table 2-1. HP 16500A HP-IB Functions

Mne-monic	Interface Function Name	HP 16500A Implemen-tation
SH	Source Handshake	SH1
AH	Acceptor Handshake	AH1
T	Talker (or TE=Extended Talker)	T5
L	Listener (or LE=Extended Listener)	L4
SR	Service Request	SR1
RL	Remote Local	RL1
PP	Parallel Poll	PP1
DC	Device Clear	DC1
DT	Device Trigger	DT1
C	Any Controller	C0
E	Electrical Characteristics	E2

2-12. RS-232C Interface

The HP 16500A interfaces with RS-232C communication lines through a standard 25-pin D connector. The HP 16500A is compatible with RS-232C protocol.

When a hardwire handshake method is used, the Data Terminal Ready (DTR) line (pin 20 on the Computer/Modem connector) is used to signal whether space is available in the logical I/O buffer for more data. Table 2-2 shows the RS-232C signal definitions.

Table 2-2. RS-232C Signal Definitions

Pin No.	Function	RS-232C Standard	Signal Direction and Level
1	Protective Ground	AA	Not applicable
2	Transmitted Data (TD)	BA	Data from Mainframe High = Space = "0" = +12V Low = Mark = "1"= -12V
3	Received Data (RD)	BB	Data to Mainframe High = Space = "0" = +3V to +25V Low = Mark = "1" = -3V to -25V
4	Request to Send (RTS)	CA	Signal from Mainframe High = ON = +12V Low = OFF = -12V
5	Clear to Send (CTS)	CB	Signal to Mainframe High = ON = +3V to +12V Low = OFF = -3V to -25V
6	Data Set Ready (DSR)	CC	Signal to Mainframe High = ON = +3V to +25V Low = OFF = -3V to -25V
7	Signal Ground (SGND)	AB	Not applicable
8	Data Carrier Detect (DCD)	CF	Signal to Mainframe High = ON = +3V to +25V Low = OFF = -3V to -25V
20	Data Terminal Ready (DTR)	CD	Signal from Mainframe High = ON = +12V Low = OFF = -12V
23	Data Signal Rate Selector	CH/CI	Signal from Mainframe Always High = ON = +12V

2-13. Baud Rate Selection

The baud rate of the HP 16500A is set at power-on for 9600 baud. To change the baud rate, proceed as follows:

1. With the operating system disk in one of the disk drives, turn on the instrument to obtain the System Configuration menu. See figure 2-8.

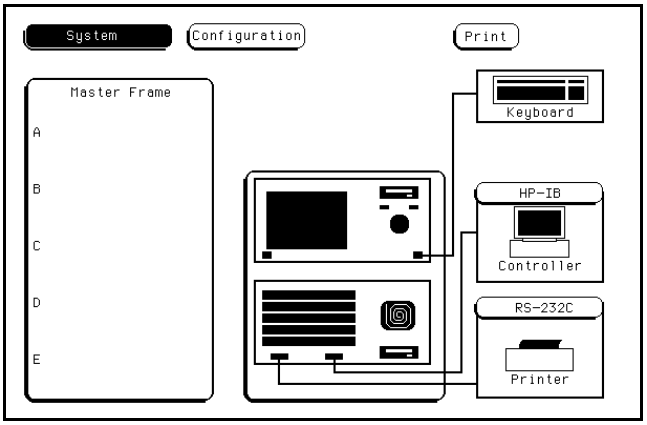


Figure 2-8. System Configuration Menu

2. Touch the **RS-232C** field in the lower right corner of the screen to obtain the RS-232C configuration menu. See figure 2-9.

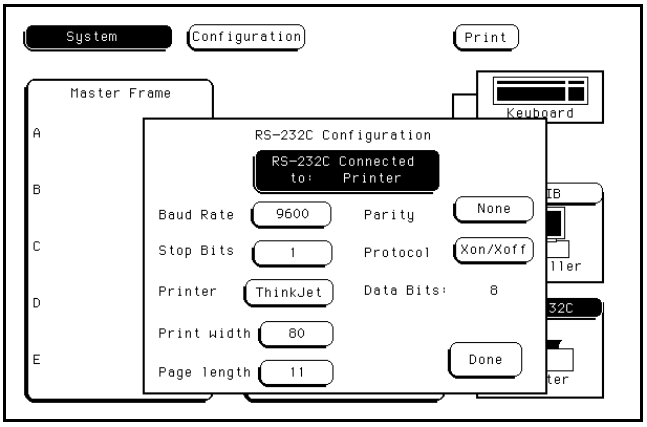


Figure 2-9. RS-232C Configuration Menu

3. Touch the **Baud Rate** field, then select the required rate. See figure 2-10. Make any other changes to the RS-232C configuration while you are in this menu.

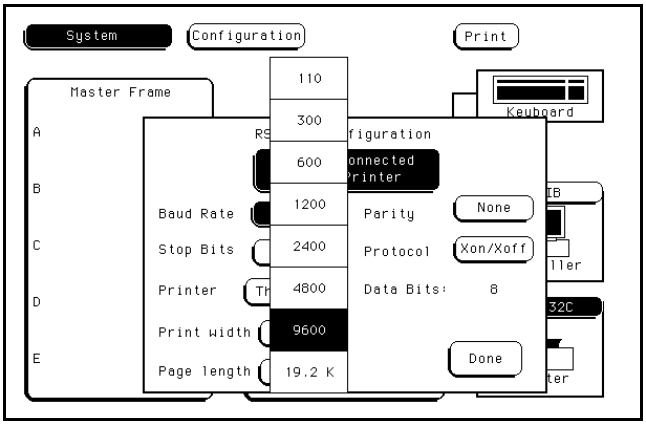


Figure 2-10. Baud Rate Pop-Up Menu

4. When the RS-232C configuration is correct, touch the **Done** field and the System Configuration screen will be displayed.

2-14. Degaussing the Display

After the HP 16500A has been used for awhile, the CRT may become magnetized and the color or other display data may become distorted. To correct these problems, press the Degauss button on the power supply rear panel several times. If the instrument has been subjected to strong magnetic fields, it may be necessary to degauss the CRT with a conventional external television-type degaussing coil or to replace the CRT.

2-15. Operating Environment

The operating environment is listed in table 1-2. Note should be made of the non-condensing humidity limitation. Condensation within the instrument can cause poor operation or malfunction. Protection should be provided against internal condensation.

The HP 16500A/16501A will operate at all specifications within the temperature and humidity range given in table 1-2. However, reliability is enhanced by operating the instrument within the following ranges.

Temperature: +20 °C to +35 °C
(+68 °F to +95 °F)
Humidity: 20% to 80% non-condensing

2-16. Storage and Shipment

The instrument may be stored or shipped in environments within the following limits:

Temperature: -40 °C to +75 °C
Humidity: Up to 90% at 65 °C
Altitude: Up to 15,300 meters (50,000 feet)

The instrument should also be protected from temperature extremes which cause condensation within the instrument.

2-17. Packaging

Use the following general instructions for repacking the instrument with commercially available materials.

- Remove the disks from the disk drives and install the yellow shipping disks.
- Wrap the instrument in heavy paper or plastic.
- Use a strong shipping container. A double-wall carton made of 350-lb test material is adequate.
- Use a layer of shock-absorbing material, 70 to 100 mm (3 to 4 inches) thick, around all sides of the instrument to provide firm cushioning and to prevent movement inside the container. Protect the control panel with cardboard.
- Seal the shipping container securely.
- Mark the shipping container FRAGILE to ensure careful handling.
- In any correspondence, refer to instrument by model number and by full serial number.

2-18. Tagging for Service

If the instrument is to be shipped to a Hewlett-Packard office for service or repair, attach a tag showing the owner (with address), the complete instrument serial number, and a description of the service required.

2-19. Cleaning Requirements

Use mild soap and water to clean the HP 16500A/16501A Do not use ammonia-based products to clean the screen. Ammonia damages the screen coating.

Clean the CRT display and surrounding area regularly. Do not place tape or other foreign material on the screen.

Note

If the CRT display is not clean or if foreign objects block the edges of the screen, touchscreen failures can occur.

Vacuum the ventilation slots on the sides of the instrument and on the rear-panel fan whenever there is a visible amount of dust on them.

2-20. HP 16501A Expansion Frame Installation

CAUTION

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when you are performing any kind of service to this instrument.

Installation Considerations

- The mainframe interface card can be installed in any available card slot in the HP 16500A mainframe.
- Cards or filler panels in the HP 16500A located below the empty slot intended for installation do not have to be moved.

Procedure

1. Turn off the HP 16500A mainframe power switch, then unplug the power cord. Disconnect any input connections.
2. Verify the correct setting of the Line Select switch located on the rear panel of the HP 16501A. See section 2-6, "Line Voltage Selection."
3. Starting **from the top**, loosen thumb screws on filler panels and cards that need to be moved. Starting **from the top**, pull the cards and filler panels **half-way** out. See figure 2-11.
4. Remove the filler panel or card that is in the slot intended for the mainframe interface card. Slide the mainframe interface card into the card cage of the HP 16500A mainframe.

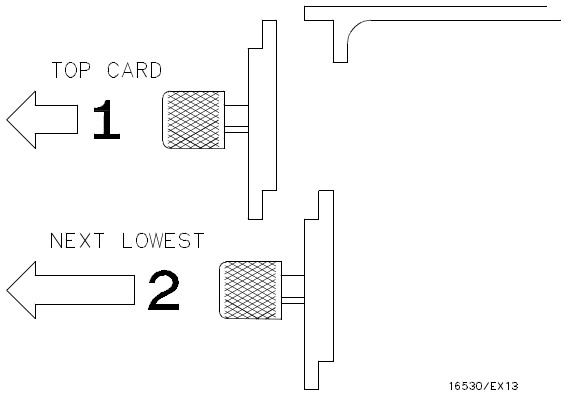


Figure 2-11. Endplate Overlap

5. Reposition all cards and filler panels so that the endplates overlap properly.

6. Firmly seat the bottom card into the backplane connector of the mainframe. **Keep applying pressure to the center of the card endplate while tightening the thumb screws finger tight.** Repeat for all cards and filler panels in a bottom to top order. See figure 2-12.

Note

Any filler panels that are not used should be kept for future use. Filler panels **must** *be installed in all unused card slots for correct air circulation.*

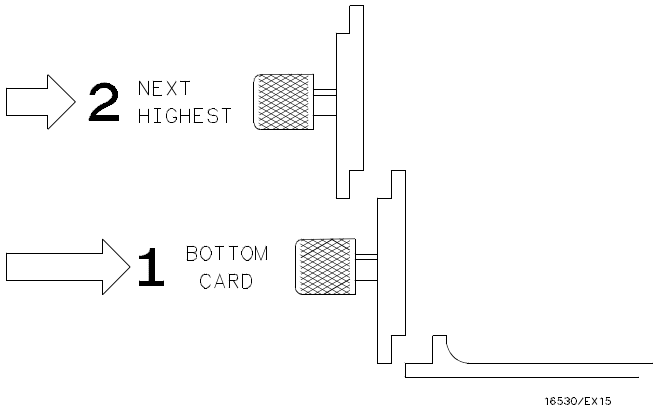


Figure 2-12. Endplate Overlap

Note

In order to ensure correct insertion, the 68-pin "D" connectors on each end of the interface cable are asymmetric in shape. They only fit into their respective ports on the cards when oriented to match the shape of the ports.

7. Insert one end of the interface cable into the port located on the mainframe interface card in the HP 16500A. Insert the other end of the interface cable into the port located on the expansion interface card in the HP 16501A.

Note

When connecting the interface cable, you will hear two clicks. Make sure the cable connector is properly seated into the port by pulling the connector without pressing the release tabs. If the connector is properly seated, it will remain connected to the port.

Figure 2-13 shows the HP 16500A and HP 16501A configuration.

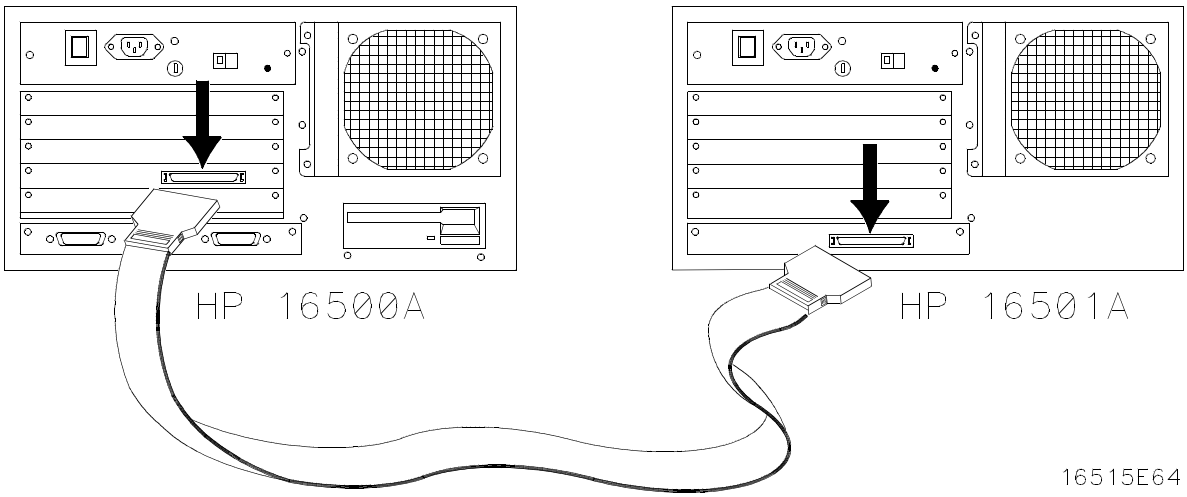


Figure 2-13. Configuration

8. Turn on the HP 16500A/16501A Logic Analysis System.

   a. Connect a power cord to each frame.

   b. Turn on the line switch located on the rear panel of each frame.

   c. Turn on the power standby switch located on the front-panel of the HP 16500A mainframe. When the power-up tests are complete, the HP 16500A mainframe screen shows the Mainframe Interface Card in one of the card slots. See figure 2-14.

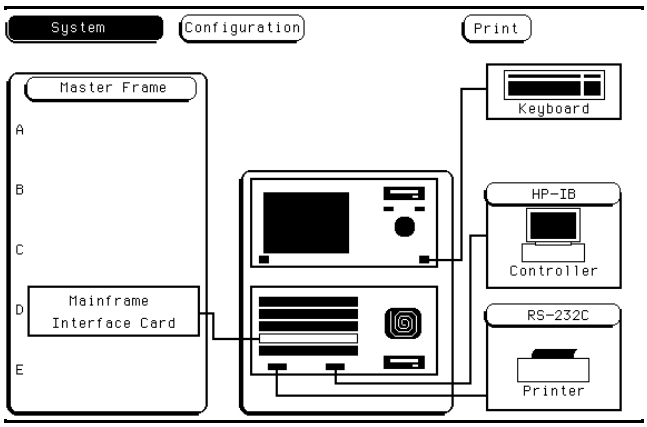


Figure 2-14. System Configuration Menu

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SECTION III
Performance Tests

3-1. Introduction

This section normally contains the performance verification tests. Because there are no specifications for the HP 16500A/16501A to test, there are no performance tests.

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SECTION IV
Adjustments

4-1. Introduction

The HP 16500A/16501A requires no adjusting when used in a normal environment. The procedure given in this section is for the color module. Do not perform these adjustments as part of regular maintenance. Observe the following rules before making any color module adjustments.

CAUTION

Do not perform this procedure as normal maintenance.

Make adjustments only if the instrument has been subjected to extreme magnetic environments and the colors are incorrect.

Before making any adjustments, try degaussing the unit using the rear panel degaussing switch or a color television type degaussing coil.

Only qualified personnel who are familiar with color CRT convergence procedures should perform this adjustment.

Before adjustments are made, mark the position of the potentiometers. This process allows you to return the adjustments to their original starting position.

4-2. Degaussing the Display

After the instrument has been used for awhile, the CRT may become magnetized and the color or other data may become distorted. To correct these problems, press the Degauss button on the power supply rear panel several times. If the instrument has been subjected to strong magnetic fields, it may be necessary to degauss the CRT with a conventional external television-type degaussing coil.

4-3. Safety Considerations

Although this instrument has been designed in accordance with international safety standards, general safety precautions must be observed during all phases of operation, service, and repair of the instrument. Failure to comply with the precautions listed in the Safety Summary at the front of this manual, or with specific warnings given throughout this manual, could result in serious injury or death. Service adjustments should be performed only by qualified service personnel.

WARNING

Read the Safety Considerations at the front of this manual before performing adjustment procedures. Disconnect the instrument from all voltage sources before it is opened for any adjustment, replacement, maintenance, or repair.

4-4. Adjustment Test Patterns

Six test patterns are required for adjusting the color module: one white cross hatch pattern, one white full screen raster, a full screen pattern for each primary color (red, green, blue), and one black full screen raster.

Access to the test patterns is gained through the Mainframe Test system. To access the test patterns, proceed as follows:

1. Insert the operating system disk into one of the disk drives, then turn on the instrument to obtain the System Configuration menu. See figure 4-1.

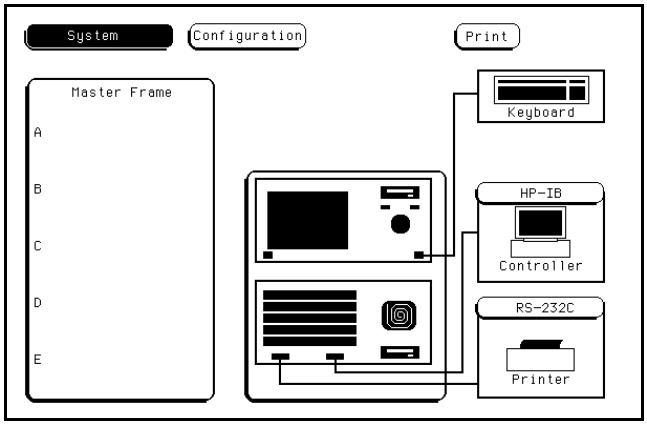


Figure 4-1. System Configuration Menu

2. Touch the **Configuration** field, then touch the **Test** field from the pop-up menu. See figure 4-2.

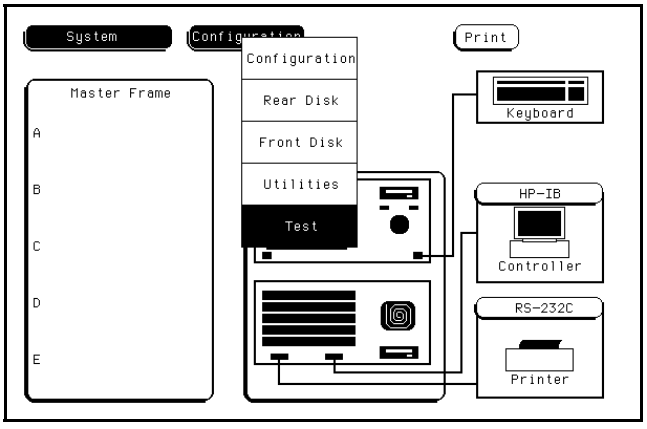


Figure 4-2. Accessing the Test System

3. Verify that test files are on an installed disk. Touch the field close to the center of the screen to load the Test System. See figure 4-3.

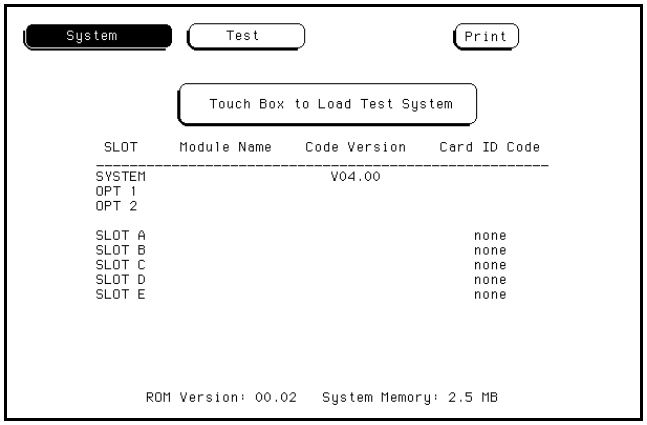


Figure 4-3. Loading the Test System

4. After the Test System has been loaded from the disk, the Test Configuration will be displayed. See figure 4-4.

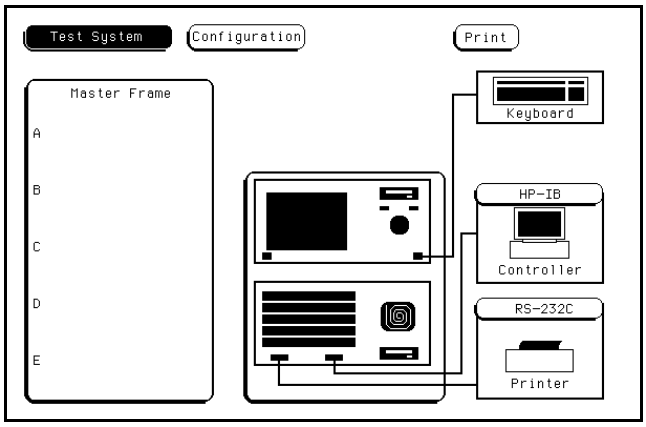


Figure 4-4. Test System Configuration

5. Touch the **Test System** field, then select **Mainframe Test** from the pop-up menu. See figure 4-5.

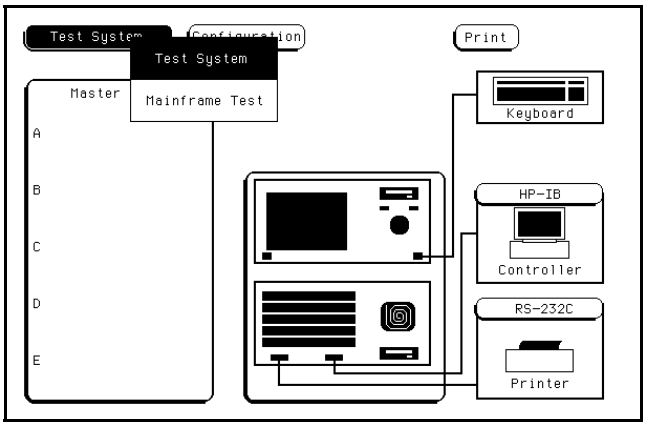


Figure 4-5. Selecting Mainframe Test Menu

6. The Mainframe Test menu is now displayed. See figure 4-6. Select the **Color Display Test** field to display the white cross hatch test pattern, which is the first test pattern in the system. See figure 4-7.

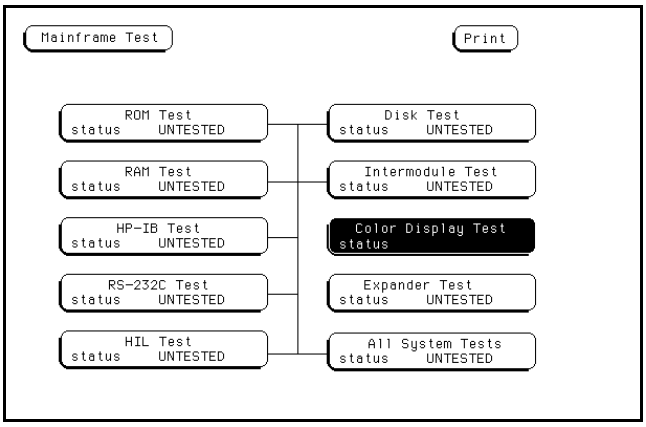


Figure 4-6. Mainframe Test Menu

7. With every touch of the **Continue** field, the next test pattern will be displayed. See figure 4-7.

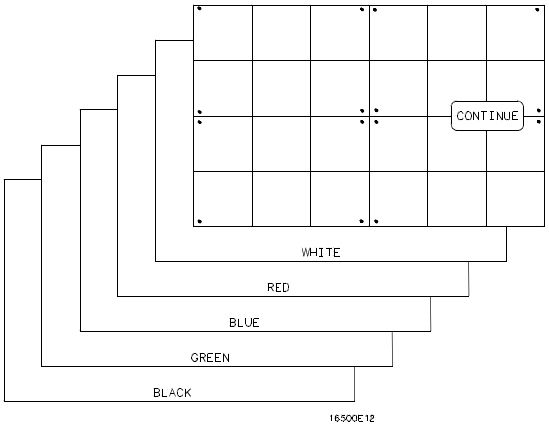


Figure 4-7. Selecting the Test Patterns

When **Continue** is selected from the black raster pattern, the Mainframe Test menu will be displayed. Notice that the status of the Display Test field has changed to TESTED.

8. To exit the Mainframe Test system and to reload the mainframe operating system, touch the **Mainframe Test** field. Then touch the **Test System** field from the pop-up menu shown in figure 4-8. The Test System configuration will be displayed.

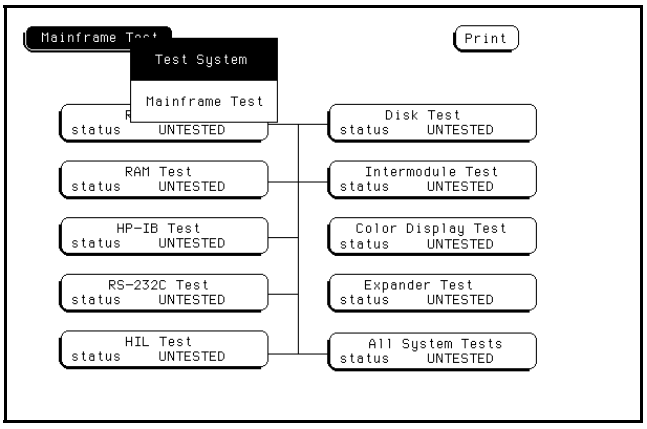


Figure 4-8. Exiting Mainframe Test System

9. Touch the **Configuration** field, then touch **Exit Test.** Install the operating system disk into one of the disk drives, then touch the field close to the center of the screen to reload the mainframe operating system. See figure 4-9.

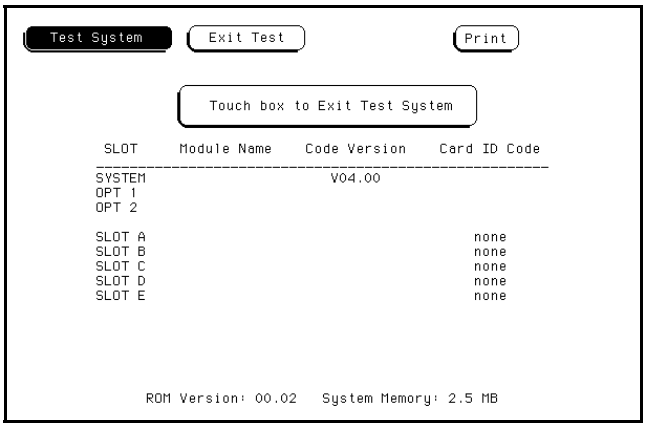


Figure 4-9. Exiting Test System Configuration

10. After the operating system has been reloaded, the System Configuration will be displayed. See figure 4-10.

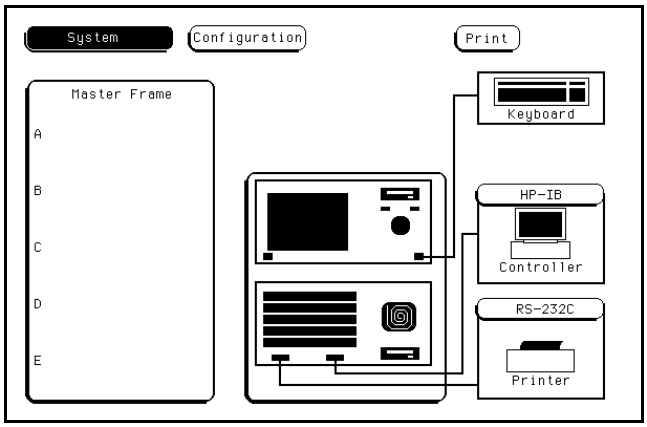


Figure 4-10. System Configuration

4-5. Color Display Module Adjustments

Description:

The Color Display Module is adjusted to compensate for external magnetic influences causing misconvergence.

Note

DO NOT continue with this procedure before first degaussing the CRT screen using the rear panel degaussing switch. In extreme cases of magnetism, it may be necessary to degauss the CRT using a conventional external television-type degaussing coil. During any of the following adjustments, the CRT module must face west.

Equipment Required:

Nonmetallic Adjustment Tool.....HP Part Number 8710-1355

Procedure:

Note

The following adjustments are broken down into adjustment groups. The sequence of the adjustment groups must be followed due to the interaction and dependency of one adjustment to another. The adjustment group sequence is shown in the adjustment flow diagram in figure 4-11. There will be cases where not all the adjustment groups will be used. For example, if the Geometry Adjustment Group corrects the problem, this will be the only group used.

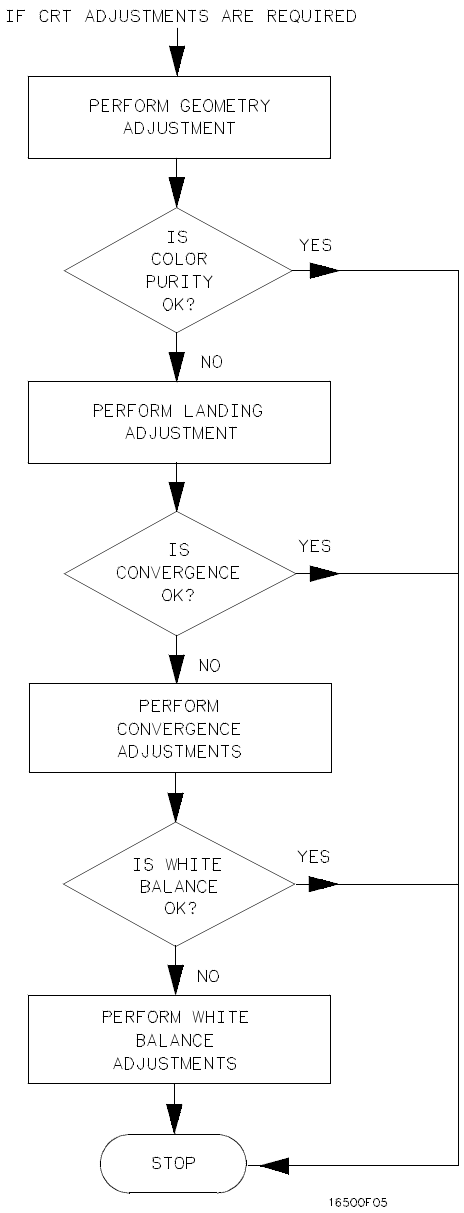


Figure 4-11. CRT Module Adjustment Flow Diagram

Geometry Adjustments

1. From the Mainframe Test System, select the Display Test menu. Select the white cross hatch test pattern. Refer to section 4-4, "Adjustment Test Patterns," for accessing the test patterns.

2. Preset the front panel BACKGROUND control to mechanical center.

3. Preset the front panel BRIGHTNESS control to maximum.

4. Preset H.SUB SHIFT (RV006) and V.SUB SHIFT (RV008), located on the bottom PC board, to mechanical center.

5. Using a flexible ruler, adjust H.SIZE (RV504) and V.HEIGHT (RV502), located on the left hand side PC board, so that the border of the cross-hatch is 120.5 mm (4.74 in.) vertically and 161 mm (6.34 in.) horizontally.

6. Adjust V.CENT (RV510) and H.CENT (RV503), located on the left hand side PC board, to center pattern.

7. Adjust PIN AMP (RV506), located on the left hand side PC board, to eliminate pincushion distortion in the vertical lines of the cross-hatch pattern as shown in figure 4-12.

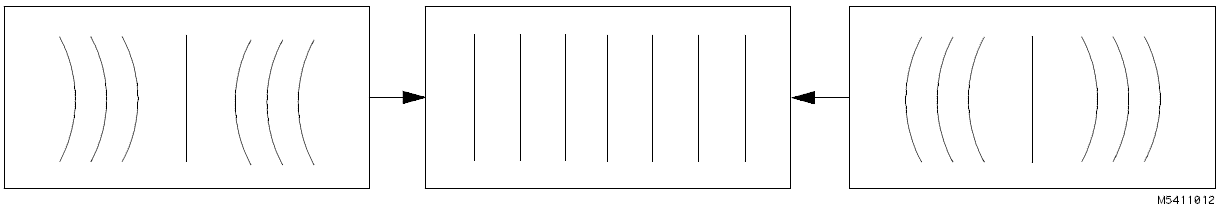


Figure 4-12. PIN AMP Adjustment

Geometry Adjustments (Continued)

8. Set the instrument on its left side, color module side up, then remove the bottom rail. See figure 4-13.

Note

Leave the instrument standing on its left side until the PIN PHASE adjustment has been completed.

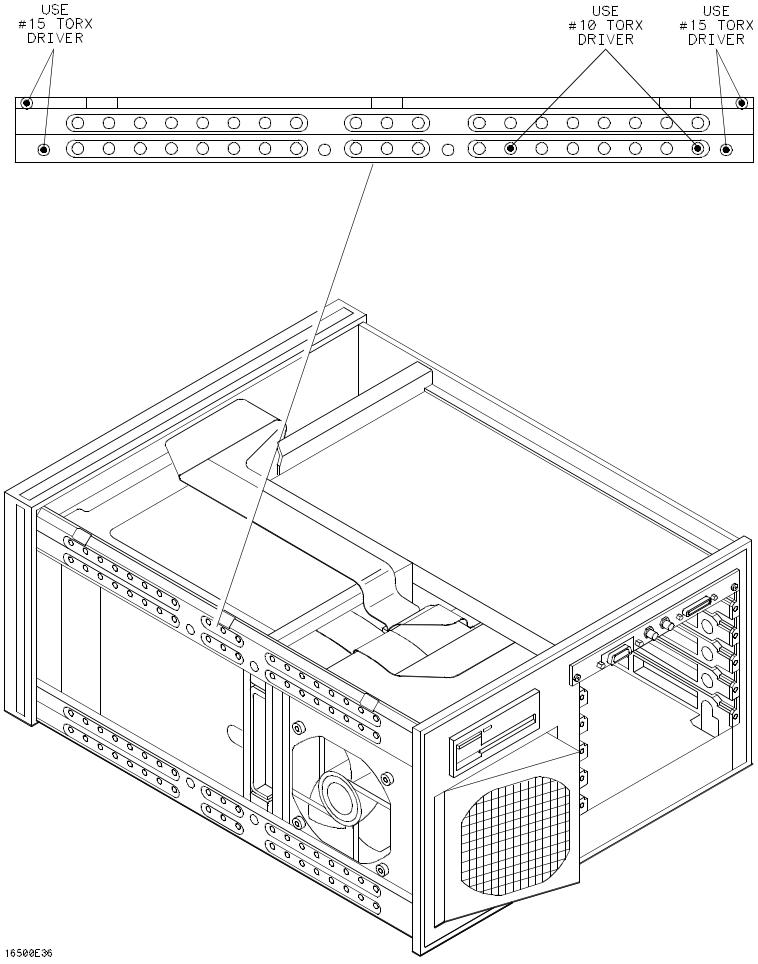


Figure 4-13. Bottom Rail Removal

Geometry Adjustments (Continued)

9. Adjust PIN PHASE (RV505), located on the left side PC board, to eliminate pin phase distortion in vertical lines of cross-hatch pattern as shown in figure 4-14.

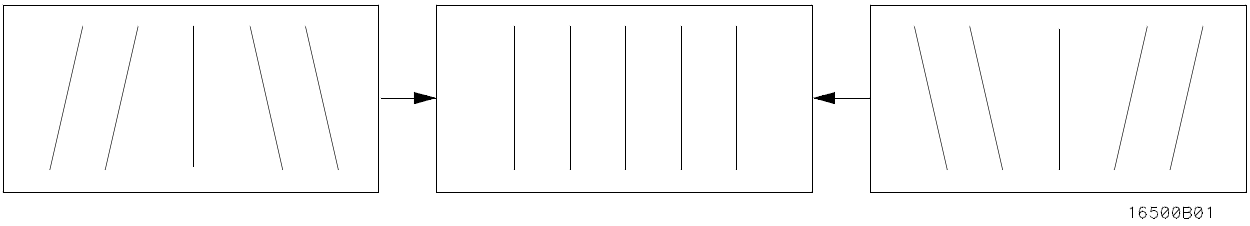


Figure 4-14. PIN PHASE Adjustment

10. Reinstall the bottom rail.

11. Adjust the TOP PIN (RV511), located on the left hand side PC board, so the top horizontal line is parallel with the center horizontal line.

12. Adjust the BOTTOM PIN (RV512), located on the left hand side PC board, so the bottom horizontal line is parallel with the center horizontal line.

Focus Adjustment

Note

Geometry adjustments must be performed before making the focus adjustment.

1. Remove the rear and side fan. Refer to section 6, "Service," for the fan removal procedures.
2. From the Display Test menu of the Mainframe Test system, select the white cross-hatch test pattern.
3. Adjust FOCUS (RV701), located on the rear PC board, for best overall focus.

Landing and Convergence Adjustment Preparation

1. From the Display Test menu, select a white raster pattern and check for color purity. Repeat this step using the Red, Green, and Blue raster patterns and check for color purity.

   If the color purity is correct, do not perform this Landing and Convergence adjustment.
2. Turn off the instrument, then disconnect the power cord. Loosen the deflection yoke clamp screw.
3. Remove the deflection yoke spacers by moving the deflection yoke towards the rear of the instrument, then by removing the spacers.

Note

The deflection yoke spacers are tapered rubber blocks located between the front of the yoke and the rear of the CRT funnel.

4. Plug the power cord into the instrument, then turn on the instrument. For thermal stability, allow the instrument to warm up for 20 minutes.

WARNING

Exercise caution when moving purity magnets. Power is applied to the instrument and high voltages are present around the CRT.

Landing Adjustment

1. From the Display Test menu, select the white raster (full screen display).
2. Turn the front panel BRIGHTNESS Control to maximum.
3. Degauss the entire CRT screen by pressing the Degaussing switch located on the rear panel of the instrument.

Note

In cases where your environment or the shipping environment has caused high levels of magnetization to take place, you may need to externally degauss the CRT using a conventional television-type degaussing coil to completely degauss the CRT.

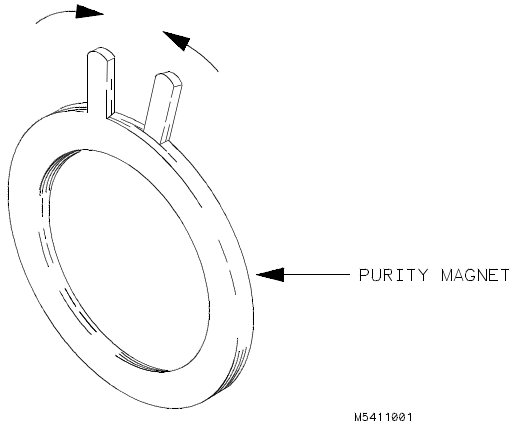


Figure 4-15. Purity Magnet Centering

4. Set the purity magnet tabs to mechanical center. See figure 4-15.
5. Select the green raster from the Display Test menu.

Landing Adjustment (Continued)

6. Move the deflection yoke towards the rear of the instrument, until the left edge of the raster turns red

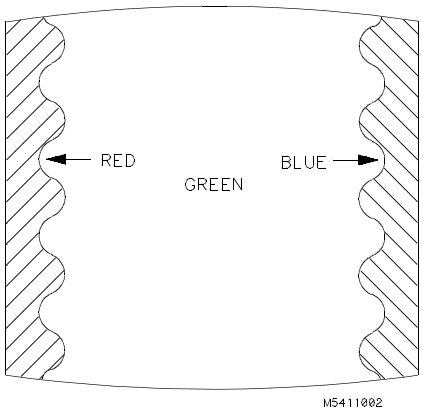


Figure 4-16. Purity Magnet Adjustment Raster

and the right edge of the raster turns blue. See figure 4-16.

7. Adjust the purity magnets until green is in the center of the raster with red and blue bands evenly distributed on the sides. See figure 4-15. The purity magnets need no more than ±15° movement from the mechanical center.

8. Move the deflection yoke forward until the entire raster is green.

Note

The landing adjustment is easier if the yoke is moved all the way forward and then moved backward until the raster is completely green.

9. Replace the green raster with a full screen red raster. Check for proper landing adjustment (color purity). Select a blue full-screen raster and check it for proper landing adjustment.

Landing Adjustment (Continued)

10. If the landing is not correct in step 9, repeat steps 6 through 9 for the best compromise. See

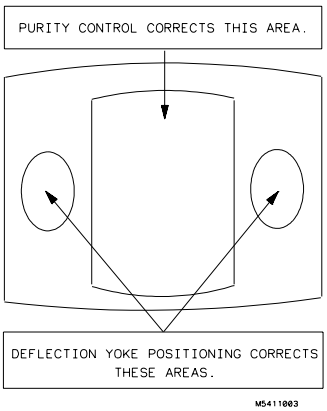


Figure 4-17. Landing and Purity Adjustment Guide

figure 4-17.

11. If the landing is not correct in step 10, readjust the purity magnets for the best landing of each color.

12. Turn off the instrument and remove the power cord. Reinstall the yoke spacers.

13. When the landing adjustment is complete, tighten the deflection yoke clamp screw just enough to keep the yoke from moving. DO NOT over-tighten.

Note

While moving the deflection yoke forward and backward, rotate the yoke as necessary to make the vertical edges of the raster parallel to the sides of the instrument frame.

Static Convergence

1. Preset the front panel BACKGROUND control to mechanical center.

2. Preset the front panel BRIGHTNESS control to maximum.

3. Temporarily disconnect the power from the instrument and remove the PC board shield cover from the rear of the CRT Display Module by prying evenly on all four sides.

4. Reapply the power and from the Display Test menu select the white cross-hatch test pattern.

5. Check the four dots located around the center intersection of the cross-hatch pattern for coincidence of blue, red, and green dots. If the dots are not coincident, adjust H.STAT (RV703), located on the rear PC board, to obtain horizontal coincidence and V.STAT (RV803), located on the bottom PC board, to obtain vertical coincidence. See figure 4-18.

Note

Due to interaction, the BEAM LANDING will need to be readjusted if either H.STAT or V.STAT adjustments are made. Once the BEAM LANDING is readjusted, repeat step 5, if necessary, to obtain center-screen coincidence of the dots.

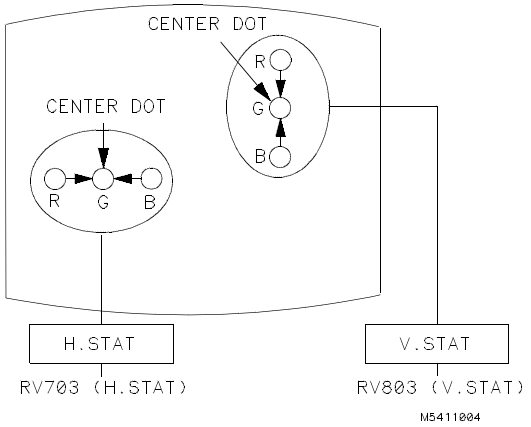


Figure 4-18. Static Convergence

Dynamic Convergence

1. From the Display Test menu, select the white cross-hatch test pattern.

2. Adjust the Y BOW (RV805), located on the bottom PC board, to eliminate red, green, and blue bowing at the top and bottom of the center vertical line. See figure 4-19.

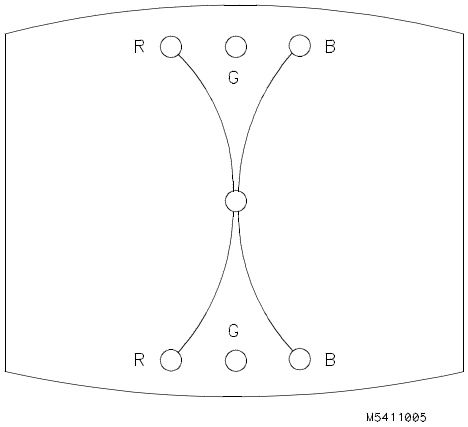


Figure 4-19. Y BOW Adjustment

3. Adjust the Y BOW CROSS (RV804), located on the bottom of the PC board, to eliminate red, green, and blue orthogonal misalignment at the top and bottom of the center vertical line. See figure 4-20.

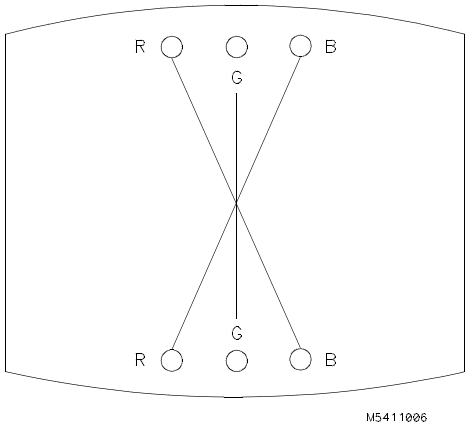


Figure 4-20. Y BOW CROSS Adjustment

Dynamic Convergence (Continued)

4. Adjust the V.STAT TOP (RV801) and the V.STAT BOTTOM (RV802), located on the bottom PC board. These two adjustments allow you to obtain coincidence of red, blue, and green where the top and bottom horizontal lines intersect with the center vertical line. See figures 4-21 and 4-22.

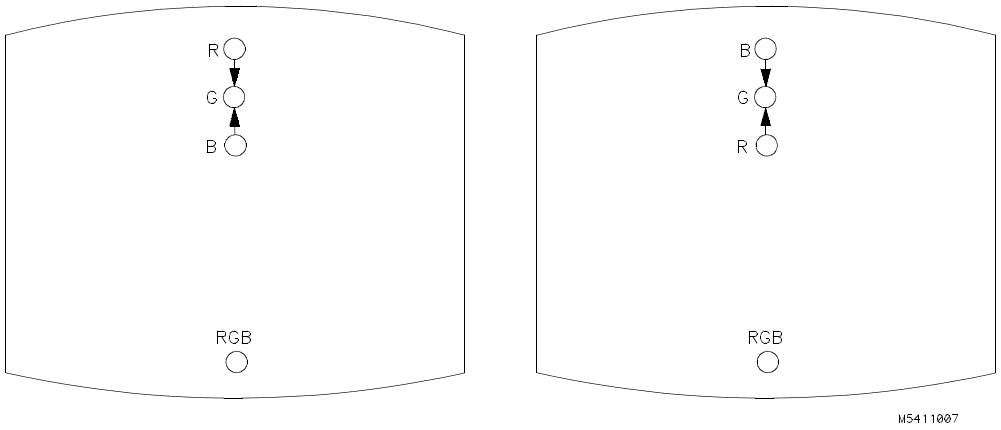


Figure 4-21. V.STAT TOP Adjustment

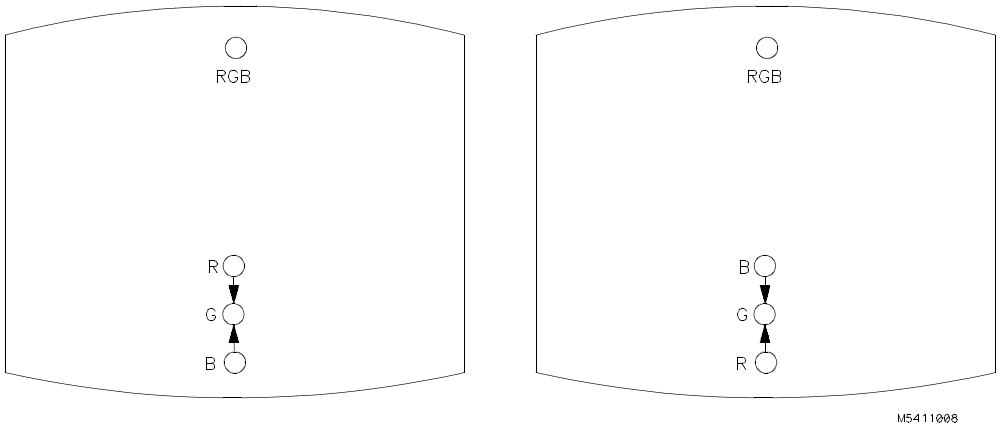


Figure 4-22. V.STAT BOTTOM Adjustment

Dynamic Convergence (Continued)

5. Adjust the H.AMP (RV807), located on the bottom PC board, for equal amounts of misconvergence

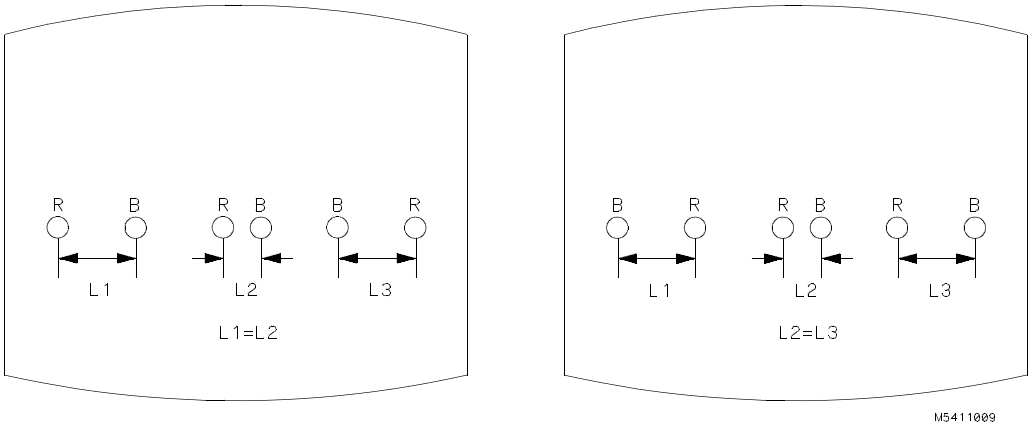


Figure 4-23. H.AMP Adjustment

at the right and left sides of the screen. See figure 4-23.

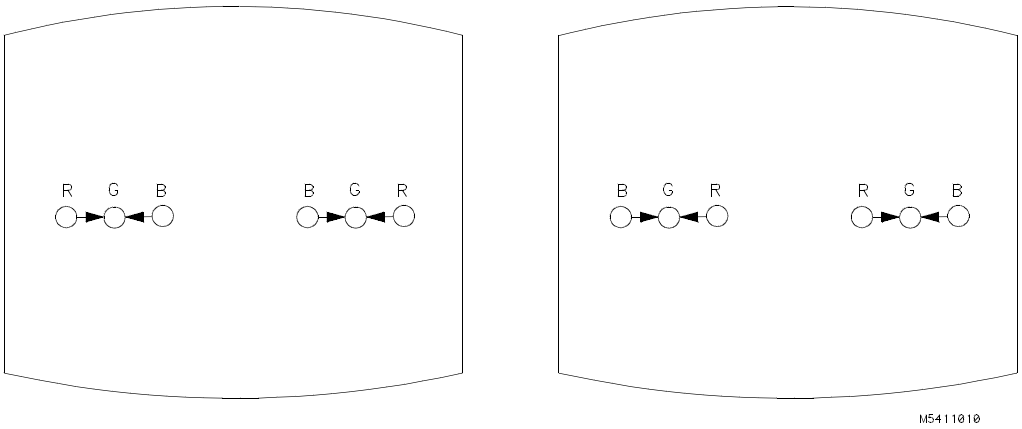


Figure 4-24. H.TILT Adjustment

6. Adjust the H.TILT (RV806), located on the bottom PC board, for coincidence of red, green, and blue at the right and left sides of the screen. See figure 4-24.

White Balance

1. From the Display Test menu, select a blank (colorless) raster.

Note

Any text on the screen will not affect this adjustment.

2. Set the front panel BACKGROUND and SUB BRT (RV901), located on the bottom PC board, to mechanical center.

3. Set the front panel BRIGHTNESS and SUB CONT (RV902), located on the bottom PC board, to mechanical center.

4. Set the G. DRIVE (RV921), B. DRIVE (RV931), and R. DRIVE (RV911), located on the bottom PC board, to mechanical center.

5. Set the G.BKG (RV721), B.BKG (RV731), and R.BKG (RV711), located on the rear PC board, fully counterclockwise (CCW).

6. Adjust the SCREEN (RV702), located on the rear PC board, until either a red, green, or blue raster just starts to become visible. Note which color becomes visible first and do not adjust background control (BKG) for that color in the next step.

7. Adjust the other two background (BKG) controls for the best white balance.

8. From the Display Test menu, select the white raster test pattern.

9. Set the front panel BRIGHTNESS control to maximum.

10. Observe the screen and adjust the DRIVE controls (RV921, RV931, and RV911), located on the bottom PC board for the best white balance.

Note

Using an average piece of white photocopy paper, compare the white on the CRT to the paper.

11. Repeat steps 1 through 3 and 6 through 10 until the white balance is acceptable.

12. Reinstall the cooling fans. Refer to section 6, "Service," for the fan installation procedures.

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SECTION V
Replaceable Parts

5-1. Introduction

This section contains information for ordering parts. Table 5-1 lists abbreviations used in the parts list. Table 5-2 and table 5-3 list all replaceable parts in reference designator order.

5-2. Abbreviations

Table 5-1 lists abbreviations used in the parts list and throughout the manual. In some cases, two forms of the abbreviations are used, one all in capital letters, and one in partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in other parts of the manual other abbreviation forms are used with both lower and uppercase letters.

5-3. Replaceable Parts List

Table 5-2 shows the list of replaceable parts for the HP 16500A and table 5-3 shows the list of replaceable parts for the HP 16501A. The tables are organized as follows:

- Exchange assemblies in alphanumerical order by reference designation.
- Electrical assemblies in alphanumerical order by reference designation.
- Chassis-mounted parts in alphanumerical order by reference designation.

The information given for each part consists of the following:

- Reference designator.
- Hewlett-Packard part number.
- Check digit (CD).
- Total quantity (Qty) in the instrument. The total quantity for each part is only given once, at the first appearance of the part number in the list.
- Part description.

5-4. Exchange Assemblies

Some of the parts used in this instrument have been set up on an exchange program. This allows the customer to exchange a faulty assembly with one that has been repaired, calibrated, and performance-verified at Hewlett-Packard. The cost of the exchange assembly is significantly less than that of a new part.

Exchangeable assemblies are listed separately in table 5-2 and in table 5-3, under the heading "Exchange Assemblies." They usually have a part number in the form XXXXX-695XX (where the new part would be XXXXX-665XX).

Before ordering an exchange assembly, check with your Hewlett-Packard Sales Office for the procedures associated with the exchange program.

5-5. Ordering Information

To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number and check digit, indicate the quantity required, and address the order to the nearest Hewlett-Packard Sales Office.

To order a part not listed in the replaceable parts table, include the instrument model number, the instrument serial number, the description and function of the part, and the quantity of parts required. Address the order to the nearest Hewlett-Packard Sales Office.

5-6. Direct Mail Order System

Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

- Direct ordering and shipping from Hewlett-Packard Parts Center in Mountain View, California.
- No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through local Hewlett-Packard Sales Offices when orders require billing and invoicing).
- Prepaid transportation (there is a small handling charge for each order).
- No invoices.

To provide these advantages, a check or money order must accompany each order.

Mail-order forms and specific ordering information are available through your local Hewlett-Packard Sales Office.

Table 5-1. Reference Designator and Abbreviations

REFERENCE DESIGNATOR

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

ABBREVIATIONS

A		DWL	**=dowel**	=kilo(103)	**MFR**	=manufacturer
A/D	=amperes	**ECL**	=emitter coupled logic	=low	MICPROC	=microprocessor
AC	=analog-to-digital	**ELAS**	=elas-tomeric	=pound	MINTR	=miniature
ADJ	=alternating current	**EXT**	=external	=latch	**MISC**	=miscellaneous
AL	=adjust(ment)	**F**	=far-ads;metal film (resistor)	=local	**MLD**	=molded
AMPL	=aluminum			=light-emitting diode	**MM**	=millimeter
ANLG	=amplifier	**FC**	=carbon film/ composi-tion	=long	**MO**	=metal oxide
ANSI	=analog =American National Standards Institute	**FD**		=lithium	**MTG**	=mounting
		FEM		=lock	**MTLC**	=metallic
ASSY	=assembly	**FF**		=lockwasher	**MUX**	=multiplexer
ASTIG	=astigmatism	**FL**		=low power Schottky	**MW**	=milliwatt
ASYN-CHRO	=asynchronous	**FM**		=low voltage	**N**	=nano(10-9)
ATTEN	=attenuator	**FR**		=mega(106);megohms; meter(distance)	**NC**	=no connection
AWG	=American wire gauge	**FT**	=feed	=machine	**NMOS**	=n-channel metal-oxide-semiconductor
BAL	=balance	**FW**	=female	=maximum	**NPN**	=negative-positive-negative
BCD	=binary-code decimal	**FXD**	=flip-flop		**NPRN**	=neoprene
BD	=board	**GEN**	=flat		**NRFR**	=not recommended for field replacement
BFR	=buffer	**GND**	=foam;from		**NSR**	=not separately replaceable
BIN	=binary	**GP**	=front		**NUM**	=numeric
BRDG	=bridge	**GRAT**	=gain band-width product		**OBD**	=order by description
BSHG	=bushing	**GRV**			**OCTL**	=octal
BW	=bandwidth	**H**			**OD**	=outside diameter
C	=ceramic;cermet (resistor)	**HD**	=full wave		**OP AMP**	=operational amplifier
CAL	=calibrate;calibration	**HDND**	=fixed		**OSC**	=oscillator
CC	=carbon composition	**HG**	=generator		**P**	=plastic
CCW	=counterclockwise	**HGT**	=ground(ed)		**P/O**	=part of
CER	=ceramic	**HLCL**	=general purpose		**PC**	=printed circuit
CFM	=cubic feet/minute	**HORIZ**	=graticule		**PCB**	=printed circuit board
CH	=choke	**HP**	=groove		**PD**	=power dissipation
CHAM	=chamfered	**HP-IB**	=hen-ries;high		**PF**	=picofarads
CHAN	=channel	**HR**	=hardware		**PI**	=plug in
CHAR	=character	**HV**	=hardened		**PL**	=plate(d)
CM	=centimeter	**HZ**	=mercury		**PLA**	=programmable logic array
CMOS	=complementary metal-oxide-semiconductor	**I/O**	=height		**PLST**	=plastic
CMR	=common mode rejec-tion	**IC**	=helical		**PNP**	=positive-negative-positive
CNDCT	=conductor	**ID**	=horizontal		**POLYE**	=polyester
CNTR	=counter	**IN**	=Hewlett-Packard =Hewlett-Packard Interface Bus		**POS**	=positive;position
CON	=connector	**INCL**			**POT**	=potentiometer
CONT	=contact	**INCAND**			**POZI**	=pozidrive
CRT	=cathode-ray tube	**INP**			**PP**	=peak-to-peak
CW	=clockwise	**INTEN**			**PPM**	=parts per million
D	=diameter	**INTL**			**PRCN**	=precision
D/A	=digital-to-analog	**INV**			**PREAMP**	=preamplifier
DAC	=digital-to-analog converter	**JFET**	=hour(s) =high volt-age		**PRGMBL**	=programmable
DARL	=darlington	**JKT**			**PRL**	=parallel
DAT	=data	**K**	=Hertz		**PROG**	=programmable
DBL	=double	**L**	=input/out-put		**PSTN**	=position
DBM	=decibel referenced to 1mW	**LB**			**PT**	=point
DC	=direct current	**LCH**	=integrated circuit		**PW**	=potted wirewound
DCDR	=decoder	**LCL**			**PWR**	=power
DEG	=degree	**LED**	=inside di-ameter		**R-S**	=reset-set
DEMUX	=demultiplexer	**LG**	=inch		**RAM**	=random-access memory
DET	=detector	**LI**	=include(s)		**RECT**	=rectifier
DIA	=diameter	**LK**	=incandes-cent		**RET**	=retainer
DIP	=dual in-line package	**LKWR**			**RF**	=radio frequency
DIV	=division	**LS**	=input		**RGLTR**	=regulator
DMA	=direct memory access	**LV**	=intensity		**RGTR**	=register
DPDT	=double-pole, double-throw	**M**	=internal =inverter		**RK**	=rack
DRC	=DAC refresh controller	**MACH**	=junction		**RMS**	=root-mean-square
DRVR	=driver	**MAX**	field-effect tran-sistor =jacket			

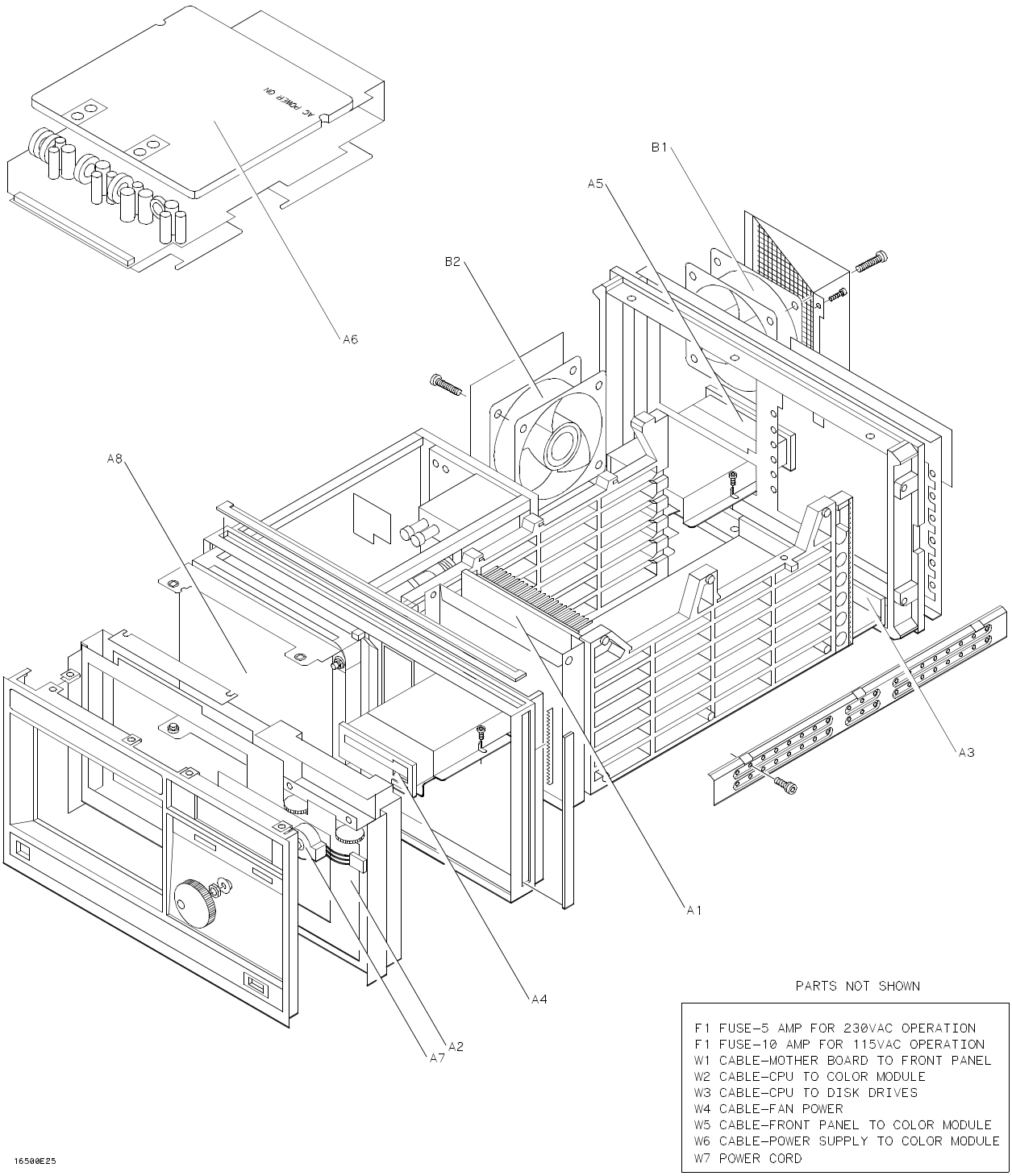
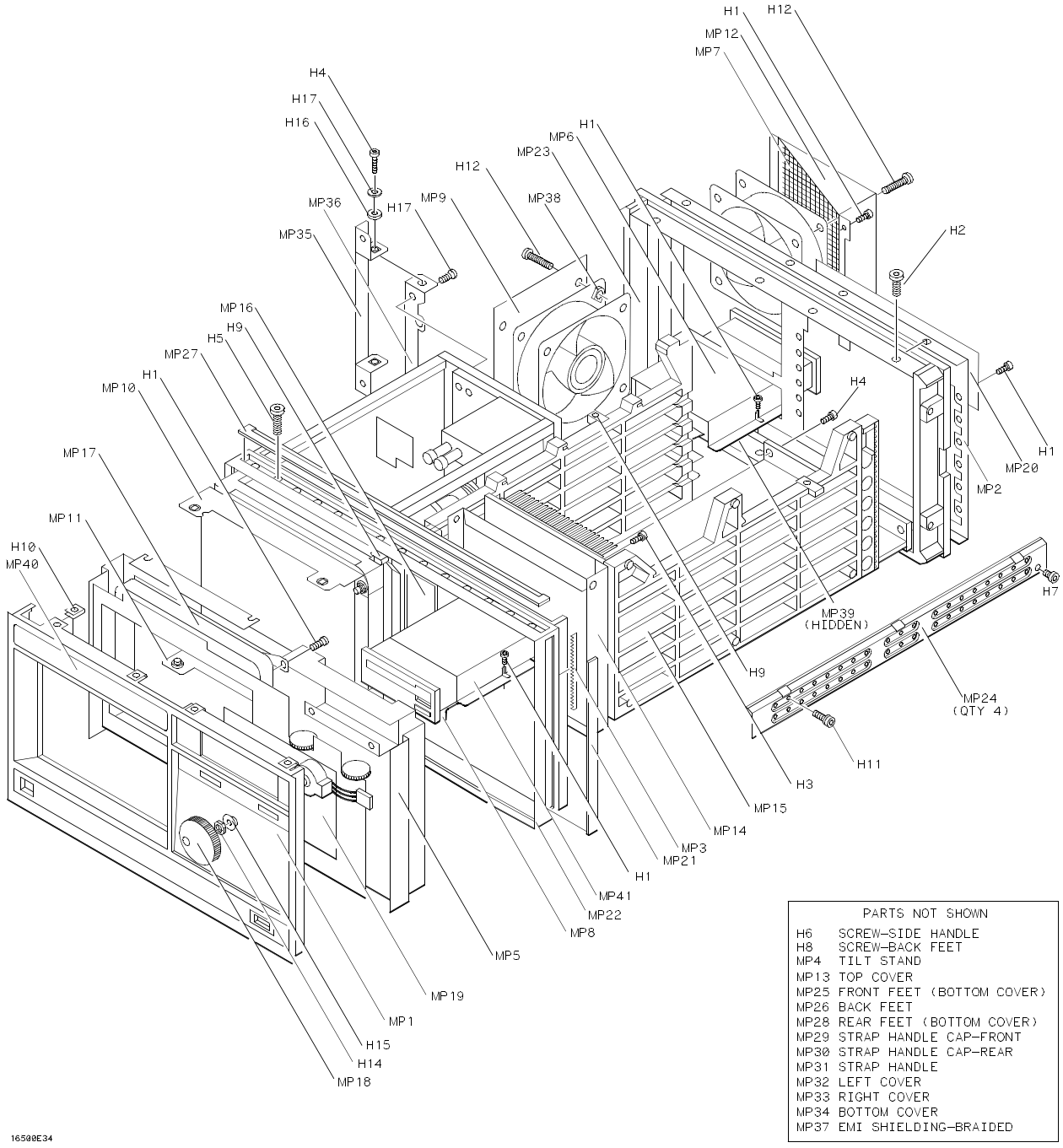


Figure 5-1. HP 16500A Assembly Parts

Table 5-2. HP 16500A Replaceable Parts

Reference Designator	HP Part Number	CD	QTY	Description
				HP 16500A EXCHANGE ASSEMBLIES
A2	16500-69502	5		BOARD ASSEMBLY-FRONT PANEL (EXCHANGE)
A3	16500-69503	6		BOARD ASSEMBLY-MICROPROCESSOR (EXCHANGE-VER. 00.00 ROM)
A3	16500-69507	0		BOARD ASSEMBLY-MICROPROCESSOR (EXCHANGE-VER. 00.02 ROM)
A4	5080-8600	7		FRONT DISK DRIVE (EXCHANGE)
A5	5080-8600	7		REAR DISK DRIVE (EXCHANGE)
A6	16500-69500	3		LOW VOLTAGE POWER SUPPLY ASSEMBLY (EXCHANGE)
				HP 16500A ELECTRICAL ASSEMBLIES
A1	16500-66501	8	1	BOARD ASSEMBLY-MOTHER
A2	16500-66502	9	1	BOARD ASSEMBLY-FRONT PANEL
A3	16500-66503	0	1	BOARD ASSEMBLY-MICROPROCESSOR (VER. 00.00 ROM)
A3	16500-66507	4	1	BOARD ASSEMBLY-MICROPROCESSOR (VER. 00.02 ROM)
A4	0950-1798	0	2	FRONT DISK DRIVE
A5	0950-1798	0		REAR DISK DRIVE
A6	0950-1853	8	1	LOW VOLTAGE POWER SUPPLY ASSEMBLY
A7	0960-0753	6	1	ROTARY PULSE GENERATOR ASSEMBLY
A8	2090-0226	5	1	COLOR CRT MODULE ASSEMBLY
B1	3160-0429	0	2	FAN-TUBEAXIAL
B2	3160-0429	0		FAN-TUBEAXIAL
F1	2110-0010	9		FUSE-5 AMP FOR 230VAC OPERATION
F1	2110-0395	3		FUSE-10 AMP FOR 115VAC OPERATION
W1	16500-61601	9	1	CABLE-MOTHER BOARD TO FRONT PANEL
W2	16500-61602	0	1	CABLE-CPU TO COLOR MODULE
W3	16500-61603	1	1	CABLE-CPU TO DISK DRIVES
W4	16500-61604	2	1	CABLE-FAN POWER
W5	16500-61605	3	1	CABLE-FRONT PANEL TO COLOR MODULE
W6	16500-61606	4	1	CABLE-POWER SUPPLY TO COLOR MODULE
W7	8120-1521	6	1	POWER CORD-UNITED STATES (7.5 FT)
				MISCELLANEOUS
	01650-84502	7	1	ACCESSORY POUCH
	16500-40502	5		FILLER PANEL
	01650-63202	0	1	RS-232C LOOPBACK CONNECTOR
	5061-2819	8	2	YELLOW SHIPPING DISK



PARTS NOT SHOWN

H6 SCREW-SIDE HANDLE
H8 SCREW-BACK FEET
MP4 TILT STAND
MP13 TOP COVER
MP25 FRONT FEET (BOTTOM COVER)
MP26 BACK FEET
MP28 REAR FEET (BOTTOM COVER)
MP29 STRAP HANDLE CAP-FRONT
MP30 STRAP HANDLE CAP-REAR
MP31 STRAP HANDLE
MP32 LEFT COVER
MP33 RIGHT COVER
MP34 BOTTOM COVER
MP37 EMI SHIELDING-BRAIDED

Figure 5-2. HP 16500A Chassis Parts

Table 5-2. HP 16500A Replaceable Parts (continued)

Reference Designator	HP Part Number	CD	QTY	Description
				HP 16500A CHASSIS PARTS
H1	0515-0372	2	38	SCREW M3 X 0.5 8MM-LG
H2	0515-0433	2	12	SCREW M4 X 0.7 10MM-LG
H3	0515-0435	8	6	SCREW M4 X 0.7 14MM-LG
H4	0515-0664	5	6	SCREW M3 X 0.5 12MM-LG
H5	0515-0943	3	14	SCREW M4 X 0.7 12MM-LG
H6	0515-1384	8	2	SCREW M5 X 0.8 10MM-LG
H7	0515-1403	2	16	SCREW M4 X 0.7 6MM-LG 90-DEG FH
H8	0515-1444	1	4	SCREW M3.5 X 0.6 25.4MM-LG (BACK FEET)
H9	0535-0105	1	4	NUT SHEET METAL M4
H10	0535-0106	2	9	NUT SHEET METAL M4
H11	0624-0520	3	9	SCREW TPG 6-19 .5-IN-LG
H12	0515-0821	2	8	SCREW M3 0.5 X 20 (FAN)
H13	2190-0763	7	2	WASHER-FL MTLCH NO. 6 .14-IN-ID .5-IN-OD
H14	2950-0043	8	1	NUT-HEX3/8-32-THD .094-IN-THK (RPG)
H15	3050-0188	5	1	WASHER-SPCR 3/8-IN .385-IN-ID (RPG)
H16	3050-1238	8	2	WASHER-FL NM 9/64 .149-IN-ID .478-IN-OD (COLOR MONITOR SIDE BRACKET)
H17	0515-0641	5	2	SCREW (COLOR MONITOR BRACKET)
MP1	16500-40202	2	1	FRONT PANEL
MP2	16500-00201	7	1	REAR PANEL
MP3	0363-0125	0	4	RFI STRIP-FINGERS (TOP AND BOTTOM COVERS)
MP4	1460-1345	5	2	TILT STAND
MP5	16500-00601	1	1	STATIC SHIELD
MP6	16500-00602	2	1	DISK DRIVE SHIELD-REAR
MP7	16500-00603	3	1	FAN SCREEN-REAR
MP8	16500-01209	7	1	BRACKET-FRONT DISK DRIVE
MP9	16500-01210	0	1	BRACKET-REAR DISK DRIVE AND SIDE FAN
MP10	16500-01205	3	1	BRACKET-COLOR MODULE TOP
MP11	16500-01206	4	1	BRACKET-COLOR MODULE BOTTOM
MP12	16500-01207	5	1	FAN SHROUD-REAR
MP13	16500-04102	5	1	TOP COVER
MP14	16500-04701	0	1	STRUT-MOTHER BOARD
MP15	16500-23101	4	1	CARD GUIDE-SIDE
MP16	16500-23102	5	1	CARD GUIDE-CENTER
MP17	16500-42201	5	1	TOUCHSCREEN BEZEL
MP18	16500-42502	9	1	CONTROL KNOB
MP19	16500-45401	3	1	INSULATOR-FRONT PANEL BOARD
MP20	16500-61202	6	1	POWER SUPPLY COVER-REAR PANEL
MP21	5001-0541	3	2	SIDE TRIM-FRONT FRAME
MP22	5021-8407	8	1	FRAME-FRONT
MP23	5021-5808	7	1	FRAME-REAR
MP24	5021-5837	2	4	STRUT-CORNER
MP25	5041-8801	8	2	FEET-FRONT (BOTTOM COVER)
MP26	54110-40502	3	4	FEET-BACK
MP27	5041-8802	9	1	TOP TRIM STRIP-FRAME
MP28	5041-8822	3	2	FEET-REAR (BOTTOM COVER)
MP29	5041-8819	8	1	STRAP HANDLE CAP-FRONT
MP30	5041-8820	1	1	STRAP HANDLE CAP-REAR
MP31	5062-3704	4	1	STRAP HANDLE
MP32	5062-3847	6	1	COVER-LEFT SIDE (WITH HANDLE)
MP33	5062-3822	7	1	COVER-RIGHT SIDE (WITHOUT HANDLE)
MP34	5062-3747	5	1	COVER-BOTTOM
MP35	54110-01210	8	1	BRACKET-COLOR MODULE REAR
MP36	54110-04702	9	1	SUPPORT-COLOR MODULE REAR

Table 5-2. HP 16500A Replaceable Parts (continued)

Reference Designator	HP Part Number	CD	QTY	Description
MP37	8160-0551	4	6	EMI SHIELDING-BRAIDED
MP38	0590-1868	3	8	FAN CLIP
MP39	16500-45402	4	2	DISK INSULATOR
MP40	16500-94307	5	1	IDENTIFICATION LABEL
MP41	16500-00604	4	1	SHIELD-FRONT DISK DRIVE
	0515-1245	0	0	REPLACEMENT SCREW FOR TOP AND BOTTOM COVERS
	0510-1253	0	0	REPLACEMENT RETAINING RING FOR TOP AND BOTTOM COVERS

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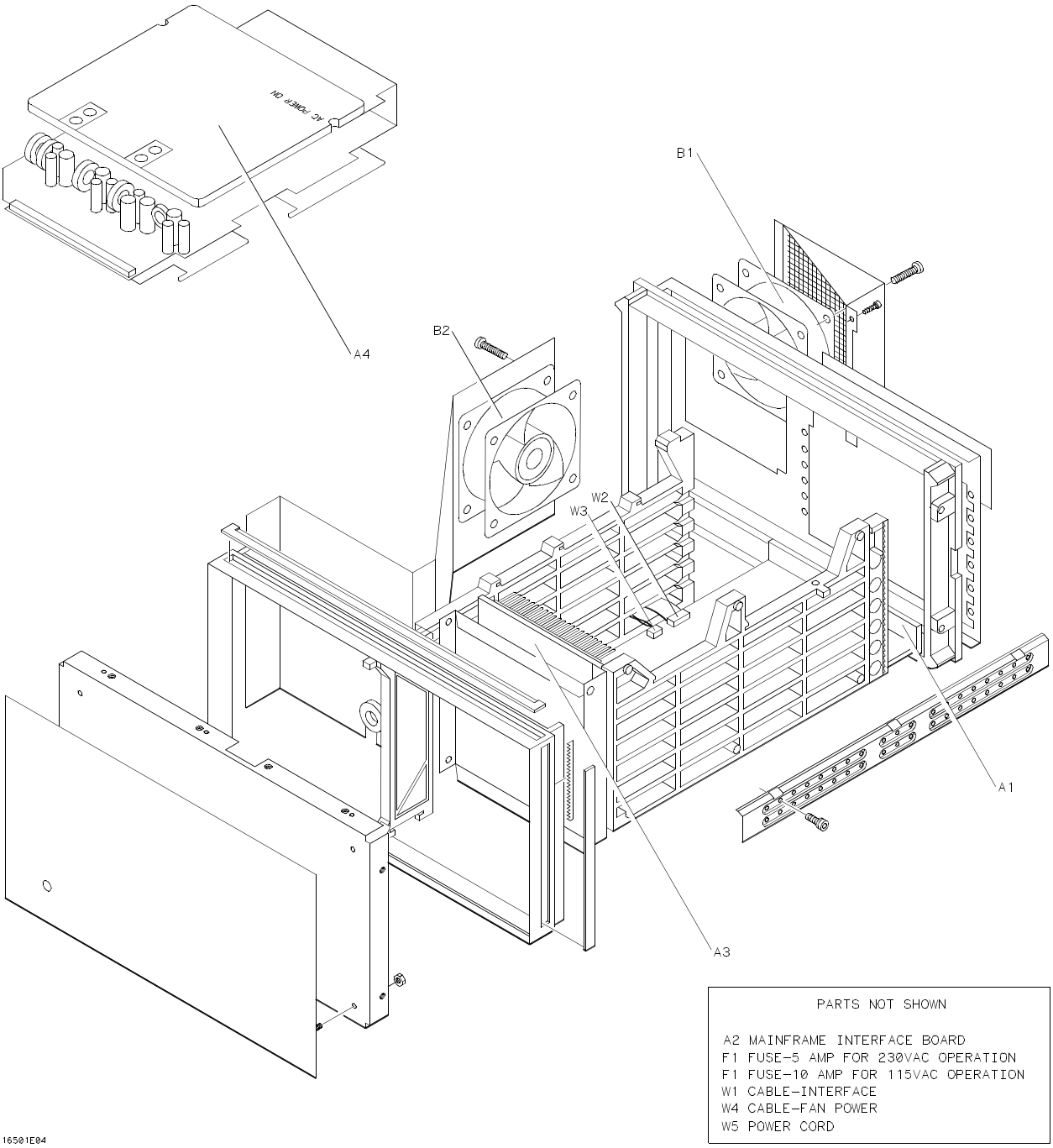


Figure 5-3. HP 16501A Assembly Parts

Table 5-3. HP 16501A Replaceable Parts

Reference Designator	HP Part Number	CD	QTY	Description
				HP 16501A EXCHANGE ASSEMBLIES
A2	16500-69508	1		MAINFRAME INTERFACE BOARD (EXCHANGE)
A4	16500-69500	3		LOW VOLTAGE POWER SUPPLY ASSEMBLY (EXCHANGE)
				HP 16501A ELECTRICAL ASSEMBLIES
A1	16501-66501	9	1	EXPANSION INTERFACE BOARD
A2	16500-66508	5	1	MAINFRAME INTERFACE BOARD
A3	16500-66501	8	1	MOTHER BOARD
A4	0950-1853	8	1	LOW VOLTAGE POWER SUPPLY ASSEMBLY
B1	3160-0429	0	2	FAN-TUBEAXIAL
B2	3160-0429	0		FAN-TUBEAXIAL
F1	2110-0010	9		FUSE-5 AMP FOR 230VAC OPERATION
F1	2110-0395	3		FUSE-10 AMP FOR 115VAC OPERATION
W1	98735-61601	4	1	CABLE ASSEMBLY-INTERFACE
W2	16501-61604	3	1	CABLE ASSEMBLY-RIBBON (MOTHER BOARD TO EXPANSION INTERFACE BOARD)
W3	16501-61603	2	1	CABLE ASSEMBLY-LED
W4	16500-61604	2	1	CABLE-FAN POWER
W5	8120-1521	6	1	POWER CORD-UNITED STATES (7.5 FT)
				MISCELLANEOUS
	01650-84502	7	1	ACCESSORY POUCH
	16500-40502	5		FILLER PANEL

Figure 5-4. HP 16501A Chassis Parts

Table 5-3. HP 16501A Replaceable Parts (continued)

Reference Designator	HP Part Number	CD	QTY	Description
				HP 16501A CHASSIS PARTS
H1	0515-0372	2	19	SCREW M3 X 0.5 8MM-LG
H2	0515-0433	6	12	SCREW M4 X 0.8 15MM-LG
H3	0515-0435	8	6	SCREW M4 X 0.7 14MM-LG
H4	0515-0664	5	2	SCREW M3 X 0.5 12MM-LG
H5	0515-0943	3	14	SCREW M4 X 0.7 12MM-LG
H6	0515-1384	8	2	SCREW M5 X 0.8 10MM-LG
H7	0515-1403	2	16	SCREW M4 X 0.7 6MM-LG 90-DEG FH
H8	0515-1444	1	4	SCREW M3.5 X 0.6 25.4MM-LG (BACK FEET)
H9	0535-0105	1	4	NUT SHEET METAL M4
H11	0624-0520	3	9	SCREW TPG 6-19 .5-IN-LG
H12	0515-0821	2	8	SCREW M3 0.5 X 20 (FAN)
H13	0510-0684	9	2	THUMBSCREW RETAINING RING
H14	0515-0366	4	4	SCREW M2.5 X 0.45
H15	0515-0430	3	6	ENDPLATE SCREW M3 X 0.5
H16	16500-22401	5	2	ENDPLATE THUMBSCREW
H17	16500-29101	6	2	GROUND SPRING
H18	0400-0001	1	2	GROMMET
H19	0535-0031	2	6	NUT
H20	1400-0611	0	1	CABLE CLAMP
MP1	16501-00201	8	1	FRONT PANEL
MP2	16501-00203	8	1	REAR PANEL
MP3	0363-0125	0	4	RFI STRIP-FINGERS (TOP AND BOTTOM COVERS)
MP4	1460-1345	5	2	TILT STAND
MP5	16501-00202	9	1	SUB PANEL
MP6	16501-01201	0	1	FAN BRACKET
MP7	16500-00603	3	1	FAN SCREEN (REAR)
MP8	16501-40501	5	2	MODULE PANEL
MP9	1400-0560	8	1	CL-SET-LED-MTG (LED CLAMP SET)
MP12	16500-01207	5	1	FAN SHROUD (REAR)
MP13	16500-04102	5	1	TOP COVER
MP14	16500-04701	0	1	STRUT-MOTHER BOARD
MP15	16500-23101	4	1	CARD GUIDE-SIDE
MP16	16500-23102	5	1	CARD GUIDE-CENTER
MP20	16500-61202	6	1	POWER SUPPLY COVER-REAR PANEL
MP21	5001-0541	3	2	SIDE TRIM-FRONT FRAME
MP22	5021-8407	3	1	FRAME-FRONT
MP23	5021-5808	7	1	FRAME-REAR
MP24	5021-5837	2	4	STRUT-CORNER
MP25	5041-8801	8	2	FEET-FRONT (BOTTOM COVER)
MP26	54110-40502	3	4	FEET-BACK
MP27	5041-8802	9	1	TOP TRIM STRIP-FRAME
MP28	5041-8822	3	2	FEET-REAR (BOTTOM COVER)
MP29	5041-8819	8	1	STRAP HANDLE CAP-FRONT
MP30	5041-8820	1	1	STRAP HANDLE CAP-REAR
MP31	5062-3704	4	1	STRAP HANDLE
MP32	5062-3847	6	1	COVER-LEFT SIDE (WITH HANDLE)
MP33	5062-3822	7	1	COVER-RIGHT SIDE (WITHOUT HANDLE)
MP34	5062-3747	5	1	COVER-BOTTOM
MP37	8160-0551	4	6	EMI SHIELDING-BRAIDED
MP38	0590-1868	3	8	FAN CLIP
MP46	16501-94301	6	1	LABEL-ID (EXPANSION INTERFACE BOARD)
MP47	16500-94306	0	1	LABEL-ID (MAINFRAME INTERFACE BOARD)
	0515-1245	0	0	REPLACEMENT SCREW FOR TOP AND BOTTOM COVERS
	0510-1253	0	0	REPLACEMENT RETAINING RING FOR TOP AND BOTTOM COVERS

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SECTION VI
Service

6-1. Introduction

This section provides block diagram level theory of operation, troubleshooting, service and repair information for the HP 16500A/16501A.

6-2. Safety Considerations

The HP 16500A/16501A has been designed in accordance with accepted safety standards. Safety symbols used with Hewlett-Packard instruments are illustrated in the front of this manual. These symbols should be reviewed before service work is performed.

WARNING

Maintenance should be performed by trained service personnel aware of the hazards involved (for example, fire and electric sock). When maintenance can be performed without power applied, remove the power cord from the instrument.

6-3. Service Test Equipment Required

Equipment required for service is listed in section 1, table 1-2. Any equipment that satisfies critical specifications given in the table may be substituted.

6-4. Theory of Operation

This section contains block diagram level theory of operation for the HP 16500A/16501A.

This level of theory is not intended for component-level troubleshooting, rather it is to be used to help isolate an instrument failure to a replaceable assembly.

The theory of operation is divided into two parts: the System Overview Theory and the Microprocessor Theory.

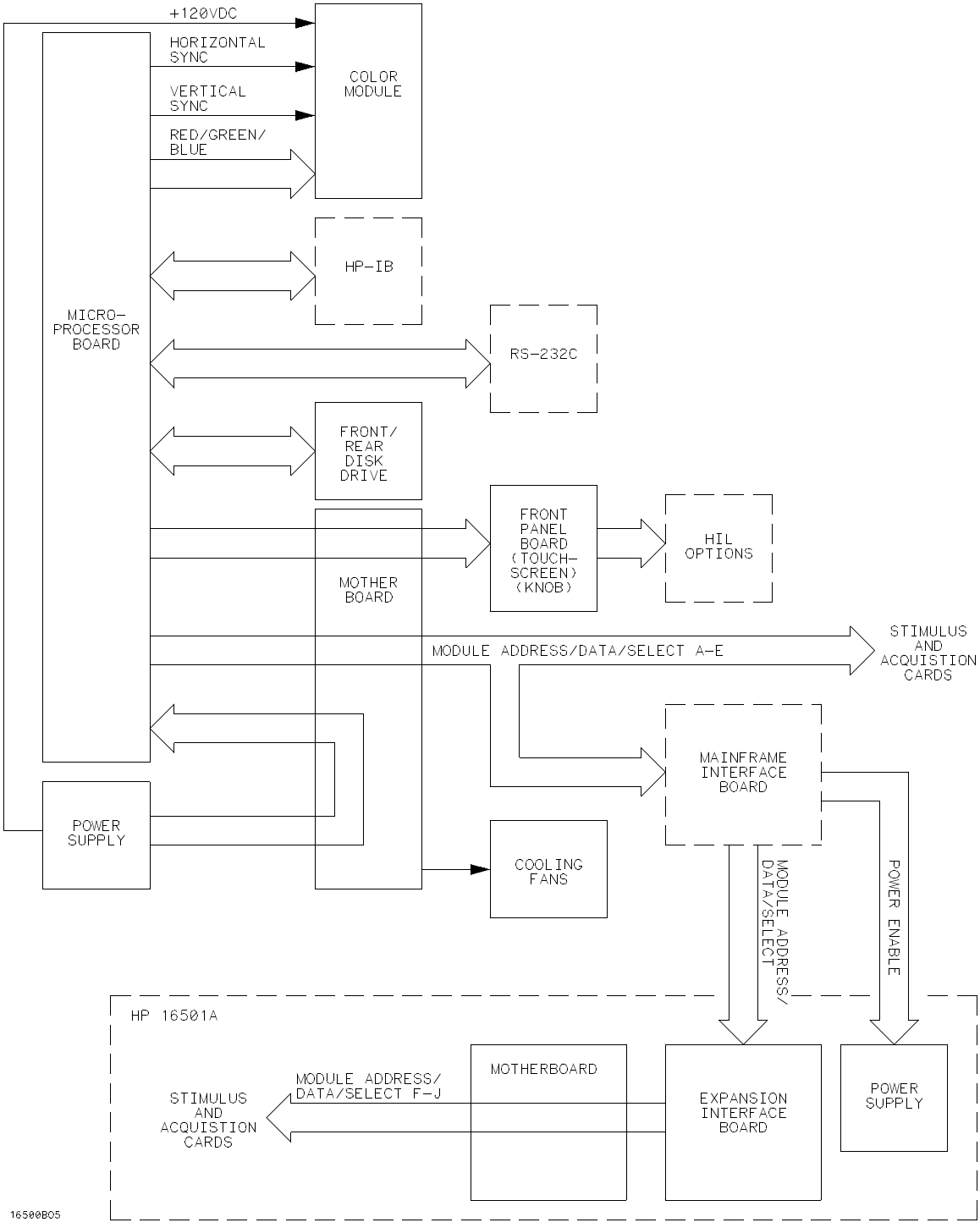


Figure 6-1. HP 16500A/16501A System Overview

System Overview Theory

The HP 16500A is the mainframe for the Logic Analysis System. The mainframe components include the following:

Microprocessor Board
Mother Board
Front and Rear Disk Drives
Color Module
Front Panel Board
Power Supply

The microprocessor board contains all the interface circuitry for managing data flow between the mainframe components and the optional boards. The microprocessor used is a Motorola 68000.

Located on the mother board are the intermodule bus and the fan speed control circuit. The mother board consists of seven card slots: five are used for the optional acquisition and stimulus boards, one for the microprocessor board and one for the power supply. The only active components on the mother board are for the fan speed control circuit. The heat sensing thermistor for the fan speed control circuit is located on the microprocessor board.

The front and rear disk drives use 3.5-inch, double-sided, double-density disks. All of the disk drive control circuitry is located on the microprocessor board.

CAUTION

To avoid the loss of your data, do not use high-density disks in the HP 16500A.

The color module display is an eight-plane color system. Each plane has a resolution of 576 pixels by 368 lines. The display is non-interlacing and is refreshed every 1/60 of a second (not synchronized to the ac line). The horizontal and vertical sync signals are generated by the CRT controller located on the microprocessor board. Color information for the display is generated on the microprocessor board. The display RAM and the color palette are also located on the microprocessor board.

The front-panel board is based on the Hewlett-Packard Human Interface Link (HP-HIL) and consists of the touchscreen system, the front-panel control knob, the optional mouse, and the optional keyboard. All of the touchscreen and knob circuitry of the HP-HIL is located on the front-panel board and the controller for the link is located on the microprocessor board.

The power supply provides the following regulated voltages:

–12.0 Vdc	+5.0 Vdc	+3.5 Vdc
+12.0 Vdc	–5.2 Vdc	–3.25 Vdc
+120 Vdc		

The +120.0 V supply is used only by the color module. Current limiting, overvoltage protection and thermal shutdown are provided for all supplies.

The HP 16501A is the expansion frame for the Logic Analysis System. The expansion frame components include the following:

Expansion Interface Board
Mainframe Interface Board (inserts into the HP 16500A)
Interface Cable
Mother Board
Power Supply

The HP 16501A is an extension of the backplane of the HP 16500A mainframe. After you turn on the mainframe, the HP 16500A microprocessor board looks for a mainframe interface board in any one of its five card slot. If it is present and if the interface cable connects the two frames, the microprocessor board establishes a link between the backplanes of the two frames, which then are displayed as a nine slot system.

The HP 16501A power supply is identical to the HP 16500A power supply. When power is applied to the HP 16500A, a relay allows the power supply in the HP 16501A to turn on. An LED on the front-panel indicates that the expansion frame has turned on.

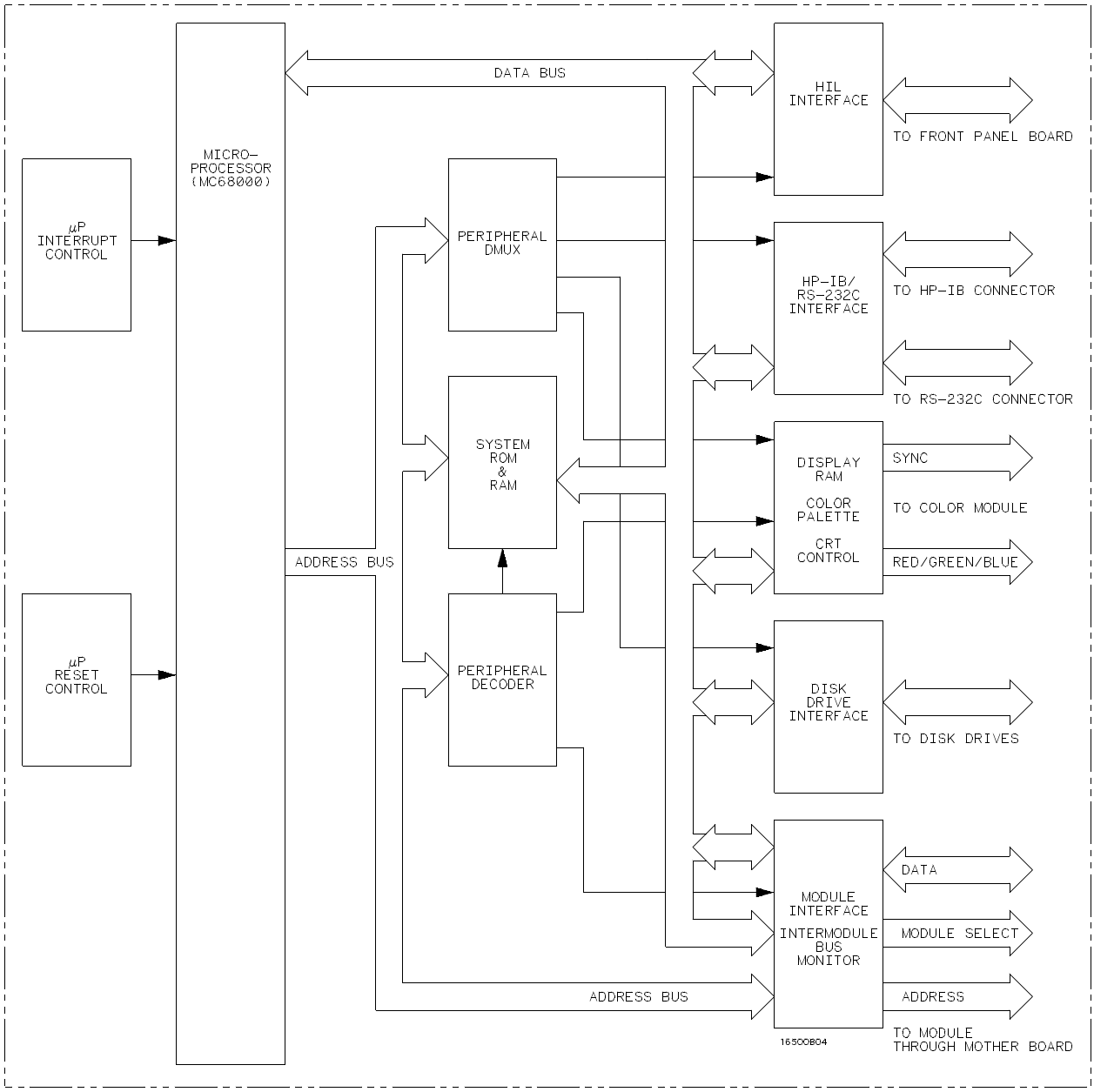


Figure 6-2. Microprocessor Block Diagram

Microprocessor Board Theory

The microprocessor board contains the system memory, all the interfaces for the mainframe peripherals, the intermodule bus monitor, and the optional board module interface.

The mainframe peripheral interfaces are selected by the microprocessor through the peripheral demultiplexer and peripheral decoder.

Using the three most significant microprocessor address bits, the peripheral decoder selects the system ROM and RAM, the display RAM, and the module interface.

The peripheral demultiplexers select the HIL interface, the HP-IB and RS-232C interfaces, the color palette, and the disk drive interface.

With the HP 16500A microprocessor board containing ROM version 00.00, the system memory consists of 64 Kbytes of ROM and 1 Mbyte of RAM. With the HP 16500A microprocessor board containing ROM version 00.20, the system memory consists of 64 Kbytes of ROM and 2.5 Mbytes of RAM. Stored in ROM is part of the operating system, the power up self-tests, the disk drive instructions and the Human Interface Link (HIL) driver.

The Hewlett-Packard Human Interface Link (HP-HIL) is the interface between the microprocessor and the front-panel board. In the write mode, the interface controller serializes the 8-bit data and transmits it to the devices on the link. In the read mode, the data is fed to the interface controller in serial format and to the microprocessor in parallel format.

The display RAM consists of eight 64 K by 4-bit RAMs and one 4-bit shift register for each RAM. Each RAM and shift register pair represents one color plane in the display system. The output of the color palette is an analog voltage of 0 V to -1.0 V for each of the primary colors (Red, Blue, Green) and is fed to the color module.

The HP 16500A interfaces to HP-IB as defined by IEEE Standard 488.2. The interface consists of two octal transceivers and an HP-IB controller. The controller relieves the microprocessor of the task of maintaining HP-IB protocol. The two transceivers provide data and control signal transfer between the bus and the controller.

The HP 16500A mainframe RS-232C interface is compatible with standard RS-232C protocol. The interface consists of a controller, an input buffer and an output buffer. The controller serializes parallel data from the microprocessor for transmission. In the receive mode, the controller converts incoming serial data to parallel data for the microprocessor. The controller also generates all the different baud rates and formats available with the mainframe. The input and output buffers transfer data and control signals to and from the RS-232C communication lines.

The main components of the disk drive interface are the drive controller and the digital data separator. The controller provides the interface between the microprocessor and the two disk drives. It also performs all functions necessary to write or read data to or from the disks. Data between the microprocessor and disk drives are serialized by the drive controller. The function of the digital data separator is to synchronize data between the interface and disk drives.

The module interface provides microprocessor access to the acquisition and stimulus boards that are plugged into the mainframe. The intermodule bus monitor provides the means for time-aligning module trace data on screen. This function is performed by a 100-MHz acquisition device, operating in the transitional timing mode.

6-5. Power-Up Tests

The HP 16500A power-up tests check the mainframe circuitry only. None of the option modules are tested at power-up. The tests run every time power is applied to the instrument and the results of the tests are reported on the screen.

If a disk is not installed in a disk drive, the advisory "no disk" is added to the Rear and Front Disk Tests. If the operating disk is not installed, and the mainframe passes the power-up tests, the message SYSTEM DISK NOT FOUND is displayed. To start the system, install the system disk into either disk drive and cycle the power.

Note

If any power-up tests fail, refer to section 6-7 ,"Troubleshooting."

The power-up tests perform the following circuit checks:

ROM Test

The ROM Test performs a checksum of both ROMs and compares the checksum value to a stored value. The test responses are "passed," "impaired," or "failed." If the message "impaired" is displayed, only one of the ROMs on the microprocessor board is defective. If the message "failed" is displayed, both ROMs are defective. For ROM Test failures, suspect a faulty microprocessor board.

RAM Test

The RAM Test performs an abbreviated read/write test at various memory locations. The test returns a pass or fail message. For RAM Test failures, suspect a faulty microprocessor board.

Interrupt Test

The Interrupt Test checks the microprocessor interrupts (interrupts 2 thorough 7). This test returns a pass or fail message. If any interrupts are active, the test fails. For Interrupt Test failures, suspect a faulty microprocessor board.

Display Test

The Display Test checks the display RAM and the CRT controller. During the RAM test, the entire address range is checked. The CRT controller ensures that an End-Of-Frame interrupt is generated. The test will report a fail message if either the display RAMs or the controller tests fail. For Display Test failures, suspect a faulty microprocessor board.

HIL Controller Test

The HIL Controller Test checks the HIL interface circuitry on the microprocessor board to verify that the microprocessor board can talk to the front-panel board. This test reports a pass or fail message. For HIL Test failures, suspect a faulty microprocessor board.

Front-Panel Test

The Front-Panel Test checks the front-panel circuitry for correct operation and reports a pass or fail message. For Front-Panel Test failures, verify the continuity and connection of the cable from the microprocessor board to the front-panel board. If a problem is not found with the cable, suspect a faulty front-panel board.

Touchscreen Test

The Touchscreen Test checks for light pulses between LED (light emitting diode) pairs and returns a pass, fail or an impair message.

The impair message indicates that the touchscreen is faulty, but the instrument can still be operated. If two to four LED pairs of the touchscreen system are defective, then the impair message is displayed. The touchscreen can still be used to operate the instrument, except for the touch-sensitive areas controlled by the faulty LED pairs.

The fail message indicates that the touchscreen is faulty and cannot be used to operate the instrument. The fail message is displayed if five or more LED pairs of the touchscreen system are defective. If the Touchscreen Test fails, you can still operate the instrument by using a mouse.

If a mouse is connected and the Touchscreen Test fails (meaning there are five or more defective LED pairs), then the impair message is displayed instead of the fail message and the mouse can be used to operate the instrument. To obtain true Touchscreen Test results, disconnect the mouse before performing the test.

For Touchscreen Test failures, clean the screen and the surrounding area and move any objects blocking the screen at power-up. Verify the continuity and connection of the cable from the microprocessor board to the front-panel board. If a problem is not found with the cable and the Touchscreen Test still fails after cleaning the instrument, suspect a faulty front-panel board.

Front and Rear Disk Tests

The Disk Tests read each disk to identify the format. If the format cannot be identified, the test is considered to have failed for that disk drive. If a disk cannot be detected, the message "no disk" is displayed instead of the pass or fail message. This power-up disk test only checks a few tracks.

Possible problems causing a fail message include the following:

A damaged or disconnected disk drive cable.

Wrong disk formatting or no disk formatting.

Incorrect position of the address switch on the disk drive.

A faulty disk drive.

Faulty microprocessor interface circuitry to the disk drive.

For Disk Test failures, verify the continuity and connection of the disk drive cables and use formatted disks. The address switch on each disk drive is set to the correct position when the disk drive is installed at Hewlett-Packard. A failure will occur if the switch on a replacement disk drive assembly is set to the incorrect position. For the correct switch position, refer to section 6-16, "Front Disk Drive Replacement," or to section 6-15, "Rear Disk Drive Replacement."

If the Disk Test still fails after verifying that the previous items are not causing failures, refer to section 6-7, "Troubleshooting."

6-6. Mainframe Tests

The system Mainframe Tests allow the testing of portions of the microprocessor board including the system peripheral interfaces, the disk drives, and the color module.

The self-test software for the mainframe and each optional module is included on a composite disk shipped with the mainframe.

CAUTION

Whenever the test system is loaded into memory, the normal system is overwritten including all setups or acquired data for the optional modules. To preserve that information, store it onto a disk before beginning any self-tests.

Accessing the Mainframe Test System

To access the Mainframe Tests, proceed as follows:

1. With the operating system disk in one of the disk drives, apply power to the instrument to obtain the System Configuration menu. See figure 6-3.

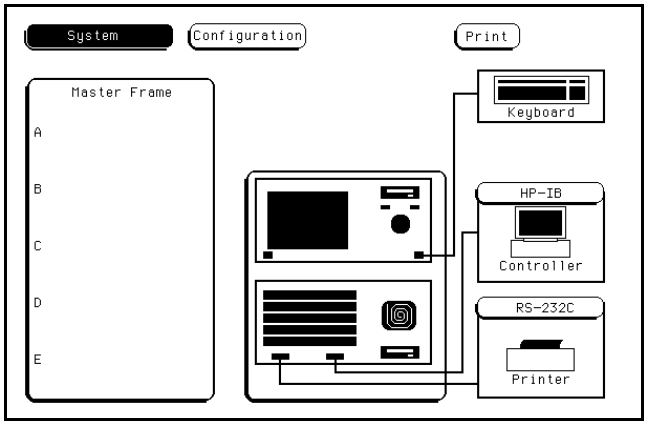


Figure 6-3. System Configuration

2. Touch the **Configuration** field, then touch the **Test** field from the pop-up menu. See figure 6-4.

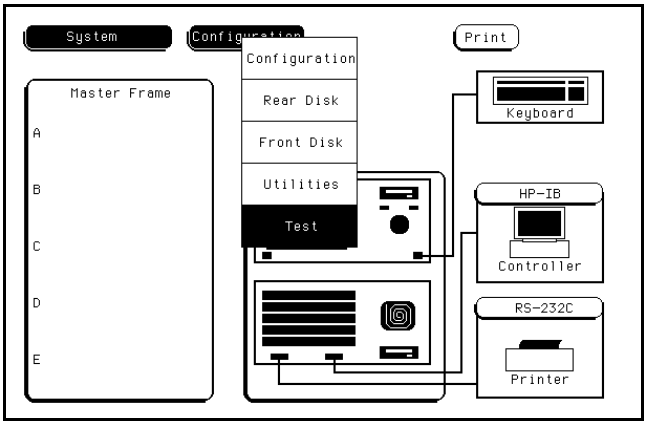


Figure 6-4. Accessing the Test System

3. Verify that test files are on an installed disk and that all valuable data has been stored. Touch the field close to the center of the screen to load the test system. See figure 6-5.

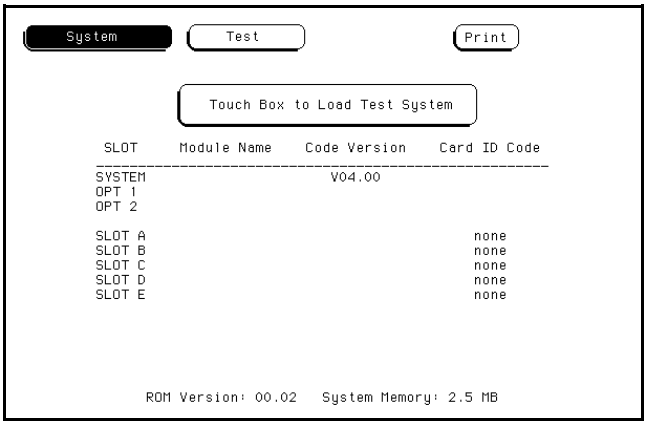


Figure 6-5. Loading the Test System Software

4. After the test software has been loaded, the Test System Configuration menu is displayed. See figure 6-6.

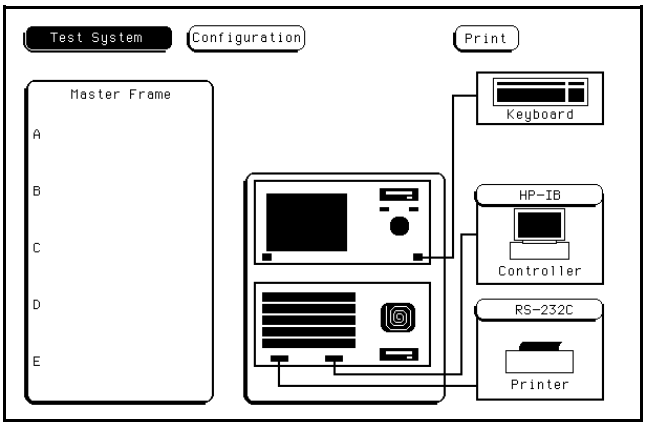


Figure 6-6. Test System Configuration

5. Touch the **Test System** field, then touch **Mainframe Test** from the pop-up menu. The Mainframe Test menu is displayed. See figure 6-7.

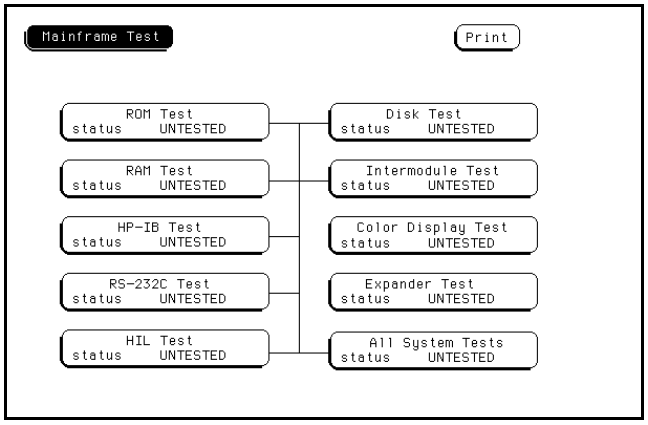


Figure 6-7. Mainframe Test Menu

Note

The Expander Test is used during troubleshooting and is not a performance verification test.

Performing the All System Test

To perform the All System Test, proceed as follows:

1. Install a formatted disk into each disk drive (be sure to verify that the disks are not write protected). Install the RS-232C loopback connector on the microprocessor RS-232C port. Remove any connections to the input BNC.

2. Access the Mainframe Test menu, as described in "Accessing the Mainframe Test System," in this section.

3. Touch the **All System Tests** field. The instrument performs all the tests that are listed on the screen except the Color Display Test and the Expander Test. See figure 6-8.

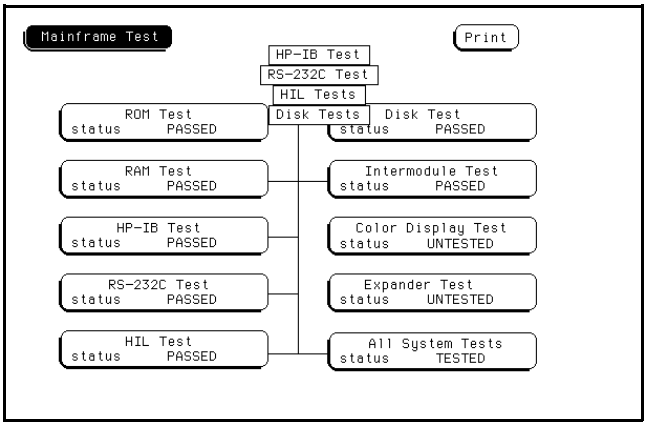


Figure 6-8. All System Test

When the tests are completed, the status advisory for each test changes from UNTESTED to either PASSED or FAILED. The All System Tests advisory changes from UNTESTED to TESTED. Note that the Color Display Test and the Expander Test remain UNTESTED.

If any test fails, refer to section 6-7, "Troubleshooting."

The Color Display Test

The Color Display Test is used to test the display.

This test is not normally needed. These screens are primarily used when the color module requires adjusting. For the adjustment procedure, refer to section 4-5, "Color Display Module Adjustments."

To check for color purity, proceed as follows:

1. From the Mainframe Test menu, touch the **Color Display Test**. The white cross-hatch pattern is displayed. This pattern is used for the color module geometry adjustments.

2. Touch the **Continue** field. The white raster pattern is displayed. With every touch of the Continue field, the next color test pattern is displayed. See figure 6-9.

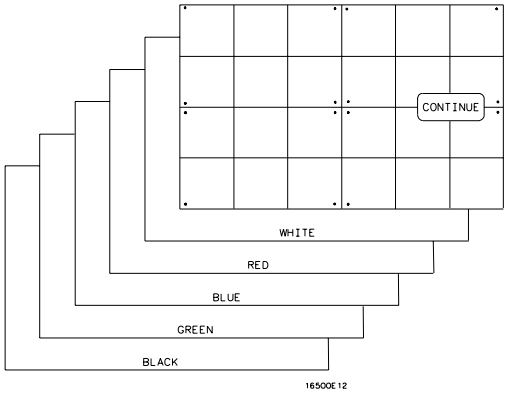


Figure 6-9. Selecting the Color Display Patterns

3. Touch **Continue** from the black raster pattern to display the Mainframe Test menu. Note that the Display Test status has changed from UNTESTED to TESTED.

Performing the Mainframe Tests

A description of each of the mainframe tests is provided at the end of the ROM Test procedure. Only performing the ROM Test is described in detail since the RAM, HP-IB, RS-232C, HIL, Disk, and Intermodule tests are accessed and performed in the same manner.

Note

Before performing the Disk Test, install a formatted disk into each disk drive (be sure to verify that the disks are not write protected). Before performing the RS-232S Test, install the RS-232C loopback connector on the microprocessor RS-232C port. Before performing the Intermodule Test, remove any connections to the input BNC.

To perform the ROM test, proceed as follows:

1. Access the Mainframe Test menu, as described in "Accessing the Mainframe Test System," in this section. See figure 6-10.

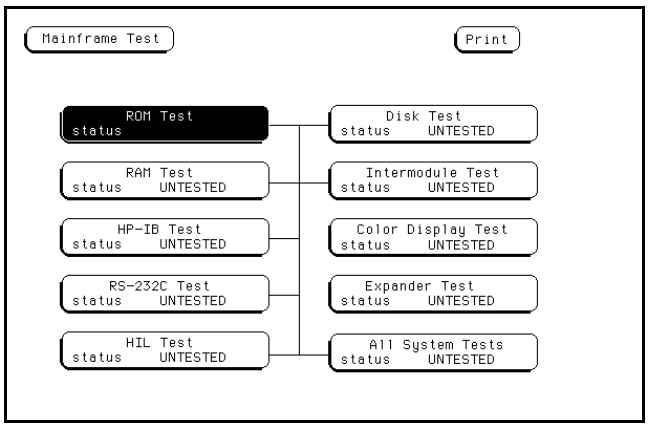


Figure 6-10. Mainframe Test Menu

2. Touch the **ROM Test** field. The ROM Test screen is displayed. See figure 6-11.

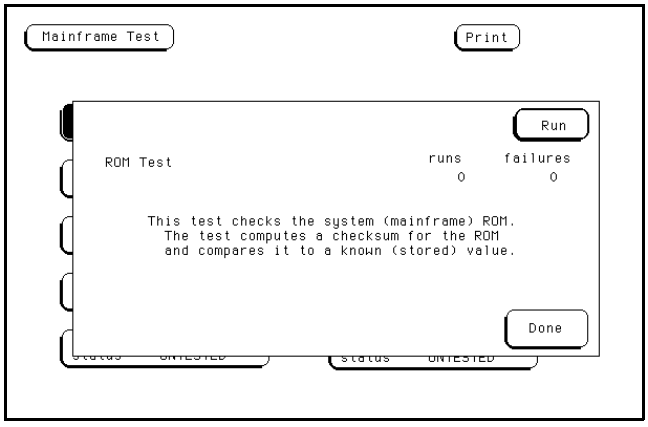


Figure 6-11. ROM Test Screen

3. Touch the **Run** field, slide your finger downward to the Single, Repetitive or Cancel field, then lift your finger off the screen. If the Cancel field is selected, the test sequence is not started. See figure 6-12.

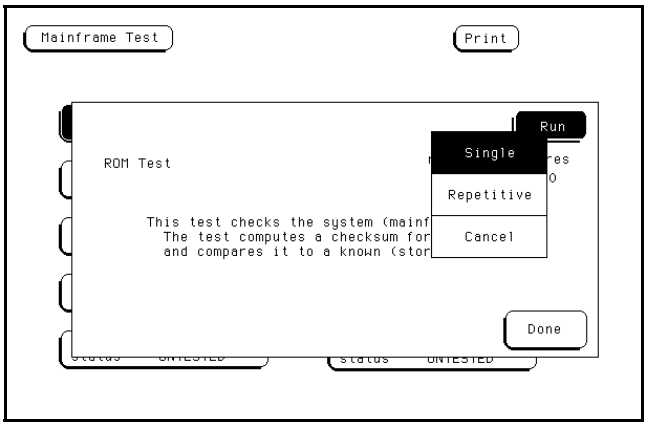


Figure 6-12. Choosing the Single or Repetitive Mode

In the Single mode, the test is done only once. In the Repetitive mode, the test repeats itself until the Stop or Done field is touched. The test results are also shown on this screen. The run column contains the number of times the test was performed and the failures column contains the number of times the test failed. See figure 6-13. The run/fail count is reset to zero when the Done field is selected.

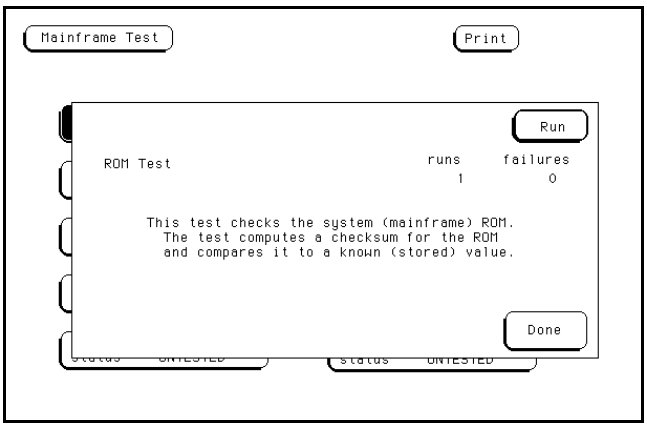


Figure 6-13. ROM Test with Test Results

4. To exit the ROM Test, touch the **Done** field. The Mainframe Test menu is displayed. Note that the test status has changed to either PASSED or FAILED.

Exiting the Mainframe Test System

The Mainframe Test System may be exited any time after a test is completed.

To exit the Mainframe Test system, proceed as follows:

1. From any test screen, touch the **Done** field to display the Mainframe Test menu.
2. Touch the **Mainframe Test** field, then touch the **Test System** field from the pop-up menu. See figure 6-14. The Test System Configuration is displayed.

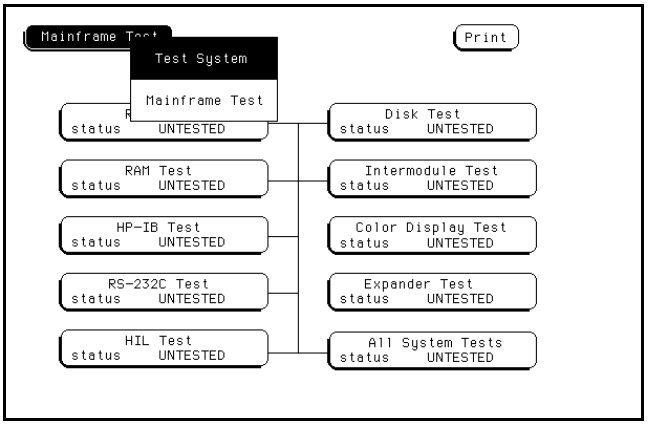


Figure 6-14. Exiting the Mainframe Test System

3. Touch the **Configuration** field, then touch the **Exit Test** field. See figure 6-15.

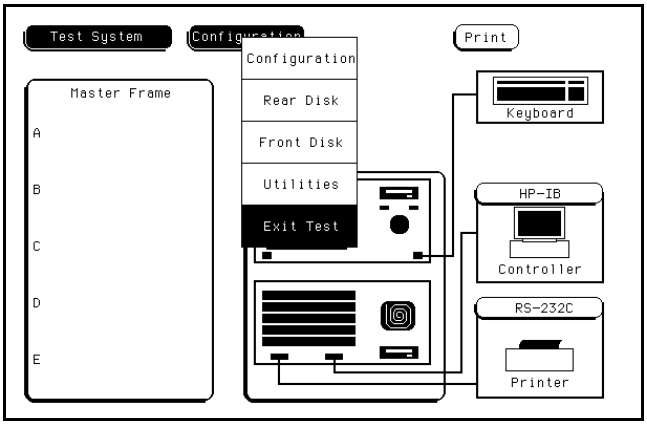


Figure 6-15. Exiting Test Configuration

4. Verify that the operating system software is installed in a disk drive. Touch the field close to the center of the screen to exit the test system and to load the mainframe operating system. See figure 6-16. After the operating system is loaded, the System Configuration menu is displayed.

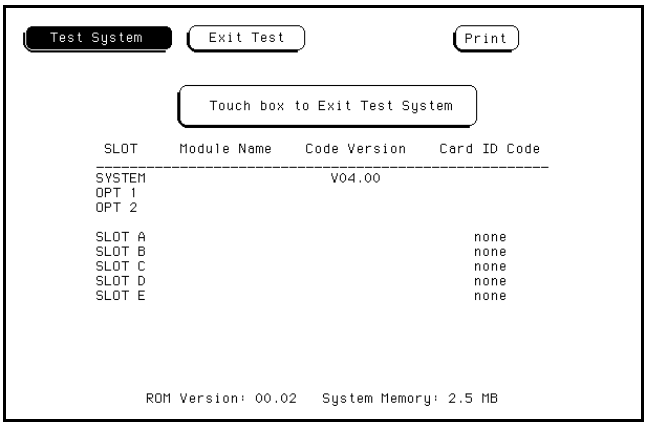


Figure 6-16. Reloading the Mainframe System

Description of Mainframe Tests

Below is a brief description of each mainframe test. After a test is run, the status advisory for each test changes from UNTESTED to PASSED or FAILED. Except for the Color Display Test and the All System Tests, when a test is selected from the Mainframe Test screen, a test screen for that specific test is displayed.

Note

If a mainframe test fails, refer to section 6-7, "Troubleshooting."

ROM Test

This test checks the mainframe ROM on the microprocessor board. The test computes a checksum for the ROM and compares it to a stored value. For ROM Test failures, suspect a faulty microprocessor board.

RAM Test

This test checks the mainframe RAM on the microprocessor board. The test performs a non-destructive pattern write/read at every location. The initial RAM contents are restored after the test. For RAM Test failures, suspect a faulty microprocessor board.

HP-IB Test

The HP-IB Test checks the basic interface functions of the HP-IB port. Only the internal portions of the port circuitry is tested. For HP-IB Test failures, suspect a faulty microprocessor board.

RS-232C Test

This test checks the basic interface functions of the RS-232C port. Both internal and external portions of the port circuitry are tested. In order for the RS-232C test to pass, the RS-232C loopback connector must be installed on the microprocessor board rear panel. For RS-232C Test failures, verify the connection of the RS-232C loopback connector, then suspect a faulty microprocessor board.

HIL Test

The HIL Test consists of three parts: the HIL controller test, the front-panel test, and the touchscreen test. All three tests return a pass or a fail message. This test cannot be run repetitively. Every time the Run field is touched the HIL test sequence is repeated.

The HIL controller test checks the control circuitry on the microprocessor board. For HIL controller test failures, suspect a faulty microprocessor board.

The front-panel test checks the front-panel circuitry for correct operation. For front-panel test failures, verify the connection and continuity of the front-panel to microprocessor board cable. If a problem is not found with the cable, then suspect a faulty front-panel board.

The touchscreen test checks for light pulses between LED (light emitting diode) pairs. For Touchscreen Test failures, clean the screen and the surrounding area and move any objects blocking the screen when you turn on the mainframe. Verify the continuity and connection of the cable from the microprocessor board to the front-panel board. If a problem is not found with the cable and the Touchscreen Test still fails after cleaning the instrument, suspect a faulty front-panel board.

Disk Test

This test checks both disk drives for the correct disk format and checks the ability of the system to read from and write to a test track on both disks. If the disk cannot be identified, the test is considered to have failed for that disk drive. If a disk cannot be detected, the message "no disk" is displayed instead of the pass or fail message.

Possible problems causing a failed message include the following:

A damaged or disconnected disk drive cable.
Wrong disk formatting or no disk formatting.
The disk write-protect tab set to the write-protect position.
Incorrect position of the address switch on the disk drive.
A faulty disk drive.
Faulty microprocessor board interface circuitry to the disk drive.

For Disk Test failures, verify the continuity and connection of the disk drive cables, use formatted disks, and set the write protect tab on the disks to the unprotected position. The address switch on each disk drive is set to the correct position when the disk drive is installed at Hewlett-Packard. A failure will occur if the switch on a replacement disk drive assembly is set to the incorrect position. For the correct switch position, refer to section 6-16, "Front Disk Drive Replacement," or to section 6-15, "Rear Disk Drive Replacement." If the disk test still fails after verifying that the previous items are not causing failures, refer to section 6-7, "Troubleshooting."

Intermodule Test

The Intermodule Test checks the functions of the intermodule timing correlation. This test fails if there are any connections on the input BNC. For Intermodule Test failures in a mainframe, suspect a faulty microprocessor board. For Intermodule Test failures in a mainframe connected to an expansion frame, suspect a faulty mainframe interface board.

Note

The Intermodule Test screen shows the mainframe and expansion frame card slots and the card identification code of the module located in each slot.

Color Display Test

The Color Display Test puts screen patterns and color screens on the monitor. This test is mainly used to check for color purity. Usually, the purity problem can be solved using a degaussing coil. If some pixels are not colored, then there is probably a problem with the Display RAM on the microprocessor board. For Color Display Test failures, degauss the display. Refer to section 2-14, "Degaussing the Display." If the Color Display Test still fails, suspect a faulty microprocessor board or a faulty color display monitor.

All System Tests

The All System Test will perform all the tests listed on the screen on the Mainframe Test menu, except for the Color Display Test and the Expander Test. When the tests are complete, the status advisory for each test changes from UNTESTED to PASSED or FAILED. The status advisory for the Color Display Test and for the Expander Test remains UNTESTED and the status advisory for the All System Tests changes from UNTESTED to TESTED.

Expander Test

The Expander Test is used during troubleshooting to check the data and control signals through the HP 16501A expansion frame components.

6-7. Troubleshooting

The troubleshooting information for the HP 16500A/16501A consists of flowcharts, signal information for the color module, power supply voltages, and interface troubleshooting. Troubleshooting an instrument failure to the assembly level can be accomplished using the troubleshooting flowcharts provided in this section. The flowcharts refer to other tests and tables to help you isolate problems.

Equipment Required

A voltmeter, a system disk, a second formatted disk, a disk with test software, and the RS-232C connector are required to perform the tests. Also, a state analyzer is required for interface troubleshooting. Refer to table 1-2 for the recommended test equipment. Before performing any tests, install the RS-232C loopback connector, insert the system disk into one disk drive, and insert the formatted disk into the other disk drive.

Troubleshooting Flowcharts

The flowcharts are organized into the Main, Expansion Frame, Color Module, System Start, and Power Supply troubleshooting flowcharts. Also, flowcharts are included for the RS-232C, HIL, Disk, and Intermodule Tests.

Descriptions of the power-up tests and the Mainframe Tests are provided earlier in this section.

The power-up tests are automatically performed every time power is applied to the instrument. The results of the tests are reported on the screen. When the tests pass, the information printed on the instrument screen during the power-up self tests includes the following:

PERFORMING POWER_UP SELF_TESTS

passed	**ROM Test**
passed	**RAM Test**
passed	**Interrupt Test**
passed	**Display Test**
passed	**HIL Controller Test**
passed	**Front Panel Test**
passed	**Touchscreen Test**
passed	**Rear Disk Test**
passed	**Front Disk Test**

LOADING SYSTEM FILE

If the instrument passes all power-up tests, the power supply, color module, and portions of the microprocessor board are working correctly.

HP 16500A/16501A Main Flowchart

Troubleshooting Flowchart 1

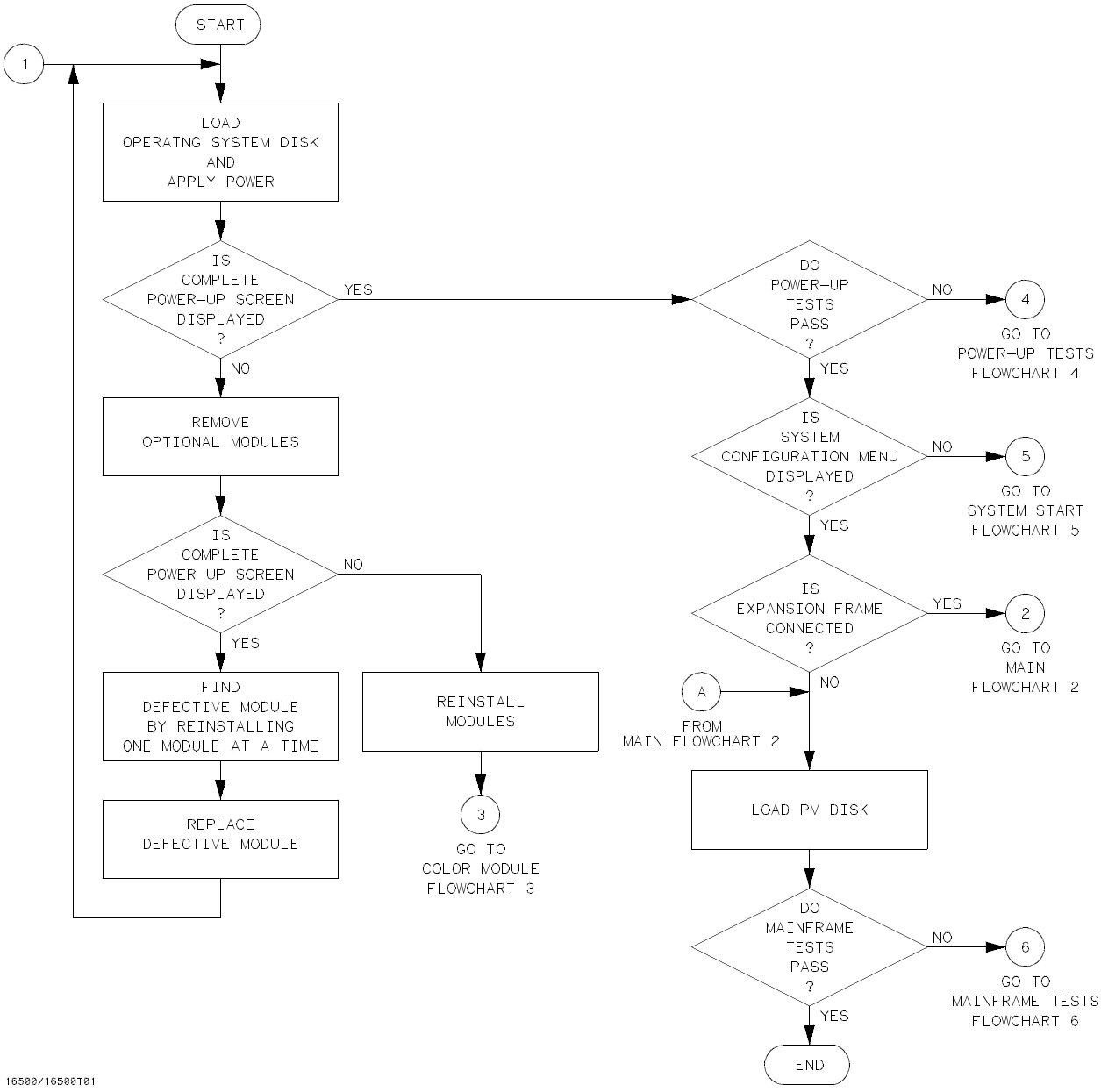


Figure 6-17. Troubleshooting Flowchart 1

HP 16500A/16501A Main Flowchart

Troubleshooting Flowchart 2

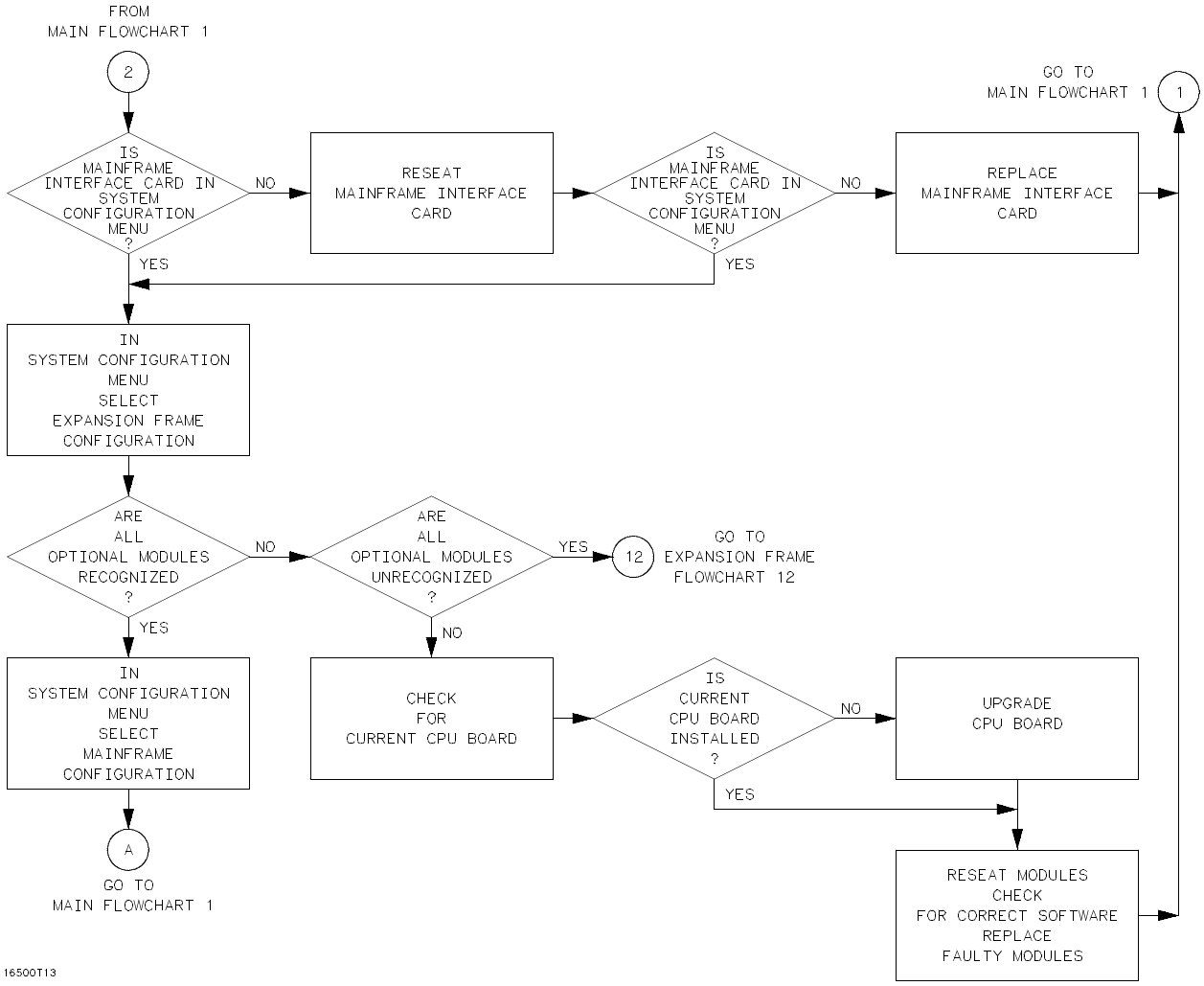


Figure 6-18. Troubleshooting Flowchart 2

HP 16500A/16501A Color Module Flowchart

Troubleshooting Flowchart 3

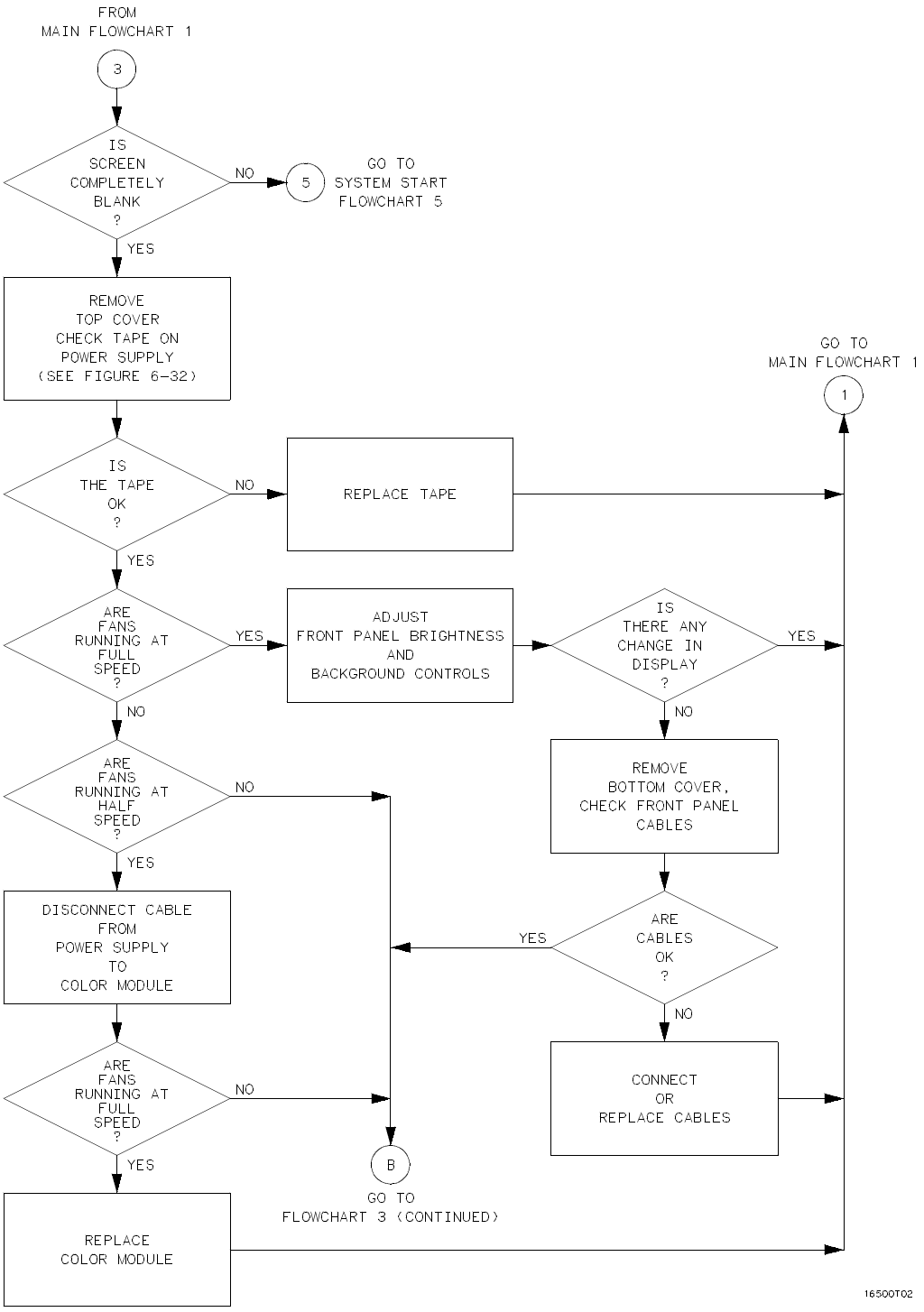


Figure 6-19. Troubleshooting Flowchart 3

HP 16500A/16501A Color Module Flowchart (continued)

Troubleshooting Flowchart 3 (continued)

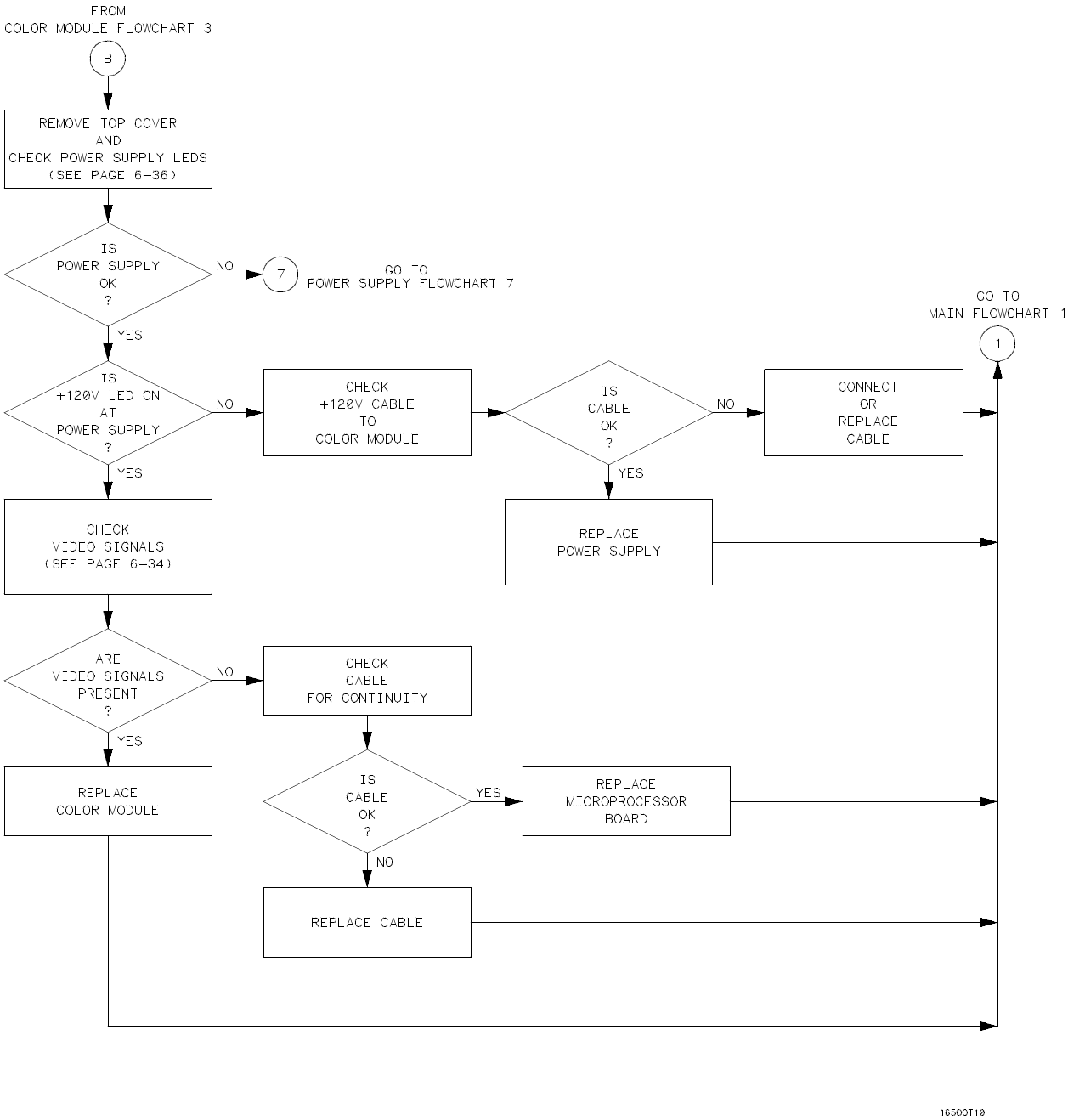


Figure 6-20. Troubleshooting Flowchart 3 (continued)

HP 16500A/16501A Power-Up Flowchart

Troubleshooting Flowchart 4

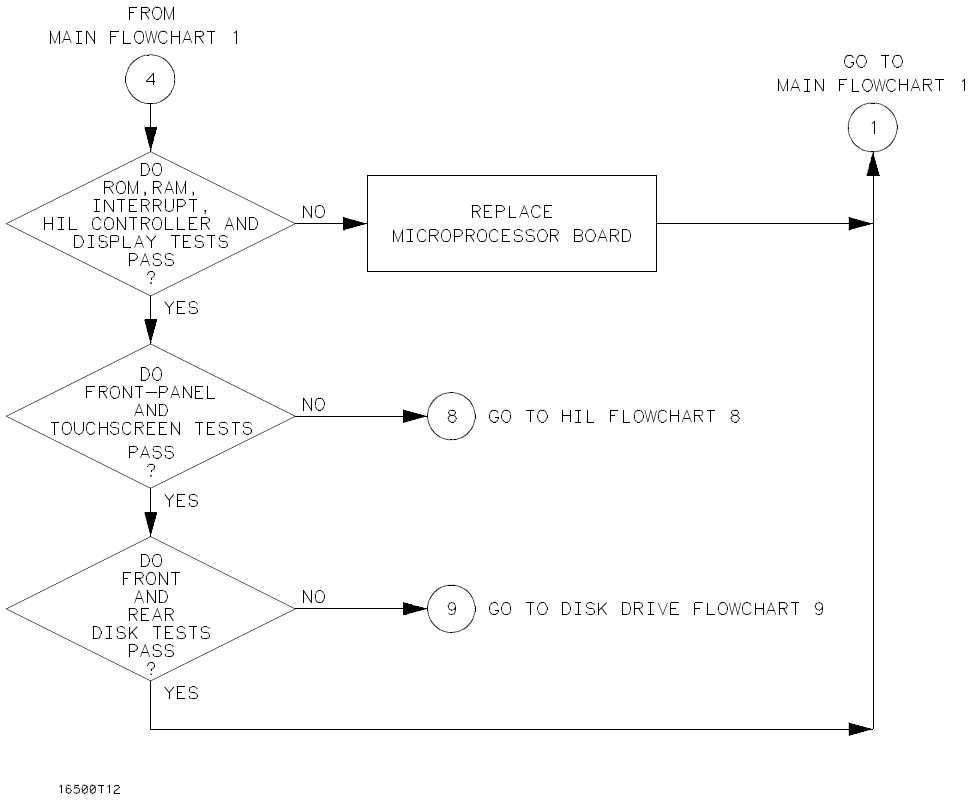


Figure 6-21. Troubleshooting Flowchart 4

HP 16500A/16501A System Start Flowchart

Troubleshooting Flowchart 5

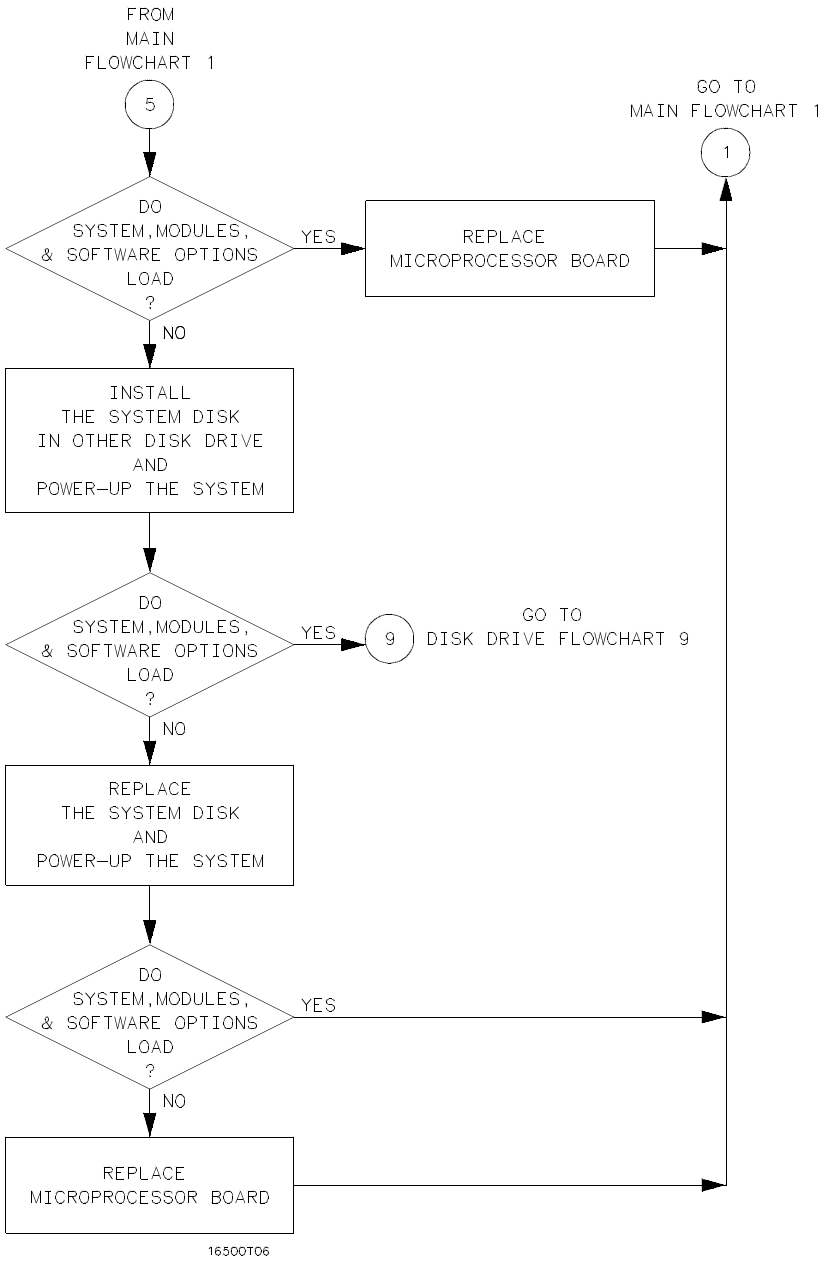


Figure 6-22. Troubleshooting Flowchart 5

HP 16500A/16501A Mainframe Tests Flowchart

Troubleshooting Flowchart 6

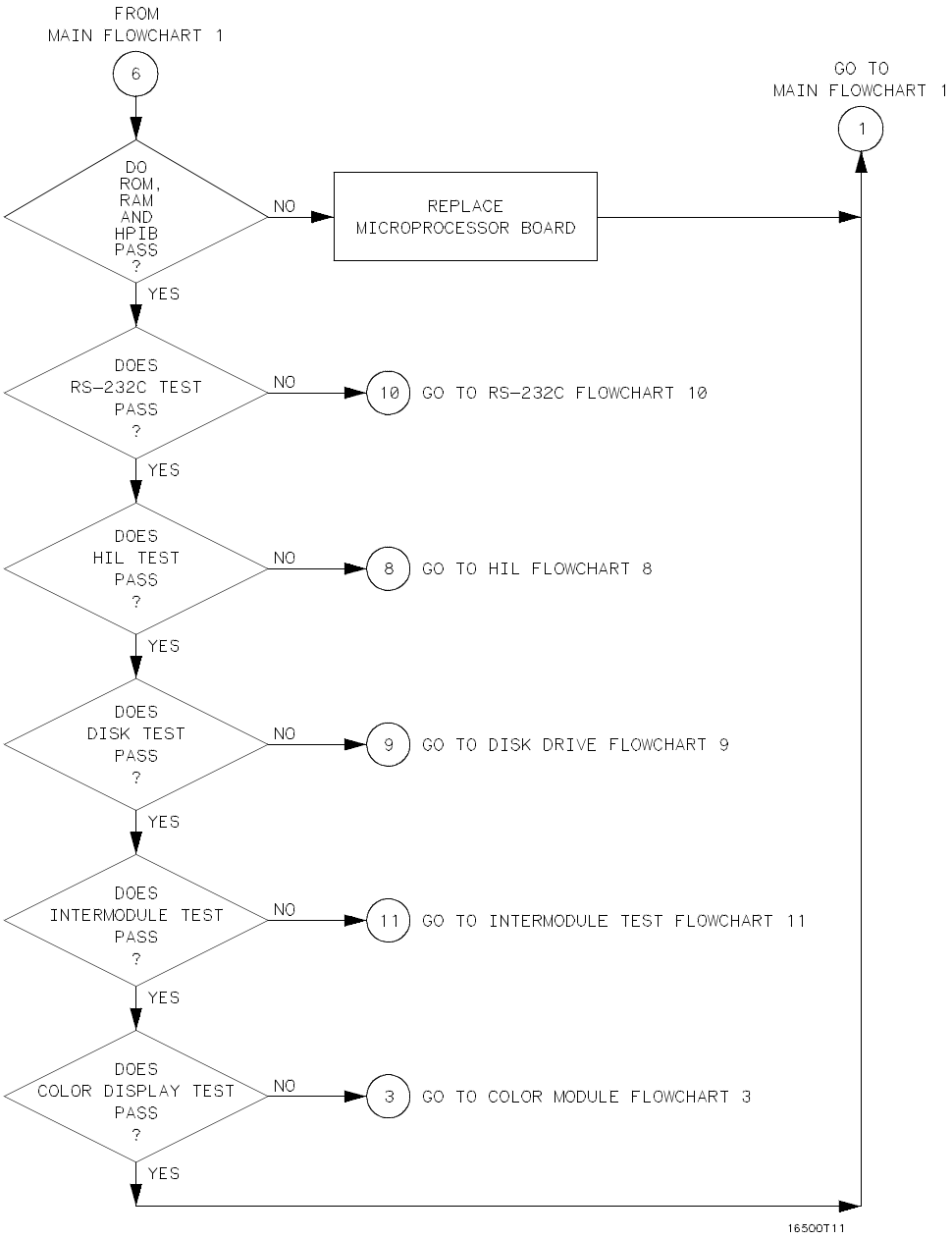


Figure 6-23. Troubleshooting Flowchart 6

HP 16500A/16501A Power Supply Flowchart

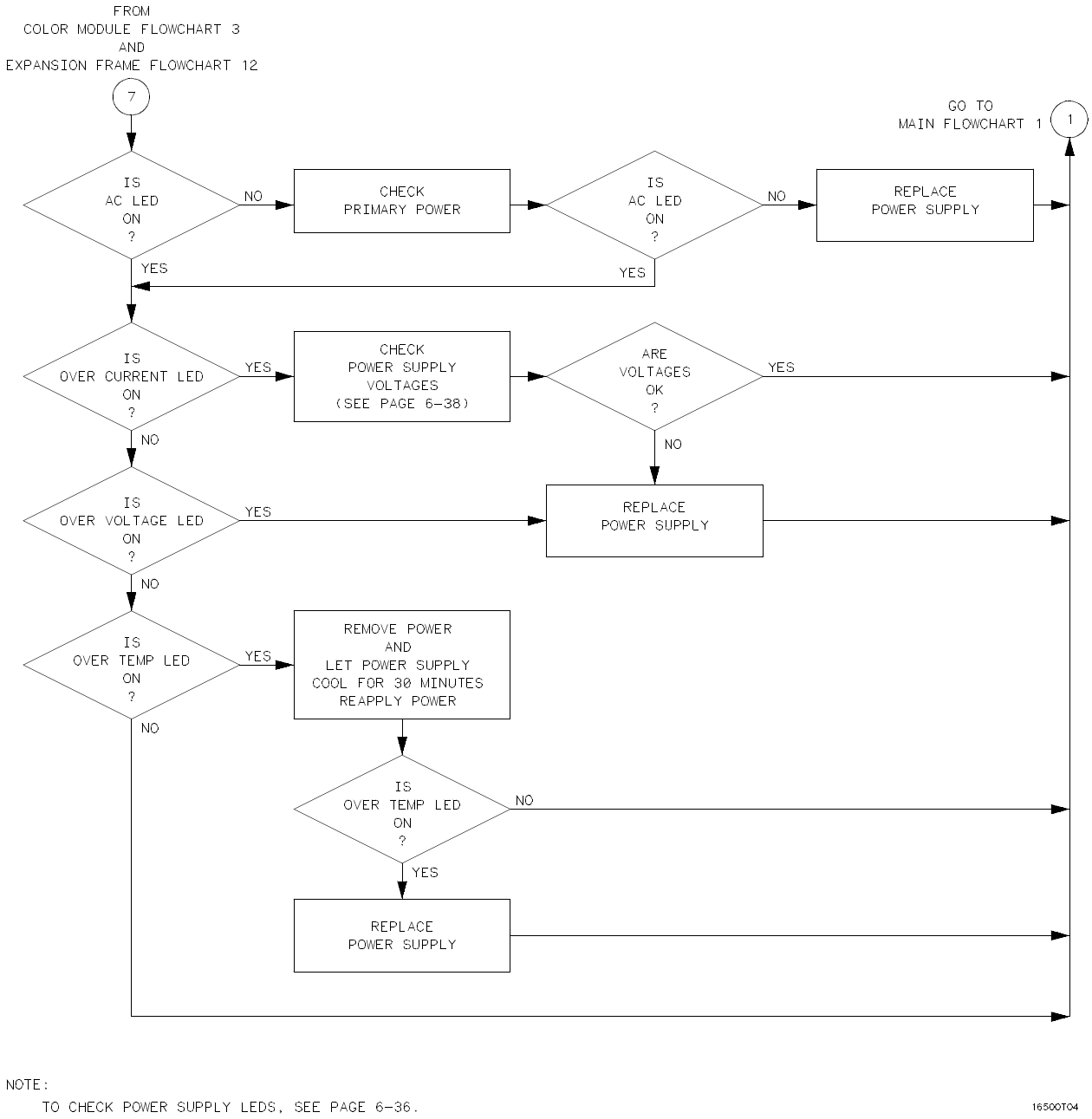


Figure 6-24. Troubleshooting Flowchart 7

Troubleshooting Flowchart 7

HP 16500A/16501A HIL Flowchart

Troubleshooting Flowchart 8

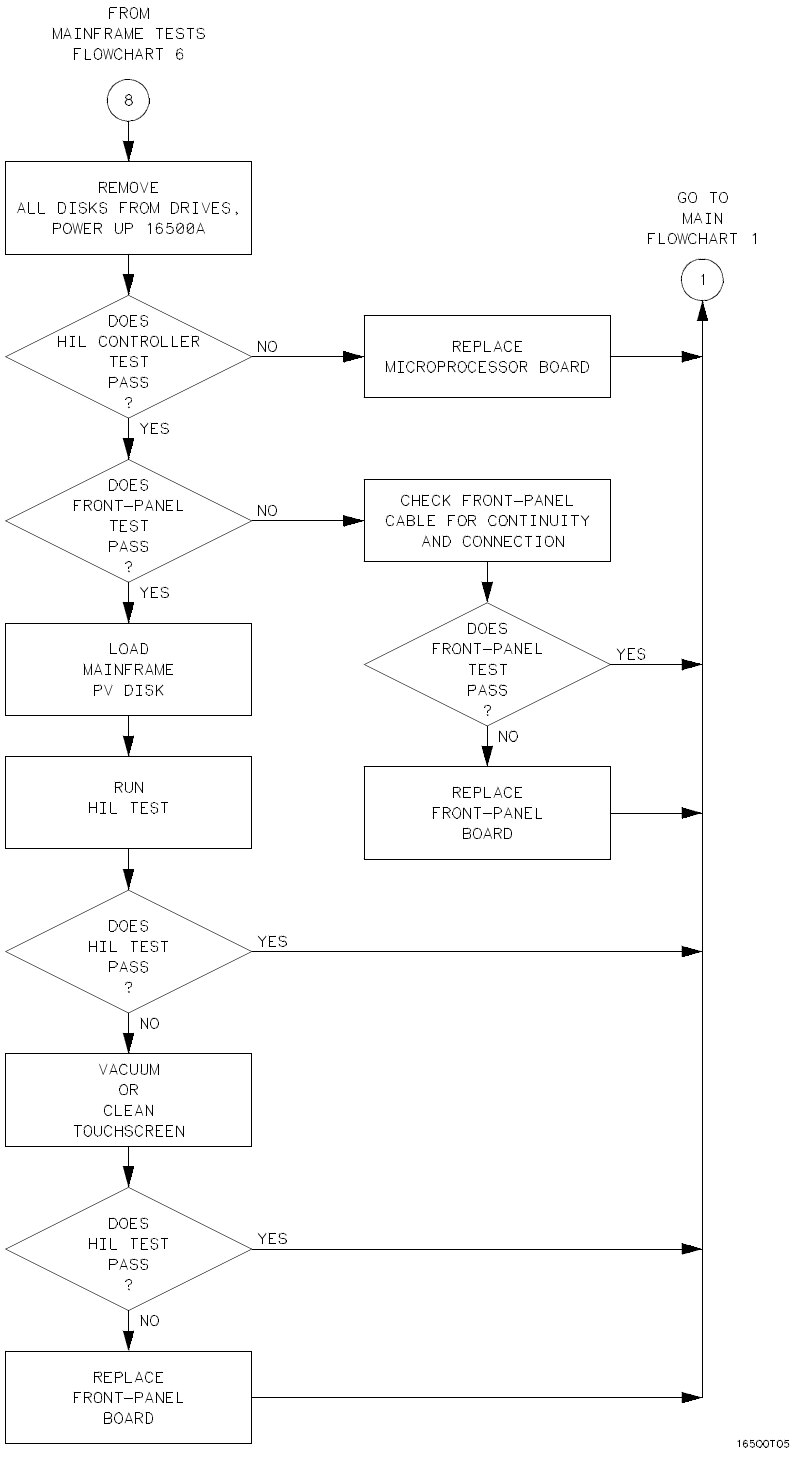


Figure 6-25. Troubleshooting Flowchart 8

HP 16500A/16501A Disk Drive Flowchart

Troubleshooting Flowchart 9

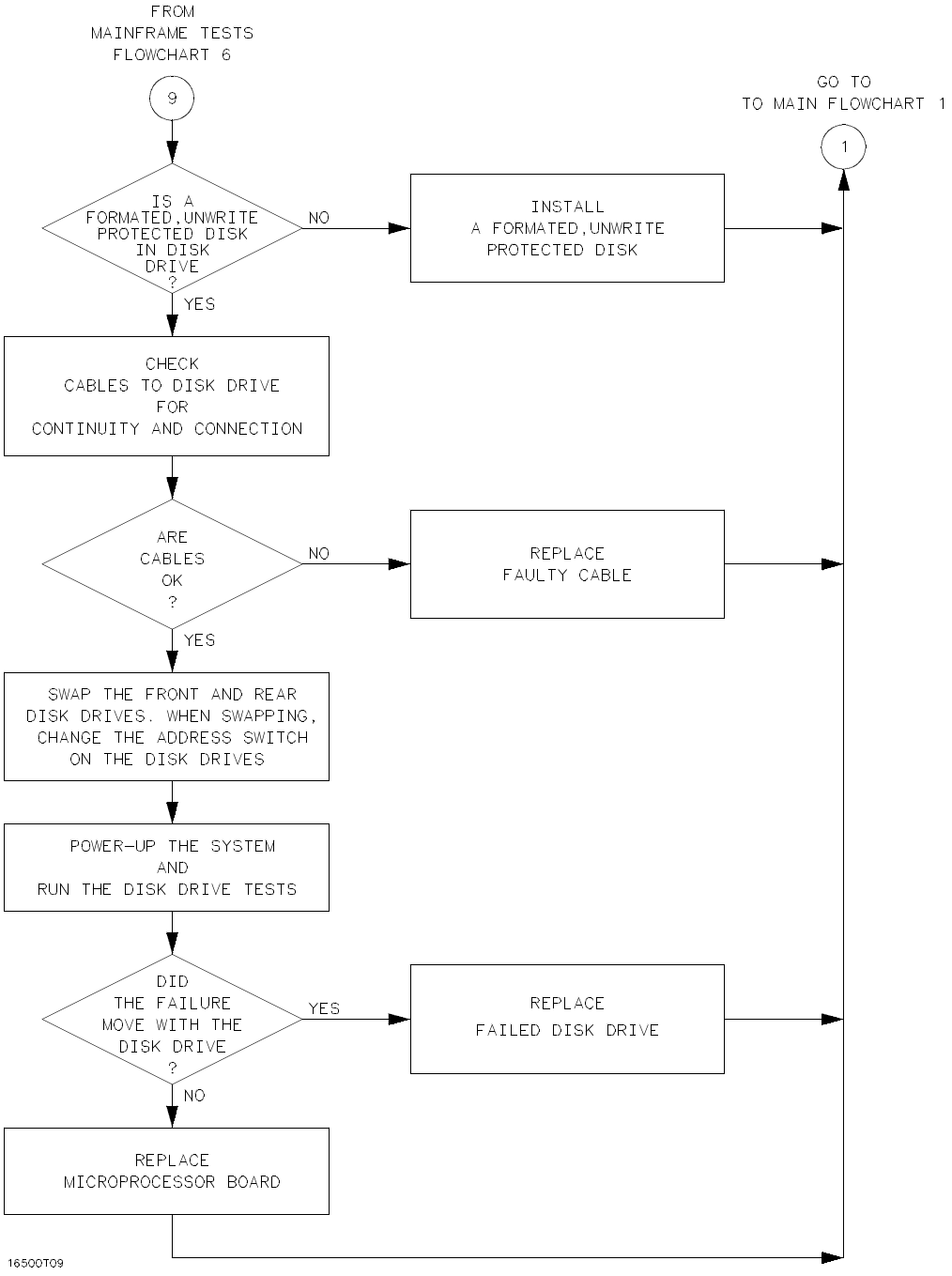


Figure 6-26. Troubleshooting Flowchart 9

HP 16500A/16501A RS-232C Flowchart

Troubleshooting Flowchart 10

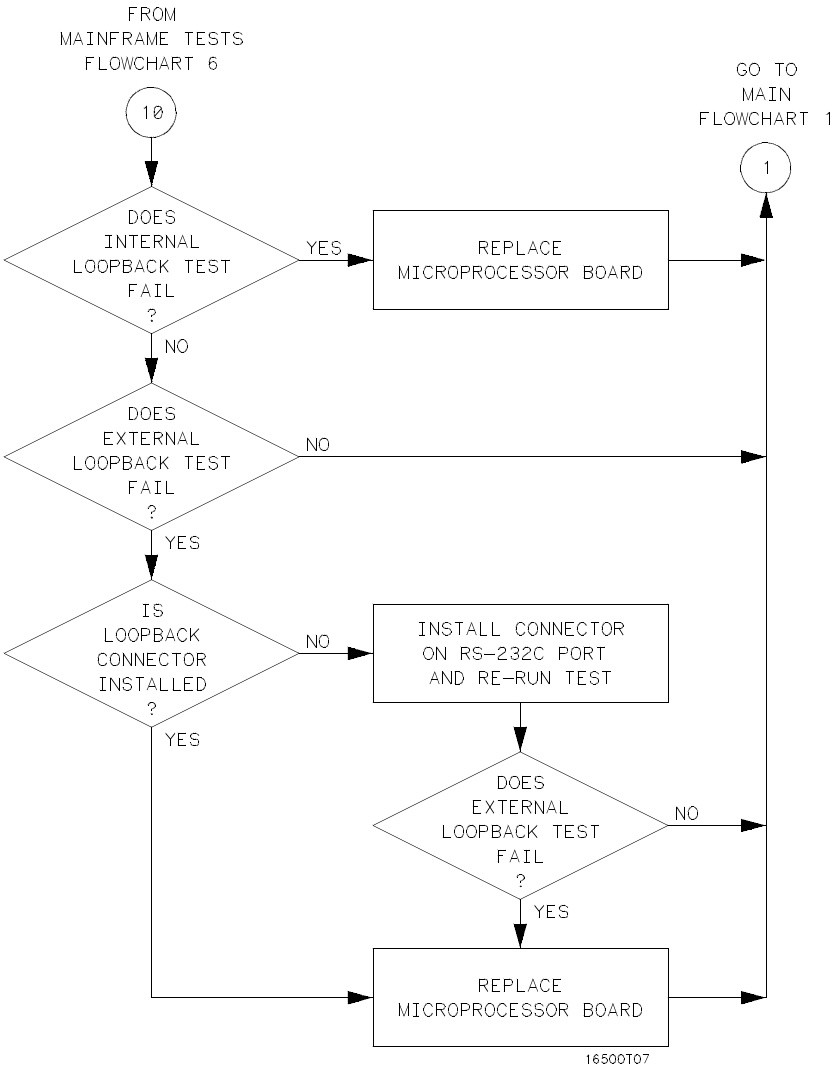


Figure 6-27. Troubleshooting Flowchart 10

HP 16500A/16501A Intermodule Flowchart

Troubleshooting Flowchart 11

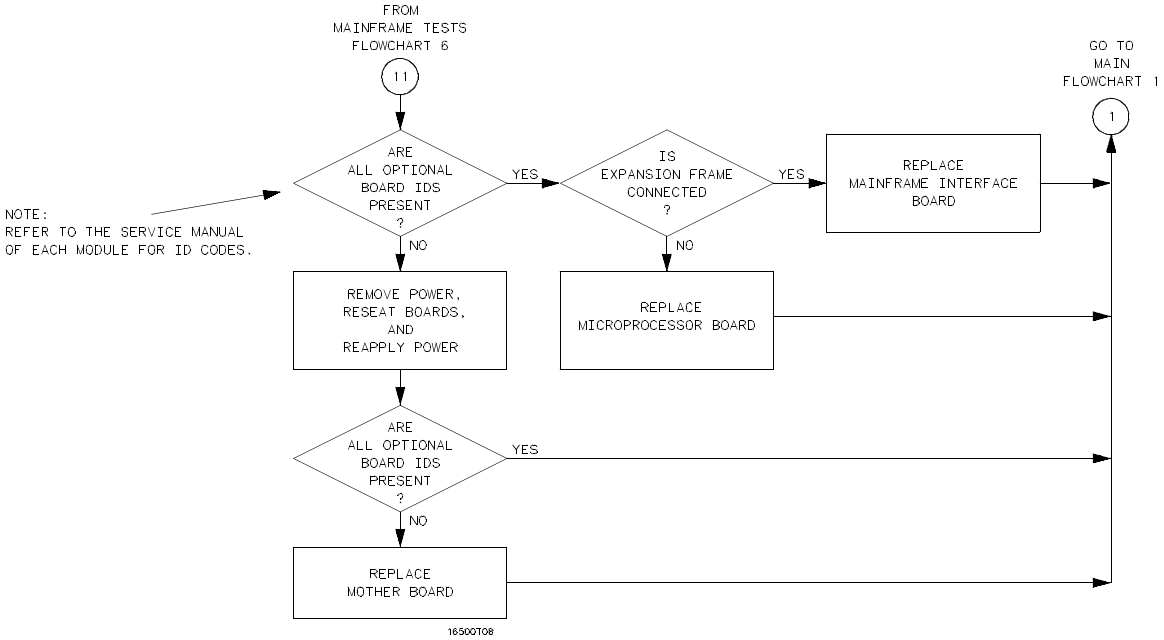


Figure 6-28. Troubleshooting Flowchart 11

HP 16500A/16501A Expansion Frame Flowchart

Troubleshooting Flowchart 12

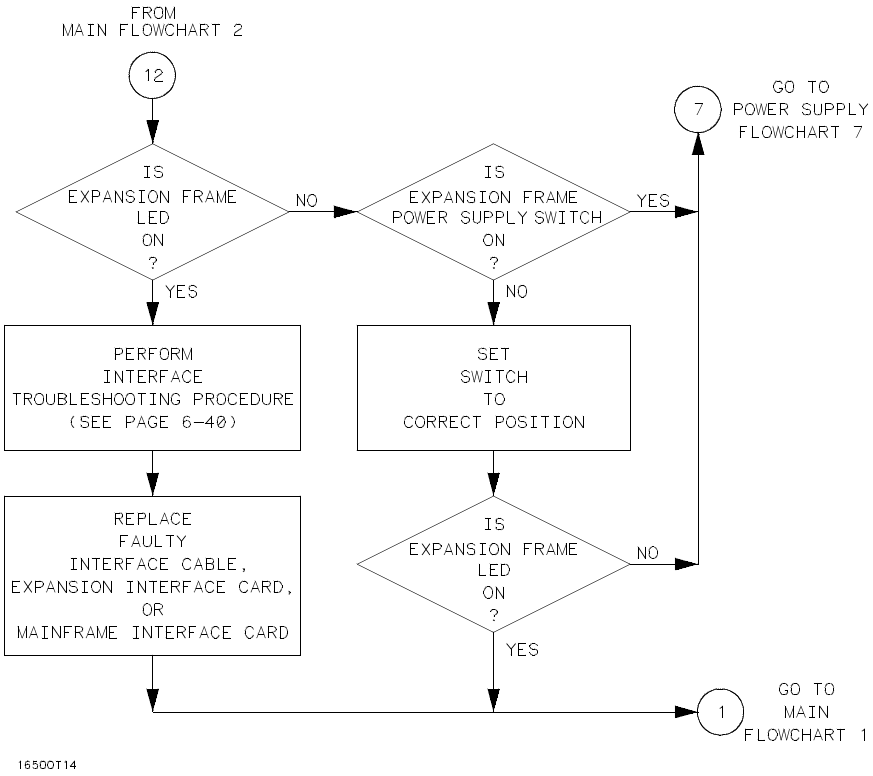


Figure 6-29. Troubleshooting Flowchart 12

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Video Signals Check

This procedure checks the video signals.

1. Turn off the instrument, then remove the bottom cover.

2. On the color module, disconnect the cable that connects the microprocessor board to the color module. Refer to figure 6-30 for the cable location.

3. Load the operating system into one disk drive and apply power to the instrument. Allow enough time for the operating system to load.

4. Probe the cable for the horizontal sync, vertical sync, and display data signals. The cable pin numbers are listed in table 6-1.

   The horizontal and vertical sync signals are TTL levels that resemble figure 6-31.

   The display data signals have a baseline of approximately –1.7 V and vary in amplitude from the baseline voltage to approximately 125 mV, depending on the characteristics of the colors displayed.

5. Reconnect the cable, then return to the color module flowchart.

Table 6-1. Cable Pin Numbers

Pin Numbers	Signal
3	Horizontal Sync
7	Vertical Sync
21	Red Display Data
29	Green Display Data
37	Blue Display Data

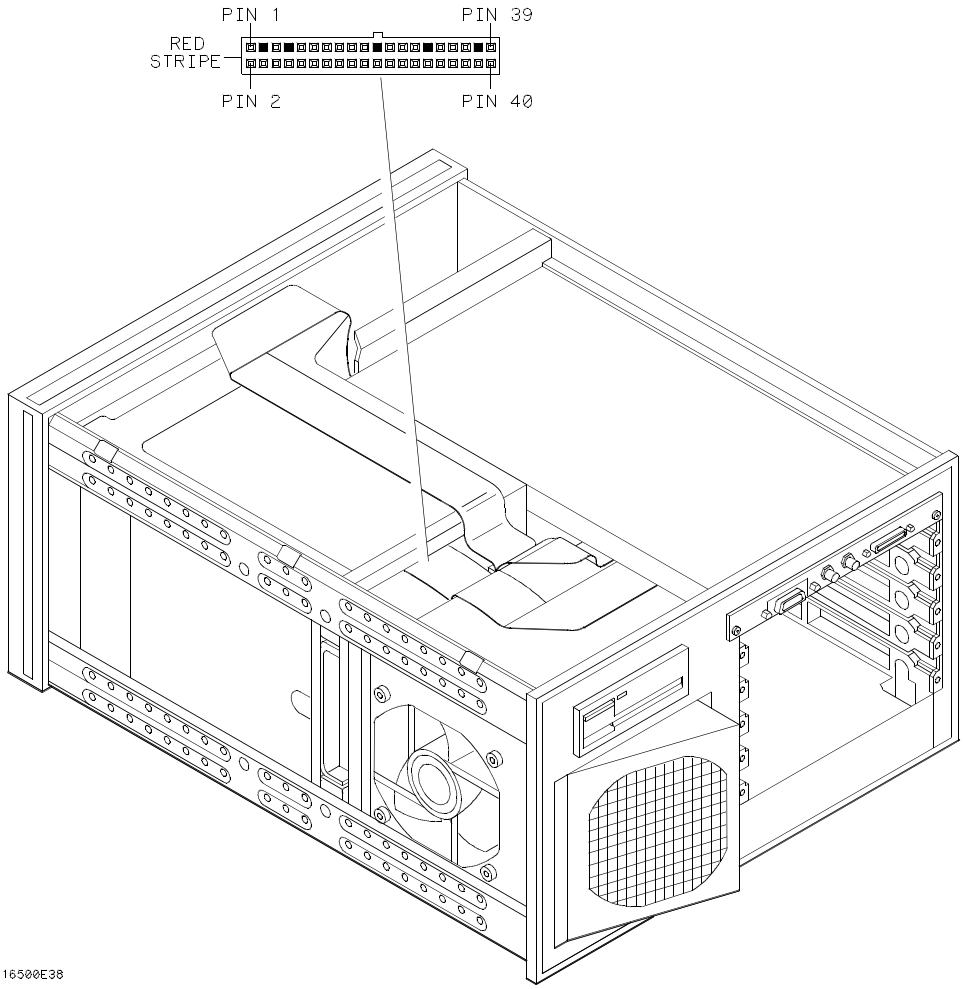


Figure 6-30. Color Module to Microprocessor Cable

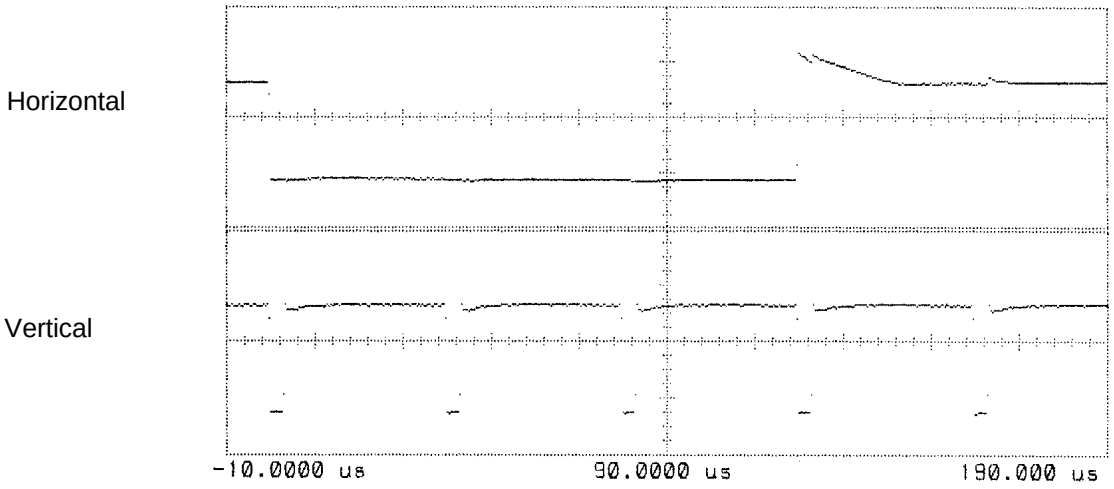


Figure 6-31. Horizontal and Vertical Sync Signals

Power Supply Check

Check the power supply LEDs for indications of power supply problems.

1. Turn off the power switch located on the rear panel of the instrument, then remove the top cover.
2. Apply power to the instrument.
3. Using figure 6-32 as a reference, check the power supply LEDs.

Note

Tape is put over the power supply screws that are close to the top cover. If the tape is missing or damaged and the top cover is installed, the power supply might shut off. If the power shuts off after installing the top cover, check the tape on the power supply, shown in figure 6-32.

4. Note problems with the power supply, then return to the power supply flowchart.

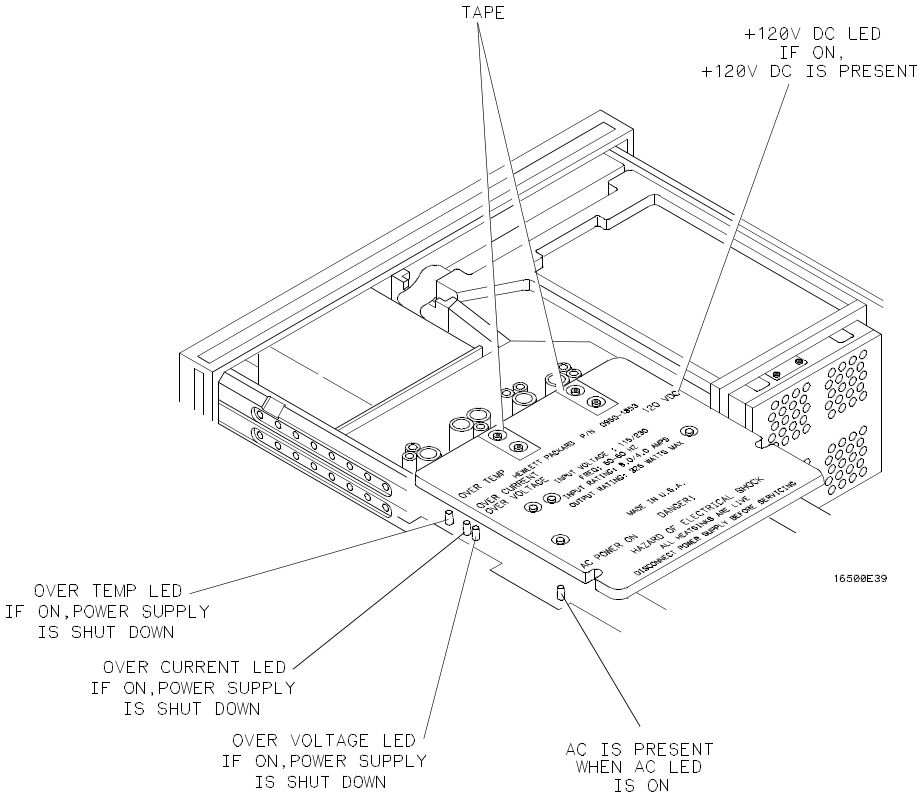


Figure 6-32. Power Supply Check

Power Supply Voltages

Check the power supply voltages for indications of power supply problems.

1. Turn off the instrument, disconnect the power cord, then remove the top cover.

2. Using a DVM, measure the power supply voltages. Use figure 6-33 for power supply pin assignments and use table 6-2 for voltages.

3. Return to the power supply flowchart.

Table 6-2. Power Supply Voltages

Pin	Supply/Signal	Voltage
Power Supply To Mother Board Connector		
1-5	+ 5 volt	+5 V
6	+5 volt remote sense	+5 V
7-9	+3.5 volt	+3.5 V
10	+3.5 volt remote sense	+3.5 V
11	+12 volt	+12 V
12	–12 volt	–12 V
13	Not connected	
14-20	Ground	0 V
21	Ground sense	0 V
22	Power valid	+5 V
23	–3.25 volt remote sense	–3.25 V
24-30	–3.25 volt	–3.25 V
31	–5.2 volt current limit	+2.5 V
32	–5.2 volt remote sense	–5.2 V
33-37	–5.2 volt	–5.2 V
38	Remote on/off	+12 V

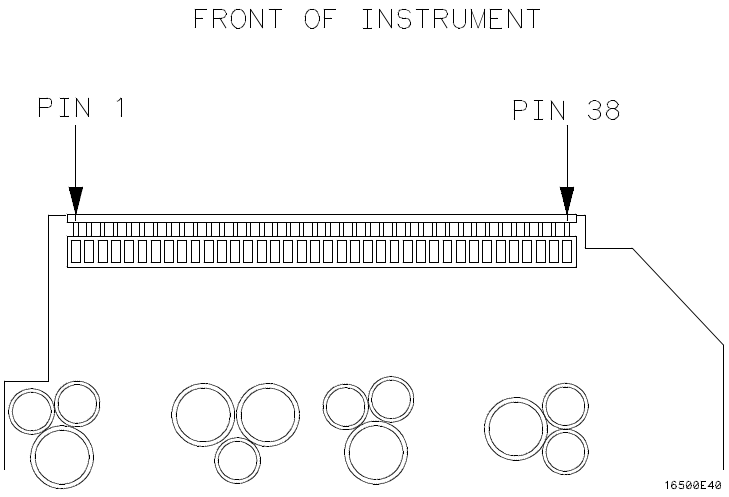


Figure 6-33. Power Supply Pins

Interface Troubleshooting Procedure

Description:

The Interface Troubleshooting Procedure is used during troubleshooting to isolate a failed interface component, the mainframe interface card, the interface cable, or the expansion interface card. The Expander Test in the performance verification software generates known bit patterns across the data and address lines of the interface and generates a walking 0 pattern on the strobe lines. Isolation is done by using a state analyzer to check these bit patterns at specific locations on the interface cards.

Equipment Required:

State Analyzer .....HP 1651B
20-pin DIP clip (qty 3)
Performance Verification Test Disk

Troubleshooting Considerations:

For the mainframe to recognize the mainframe interface card, use an operating system disk, version V04.00 or greater.

Verify that the mainframe interface card and expansion interface card are firmly seated and that the interface cable is firmly connected. To check the correct installation of the interface cable, refer to section 2-20, "HP 16501A Expansion Frame Installation."

Procedure:

1. In the HP 1651B System Configuration menu, assign the analyzer to Type: State. Then, assign Pod 1 and Pod 2 to Machine 1.

2. In the HP 1651B Format menu, assign the eight least significant bits of Pod 1 (pod 1.0 through pod 1.7) to the "Data" label and assign the eight most significant bits of Pod 1 (pod 1.8 through pod 1.15) to the "Addr" label. Assign the five least significant bits of Pod 2 (pod 2.0 through pod 2.4) to the "Strobe" label. Select a K-falling edge clock (K↓). Refer to figure 6-34.

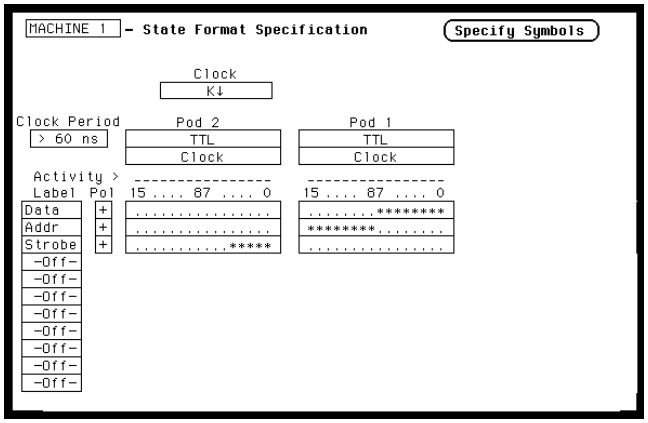


Figure 6-34. HP 1651B Format Menu

Mainframe Interface Card

3. Turn off the HP 16500A/16501A system, then remove the power cord from the mainframe and from the expansion frame. Remove all option modules from the HP 16500A mainframe. Install a disk containing the HP 16500A operating system in one of the disk drives and install a disk containing the performance verification in the other disk drive.

4. Connect the HP 1651B pod 1 and pod 2 probe tip assemblies to three DIP clips as shown in figure 6-35.

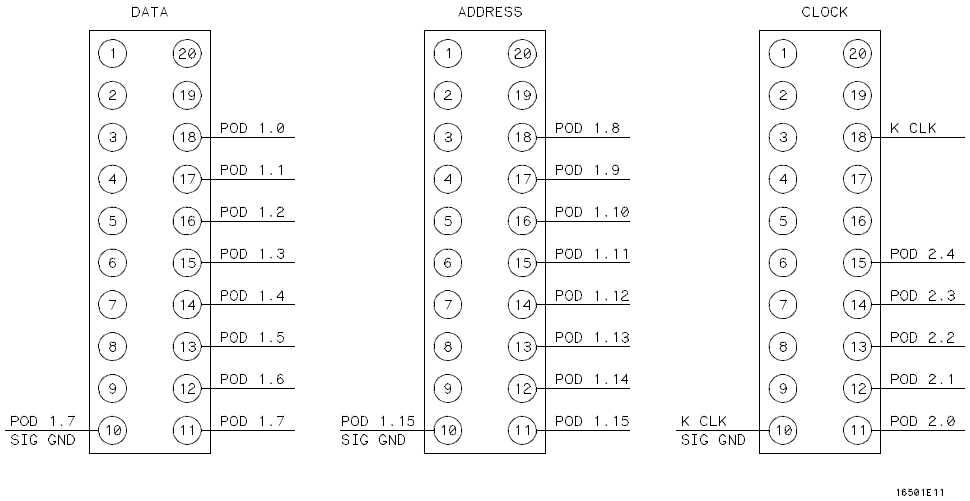


Figure 6-35. Probe Tip Connections

5. Connect the DIP clips to U18, U19, and U20 of the mainframe interface card.

   a. Connect the Data DIP clip (pod 1.0 through pod 1.7) to U18.
   b. Connect the Address DIP clip (pod 1.8 through pod 1.15) to U19.
   c. Connect the Clock and Strobe DIP clip (pod 2.0 through pod 2.4 and K CLK) to U20.

CAUTION

To prevent the +5 Vdc of the mainframe from shorting to ground, align pin 10 (ground) of the DIP clips with pin 10 (ground) of U18, U19, and U20.

6. Install the mainframe interface card into slot E of the HP 16500A. Connect the power cords to the frames, then turn on the frames. The mainframe interface card should appear in the HP 16500A System Configuration menu.

7. Run the Expander Test.

   a. In the System Configuration menu, touch **Configuration**, then touch **Test**.
   b. Touch the field closest to the center of the screen to load the test system.
   c. In the Test System Configuration menu, touch **Test System**, then touch **Mainframe Test**.
   d. In the Mainframe Test menu, touch **Expander Test**.
   e. In the Expander Test screen shown in figure 6-36, touch **Run**, slide your finger downward to **Repetitive**, then lift your finger. The Expander Test runs repetitively until you touch **Stop**.

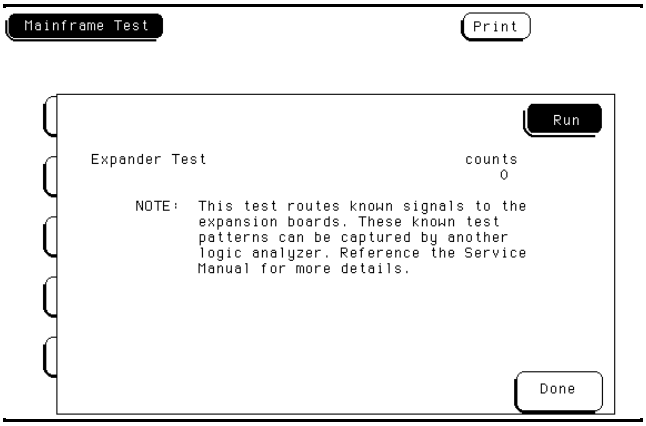
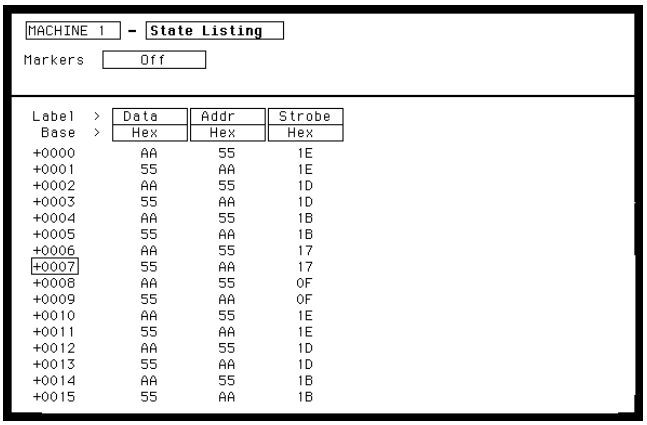


Figure 6-36. Expander Test Screen

8. Select **Run** on the HP 1651B, then scroll the data to fill the screen. The results on the HP 1651B screen should show the Data and Address alternating between AA and 55. See figure 6-37.



6-37. HP 1651B Test Screen

Also, the screen should show the Strobe with a hexadecimal representation of walking 0s through the data bits. See figure 6-37. The hexadecimal (hex) representation can be changed to a binary representation as shown below.

Hex	Binary
1E	11110
1D	11101
1B	11011
17	10111
0F	01111

If the test results are not correct, replace the mainframe interface card and reconfigure the HP 16500A/16501A system. Then, return to the Expansion Frame Flowchart 12.

If the test results are correct, reconfigure the HP 16500A/16501A system. Then, continue with this procedure.

Interface Cable

9. Turn off the HP 16500A/16501A system, then remove the power cord from the mainframe and from the expansion frame. Remove all option modules from the expansion frame.

10. Remove the expansion interface card far enough to read the reference designators of the components on the back of the card (closest to the rear panel). To remove the expansion interface card (board), refer to section 6-20, "Expansion Interface Board Replacement."

11. Connect the HP 1651B pod 1 and pod 2 probe tip assemblies to three DIP clips as shown in figure 6-38. The HP 1651B System Configuration menu and Format menu are setup the same as in step 1 and step 2.

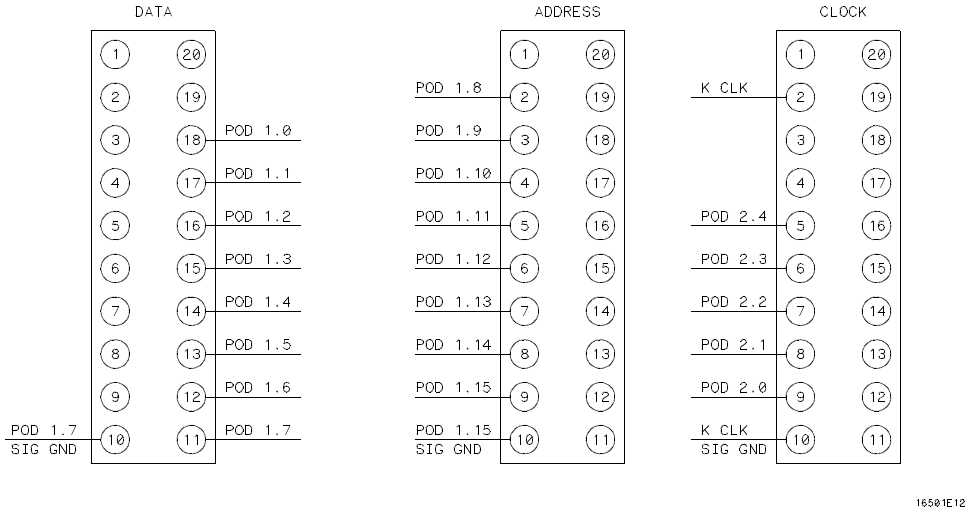


Figure 6-38. Probe Tip Connections

12. Connect the DIP clips to U7, U8, and U9 of the expansion interface card.

    a. Connect the Data DIP clip (pod 1.0 through pod 1.7) to U7.
    b. Connect the Address DIP clip (pod 1.8 through pod 1.15) to U8.
    c. Connect the Clock and Strobe DIP clip (pod 2.0 through pod 2.4 and K CLK) to U9.

CAUTION

To prevent the +5 Vdc of the mainframe from shorting to ground, align pin 10 (ground) of the DIP clips with pin 10 (ground) of U7, U8, and U9.

13. Install the expansion interface card into the expansion frame. Connect the power cords to the frames, then turn on both frames. Run the Expander Test. The Expander Test is accessed the same as in step 7.

14. On the HP 1651B, select **Run**. The results on the HP 1651B screen should be similar to figure 6-37, with the Data and Address alternating between AA and 55 and with the Strobe showing a hexadecimal representation of walking 0s through the data bits.

    If the test results are not correct, replace the interface cable and reconfigure the HP 16500A/16501A system. Then, return to the Expansion Frame Flowchart 12.

    If the test results are correct, continue with this procedure.

Expansion Interface Card

15. Turn off the HP 16500A/16501A system, then remove the power cord from the mainframe and from the expansion frame.

16. Remove the expansion interface card far enough to read the reference designators of the components on the front of the card (closest to the mother board). To remove the expansion interface card (board), refer to section 6-20, "Expansion Interface Board Replacement."

17. Connect the HP 1651B pod 1 and pod 2 probe tip assemblies to three DIP clips as shown in figure 6-35. The HP 1651B System Configuration menu and the Format menu are the same as in step 1 and step 2.

18. Connect the DIP clips to U1, U2, and U3 of the expansion interface card.

    a. Connect the Data DIP clip (pod 1.0 through pod 1.7) to U1.
    b. Connect the Address DIP clip (pod 1.8 through pod 1.15) to U2.
    c. Connect the Clock and Strobe DIP clip (pod 2.0 through pod 2.4 and K CLK) to U3.

    CAUTION

    To prevent the +5 Vdc of the mainframe from shorting to ground, align pin 10 (ground) of the DIP clips with pin 10 (ground) of U1, U2, and U3.

19. Install the expansion interface card into the HP 16501A expansion frame. Connect the power cords to the frames, then turn on the frames. Run the Expander Test. The Expander Test is accessed the same as in step 7.

20. On the HP 1651B, select **Run**. The results on the HP 1651B screen should be similar to figure 6-37, with the Data and Address alternating between AA and 55 and with the Strobe showing a hexadecimal representation of walking 0s through the data bits.

    If the test results are not correct, replace the expansion interface card and reconfigure the HP 16500A/16501A system. Then, return to the Expansion Frame Flowchart 12.

    If the test results are correct, the interface components work correctly. Reconfigure the HP 16500A/16501A system, then return to the start at Main Flowchart 1.

6-8. Repair

The repair procedures in this section are provided for the removal and replacement of major assemblies of the HP 16500A mainframe and of the HP 16501A expansion frame. After diagnosing the defective assembly using the troubleshooting flowcharts, refer to the appropriate repair procedure and follow the steps provided. Table 6-3 lists the paragraph numbers where assembly repair information is located.

WARNING

The HP 16500A is equipped with a standby switch on the front-panel that DOES NOT de-energize the power supply when switched to the STBY position. To avoid shock hazards capable of causing injury or death, disconnect the power cord for all of the assembly replacement procedures.

After making repairs, perform the power-up test and all tests of the mainframe test system.

Table 6-3. Replaceable Assemblies

Paragraph	Assembly
	HP 16500A/16501A
6-10	Cover Removal
6-11	Power Supply
6-12	Mother Board
6-13	Rear Fan
6-14	Side Fan
	HP 16500A
6-15	Rear Disk Drive
6-16	Front Disk Drive
6-17	Microprocessor Board
6-18	Front-Panel Board
6-19	Color Display Module
	HP 16501A
6-20	Expansion Interface Board (In the HP 16501A)
6-21	Mainframe Interface Board (In the HP 16500A)

6-9. Tools Required

Most hardware requires TORX tools in sizes #10, #15, and #25. Also needed is an 8-mm nut driver and a Pozidriv #2 screwdriver.

6-10. Cover Removal

There are four outside covers on the HP 16500A and on the HP 16501A, a top cover, a bottom cover, and two side covers.

When removing the covers, note where the shielding braid is located. If the shielding braid separates from the covers, reinstall it when replacing the covers. The shielding braid helps the instrument meet EMI (electromagnetic interference) specifications.

1. Remove the four rear feet. The screws connecting the feet to the frame are accessible through the holes in the end of the feet.

2. Loosen the screw in the rear of the top cover. If a captive screw was used, loosening the screw will pull the cover back. When the screw is completely loose from the frame, slide the cover off.

3. Remove the side strap handle. Note that the handle is rounded on the side closest to the instrument. Reinstall the handle with the same side toward the instrument.

4. To remove the bottom cover, turn the instrument on its side, then loosen the screw in the rear of the bottom cover. If a captive screw was used, loosening the screw will pull the cover back. When the screw is completely loose from the frame, slide the cover off.

5. Replace the covers by reversing this procedure.

6-11. Power Supply Replacement

When necessary, refer to other removal procedures.

HP 16500A

1. Remove the power cord, the top cover, the left side cover, and the card or filler panel in the top slot of the card cage. To remove the covers, refer to section 6-10, "Cover Removal." To remove the optional module card, refer to the Service Manual for each module.

2. Remove the front disk drive assembly. Leave the disk drive and bracket in one assembly. Leave the disk drive assembly connected to the cable and set it aside. Refer to section 6-16, "Front Disk Drive Replacement."

3. Remove the power supply rear panel.

4. Disconnect the color display to power supply cable from the power supply.

5. Remove the four power supply mounting screws.

6. Pull the power supply towards the rear panel of the mainframe until the power supply disconnects from the mother board connector.

7. Lift the front end of the power supply and guide it out of the mainframe.

8. Reverse this procedure to install the replacement power supply. Before pushing the power supply into place, make sure that it is properly aligned with the front connector of the mother board and with the rail guides of the card cage.

HP 16501A

1. Remove the power cord, the top cover, the left side cover, and the card or filler panel in the top slot of the card cage. To remove the covers, refer to section 6-10, "Cover Removal." To remove the optional module card, refer to the service manual for each module.

2. Remove the power supply rear panel.

3. Remove the four power supply mounting screws.

4. Pull the power supply towards the rear panel of the expansion frame until the power supply disconnects from the mother board connector.

5. Lift the front end of the power supply and guide it out of the expansion frame.

6. Reverse this procedure to install the replacement power supply. Before pushing the power supply into place, make sure that it is properly aligned with the front connector of the mother board and with the rail guides of the card cage.

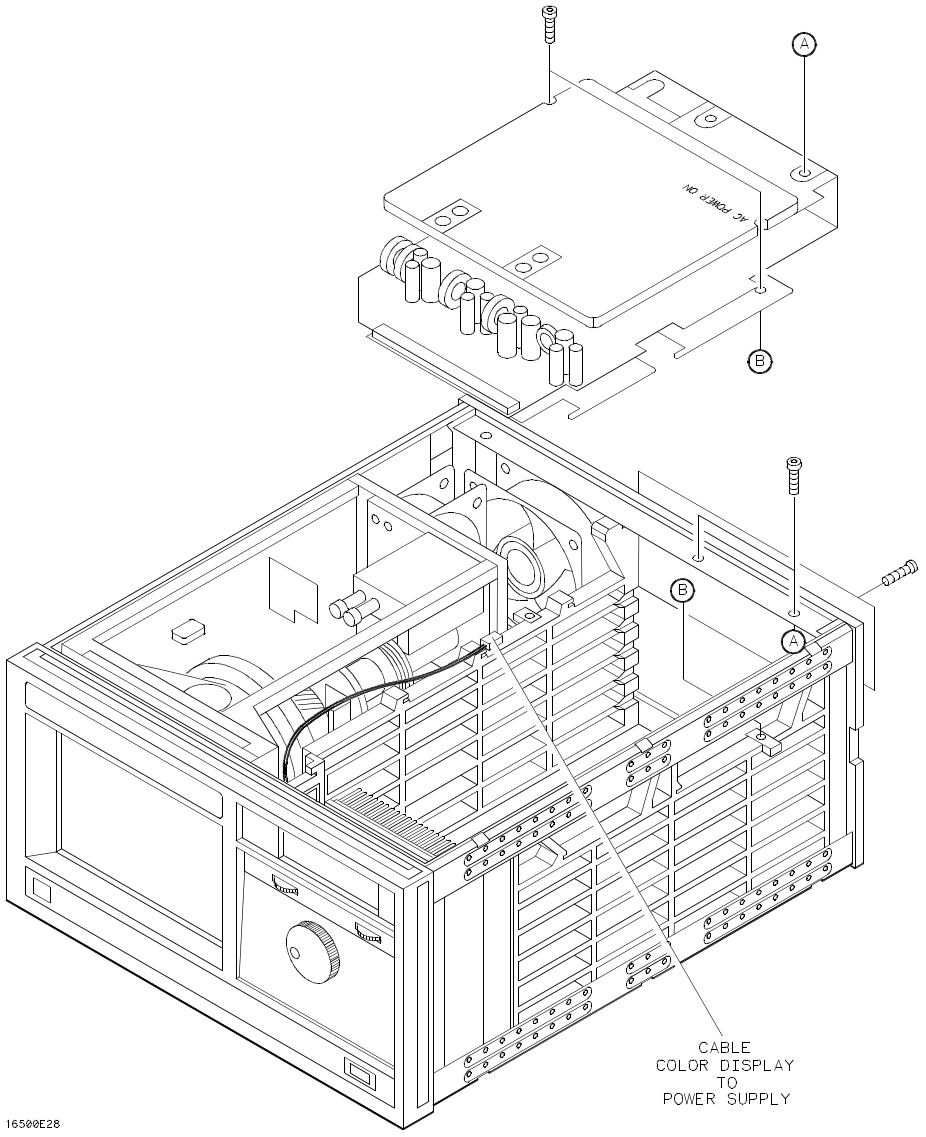


Figure 6-39. Power Supply Replacement

6-12. Mother Board Replacement

When necessary, refer to other removal procedures.

HP 16500A

1. Remove the power cord, all optional modules, and top, bottom and left side covers. To remove the covers, refer to section 6-10, "Cover Removal." To remove the optional modules, refer to the Service Manual for each module.

2. Remove the power supply. Refer to section 6-11, "Power Supply Replacement."

3. Remove the microprocessor board. Refer to section 6-17, "Microprocessor Board Replacement."

4. Disconnect the fan power cable and the front-panel cable from the mother board.

5. Remove the six mother board mounting screws, then lift the mother board out of the mainframe.

6. Reverse this procedure to install the replacement mother board.

HP 16501A

1. Remove the power cord, all optional modules, and top, bottom and left side covers. To remove the covers, refer to section 6-10, "Cover Removal." To remove the optional modules, refer to the service manual for each module.

2. Remove the power supply. Refer to section 6-11, "Power Supply Replacement."

3. Remove the expansion interface board. Refer to section 6-20, "Expansion Interface Board Replacement."

4. Disconnect the fan power cable from the mother board.

5. Remove the six mother board mounting screws, then lift the mother board out of the expansion frame.

6. Reverse this procedure to install the replacement mother board.

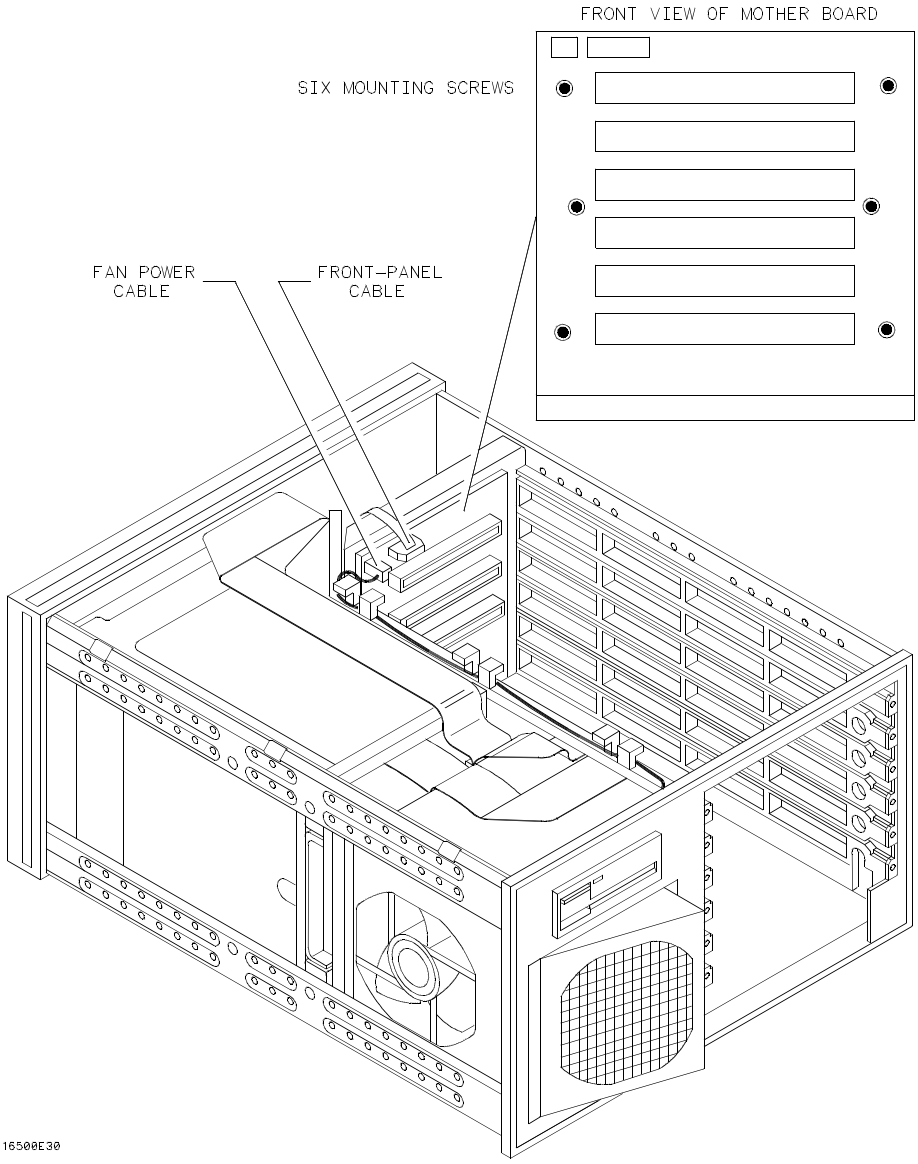


Figure 6-40. Mother Board Replacement

6-13. Rear Fan Replacement

When necessary, refer to other removal procedures.

HP 16500A and HP 16501A

1. Remove the power cord and the top cover. To remove the top cover, refer to section 6-10, "Cover Removal."

2. Remove the rear fan mounting screws. Remove the complete rear fan assembly from the rear panel of the instrument.

3. Disconnect the rear fan power cable. Remove the fan from the fan cover.

4. Reverse this procedure to install the replacement rear fan. Make sure that the fan power cable is dressed under and between the fans.

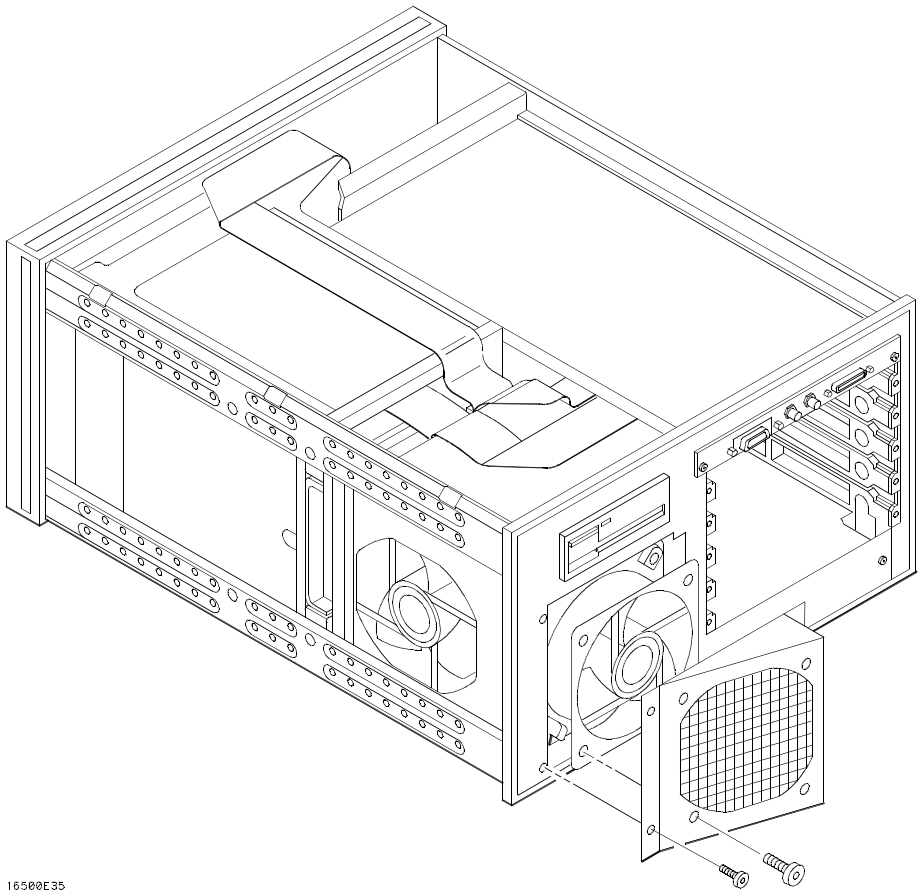


Figure 6-41. Rear Fan Replacement

6-14. Side Fan Replacement

When necessary, refer to other removal procedures.

HP 16500A and HP 16501A

1. Remove the power cord and top, bottom, and right side covers. To remove the covers, refer to section 6-10, "Cover Removal."

2. Remove the four side fan mounting screws.

3. Reach through the top of the instrument and disconnect the fan power cable. Figure 6-42 shows the bottom view of the instrument.

4. Reverse this procedure to install the replacement side fan. Make sure that the fan power cable is dressed under and between the fans.

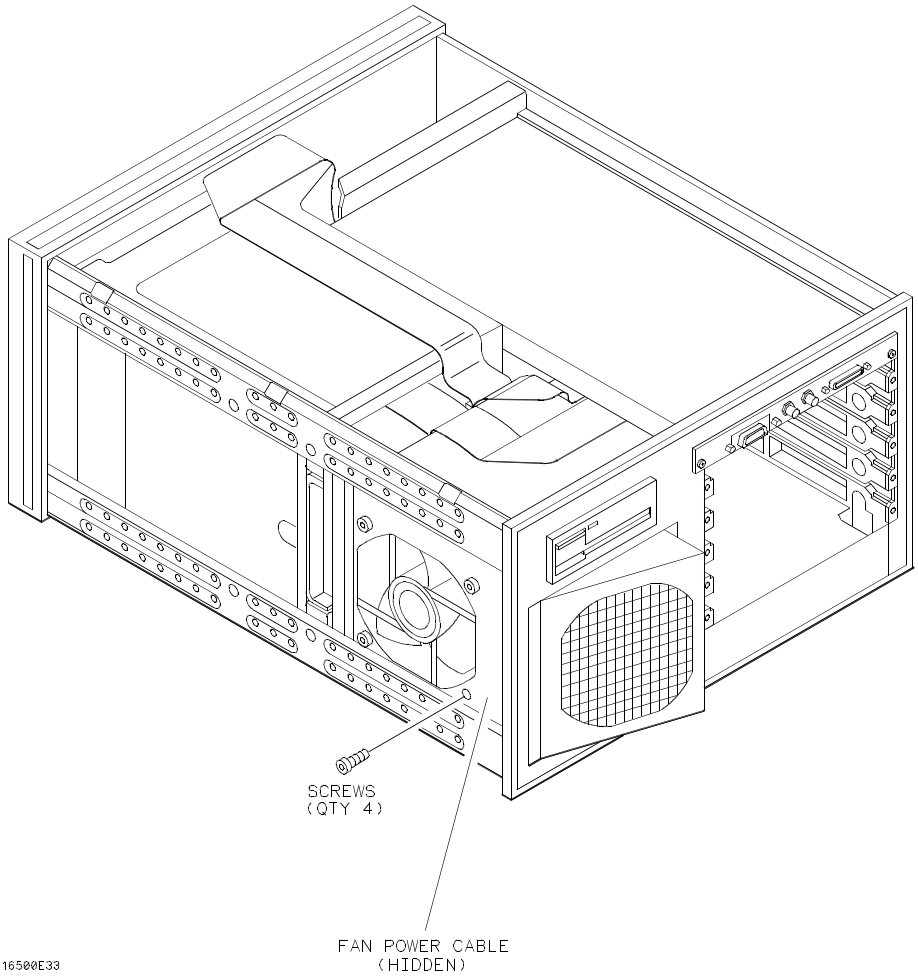


Figure 6-42. Side Fan Replacement

6-15. Rear Disk Drive Replacement

When necessary, refer to other removal procedures.

HP 16500A

1. Remove the power cord and the bottom cover of the instrument. To remove the bottom cover, refer to section 6-10, "Cover Removal."

2. Remove the four screws that connect the rear disk drive.

3. Disconnect the control cable for the disk drive, then slide the rear disk drive assembly out of the rear panel.

4. Remove the insulator from the rear disk drive and install the insulator onto the replacement disk drive.

5. Set the address switch on the replacement disk drive assembly to the "0" position, then reverse this procedure to install the replacement disk drive assembly.

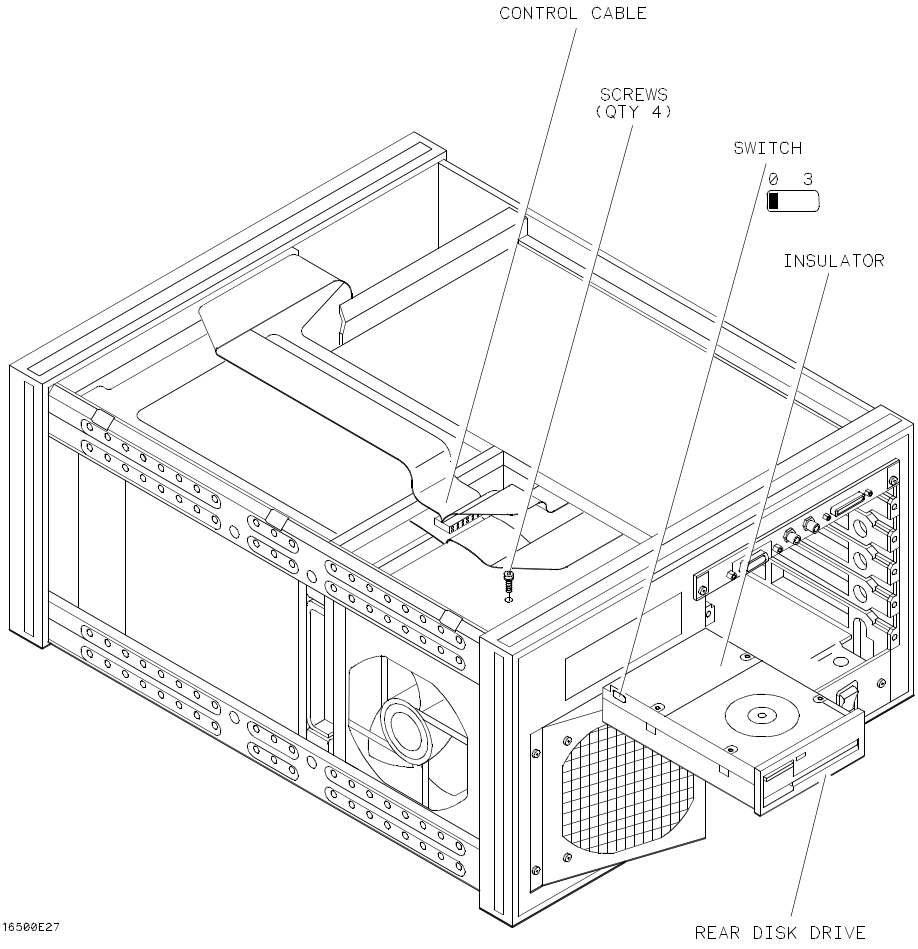


Figure 6-43. Rear Disk Drive Replacement

6-16. Front Disk Drive Replacement

When necessary, refer to other removal procedures.

HP 16500A

1. Remove the power cord and the top cover. To remove the top cover, refer to section 6-10, "Cover Removal."
2. Remove the two disk drive mounting screws.
3. Slide the front disk drive assembly toward the rear panel until the assembly is out of the instrument.
4. Disconnect the control cable for the disk drive.
5. Remove the shield from the top of the assembly and the mounting bracket from the bottom of the assembly.
6. Set the address switch on the replacement disk drive assembly to the "1" position, then reverse this procedure to install the replacement disk drive assembly.

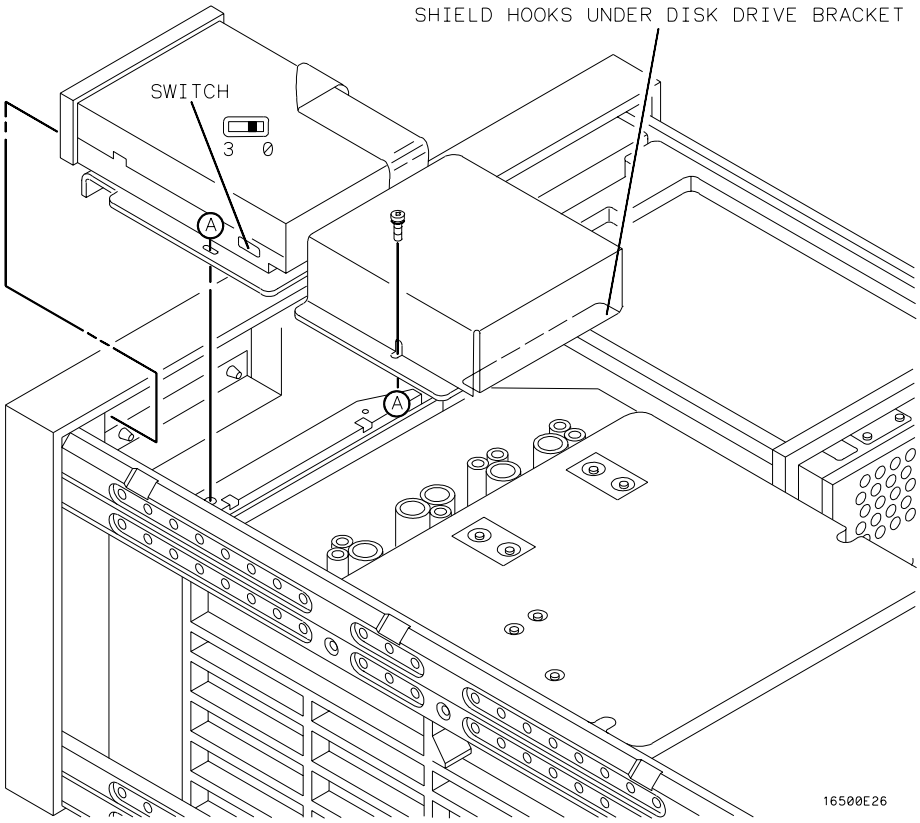


Figure 6-44. Front Disk Drive Replacement

6-17. Microprocessor Board Replacement

When necessary, refer to other removal procedures.

HP 16500A

1. Remove the power cord, all optional modules, and the bottom cover. To remove the bottom cover, refer to section 6-10, "Cover Removal." To remove the optional modules, refer to the Service Manual for each module.

2. Disconnect the two cables from the microprocessor board. The front cable is connected to the rear disk drive and the other cable is connected to the color display module.

3. Remove the two screws connecting the microprocessor to the rear panel.

4. Carefully slide the microprocessor board out of the mainframe.

5. Reverse this procedure to install the replacement microprocessor board.

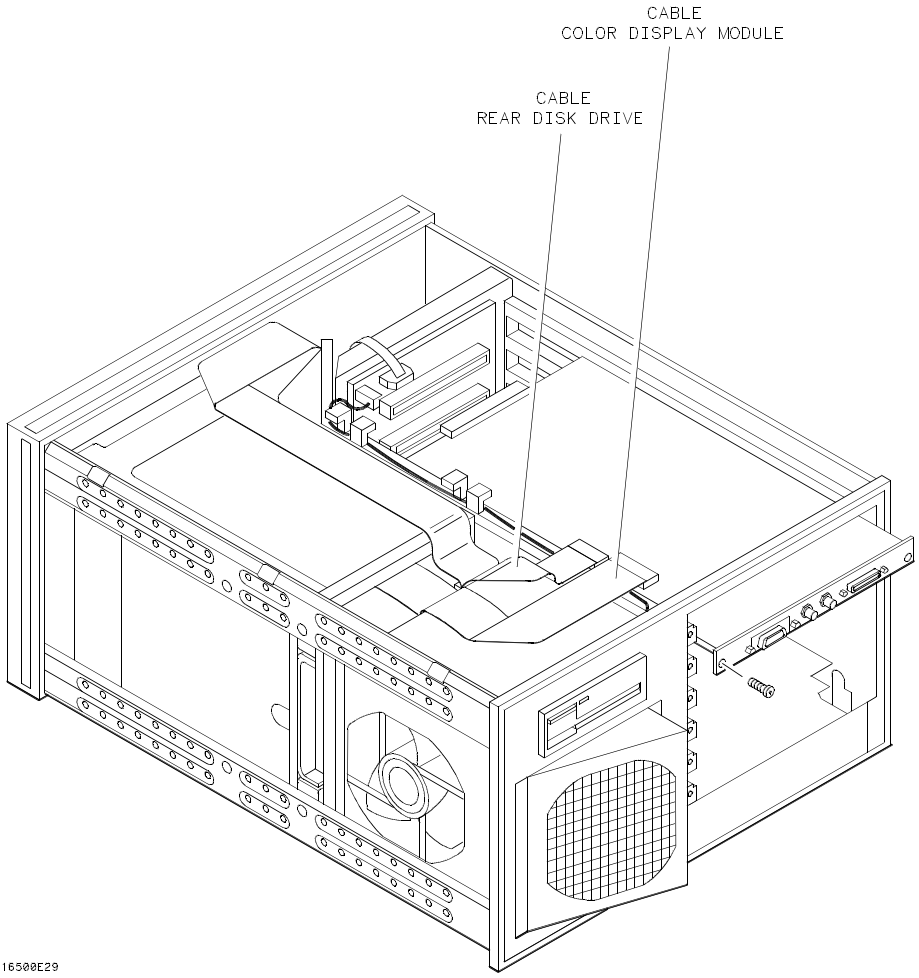


Figure 6-45. Microprocessor Board Replacement

6-18. Front-Panel Board Replacement

When necessary, refer to other removal procedures.

HP 16500A

1. Remove the power cord and the bottom cover. To remove the bottom cover, refer to section 6-10, "Cover Removal." Remove the top trim from the front frame.

2. Disconnect the two cables from the front-panel board. One cable is connected to the color display module and one cable is connected to the mother board.

3. Remove the screws connecting the front-panel assembly to the top and bottom of the frame.

4. Remove the front-panel assembly by pushing on the back of the assembly from inside the instrument.

5. Carefully remove the shield from the assembly. The shield is very fragile and must be replaced if it is bent or damaged in any way.

6. Remove the clip holding the front-panel board to the front-panel assembly.

7. Remove the bezel from the front-panel board.

8. Unplug the RPG knob cable. Remove the screws connecting the front-panel board to the front-panel, then remove the front-panel board.

9. Reverse this procedure to install the replacement front-panel board.

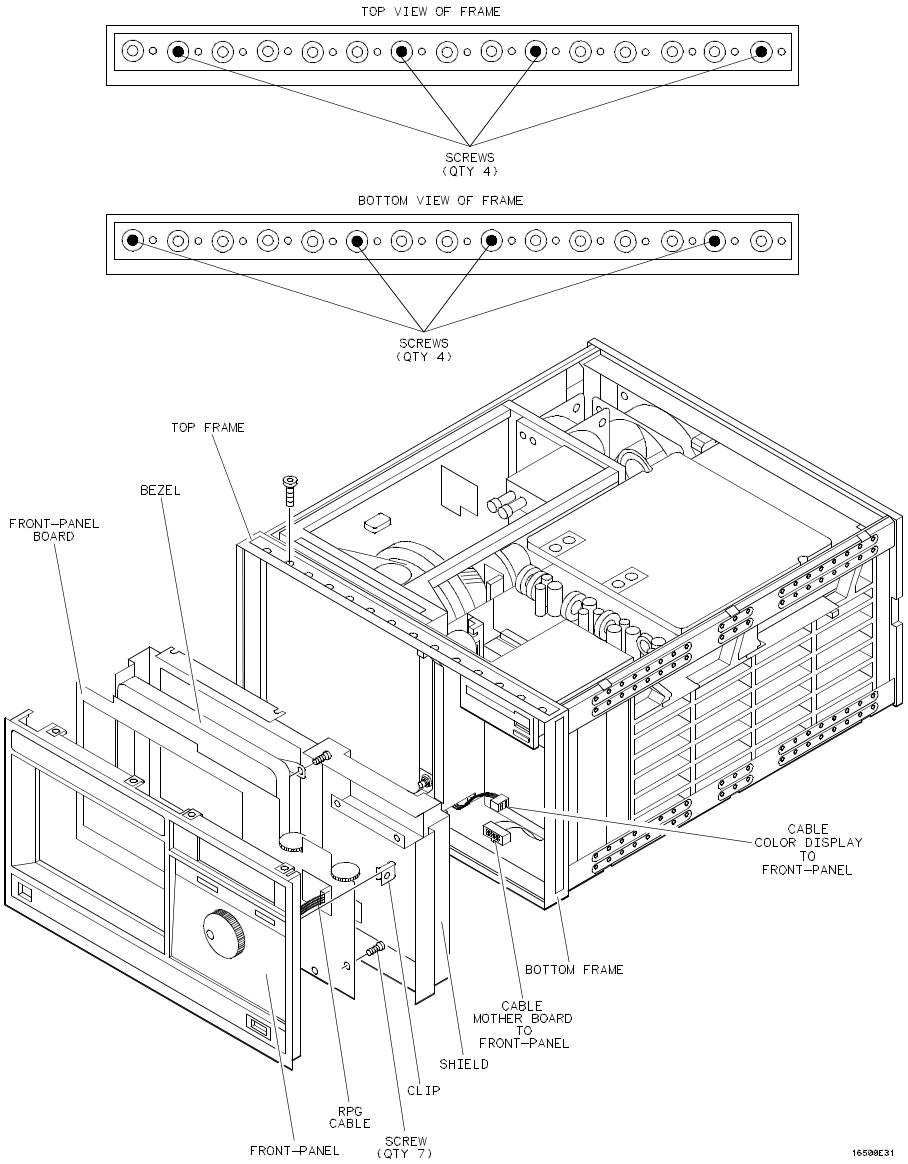


Figure 6-46. Front-Panel Board Replacement

6-19. Color Display Module Replacement

The color display module replacement procedure consists of three sections:

Removing the module from the mainframe.
Transferring parts to the replacement module.
Installing the module in the mainframe.

When necessary, refer to other removal procedures.

HP 16500A

Removing the Color Display Module from the Mainframe

1. Remove the power cord, all covers, and the front-panel assembly. To remove the covers, refer to section 6-10, "Cover Removal." To remove the front-panel assembly, refer to section 6-18, "Front-Panel Board Replacement."

2. Disconnect the color display to microprocessor cable from the microprocessor board. Disconnect the color display to power supply cable from the power supply.

3. Remove the screws that connect the rear mounting bracket on the display module to the side of the mainframe.

4. Remove the screws that connect the color display to the top and bottom of the front frame.

5. Remove the screws that connect the center board guide to the front frame. Move the sheet metal nuts, located on the center board guide, so that the display module can clear the mainframe.

6. Slide the complete color display module assembly forward out of the mainframe. To prevent damage to the module cables, make sure that they also clear the frame.

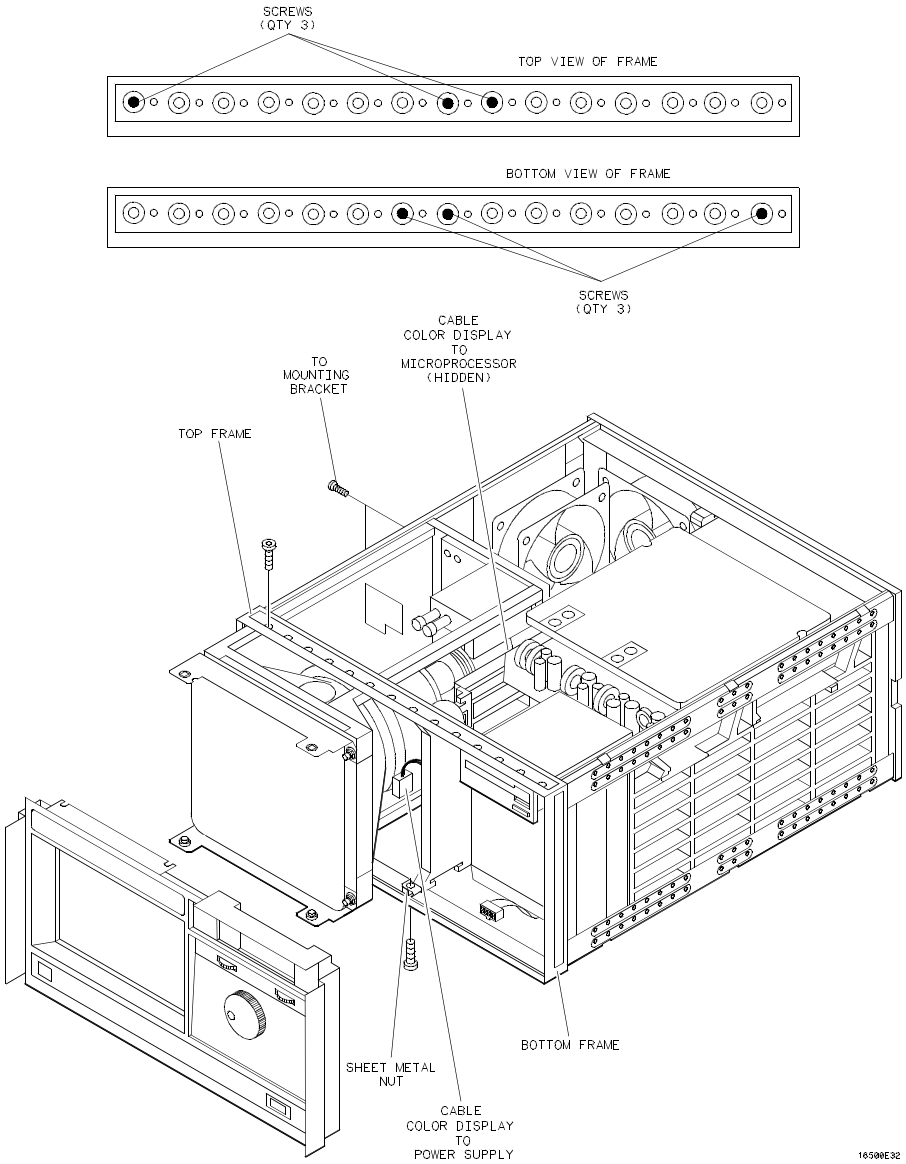


Figure 6-47. Color Display Module Removal

Transferring Parts to the Replacement Module

The purpose of this procedure is to transfer the mechanical parts from the old module to the replacement module.

1. Remove the rear mounting bracket from the rear support bracket. Remove the rear support bracket from the color display module.

2. Attach the rear support bracket to the replacement module, using the two thread-forming screws. Do not overtighten.

3. Attach the frame mounting bracket to the rear support bracket. Install hardware in the following sequence: screw, flat washer, rubber washer. Do not tighten the hardware.

4. Remove the four bracket nuts connecting the front mounting brackets to the old module, then remove the front mounting brackets. Reinstall the bracket nuts on the old module.

5. Remove the four bracket nuts from the replacement module. Using the four bracket nuts, install both front mounting brackets on the replacement display module. The upper bracket is identified by the notch on one edge.

6. Disconnect the flat microprocessor cable, the power cable, and the front-panel control cable from the old module, noting the location of the cables. Connect the cables to the replacement module.

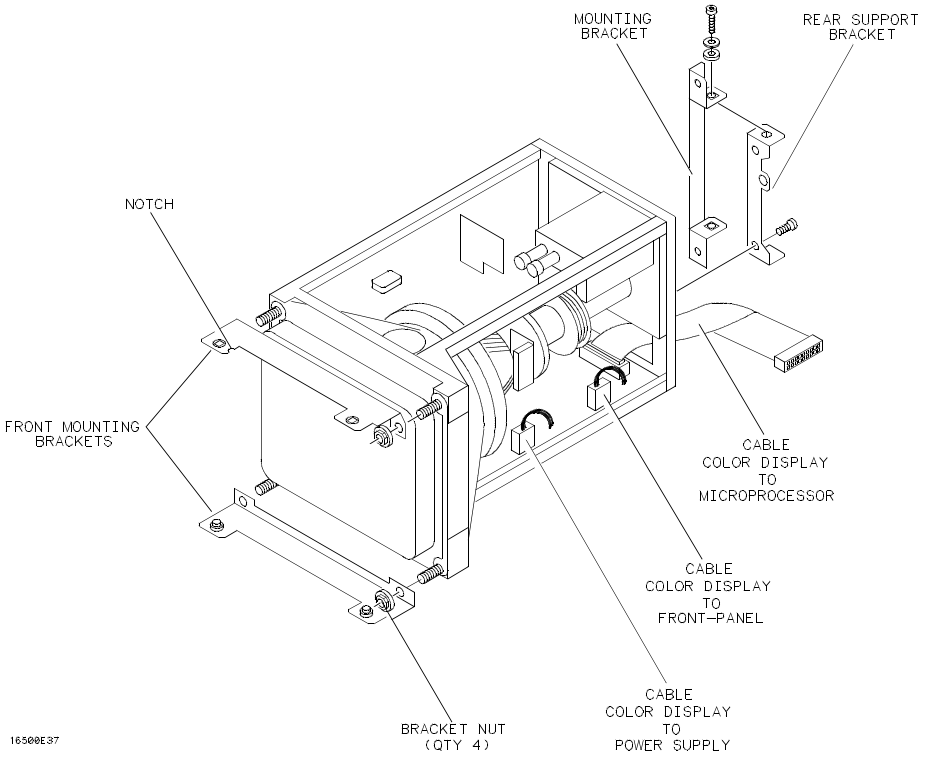


Figure 6-48. Transferring Parts

Installing the Replacement Color Display Module

1. Carefully slide the color display module most of the way into the mainframe. To prevent damage to the cables, make sure that they clear the mainframe.

2. Connect the color display to power supply cable to the power supply. Slide the display module completely into the mainframe.

3. Attach the display module to the front frame with four screws (two on the top casting and two on the bottom casting). Do not tighten the screws.

4. Move the sheet metal nuts, located on the front tabs of the center board guide, so that the holes in the sheet metal nuts and the tabs line up. Attach the front tabs of the center board guide to the front frame.

5. Reinstall the front-panel assembly, connecting the front-panel cables. Make sure the front-panel assembly is properly seated before tightening the hardware.

6. Push the display module forward, until it is properly seated against the front-panel assembly. Tighten the four display module mounting screws in the front frame.

7. Attach the rear mounting bracket of the display module to the side frame, then tighten the mounting bracket screws. To prevent damage to the rubber washers, do not overtighten the screws.

8. Tighten all of the display module mounting hardware. Reconnect the flat color display to microprocessor cable to the microprocessor board.

9. Reinstall all covers.

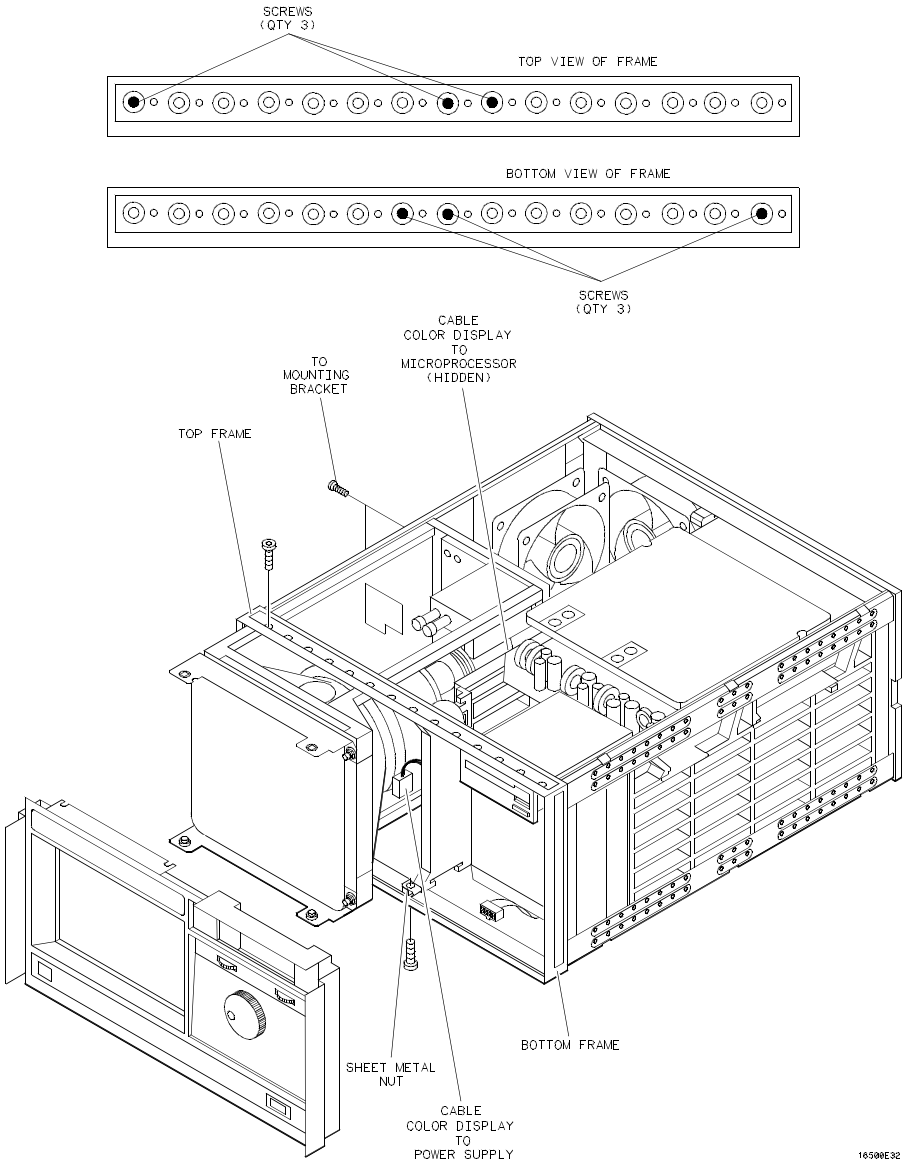


Figure 6-49. Color Display Module Installation

6-20. Expansion Interface Board Replacement

When necessary, refer to other removal procedures.

HP 16501A

1. Remove the power cord, all optional modules, and the bottom cover. To remove the bottom cover, refer to section 6-10, "Cover Removal." To remove the optional module cards, refer to the Service Manual for each module.

2. Disconnect the interface cable by pressing the release tabs on either side of the cable connector while pulling the cable connector away from the board.

3. Disconnect the two cables on the expansion interface board. One cable is connected to the front-panel LED and one cable is connected to the mother board.

4. Remove the two screws connecting the expansion interface board to the rear panel of the expansion frame.

5. Carefully slide the expansion interface board out of the expansion frame.

6. Reverse this procedure to install the replacement expansion interface board.

Note

In order to ensure correct connection of the interface cable, the 68-pin "D" connectors on the cable are asymmetric in shape. They only fit into the ports on the boards when oriented to match the shape of the ports.

When reconnecting the interface cable, make sure the cable connector is properly seated into the port on the expansion interface board by pulling the cable connector without pressing the release tabs. If the connector is properly seated, it will remain connected to the port.

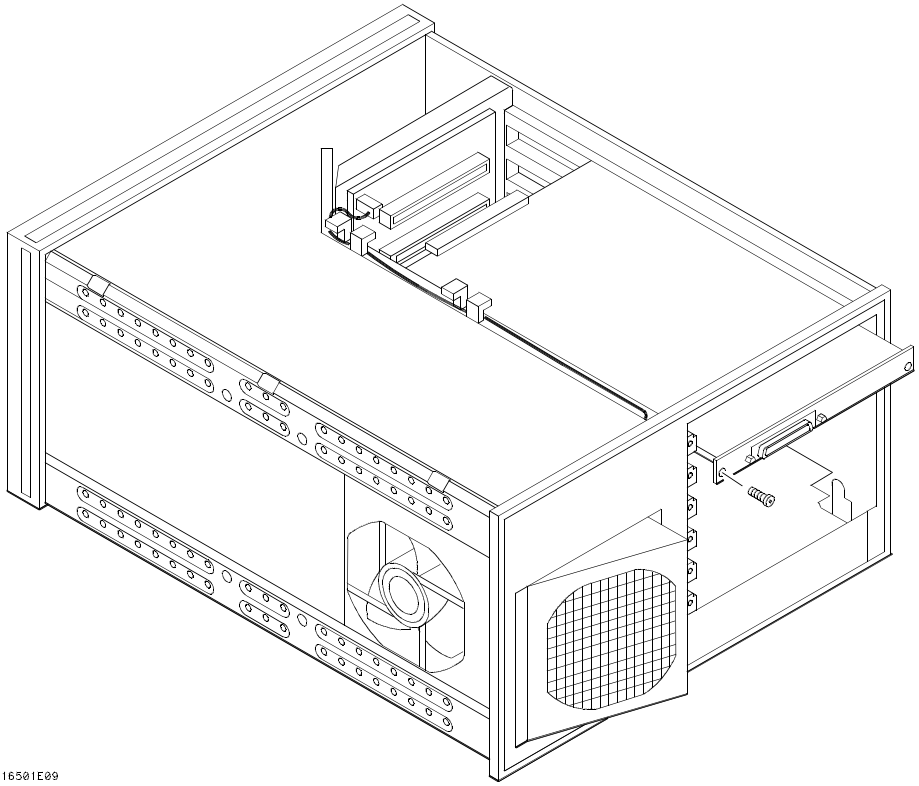


Figure 6-50. Expansion Interface Board Replacement

6-21. Mainframe Interface Board Replacement

1. Turn off the HP 16500A mainframe power switch, then unplug the power cord. Disconnect any input connections.

2. Disconnect the interface cable from the mainframe interface card (board) by pressing the release tabs on either side of the cable connector while pulling the connector away from the card.

3. Starting **from the top**, loosen the thumb screws on filler panels and cards in the HP 16500A mainframe that are located above the mainframe interface card. Starting **from the top**, pull the cards and filler panels **halfway** out. See figure 6-51.

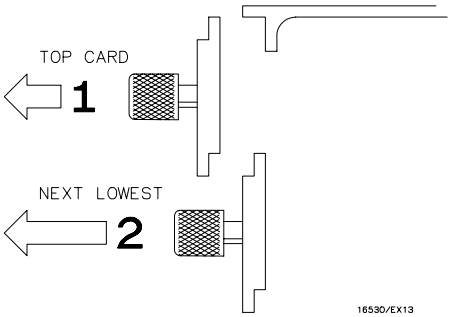


Figure 6-51. Endplate Overlap

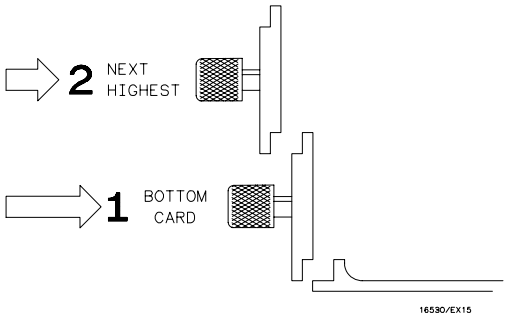


Figure 6-52. Endplate Overlap

4. Loosen the thumb screws on the mainframe interface card and remove it. Slide the replacement mainframe interface card into the card cage of the HP 16500A mainframe.

5. Reposition all cards and filler panels so that the endplates overlap properly.

6. Firmly seat the bottom card into the backplane connector of the mainframe. **Keep applying pressure to the center of the card endplate while tightening the thumb screws finger tight.** Repeat for all cards and filler panels in a bottom to top order. See figure 6-52.

Note

Filler panels **must** *be installed in all unused card slots for correct air circulation. Any filler panels that are not used should be kept for future use.*

7. Connect the interface cable to the mainframe interface card located in the HP 16500A mainframe.

Note

In order to ensure correct connection of the interface cable, the 68-pin "D" connectors on the cable are asymetric in shape. They only fit into the ports on the cards when oriented to match the shape of the ports.

When reconnecting the interface cable, make sure the cable connector is properly seated into the port on the expansion interface card by pulling the cable connector without pressing the release tabs. If the connector is properly seated, it will remain connected to the port.

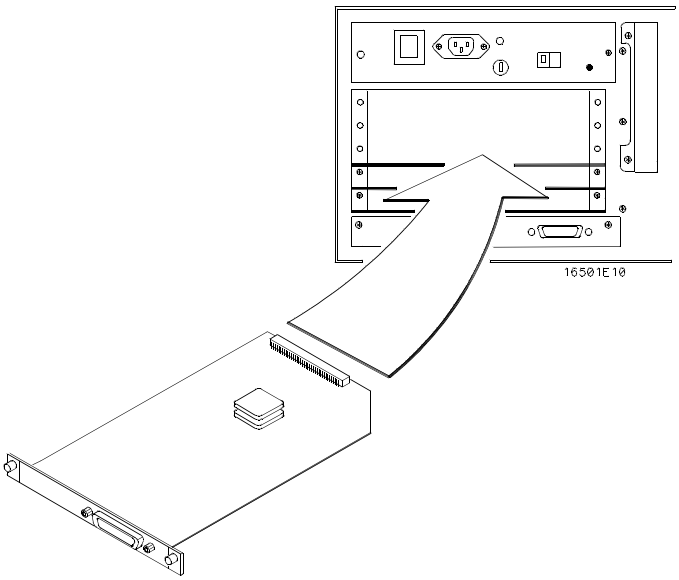


Figure 6-53. Mainframe Interface Board Replacement

SAFETY CONSIDERATIONS

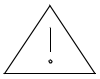
GENERAL - This is a Safety Class I instrument (provided with terminal for protective earthing).

OPERATION - BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument's external markings which are described under "Safety Symbols."

WARNING

- Servicing instructions are for use by service-trained personnel. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.
- BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminal of the instrument must be connected to the protective conductor of the (mains) powercord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.
- If this instrument is to be energized via an auto-transformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.
- Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury.
- Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.
- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.
- Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.
- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.
- Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.
- Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS



Instruction manual symbol. The product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the product.



Indicates hazardous voltages



Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

WARNING

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

CAUTION

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

CERTIFICATION

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

WARRANTY

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

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

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