

Service Guide

HP 70004A Color Display



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The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

CAUTION The *CAUTION* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the product or the user's work. Do not proceed beyond a *CAUTION* sign until the indicated conditions are fully understood and met.

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

DANGER The *DANGER* sign denotes an imminent hazard to people. It warns the reader of a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a *DANGER* sign until the indicated conditions are fully understood and met.

General Safety Considerations

- WARNING**
- These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.
 - The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.
 - The power cord is connected to internal capacitors that may remain live for five seconds after disconnecting the plug from its power supply.
 - This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.
 - For continued protection against fire hazard, replace fuse only with same type and ratings, (type nA/nV). The use of other fuses or materials is prohibited.
-

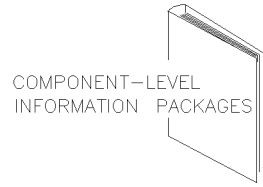
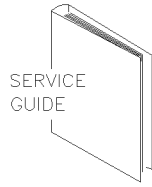
- WARNING**
- Before this instrument is switched on, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.
 - Before this instrument is switched on, make sure its primary power circuitry has been adapted to the voltage of the ac power source.

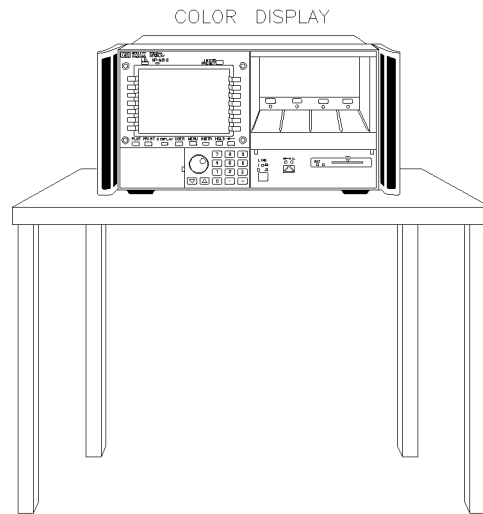
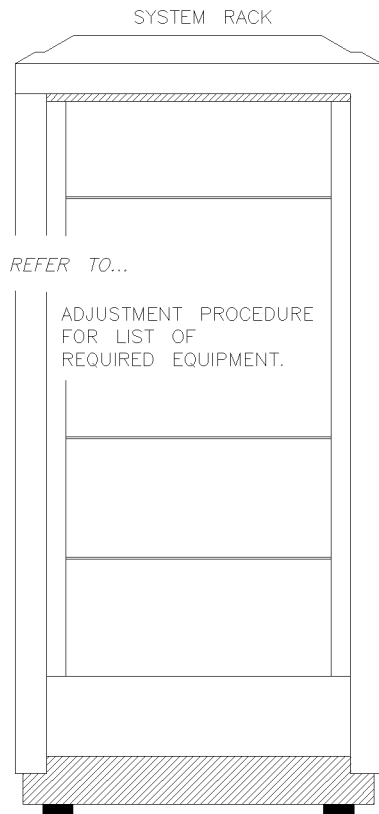
Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.
-

Servicing at a Glance

DOCUMENTATION SUPPLIED



TOOLS AND EQUIPMENT NEEDED



sja54b

The color display is used in HP 70000 Series modular measurement systems. A standard modular spectrum analyzer system includes a mainframe with an RF section, IF section, local oscillator, an optional display, and an optional precision frequency reference.

Software and documentation supplied

This service guide is part of an Option OB3 package which includes:

- *HP 70004A Service Guide*
- *HP 70004A Component Level Information Packages*

Tools needed

Before servicing, refer to Chapter 5 for a list of the tools and accessories that may be needed during servicing.

Antistatic precautions

Electrical components are easily damaged by small amounts of static electricity. If possible, work at a static-safe work station. For further information, refer to “Preparing a Static-Safe Work Station” in Chapter 4.

In This Book

This book describes all of the service procedures necessary to test, adjust, calibrate, troubleshoot, and repair your color display in an HP 70000 Series modular measurement system.

Each module in the HP 70000 Series modular measurement system has its own service guide. For further information related to the servicing of additional and alternate modules that can be used in this system, refer to that module's service guide.

This service guide is part of an Option OB3 package which consists of two manuals.

Manual 1

Chapter 1 provides information to help get you started so that your color display is serviced properly.

Chapter 2 would have contained information needed to use module verification software, but your color display does not require this software because there are no module verification tests.

Chapter 3 contains information to help identify and resolve some common problems that may occur with your color display before extensive servicing.

Chapter 4 contains information about troubleshooting your color display. It presents information on preparing a static-safe work station and then it presents a set of troubleshooting procedures that can be used to optimize repair time.

Chapter 5 contains tables with a complete listing of all equipment that may be required for servicing.

Chapter 6 contains the setups for all adjustment procedures that are used to optimize module performance when assemblies are changed, repaired, or adjusted.

Chapter 7 would have contained information needed to perform all module verification tests, but your color display does not have any module verification tests.

Chapter 8 would have contained information needed for all equipment calibration procedures, but your color display does not have any equipment calibration procedures.

Chapter 9 contains procedures for removal and replacement of major assemblies in your color display. It also contains information needed to order mechanical parts for your color display.

Chapter 10 contains information on all overall parts identification drawings that should be used when performing the troubleshooting procedures described in this service guide.

An index is also added at the end of this service guide to aid the user in finding key items of interest.

Manual 2

Manual 2 contains packets of component-level repair information for each color display board assembly that has field-replaceable parts. Each packet includes the parts list, component-location drawing, and schematics for a specific board-assembly part number. This manual also contains a table that can be used to cross reference different board assemblies that have different serial prefix breaks.

Before you begin servicing, refer to "Preparing a Static-Safe Work Station" in Chapter 4.

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Getting Started

This chapter provides information to help get you started so that your color display is serviced properly.

This chapter answers the questions “What Is Servicing?” and “When Is Servicing Needed?”. It then describes the procedures used to return your color display to Hewlett-Packard for servicing.

What Is Servicing?

Servicing includes testing, adjusting, calibrating, troubleshooting, and repairing.

There are different categories of testing available. These categories are module verification tests, system verification of operation tests, and system performance tests.

Module Verification Tests Module verification tests are used to test modules so that when assembled into a system, the system meets the system's specifications. These sets of tests are used during servicing.

System Verification of Operation Tests System verification of operation tests are used to verify the proper operation of an instrument and to verify that the instrument meets approximately 80% of its measurement related specifications. These sets of tests are subsets of system performance tests.

System Performance Tests System performance tests are used to verify the proper operation of a complete modular measurement system (MMS) to full system specifications.

This service guide provides information related to testing, adjusting, calibrating, troubleshooting, and repairing your color display; it also provides information on module verification tests. These sets of tests are used during servicing.

For information related to system verification of operation tests, refer to the *HP 70000 Modular Spectrum Analyzer Installation and Verification Manual*, and for information related to system performance tests, refer to the documentation for HP 11990A system performance test software.

When Is Servicing Needed?

Servicing is needed:

- if error messages are displayed on your HP 70000 Series display
- if an ERROR LED or FAULT LED is on
- to perform repairs or adjustments or both
- to verify the correct operation of your color display
- or, if applicable, when upgrading firmware

If you determine that your color display needs servicing, you can perform the servicing yourself or, you can return your color display to a Hewlett-Packard service center.

If You Want Hewlett-Packard to Service Your Color Display

Before calling Hewlett-Packard or returning your color display for service, please read your warranty information. Warranty information is printed at the front of this service guide.

In any correspondence or telephone conversations, refer to the color display by its full model number and full serial number. With this information, the Hewlett-Packard representative can determine whether your unit is still within its warranty period.

Determining Your Color Display's Serial Number

When a module is manufactured by Hewlett-Packard, it is given a unique serial number. This serial number is attached to a label on the front frame or front panel of the module. A serial number label is in two parts. (Refer to Figure 1-1.) The first part makes up the serial number prefix and consists of four digits and a letter. The second part makes up the serial number suffix and consists of the last five digits on the serial number label. The serial number prefix is the same for all identical modules; it only changes when a change in the electrical or physical functionality is made. The serial number suffix, however, changes sequentially and is different for each module.



Figure 1-1. Typical Serial Number Label

Table 1-1. Hewlett-Packard Sales and Service Offices

US FIELD OPERATIONS HEADQUARTERS	EUROPEAN OPERATIONS HEADQUARTERS	INTERCON OPERATIONS HEADQUARTERS
Hewlett-Packard Company 19320 Pruneridge Avenue Cupertino, CA 95014, USA (800) 752-0900	Hewlett-Packard S.A. 150, Route du Nant-d'Avril 1217 Meyrin 2/Geneva Switzerland (41 22) 780.8111	Hewlett-Packard Company 3495 Deer Creek Rd. Palo Alto, California 94304-1316 (415) 857-5027
California Hewlett-Packard Co. 1421 South Manhattan Ave. Fullerton, CA 92631 (714) 999-6700 Hewlett-Packard Co. 301 E. Evelyn Mountain View, CA 94041 (415) 694-2000	France Hewlett-Packard France 1 Avenue Du Canada Zone D'Activite De Courtaboeuf F-91947 Les Ulis Cedex France (33 1) 69 82 60 60	Australia Hewlett-Packard Australia Ltd. 31-41 Joseph Street (P.O. Box 221) Blackburn, Victoria 3130 (61 3) 895-2895
Colorado Hewlett-Packard Co. 24 Inverness Place, East Englewood, CO 80112 (303) 649-5000	Germany Hewlett-Packard GmbH Hewlett-Packard-Strasse 61352 Bad Homburg Germany (+ 49 6172) 16-0	Canada Hewlett-Packard (Canada) Ltd. 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 Canada (514) 697-4232
Georgia Hewlett-Packard Co. 2000 South Park Place Atlanta, GA 30339 (404) 955-1500	Great Britain Hewlett-Packard Ltd. Eskdale Road, Winnersh Triangle Wokingham, Berkshire RG11 5DZ England (44 734) 696622	Japan Yokogawa-Hewlett-Packard Ltd. 1-27-15 Yabe, Sagamihara Kanagawa 229, Japan (81 427) 59-1311
Illinois Hewlett-Packard Co. 5201 Tollview Drive Rolling Meadows, IL 60008 (708) 342-2000		China China Hewlett-Packard, Co. 38 Bei San Huan X1 Road Shuang Yu Shu Hai Dian District Beijing, China (86 1) 256-6888
New Jersey Hewlett-Packard Co. 150 Green Pond Road Rockaway, NJ 07866 (201) 586-5400		Singapore Hewlett-Packard Singapore Pte. Ltd. Alexandra P.O. Box 87 Singapore 9115 (65) 271-9444
Texas Hewlett-Packard Co. 930 E. Campbell Rd. Richardson, TX 75081 (214) 231-6101		Taiwan Hewlett-Packard Taiwan 8th Floor, H-P Building 337 Fu Hsing North Road Taipei, Taiwan (886 2) 712-0404

Returning Your Color Display for Service

Hewlett-Packard has sales and service offices around the world to provide complete support for your color display. To obtain servicing information or to order replacement parts, contact the nearest Hewlett-Packard sales and service office listed in Table 1-1.

Use the following procedure to return your color display to Hewlett-Packard for service:

1. Fill out a service tag (available at the end of this service guide) and attach it to the instrument. Please be as specific as possible about the nature of the problem. Send a copy of any or all of the following information:
 - any error messages that appeared on the HP 70000 Series display
 - a completed Performance Test record
 - any other specific data on the performance of the color display

CAUTION Damage can result if the original packaging materials are not used. Packaging materials should be anti-static and should cushion the color display on all sides.

Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the instrument or prevent it from moving in the shipping container. Styrene pellets can also cause equipment damage by generating static electricity or by lodging in fan motors.

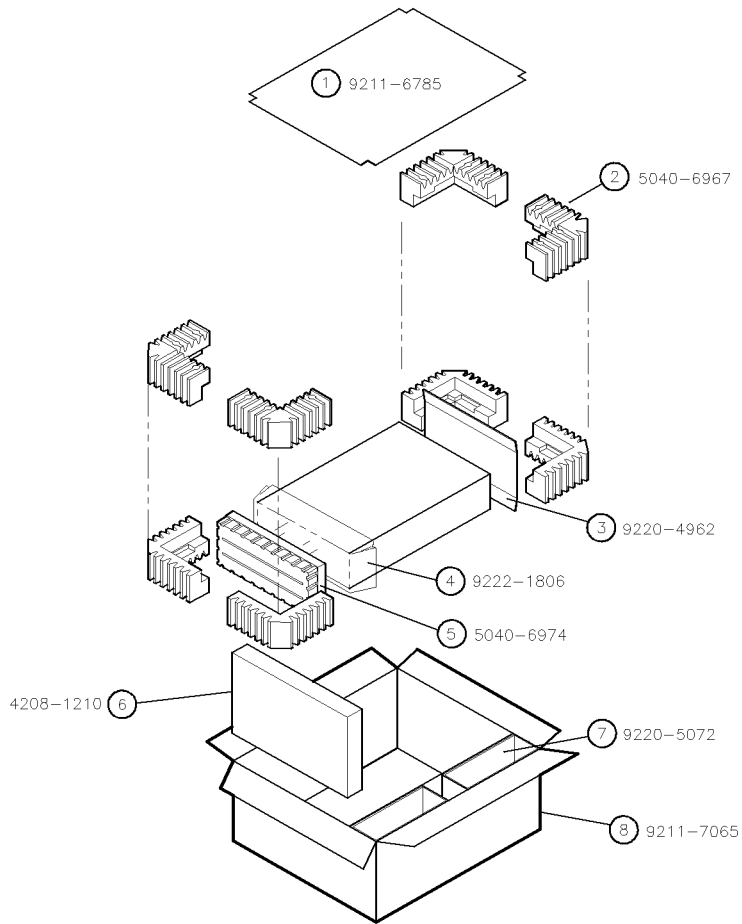
2. Place the color display in its original packaging materials.

If the original packaging materials are not available, you can contact a Hewlett-Packard sales and service office to obtain information on packaging materials or you may use an alternative packing material referred to as "bubble-pack". One of the companies that makes bubble-pack is Sealed Air Corporation of Commerce, California, 90001.

3. Surround the color display with at least 3 to 4 inches of its original packing material or bubble-pack to prevent the color display from moving in its shipping container.
4. Place the color display, after wrapping it with packing material, in its original shipping container or a strong shipping container that is made of double-walled corrugated cardboard with 159 kg (350 lb) bursting strength.

The shipping container must be both large enough and strong enough to accommodate your color display and allow at least 3 to 4 inches on all sides for packing material.

5. Seal the shipping container securely with strong nylon adhesive tape.
6. Mark the shipping container "FRAGILE, HANDLE WITH CARE" to help ensure careful handling.
7. Retain copies of all shipping papers.



packing8

Table 1-2. Packaging for an 8/8 Module

Item	Description	HP Part Number	Qty
1	Corrugated Carton (Top)	9211-6785	1
2	Foam Corner-Pads	5040-6967	8
3	Flat End-Cap	9220-4962	1
4	Static Sheet	9222-1806	1
5	Front Cover	5040-6974	1
6	Foam Plastic	4208-1210	1
7	Corrugated Pad	9220-5072	1
8	Corrugated Carton (Outer)	9211-7065	1

Module Verification Software

Module Verification Software is a program that is designed to automate module verification tests and adjustment procedures.

Note The HP 70004A color display does not have any automated module verification tests and therefore does not use module verification software.

 The HP 70004A color display's tests and adjustment procedures are not automated; they require the user to perform step-by-step manual procedures.

Before Extensive Servicing

This chapter contains information to help identify and resolve some common problems that may occur with your color display before extensive servicing.

Symptoms to various problems are listed at the top of each page. Most symptoms have a brief description or explanation to help provide more insight into their cause. A possible cause for the symptom and a checklist of possible solutions are then presented. Use this checklist as an aid to correct the problem.

If you determine that your color display needs further servicing and your color display is not experiencing any of the symptoms presented in this chapter, refer to Chapter 4 for information about troubleshooting your color display and Table 5-1 for a list of recommended test equipment to use when assemblies are changed, repaired, or adjusted.

Note

If you decide to perform the servicing yourself, prepare a static-safe work station before you begin any servicing procedures. (Refer to “Preparing a Static-Safe Work Station” in Chapter 4.)

If you do not wish to perform the servicing yourself, return your color display to a Hewlett-Packard service center. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

If an E is Flashing in the Display Status Box

On power-up, the E in the display status box will flash if the external HP-MSIB loop is not yet ready. The flashing E will stop when the external loop is established. No error messages are displayed.

The flashing E fault indicator light in the display status box performs a similar function as the flashing ERR fault indicator on HP 70000 Series modular spectrum analyzer system.

A flashing E or ERR indicates one of the following three problems:

- An HP-MSIB backplane error (or module fault) has been detected at power-up which may prevent normal HP-MSIB communications (and normal error reporting). This problem must be repaired before any predictable system operation can occur.
- The A6 HP-MSIB is not receiving +5 V bias.
- The A6 HP-MSIB is defective.

The most probable cause for a flashing E or ERR in a new system occurs when two modules in the same system have the same HP-MSIB address (row and column). This will generate a backplane error. The display's address map will always lock-up under this condition.

To solve this problem:

- Wait for the external HP-MSIB loop to become ready or,
- Refer to “State 11. HP-MSIB Troubleshooting, HP-MSIB Light is Off.” in Chapter 4
- If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

Troubleshooting

This chapter contains information about troubleshooting your color display. It presents information on preparing a static-safe work station and then it presents a set of troubleshooting procedures that can be used to optimize repair time.

Safety Considerations

This instrument has been designed in accordance with international safety standards. This manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition. Service and adjustments should be performed only by qualified service personnel.

-
- DANGER**
- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
 - **Use electrostatic discharge (ESD) precautions when performing any servicing.**
 - **Do not touch the A4 power supply with your hands while power is applied.**
 - **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
 - **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $>>1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**

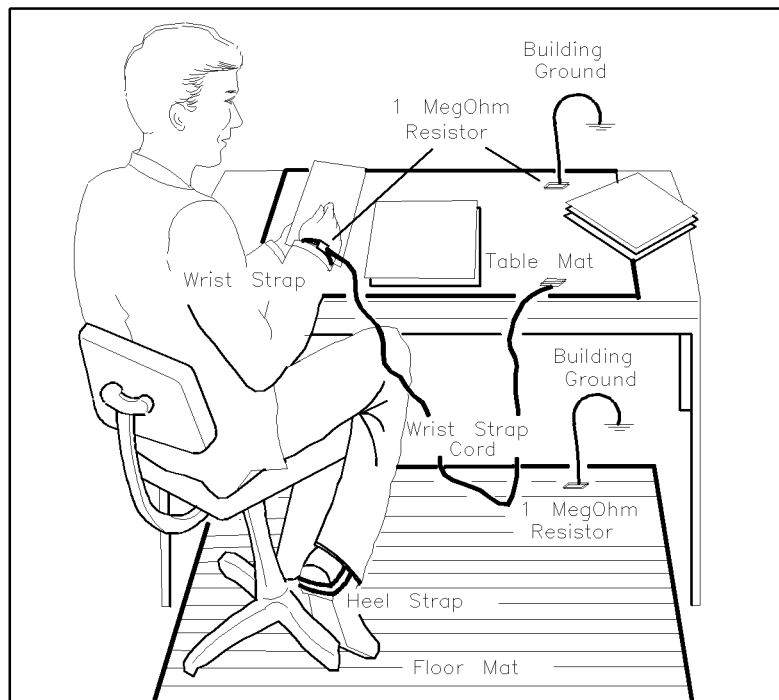
-
- CAUTION**
- Do not use erasers to clean the pin connector contacts. Erasers generate static electricity and remove the thin gold plating, which degrades the electrical quality of the contacts. Do not use paper of any kind to clean the pin connector contacts. Paper or lint particles left on the contact surface can cause intermittent electrical connections. Do not touch the pin connector contacts or trace surfaces with bare hands. Always handle board assemblies by the edges.
- The pin connector contacts of PC board assemblies may be cleaned by using a lint-free cloth with a solution of 80% electronics-grade isopropyl alcohol and 20% *de-ionized* water. Perform this procedure at a static-free work station.
-

Preparing a Static-Safe Work Station

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all work performed on assemblies consisting of electronic components should be done at a static-safe work station.

Figure 4-1 shows an example of a static-safe work station. Two types of ESD protection are shown:

- a conductive table mat and wrist strap combination
- a conductive floor mat and heel strap combination



ESDPARTS

Figure 4-1. Static-Safe Work Station

These two types of ESD protection must be used together. Refer to Table 4-1 for a list of static-safe accessories and their HP part numbers.

-
- CAUTION**
- Do not touch the edge-connector contacts or trace surfaces with bare hands. Always handle board assemblies by the edges.
 - Do not use erasers to clean the edge-connector contacts. Erasers generate static electricity and degrade the electrical quality of the contacts by removing the thin gold plating.
 - Do not use paper of any kind to clean the edge-connector contacts. Paper or lint particles left on the contact surface can cause intermittent electrical connections.
-

Reducing ESD Damage

To help reduce the amount of ESD damage that occurs during testing and servicing use the following guidelines:

- Be sure that all instruments are properly earth-grounded to prevent buildup of static charge.
- Personnel should be grounded with a resistor-isolated wrist strap before touching the center pin of any connector and before removing any assembly from a piece of equipment.

Use a resistor-isolated wrist strap that is connected to the HP 70000 Series modular spectrum analyzer system mainframe's chassis. If you do not have a resistor-isolated wrist strap, touch the chassis frequently to equalize any static charge.

- Before connecting any coaxial cable to an instrument connector for the first time each day, *momentarily* short the center and outer conductors of the cable together.
- Handle all PC board assemblies and electronic components only at static-safe work stations.
- Store or transport PC board assemblies and electronic components in static-shielding containers.
- PC board assembly edge-connector contacts may be cleaned by using a lintfree cloth with a solution of 80% electronics-grade isopropyl alcohol and 20% deionized water. This procedure should be performed at a static-safe work station.

Static-Safe ESD Accessories

Table 4-1. Static-Safe ESD Accessories

HP Part Number	Description
9300-0797	Set includes: 3M static control mat 0.6 m × 1.2 m (2 ft × 4 ft) and 4.6 m (15 ft) ground wire. (The wrist-strap and wrist-strap cord are not included. They must be ordered separately.)
9300-0865	Ground wire, 4.6 m (15 ft)
9300-0980	Wrist-strap cord 1.5 m (5 ft)
9300-1383	Wrist-strap, color black, stainless steel, without cord, has four adjustable links and a 7 mm post-type connection.
9300-1169	ESD heel-strap (reusable 6 to 12 months).

Order the following by calling HP DIRECT at (800) 538-8787 or through any Hewlett-Packard Sales and Service Office.

If Display-Disruptive Errors Occur

Display-disruptive errors are those that interfere with normal display operation and error reporting. The testing will stop at the first failed test.

The display-disruptive error messages are shown in two ways depending on whether or not the Test Mode switch is set:

- if the Test Mode switch is not set, errors are displayed in large block letters
- if the Test Mode switch is set, errors are shown as an LED pattern on the A5 processor

In test mode, the LEDs indicate which test has failed. When the display indicates a display-disruptive error, the error LEDs (A5DS2) will light. The error messages indicated by these LED patterns are a duplication of the error messages displayed on the CRT. Because the screen may be blank, this may be the only way to tell what error is indicated.

Table 4-2.
Display-Disruptive Errors and Their Associated A5DS2 LED Patterns

Error Messages	A5DS2 LED Pattern
○ = LED off, ● = LED on	
RAM DATA ERROR (U19)	● ○ ● ● ● ● ● ● ○ ●
RAM DATA ERROR (U20)	● ○ ● ● ● ● ● ● ○ ●
RAM ADDR ERROR	● ○ ● ● ● ● ● ● ○ ○
ROM 23 CHECKSUM	● ○ ● ● ● ● ● ● ○
ROM 24 CHECKSUM	● ○ ● ● ● ● ● ● ○
ROM 25 CHECKSUM	● ○ ● ● ● ● ● ● ○
ROM 26 CHECKSUM	● ○ ● ● ● ● ● ● ○
A5 8041 INTERFACE	● ○ ● ● ● ● ● ○ ● ●
A5 GRAPHICS VRAM	● ○ ● ● ● ● ● ○ ○ ●
A5 GRAPHICS DRAM	● ○ ● ● ● ● ● ○ ○
A5 GRAPHICS PROCESSOR	● ○ ● ● ● ○ ● ● ● ●

RAM DATA ERROR (U19) A5DS2 LED Pattern: ● ○ ● ● ● ● ● ● ○ ●

RAM DATA ERROR (U20) A5DS2 LED Pattern: ● ○ ● ● ● ● ● ● ○ ●

These display-disruptive errors occur when the processor on the A5 processor receives an unrecognizable command.

A test of CMOS RAM has failed. Data is cycled through all the address locations on the data bus. Each time data is written, it is read back and compared with the written data. At least one comparison failed.

To solve this problem:

1. Replace the A5 processor.

RAM ADDR ERROR A5DS2 LED Pattern: ● ○ ● ● ● ● ● ● ○ ○

This display-disruptive error occurs when the processor on the A5 processor receives an unrecognizable command.

If Display-Disruptive Errors Occur

A test of CMOS RAM has failed. The data in CMOS RAM is read, saved, and complemented. Every other address is then tested to see if the data is unchanged.

To solve this problem:

1. Replace the A5 processor.

A5 ROM (U23) CHECKSUM A5DS2 LED Pattern: ● ○ ● ● ● ● ● ● ● ○

A5 ROM (U24) CHECKSUM A5DS2 LED Pattern: ● ○ ● ● ● ● ● ● ● ○

A5 ROM (U25) CHECKSUM A5DS2 LED Pattern: ● ○ ● ● ● ● ● ● ● ○

A5 ROM (U26) CHECKSUM A5DS2 LED Pattern: ● ○ ● ● ● ● ● ● ● ○

These display-disruptive errors occur when the processor on the A5 processor receives an unrecognizable command.

A checksum was calculated on all ROMs, one or more ROMs failed. Replace the defective ROM.

To solve this problem:

1. Replace the A5 processor.

A5 8041 INTERFACE A5DS2 LED Pattern: ● ○ ● ● ● ● ● ○ ● ●

This display-disruptive error occurs when the processor on the A5 processor receives an unrecognizable command.

Communications failed between the A5 8041 processor chip and the A5 main processor chip. The 8041 processor chip is instructed to send a data sequence to the main processor chip, which if received correctly should verify the 8041 and the link to it.

To solve this problem:

1. Replace the A5 processor.

A5 GRAPHICS DRAM A5DS2 LED Pattern: ● ○ ● ● ● ● ● ○ ● ○

This display-disruptive error occurs when the processor on the A5 processor receives an unrecognizable command.

A test of the Dynamic RAM has failed. An address register is increased by one (increment) as a data pattern is decreased by one (decrement). The processor's attempt to write and verify the data pattern to the Dynamic RAM has failed.

To solve this problem:

1. Replace the A5 processor.

A5 GRAPHICS VRAM A5DS2 LED Pattern: ● ○ ● ● ● ● ● ○ ● ○

This display-disruptive error occurs when the processor on the A5 processor receives an unrecognizable command.

A test of the Video RAM has failed. An address register is increased by one (increment) as a data pattern is decreased by one (decrement). The processor's attempt to write and verify the data pattern to the Video RAM has failed.

To solve this problem:

If Display-Disruptive Errors Occur

1. Replace the A5 processor.

A5 GRAPHICS PROCESSOR A5DS2 LED Pattern: ●○●●●○●●●●

This display-disruptive error occurs when the processor on the A5 processor receives an unrecognizable command.

A test of the Graphics Processor System has failed. The processor has attempted to read and verify the contents of a location in the graphics system DRAM. The GSP loads this location with a known pattern during its initialization.

To solve this problem:

1. Replace the A5 processor.

If Hardware-Warning Errors Messages (6000 –6999) Occur

The A5 RAM memory failed a checksum test.

6002 **A5 RAM Checksum (battery?)**

To solve this problem:

1. Cycle the line power to try and clear the error.
2. Replace the battery BT1 located on the A5 processor.
3. If the problem persists, replace the A5 processor. (Refer to Chapter 9.)

If Hardware Error Messages (7000–7999) Occur

Hardware errors are generated when a module in the HP 70000 Series modular spectrum analyzer system is not working properly. These errors can occur at any time. Hardware errors range from 7000–7999.

One or more of the following hardware error messages may appear on your system display:

7038 A5 Error in 8041

This hardware error occurs when communications fail between the A5 8041 processor and the main processor. The 8041 processor is instructed to send a data sequence to the main processor, which if received correctly should verify the 8041 and the link to it.

To solve this problem:

1. Replace the A5 processor.
2. If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

7040 A5 GSP Checksum error

This hardware error occurs when a test of the Graphics Processor System has failed. A test pattern was loaded into the Video RAM by the graphics processor. A checksum of the Video RAM was calculated by the processor.

To solve this problem:

1. Replace the A5 processor.
2. If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

7060 A5 RAM Data (U20)

7061 A5 RAM Data (U19)

This hardware error occurs when a test of CMOS RAM has failed. Data is cycled through all the address locations on the data bus. Each time data is written, it is read back and compared with the written data. At least one test failed.

To solve this problem:

1. Replace the A5 processor.
2. If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

7062 RAM Address

This hardware error occurs when a test of CMOS RAM has failed. The data in CMOS RAM is read, saved, and complemented. Every other address is then tested to see if the data is unchanged.

To solve this problem:

1. Replace the A5 processor.
2. If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

If Hardware Error Messages (7000–7999) Occur

7063 **A5 ROM (U24) Checksum**

7064 **A5 ROM (U26) Checksum**

7065 **A5 ROM (U23) Checksum**

7066 **A5 ROM (U25) Checksum**

This hardware error occurs when a checksum is calculated on all ROMs.

To solve this problem:

1. Replace the defective ROM.
2. If the problem persists, replace the A5 processor.
3. If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

7090 **A5 Graphics DRAM error**

This hardware error occurs when a test of the Dynamic RAM has failed. An address register is increased by one (increment) as a data pattern is decreased by one (decrement). The processor’s attempt to write and verify the data pattern to the Dynamic RAM has failed.

To solve this problem:

1. Replace the A5 processor.
2. If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

7091 **A5 Graphics VRAM error**

This hardware error occurs when a test of the Video RAM has failed. An address register is increased by one (increment) as a data pattern is decreased by one (decrement). The processor’s attempt to write and verify the data pattern to the Video RAM has failed.

To solve this problem:

1. Replace the A5 processor.
2. If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

7092 **A5 Graphics Processor**

This hardware error occurs when a test of the Graphics Processor System has failed. The processor has attempted to read and verify the contents of a location in the graphics system DRAM. The GSP loads this location with a known pattern during its initialization.

To solve this problem:

1. Replace the A5 processor.
2. If necessary, obtain service from Hewlett-Packard. (Refer to “If You Want Hewlett-Packard to Service Your Color Display” in Chapter 1.)

Overall Block Diagram of Color Display

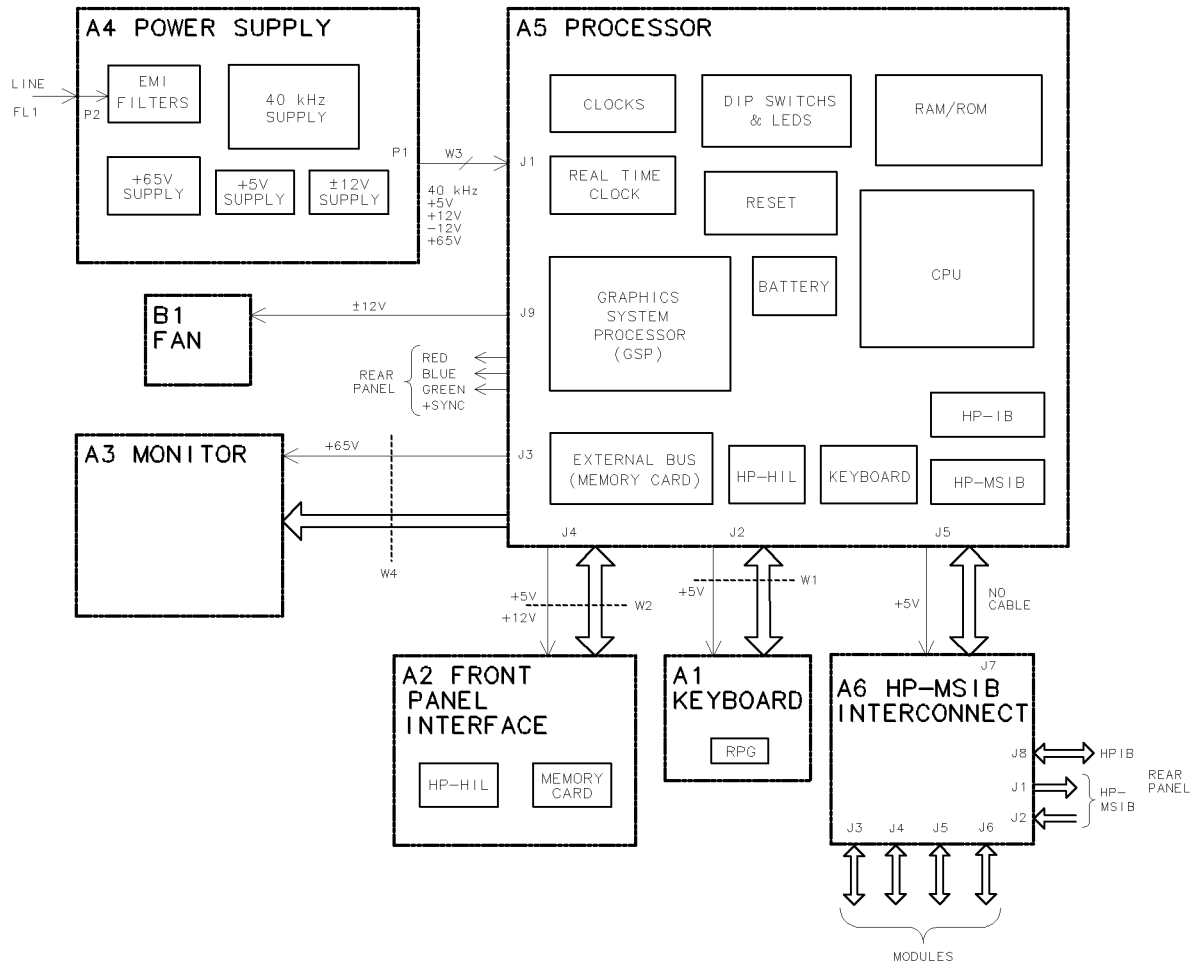


Figure 4-2. Overall Block Diagram of Color Display

Display Troubleshooting

- DANGER**
- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
 - **Use electrostatic discharge (ESD) precautions when performing any servicing.**
 - **Do not touch the A4 power supply with your hands while power is applied.**
 - **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
 - **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**
-

Display operation can be considered to fall into 13 categories, normal operation plus 12 failure modes. Most of these can be quickly identified for troubleshooting. Several conditions require removal of the instrument cover.

There are two banks of LEDs on the A5 processor. Each bank contains 10 LED segments. These are located just behind the address switches (rear panel). By looking down and to the left, through the fan, these LEDs may be observed. Adjacent to the LEDs is a second set of DIP switches used for some diagnostic tests. (Refer to Figure 4-3.) The leftmost two LEDs in each bank are used for status indicators. The rightmost eight in each bank are used to indicate failures, or diagnostic results. In normal operation, the leftmost LED of A5DS2 is on, indicating that the +5 V supply is working. Other LEDs are discussed in appropriate sections.

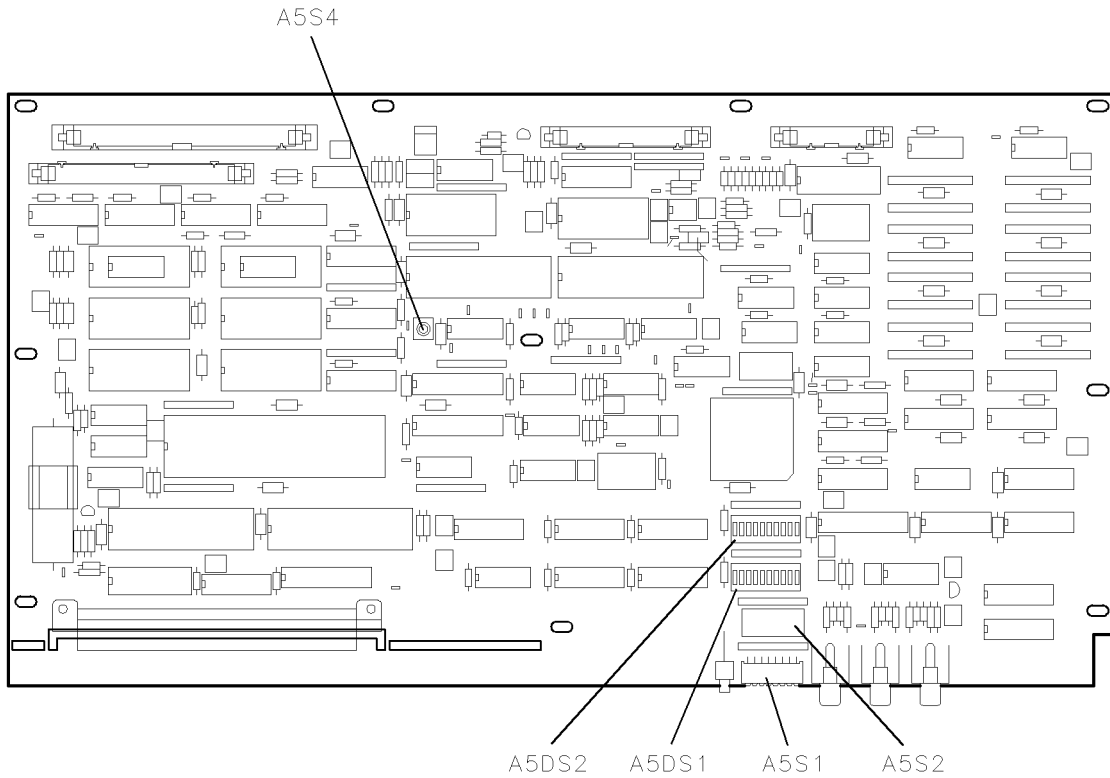


Figure 4-3. A5 Processor Diagnostics Location

The instrument can be conceptually divided into three parts: a power supply function, a display function, and an HP-MSIB control function. With this division in mind, troubleshooting can be performed sequentially, beginning with the power supply function. This procedure is divided into three corresponding sections. If the power supply is known to be operating properly, skip to the next section.

Diagnostic Tools

There are a number of diagnostic tools built into the color display to aid in troubleshooting. These are described as follows:

A4 Power Supply Diagnostic Tools

Several indicators aid in determining the operating condition of the power supply. These are:

- Front-Panel Lights
- Internal Lights
- Fan Operation
- Module Operation

For descriptions of these tools, refer to “Troubleshooting the A4 Power Supply”.

Display Diagnostic Tools, Turn-On

The display performs a number of diagnostic tests at turn-on.

Functions verified at turn on are:

- HP-MSIB
- ROM Checksums
- RAM Checks
- Keyboard Processor Checks
- Graphics Processor

There are two modes of operation for the turn-on tests. These are controlled by the Test Mode switch on the rear panel. In normal operation the Test Mode switch is off, and testing halts on any failed test. Alternately, with the Test Mode switch set on, testing will continue past a failed test.

If the Test Mode switch is not set (normal operation), and a failure occurs, operation halts. The processor will display a display-disruptive error message on-screen. Also, the failure will be encoded on A5DS2. (Refer to “If Display-Disruptive Errors Occur” for descriptions of the error messages and the corresponding LED codes.)

Display Diagnostic Tools, Front-Panel

The display also has several diagnostic tests which may be initiated from the front panel. These are found by pressing `misc`, `display tests`. Four tests are available at this level:

- Confidence Test
- Key Test
- Knob Test
- Tumbling Figures Demonstration

The Confidence Test may be initiated by the user at any time. This is done using the `misc`, `display tests`, `CONFID TEST` softkeys, or by sending the HP-IB command `TE`. The two methods cause identical testing to be done. The tests performed are:

- Keyboard Processor
- RAM Checks
- Graphics Processor
- Graphics Processor RAM (Pattern) Checksum
- Displays the Character Set on Screen

The Key Test may be initiated by the user at any time. This is done using the `misc`, `display tests`, `KEY TEST` softkeys. This test allows each front panel key to be tested. Detailed instructions are placed on the screen. Each key is verified by displaying a description of the key pressed. The left arrow, or backspace, key is verified and then causes the test program to exit.

The Knob Test may be initiated by the user at any time. This is done using the `misc`, `display tests`, `Knob TEST` softkeys. This test places a circle on the screen, with a number position centered. When the knob is turned, the circle rotates, and the center number either increases or decreases, based on the direction the knob is turned. This allows the operation of the knob to be verified. The test exits when a different activity is selected by the softkeys.

The Tumble Figures Demonstration, although usable at any time, may interfere with normal MMS operation. It is accessed by pressing the `misc`, `display test`, `TUMBLE FIGURES` softkeys. This demonstration exercises the graphics processor and is a good indication that it is operating properly.

Display Diagnostic Tools, Failures

The display is capable of placing diagnostic messages on the screen for many different problems. (Refer to “If Display-Disruptive Errors Occur”.)

Should problems prohibit error messages from being displayed on screen, a number of tests are built into the firmware to help identify the problem. The most common of these are initiated by setting the rear panel test switch on and selecting the test, using the address switches. Additional tests may be initiated using additional switches on the A5 processor. The A5 processor has lights to indicate the results of the tests.

HP-MSIB Diagnostic Tools

The HP 70004A color display has two built-in HP-MSIB utilities. These utilities are accessed by pressing the following keys:

`DISPLAY` `Misc` `display tests` `service modes`

The `ACTIVE ON/OFF` utility has two main softkeys: `ACTIVE ON` and `ACTIVE OFF`. These softkeys send the HP-MSIB command to turn the active LED on any module in the system on and off. This utility interferes with the normal system operation.

Once the command is sent, the display examines the HP-MSIB to see if the module received the instruction. Use the following procedure to send the Active On command.

Note The Module Not Accepting Data message is returned for a master module if one of its slaves has a faulty HP-MSIB interface. Therefore, verify that all of the slaves of a master can communicate before determining that the master is unable to communicate.

1. Press the `ACTIVE ON` softkey.
2. Using the numeric keypad, enter the row address of the module that is to be tested for an HP-MSIB failure.
3. Press the `ENTER` softkey.
4. Enter the column address of the module as a hexadecimal number. Refer to Table 4-3 for decimal-to-hexadecimal conversion information. Use the alphabetical softkeys and the keypad to enter the hexadecimal numbers.

5. Press **ENTER**.

Table 4-3. Decimal/Hexadecimal Conversion

Decimal	Hexadecimal	Decimal	Hexadecimal
0	0	16	10
1	1	17	11
2	2	18	12
3	3	19	13
4	4	20	14
5	5	21	15
6	6	22	16
7	7	23	17
8	8	24	18
9	9	25	19
10	A	26	1A
11	B	27	1B
12	C	28	1C
13	D	29	1D
14	E	30	1C
15	F	31	1D

The **HP-MSIB Utility** key begins a utility for managing HP-MSIB directly. The HP-MSIB utility is intended for use during the development of new modules. This utility interferes with the normal system operation. Further descriptions of this utility and its softkeys are *not* available.

Test Pattern Diagnostic Tools

The HP 70004A color display has built-in test pattern utilities for monitor adjustments and troubleshooting. These utilities are accessed by pressing the following keys:

DISPLAY Misc display tests test patterns

Troubleshooting the A4 Power Supply

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

Troubleshooting the power supply involves inspection of fault indicators on the A4 power supply. Several fuses are also accessed. See Figure 4-4 and Figure 4-5 for the location of these components.

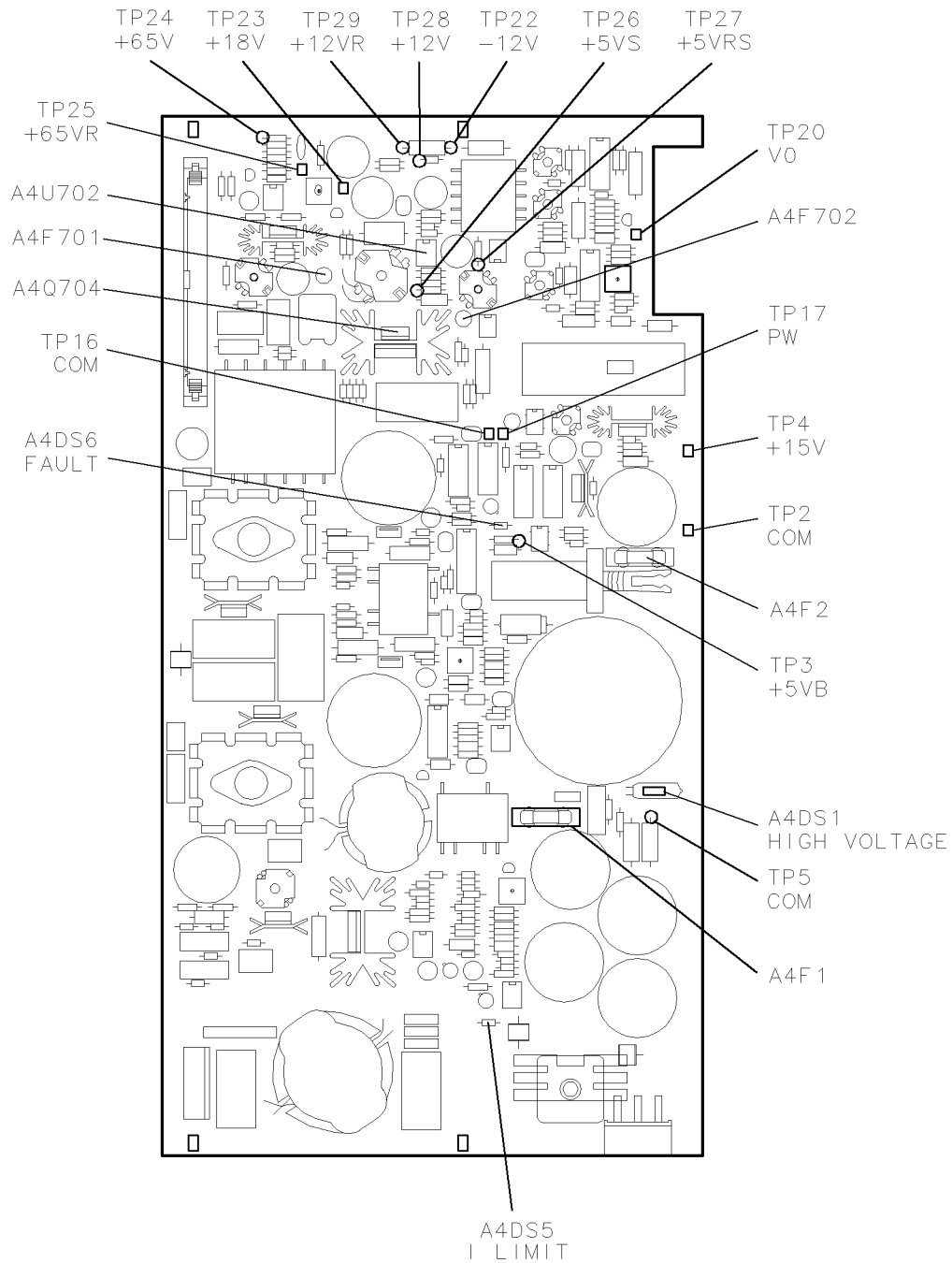


Figure 4-4. A4 Power Supply Indicators and Fuses (Front)

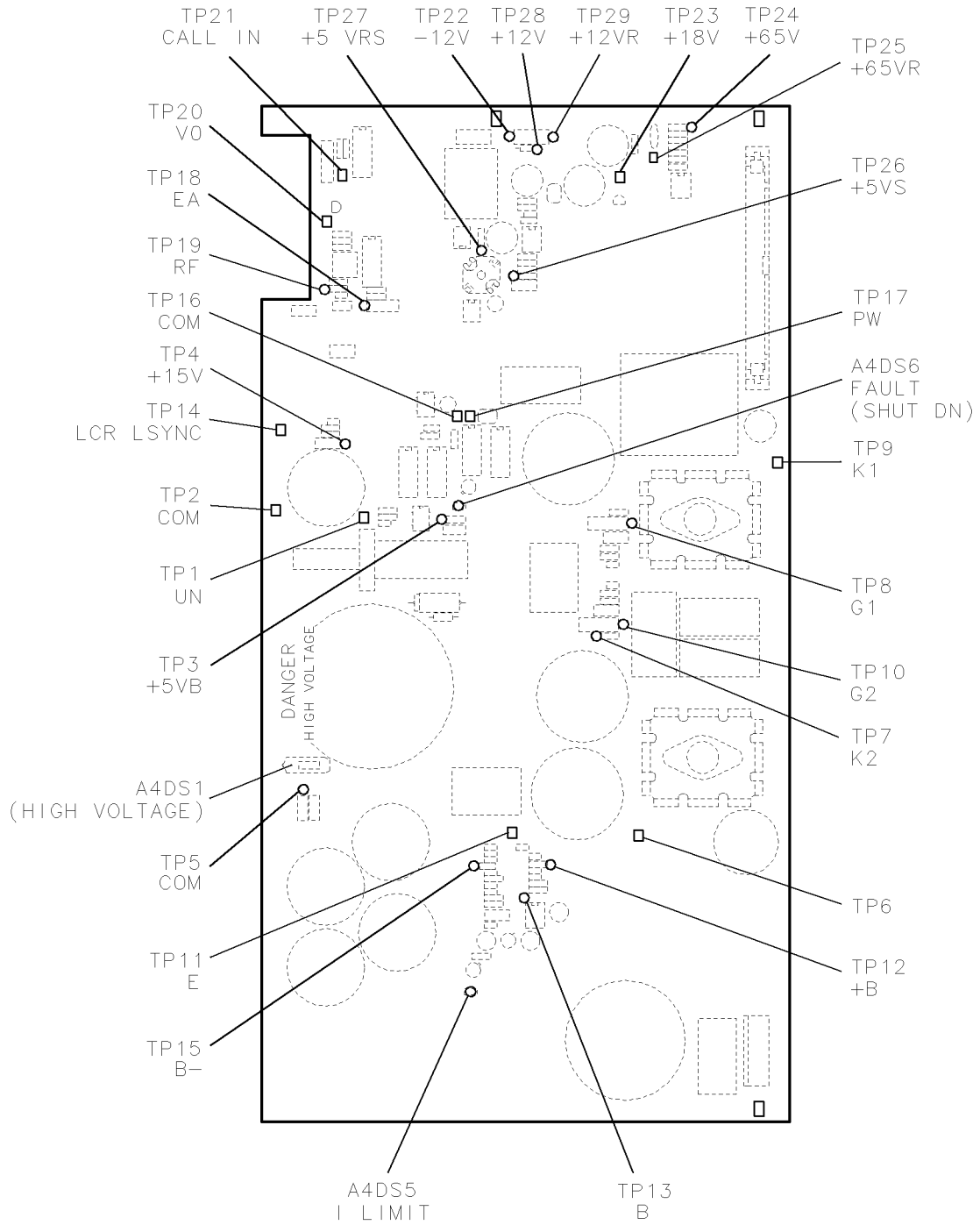


Figure 4-5. A4 Power Supply Indicators and Fuses (Back)

Potential A4 power supply failures may be categorized as follows:

State 1.

No Observed Power. The Front-Panel Indicator is off.

State 2.

The FAULT Indicator Light (A4DS6) is Lit.

State 3.

The I-LIMIT Fault Indicator Light (A4DS5) is Lit.

State 4.

Front-Panel LINE Indicator is Off. Modules Have Power.

State 5.

Normal Operation Except Display is Blank.

State 6.

Front-Panel Indicators Normal, No Module Power.

Note Some fault indicators may be eliminated by adjustments.

To differentiate between some states, examination of internal indicators or voltage measurements may be required. Only failures included in “State 1” may be addressed without opening the instrument. If the first statement does not match the instrument condition, remove the instrument cover to differentiate the other conditions.

- The front panel LINE indicator is not on. Modules inserted into the display do not receive power. (There is no voltage present at A4TP3 +5 VB. Refer to Figure 4-4 and Figure 4-5.) Go to “State 1.”
- The front panel LINE indicator is not on. Modules inserted into the display do not receive power. (The voltage is correct at A4TP3 +5 VB.) Go to “State 2” or “State 3.”
- The front panel LINE indicator is not on. Modules inserted into the display are receiving power. Go to “State 4.”
- The front panel LINE indicator is not on. Operation seems to be normal, except the display is blank. Go to “State 5.”
- The display front panel indicators are normal, but a module is not receiving power. Go to “State 5.”

State 1.

No Observed Power. The Front-Panel Power Indicator is Off.

Note If the input voltage is 230 Vac, but the voltage selector switch is set for 115 Vac (see to Figure 4-6), the input fuse is blown at turn on, protecting the display.

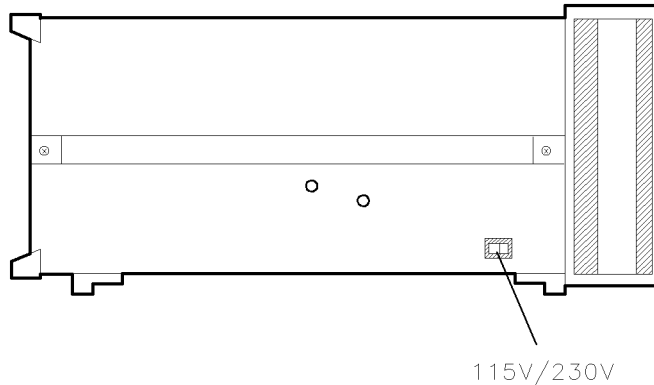


Figure 4-6. Voltage Selector Switch

Use a line cord that is known to be good. Verify that the input line voltage is within limits and that the display voltage selector switch setting agrees with the input line-voltage.

Note After troubleshooting the display, always set the voltage selector switch to match the user's input line-voltage. An incorrect voltage selector switch setting will result either in too high an input voltage (blowing the ac line fuse) or too low an input voltage (causing automatic shut-down with the internal FAULT light on).

1. Check the ac line fuse, located on the rear panel. If the fuse is blown (open), replace it. Then, verify the voltage selector switch is set correctly and turn on the display .
 - a. If the display starts working (the fan is turning, the green front panel line indicator light is lit, and all fault indicator lights are off), the problem has been fixed. If not, continue with step 1b.
 - b. If the green front panel line indicator light is still off after checking or replacing the ac line fuse, then turn off the display. Set the voltage selector switch to 115 Vac. Open the instrument and access the A4 power supply.

-
- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.

- **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $>>1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**
-

2. Connect the isolated output of the Line-Isolated Variable Mains Transformer (VARIAC) to the display's input. Turn the Line-Isolated Variable Mains Transformer (VARIAC) on and adjust its output to 115 Vac.

Observe the A4DS1 HV neon indicator light (see Figure 4-4 and Figure 4-5):

- If A4DS1 HV is off, then unplug the line cord and recheck the ac line fuse. If the fuse is blown (open), continue with step 2a. If the fuse is good, check the ac input to the A4 power supply and the output of the A4S1 on/off. (The output of A4S1 is checked between A4E1 and A4E2, using the leads closest to A4S2, the 120/240 Line Select switch.) If these points show 115 Vac, replace the A4 power supply otherwise, replace the failed component. Continue with step 3.
 - If A4DS1 HV is on, and *all* other fault indicator lights are off, check the voltage between A4TP3 +5 VB and A4TP2 COM for 5 Vac ± 0.25 V. (Refer to Figure 4-4.) If the voltage at A4TP3 is good, continue with 2c.
- a. If the ac line fuse is blown (open), then something is shorting the ac input voltage. First, check the ac input cable plugged into A4P2. If it is offset by one pin (on either side) the input will be shorted to ground and the ac line fuse will blow. Replace the fuse, then continue with step 3. Second, check the line module and cable (FL1) by applying power with the cable disconnected from the power supply. If FL1 is faulty, replace it, then continue with step 3.
 - If no problem has been identified, the A4 power supply has failed. Replace the A4 power supply, and continue with step 3.
 - b. If the voltage at A4TP3 is bad, then turn the Line-Isolated Variable Mains Transformer (VARIAC) off. Wait one minute after A4DS1 HV goes out. Remove and check the A4F2 Bias Fuse (see Figure 4-4).
 - If the A4F2 fuse is blown (open), then replace the fuse. Turn the Line-Isolated Variable Mains Transformer (VARIAC) on. If the power supply indicator lights are now NORMAL with the fan running, continue with step 3. If the power supply is not operating normally, turn the Line-Isolated Variable Mains Transformer (VARIAC) off. Wait one minute after A4DS1 HV goes out, replace the A4 power supply, then continue with step 3.
 - If the A4F2 fuse is good, the failure is likely to be in the bias supply. For assembly level support, replace the A4 power supply and continue with step 3.
 - c. If the voltage at A4TP3 is good, and all fault indicators are off, the failure is likely in the switching regulator circuit. Turn the Line-Isolated Variable Mains Transformer (VARIAC) off and wait one minute after A4DS1 HV goes out. Replace the A4 power supply, and continue with step 3. (Refer to the "Component-Level Hints".)
3. If the display starts working (the fan is turning, the green front panel line indicator light is lit, and all fault indicator lights are off), the problem has been fixed. Reassemble the display.

If the problem is not fixed, a troubleshooting clue was missed and more thorough troubleshooting is required.

State 2.
The FAULT Indicator Light (A4DS6) is Lit.

Note Some fault indicators may be eliminated by adjustments.

To determine if this is the correct state to troubleshoot, remove the instrument cover. Refer to Figure 4-4 and Figure 4-5 for the location of the test points and indicators discussed below.

- Verify that the voltage at A4TP3 is approximately 5 V. If it is not, return to “State 1.”
- If the indicator labeled I LIMIT is on, skip to “State 3.”
- If the indicator labeled FAULT is on, proceed with “State 2.”

A4DS6 FAULT indicator light indicates that a fault has occurred and the A4 power supply has turned off its output to protect both itself and any modules resident in the display. Five conditions can cause the FAULT indicator to light.

- If the internal temperature rises too high, the display will protect itself and the modules from overheating by shutting down. This temperature is set to trip if the ambient temperature surrounding the display exceeds 55°C. This is not a failure. To allow the display’s internal temperature to cool down move the display into a cooler environment and wait at least 20 minutes before turning it back on. The display should now operate correctly. The internal temperature may also rise if the air inlet is blocked, or the fan has failed. Check the air inlet for blockage. If the FAULT light is still on, continue with step 1.
- Low ac input voltage to the display. Check the voltage selector switch setting (see Figure 4-6) on the bottom cover. The switch setting must be either 115 Vac for 87 to 132 Vac input or 230 Vac for 174 to 264 Vac input. If the line-voltage does not meet specification, then the display is probably good. Connect the display to a good line-voltage source and verify its operation. If the voltage selector switch setting is incorrect, unplug the line cord, then change the setting. The display should now operate correctly.
- The A4 power supply output voltage to the fan is protected by the A4F702 +12 V fuse (see Figure 4-4). If A4F702 is blown (open), the A4DS6 FAULT indicator will light.
- The +5 Vdc supply current supplied by the A4 power supply is monitored. If too much current is drawn by the display, the power supply will shut down and the A4DS6 FAULT indicator will light.
- If the display’s 40 kHz output exceeds its maximum voltage specification by 30%, the display will shut down.

DANGER

- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
 - **Use electrostatic discharge (ESD) precautions when performing any servicing.**
 - **Do not touch the A4 power supply with your hands while power is applied.**
 - **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
 - **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**
-

1. Remove the cover and access the A4 power supply. With the Line-Isolated Variable Mains Transformer (VARIAC) turned off, connect its isolated output to the display's input.
2. Verify the display's voltage selector switch setting (115 Vac).
3. Remove and check fuse A4F702.
 - a. If fuse A4F702 is good, insert the fuse, turn the Line-Isolated Variable Mains Transformer (VARIAC) on, and check to see if the fan B1 is operating. (The instrument should be cool to prevent an over-temperature condition from looking like another problem.) If the fan does not run, the FAULT indicator is not on, and the instrument appears to be operating normally, verify that the B1 Fan Assembly is plugged in. If the fan still does not run, replace the fan assembly. Otherwise, go to step 4.
 - b. If A4F702 is open, replace it. A faulty external HP-HIL device could cause this problem, remove any external HP-HIL devices which may be connected to the display. Turn the Line-Isolated Variable Mains Transformer (VARIAC) on and adjust its output to 115 Vac. If removing the external HP-HIL device fixes the display (indicators in the NORMAL state) then reassemble the display. The external HP-HIL device requires repair. This is *not* a display failure.
 - c. If the A4F702 fan fuse is blown (open) again, then the fan may be shorting this output. Turn the Line-Isolated Variable Mains Transformer (VARIAC) off. Wait one minute after A4DS1 HV goes out, then disconnect the fan connector from A5J9 on the A5 processor. Replace A4F702 and turn the Line-Isolated Variable Mains Transformer (VARIAC) on. If the FAULT indicator is lit, turn off power, and wait 1 minute after A4DS1 HV goes out, then replace the A4 power supply and reassemble the display. If the FAULT indicator light (A4DS6) stays off, turn the Line-Isolated Variable Mains Transformer (VARIAC) off. Replace the fan. All the indicators should be in their normal state with the fan running. If no other errors are present, reassemble the display.
4. If the A4DS6 FAULT indicator remains lit, the problem is either on the A4 power supply or too much current is being drawn from the +5 Vdc supply.
 - a. With the Line-Isolated Variable Mains Transformer (VARIAC) turned off, disconnect the W3 ribbon cable from the A4P1 connector. Turn on the Line-Isolated Variable Mains

Transformer (VARIAC) and check the A4DS6 FAULT indicator to see if the supply is now working.

- b. If the supply is now working, the problem is likely a short on one of the assemblies using the +5 Vdc supply. Isolate the fault to the A5 processor, the A6 HP-MSIB or the A2 interface by connecting them one at a time.
- c. If the supply is still not working, the problem is likely in the switching power supply. Additional troubleshooting information is located in the “Component-Level Hints”.) Replace the A4 power supply and reassemble the display. The display should now be repaired.

State 3.

The I LIMIT Fault Indicator Light (A4DS5) is Lit.

Note Some fault indicators may be eliminated by adjustments.

To determine if this is the correct state to troubleshoot, remove the instrument cover. Refer to Figure 4-4 and Figure 4-5 for the location of test point and indicators discussed below.

- Verify that the voltage at A4TP3 is approximately 5 V. If it is not, return to “State 1.”
- If the indicator labeled FAULT is lit, return to “State 2.”
- If the indicator labeled I LIMIT is lit, proceed with “State 3.”

The display’s 40 kHz output is overloaded (too much current), causing the A4 power supply to shut down to prevent damage to itself.

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- DANGER**
- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
 - **Use electrostatic discharge (ESD) precautions when performing any servicing.**
 - **Do not touch the A4 power supply with your hands while power is applied.**
 - **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
 - **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**
-

1. First, remove all the modules. Turn the display on and verify operation. If the display I LIMIT light is still on, continue with step 2. If the I LIMIT light is no longer on, turn off the display and install each module *one at a time* (cycling power after installing each module) to locate the faulty module. Remove the first module and install the second, and so on. If, after replacing each module, the I LIMIT light is off, check the I LIMIT trip point.
2. Disconnect the W3 ribbon cable from the A4P1 connector. Refer to Figure 4-4. Verify that the display’s voltage selector switch is set to 115 Vac. Refer to Figure 4-6. Connect the isolated output of the Line-Isolated Variable Mains Transformer (VARIAC) to the display’s input. Turn the Line-Isolated Variable Mains Transformer (VARIAC) on and adjust the Line-Isolated Variable Mains Transformer (VARIAC)’s output to 115 Vac.
 - a. If the I LIMIT indicator (A4DS5) is still on, turn the Line-Isolated Variable Mains Transformer (VARIAC) off, and wait one minute after A4DS1 HV goes out. Replace the A4 power supply. The power supply should be operating normally (the fan turning and fault indicators off). Reassemble the display.

- b. If the I LIMIT indicator (A4DS5) is off and the power supply begins operating, verify the voltages between the following test points:

A4TP24 +65V to A4TP25 +65VR
A4TP26 +5VS to A4TP27 +5VRS
A4TP23 +18V to A4TP29 +12VR
A4TP28 +12V to A4TP29 +12VR
A4TP22 -12V to A4TP29 +12VR

If the voltages are within $\pm 5\%$, a short probably exists on one or more of the following: the W3, the A5 processor, the A6 HP-MSIB, or the A2 interface. Turn the Line-Isolated Variable Mains Transformer (VARIAC) off.

Note When the faulty assembly has been identified and replaced, check the operation of the power supply. If the power supply operates normally (the fan is turning and the fault indicators are off), reassemble the display.

3. The other assemblies should be connected to the power supply *one at a time*. In this manner, the I LIMIT fault indicator will help to identify the faulty assembly. Be certain to turn off the display before each step. Connect the components and monitor A4DS5 in the following order:
 - a. Connect the W3 ribbon cable into the A4P1 Connector without the the A5 processor connected.
 - b. Turn off the Line-Isolated Variable Mains Transformer (VARIAC) and connect the A5 processor.
 - c. Connect the A1 front panel to the A5 processor.
 - d. Connect the A2 interface to the A5 processor.
 - e. Connect the B1 Fan Assembly to the A5 processor.
 - f. Connect the A3 monitor/monitor bracket to the A5 processor.
 - g. Connect the A6 HP-MSIB to the A5 processor.

Replace the assembly which caused the A4DS5 I LIMIT indicator to light. If A4DS5 stays off, then continue with step 4.

4. If the A4DS5 I LIMIT light is still off after performing the procedure outlined in step 3, then the likely problem is a mechanical interference between a conductive point on one of the assemblies with the display chassis. Check the W3 ribbon cable for any visible damage (pinching) caused by the sheet metal. The display should now operate normally without the A4DS5 I LIMIT light on. Reassemble the display.

State 4.

Front-Panel LINE Indicator is Off. Modules Have Power.

This condition is most likely caused by a failure in the 5 V supply of the display. This supply is connected to the front panel LINE indicator and is used by both the A5 processor and A6 HP-MSIB. In this state, any installed modules should have power, but since the HP-MSIB will not be functioning, the error (ERR) indicator on each module should blink. The I/O light or HP-MSIB light of any mainframes or other displays connected in the system should be on.

A low voltage state of the 5 V supply may cause the front panel HP-MSIB indicator to be on. In this state HP-MSIB will be in a reset condition, and all modules should keep all front panel indicators on.

DANGER

- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
- **Use electrostatic discharge (ESD) precautions when performing any servicing.**
- **Do not touch the A4 power supply with your hands while power is applied.**
- **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
- **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
- **Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
- **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**

-
1. Remove the cover and access the A4 power supply. Refer to Chapter 4, "Replacement Procedures." With the Line-Isolated Variable Mains Transformer (VARIAC) turned off, connect the isolated output of the Line-Isolated Variable Mains Transformer (VARIAC) to the display's input. Verify the display's voltage selector switch setting (115 Vac).
 2. Turn on the Line-Isolated Variable Mains Transformer (VARIAC) and set it to 115 Vac. If the A4DS6 FAULT indicator is lit, go to State 2.
 3. Measure the voltage between A4TP26 +5VS and A4TP27 +5VRS.
 - a. If the voltage is between 4.75 V and 5.2 V, the problem is likely the front panel indicator. Verify that the +5 V indicator on A5DS2 is on.
 - b. If the voltage is out of tolerance, a component failure has occurred in the +5 Vdc supply. Unless component level troubleshooting is necessary, replace the A4 power supply. The problem should now be corrected.

State 5.

Normal Operation Except Display is Blank.

This state normally means the +65 V power supply is not working. This supply is located on the A4 power supply. The supply passes through the A5 processor to the A3 monitor/monitor bracket. The A5 processor is capable of shutting down (turning off) the +65 V supply. Any keystroke turns the +65 Vdc back on. This should be done first to insure the problem is hardware. Allow *at least* one minute for the monitor to warm up. Refer to Figure 4-4 and Figure 4-5 for the location of the test points and indicators discussed below.

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- DANGER**
- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
 - **Use electrostatic discharge (ESD) precautions when performing any servicing.**
 - **Do not touch the A4 power supply with your hands while power is applied.**
 - **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
 - **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**
-

1. Remove the cover and access the A4 power supply. Refer to Chapter 4, "Replacement Procedures." With the Line-Isolated Variable Mains Transformer (VARIAC) turned off, connect the isolated output of the Line-Isolated Variable Mains Transformer (VARIAC) to the display's input. Verify the display's voltage selector switch setting (115 Vac).
 - a. Measure the voltage between A4TP24 +65V and A4TP25 +65VR.
 - If this voltage is not approximately 65 V, refer to Chapter 2, "Adjustments," or replace the A4 power supply.
 - If this voltage is approximately 65 V, the problem is either the ribbon cable W3, the A5 processor or the A3 monitor/monitor bracket. Continue with step 3.
 - b. Remove and check fuse A4F701.
 - If fuse A4F701 is open, replace it. Turn the Line-Isolated Variable Mains Transformer (VARIAC) on and adjust its output to 115 Vac. If replacing the A4F701 fuse fixes the display (indicators in the NORMAL state) then reassemble the display.
 - c. If fuse A4F701 is blown (open) again, then the display may be shorting this supply. Turn the Line-Isolated Variable Mains Transformer (VARIAC) off. Wait one minute after A4DS1 HV goes out, then replace A4F701 and disconnect the ribbon cable W3 from A4P1. Turn on the display and measure the voltage between A4TP24 +65V and A4TP25 +65VR.
 - If this voltage is not approximately 65 V, refer to Chapter 2, "Adjustments," or replace the A4 power supply.

- If this voltage is approximately 65 V, the problem is either the ribbon cable W3, the A5 processor or the A3 monitor/monitor bracket. Continue with step 3.
- d. There is either a short or an open in the +65 Vdc system. To isolate the faulty assembly, disconnect W3, A5 processor, W4, and A3 monitor/monitor bracket. Reconnect W3, A5 processor, W4, and A3 monitor/monitor bracket *one at a time*, check A4F701 or the voltage between A4TP24 +65V and A4TP25 +65VR. Verify the output voltage of the assembly just connected is approximately 65 V. Replace the faulty assembly.

State 6.

Front-Panel Indicators Normal, No Module Power.

The display supplies the power requirements of the modules. This state presumes that the 40 kHz supply is working, because the front panel indicators are normal. The front panel LINE indicator is powered by the +5 V supply, which is derived from the 40 kHz system.

The 40 kHz power is generated on the A4 power supply. It is routed out connector A4P1, through W3 ribbon cable, to the A5 processor, coming in on connector A5J1. The A5 processor passes the power directly to the A6 HP-MSIB Interconnect Assembly, leaving through A5J5, entering through A6J7.

At power-up, all module front panel LEDs turn on, then off, indicating that the module has input power. If a module's LEDs do not flash, then the slot that contains the module may be bad (no 40 kHz power).

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- DANGER**
- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
 - **Use electrostatic discharge (ESD) precautions when performing any servicing.**
 - **Do not touch the A4 power supply with your hands while power is applied.**
 - **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
 - **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**
-

1. If the display fan is turning, or the display is working, but one of the modules is not receiving power, move that module to a different slot. If moving the module to a different slot corrects the problem, verify that there was not a connector-mating or alignment problem, by placing the module back to the original slot. If the original slot still does not provide power, replace the A6 HP-MSIB Interconnect Assembly. The display should now operate correctly.
2. If moving the module to another slot does not correct the problem, install a known good module in the slot. If the known good module receives power, then the first module requires repair. This is *not* a display failure.
3. If the display fan is turning, but none of the module front panel LEDs turn on and any possible connector-mating problems have been identified. Either the A6 HP-MSIB Interconnect Assembly or the A5 processor has failed.
 - a. Remove the cover and access the A4 power supply. Refer to Chapter 4, "Replacement Procedures." With the Line-Isolated Variable Mains Transformer (VARIAC) turned off, connect the Line-Isolated Variable Mains Transformer (VARIAC)'s isolated output to the display's input. Dangerous voltages exist on the power supply board assembly. *Do not*

- touch* the power supply while power is applied. Verify the display's voltage selector switch setting (115 Vac).
- b. Using a DVM, check the voltage between pins 37/39 and 38/40 on A5J5 for a reading of approximately 27 Vac.
 - c. If the voltage on A5J5 is good, the problem is likely on the A6 assembly. This can be verified by checking the continuity between the corresponding pins of A6J7 and the pins on each of A6J3 through A6J6. Replacing the A6 assembly should correct the problem.
 - d. If the voltage on A5J5 is bad, verify that the voltage on A5J1 is approximately 27 Vac (between pins 3/4/5/6/15/16/17/18 and pins 9/10/11/12/21/22/23/24). These pins are labeled AC A and AC B on the schematic. If the voltage is good, the problem is the A5 processor. If the voltage is bad, suspect the ribbon cable W3. Check the voltage between A4P1-3/4/5/6/15/16/17/18 and A4P1-9/10/11/12/21/22/23/24). By this point, sufficient isolation should have identified the failed assembly.

Component-Level Hints

The purpose of this service manual is to facilitate assembly-level repair. There may be times when assembly-level is not sufficient. In these cases, the following basic information may help.

The main power supply is a switching supply. These circuits are generally complex, and the HP 70004A color display is no exception. Troubleshooting switching supplies can be very difficult. The following are functional groups of supplies which are more straightforward to troubleshoot. (Refer to Figure 4-4 and Figure 4-5 for the location of the test points and indicators discussed below.)

- The pulse modulator controls the switching supply. If A4DS6 FAULT indicator is lit, and the problem is known to be on the A4 power supply, the following steps should identify if the pulse modulator is working correctly.
 - a. Turn off the Line-Isolated Variable Mains Transformer (VARIAC), wait one minute after A4DS1 HV goes out, then remove the A4F1 service fuse.
 - b. Connect an oscilloscope probe between test points A4TP17 PW and A4TP16 COM. (Refer to Figure 4-3.) Set the scope to 2 μ s/Div and 1 V/Div.
 - c. Turn the Line-Isolated Variable Mains Transformer (VARIAC) on and set it to 115 Vac. Observe the waveform at A4TP17 PW. The signal should be narrow pulses about 12.5 μ s apart (approximately six divisions), and about 5 V in amplitude.
- The switching supply depends on the bias supply. This conventional supply first starts by receiving power from the line-through transformer A4T1 and A4F2. Once the switching supply is working, the +15 Vdc supply is derived from the switching supply through transformer A4T2 and A4F3. The +5 Vdc bias supply is generated from the +15 Vdc bias supply.
- The +65 Vdc supply has a dedicated secondary winding on transformer A4T2. It is protected by fuse A4F701. The series-pass element is transistor A4Q703, and the regulation circuit is not unusual. It is possible for the processor to shut down the +65 Vdc supply through control line +65V SHT DWN.
- The 40 kHz output, +5 Vdc, and \pm 12 Vdc supplies share the same secondary winding on transformer A4T2. The traditional +5 Vdc supply is regulated by A4U702 and series-pass element A4Q704.
- The 12 V supplies are simple filter supplies for the fan. They are protected by fuse A4F702, which when blown shuts down the switching supply through A4U70 and control line +12V SHT DWN. When shut down, the FAULT indicator will light.

Display and Processor Troubleshooting

This section is to assist with determining which assembly, the A3 monitor/monitor bracket or the A5 processor, needs replacing. It is assumed that all power supplies are working properly. Some additional information is provided to assist in component-level troubleshooting of the A5 processor. There are no field-serviceable parts in the A3 monitor/monitor bracket.

Potential display and processor failures may be categorized as below:

State 7.

Display-Disruptive Message.

State 8.

Abnormal CRT Display.

State 9.

Memory Card Troubleshooting.

Identifying the Failed Assembly

The built-in turn-on diagnostics should be sufficient to identify any failure in the A5 processor. Unfortunately, if the A3 monitor/monitor bracket has failed, there is no front panel indication as to the location of the problem. The following steps should be helpful.

State 7.

Display Disruptive Messages.

If there is a display-disruptive message on the screen, follow the instructions displayed (refer to “If Display-Disruptive Errors Occur”). Generally, when one of these messages appears, the A5 processor has a failure. However, it is still operating sufficiently to diagnose itself and communicate the problem.

State 8.

Abnormal CRT Display.

1. If the screen is blank, and an external monitor (use the HP 35741A multisync PLUS or HP 35741A multisync XL, is available, connect it to the rear panel connections. The indication on the external monitor should be sufficient to determine which assembly is at fault.
2. During the turn-on tests, the processor displays each step of the testing on the two on-board displays, A5DS1 and A5DS2. If the lights do not blink during this time, the processor is defective. Replace the A5 processor.
3. Following the turn-on tests, the processor will indicate via A5DS2 which test failed. Set the rear panel Test Mode switch to the normal position. Turn on the instrument and allow the turn-on sequence to finish. Observe the A5 processor diagnostic LEDs. All eight fault LEDs of A5DS2 should be off. See Figure 4-3. If any of these LEDs are lit, refer to the “Display-Disruptive” section in this chapter for LED pattern definitions and repair instructions.
4. If none of the above steps identifies a problem with the A5 processor, replace the A3 monitor/monitor bracket.

State 9.

Memory Card Troubleshooting.

Memory Card information is controlled by the A5 processor. The A2 interface provides a path for control and data signals, plus the connector for the Memory Card.

1. Press **Display**, **Mass Storage**, **MSI**, and **Memory Card**.

The amber light next to the memory card slot should blink.

- If the red light is on, then the battery in the memory card needs to be replaced.
 - If the message “Unable to read device” is reported, then the memory card is not initialized or is not all the way inserted.
2. Verify the Memory Card is good by trying the suspect card in another instrument. If the card is good, proceed with step 2. If the card is the identified problem, replace the card.
 3. Inspect the memory card connector for damage. If the connector is damaged, replace the A2 interface.
 4. If no other problem is identified, replace the A5 processor. This should correct the problem.

A5 Processor Component-level Troubleshooting

Although specific troubleshooting instructions are not included for component-level repair, the following information on built-in tests is valuable, should this level of repair be required.

There are two groups of tests. The first is called “Select Mode Tests.” These are selected by the address switches on the rear panel. The results may be seen on A5DS2 through the fan. The second group is called “Service Tests.” These require access to the second bank of switches located on the A5 processor.

Select Mode Tests

These tests are used with address switch settings. They allow a set of individual diagnostic tests to be run with a minimum of processor functionality. They are intended to assist in verifying operation of specific processor blocks and help isolate faults.

These tests do not require removing the display system cover. The A5DS2 LEDs may be seen through the fan air inlet. After selecting a test mode (A5S1 ADDR SW), start the test by cycling the power. When the test begins, the test number is displayed on A5DS2.

If the test fails, the failure is indicated on A5DS2 as listed in Table 4-4 if ran in “Halt Mode.” The test number may be changed to select a different test without re-cycling power if the previous test has not failed in the “Halt Mode.”

CAUTION Some of these tests are destructive to stored system states, such as window definitions stored in non-volatile RAM and the real time-clock settings.

A5S1 ADDR SW:

ONNNN101	CONTINUE MODE:	Does not display error message, repeats test continuously. LEDs flash once per completion of test loop. If the display system functions, the test name is displayed in block letters on the monitor and re-written once per completion of test loop.
ONNNN111	HALT MODE:	Displays error message, halts test on error. LEDs display error code. LEDs flash once per completion of test loop. If the display system functions, the test name is displayed in block letters on the monitor and re-written once per completion of test loop. If the test fails, an error message is displayed with instructions for restart.

The following table lists each of the Select Mode Tests. The test number shown is used in place of the NNNN in the A5S1 ADDR SW setting. Also shown is the two indications possible on A5DS2. The first shows the test number. The second shows the indication when the test fails.

Table 4-4. Select Mode Tests

Test Number	Tests:	Test Number:	Fail Code:
0	0000 LEDs	NA	NA
1	0001 ROM Checksum	● ○ ○ ○ ○ ○ ○ ○ ○ ●	● ○ ● ● ● ● ● ● ● ○
2	0010 CMOS RAM Data	● ○ ○ ○ ○ ○ ○ ○ ● ○	● ○ ● ● ● ● ● ● ● ●
3	0011 CMOS RAM Address	● ○ ○ ○ ○ ○ ○ ○ ● ●	● ○ ● ● ● ● ● ● ● ○
4	0100 Slave Processor 8041	● ○ ○ ○ ○ ○ ○ ● ○ ○	● ○ ● ● ● ● ● ○ ● ●
5	0101 DRAM Address	● ○ ○ ○ ○ ○ ○ ● ○ ●	● ○ ● ● ● ● ● ○ ● ○
6	0110 VRAM Address	● ○ ○ ○ ○ ○ ○ ● ● ○	● ○ ● ● ● ● ● ○ ● ●
7	0111 HP-MSIB	● ○ ○ ○ ○ ○ ○ ● ● ●	● ○ ● ● ● ● ● ○ ○ ○
8	1000 HP-HIL 8042	● ○ ○ ○ ○ ○ ● ○ ○ ○	● ○ ● ● ● ● ○ ● ● ●
9	1001 Real Time Clock	● ○ ○ ○ ○ ○ ● ○ ○ ●	● ○ ● ● ● ● ● ○ ● ○
10	1010 Memory Card LED Check	● ○ ○ ○ ○ ○ ● ○ ● ○	NA
11	1011 No Test	FLASH	NA
12	1100 No Test	FLASH	NA
13	1101 No Test	FLASH	NA
14	1110 No Test	FLASH	NA
15	1111 No Test	FLASH	NA

LED Test Code: ON = ● OFF = ○

Table 4-5 lists the description of each of the Select Mode Tests. The test number shown is used in place of the NNNN in the A5S1 ADDR SW.

Table 4-5. Test Descriptions

Test Number	Name	Description	
0	0000	LEDs	To visually verify LED operation, segments of the LED displays, A5DS1 and A5DS2, are flashed alternately on and off. (LEDs flash even, odd, all, and none.) No internal verification is performed.
1	0001	ROM Checksum	The checksum is verified for each of the ROMs.
2	0010	CMOS RAM Data	For each location in CMOS RAM (with the exception of the non-volatile variable area), a 1 is cycled through all 16 locations on the data bus. Each time a word is written, it is read back and checked. The test should find any shorted or open data lines. Each word is saved before testing, and then restored to allow the test to be non-destructive.
3	0011	CMOS RAM Address	An address register is increased by one (increment) as a data pattern is decreased by one (decrement). The processor then reads and verifies each location.
4	0100	Slave Processor 8041	This test tells the 8041 processor to send a count sequence to the host processor, which if received correctly, should verify the 8041 processor and the link to it.
5	0101	DRAM Address	An address register is increased by one (increment) as a data pattern is decreased by one (decrement). The processor then reads and verifies each location.
6	0110	VRAM Address	An address register is increased by one (increment) as a data pattern is decreased by one (decrement). The processor then reads and verifies each location.

Table 4-5. Test Descriptions (continued)

Test Number	Name	Description
7	0111 HP-MSIB	The functions performed are: send a NULL to Address 31 and check for NMAA (No Module At Address), which is the expected response. Send 0, 1, 2, 4, 8, 16, 64, 128 to self and check the data after each is sent. The most likely cause of a failure of this test is the HP-MSIB itself is hung (backplane error), that some line is short or open, that the display's HP-MSIB chip has failed or that the host's interface to the HP-MSIB chip has failed.
8	1000 HP-HIL 8042	The 8042 status and data registers are read to verify its power-up initialization has completed successfully.
9	1001 Real Time Clock	The Real Time Clock seconds register is read to verify that it is incrementing.
10	1010 Memory Card LED Check	Any memory card must be removed. The test alternately flashes the red "BAT" and yellow activity indicators.

Service Tests

These tests are intended to assist in component-level fault isolation. They require the display system cover to be removed and the processor board be placed into the service position to allow system operation and access to the component side of the board.

-
- DANGER**
- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
 - **Use electrostatic discharge (ESD) precautions when performing any servicing.**
 - **Do not touch the A4 power supply with your hands while power is applied.**
 - **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
 - **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $>>1$ M Ω resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**
-

CAUTION Some of these tests are destructive to stored system states, such as window definitions stored in non-volatile RAM and the real time-clock settings.

With the A5 processor board schematic and a two channel oscilloscope, signals are examined to locate the failed component. The test routines use a minimum of hardware and instructions to allow low-level fault isolation. The routines loop continuously with short cycle times to allow the oscilloscope to trigger and display the complete loop with practical sweep times.

All tests are started from the reset state. The test code is set on A5S1 and A5S2, then A5S4 is pressed and released to start the test.

Each of the tests in this section require the processor kernel to be operating. If a problem is suspected in the kernel, the following test should be performed.

Free Run Test

1. Place the A5 processor with the circuit side down.
2. With power turned off, remove jumper A5U9.
3. Turn on power. The processor should now receive a command that causes it to increment through its entire address range.
4. Using an oscilloscope and the schematic, verify each of the address lines. The address lines should be toggling, with each successive higher address line at one-half the frequency of the previous lower line.)
5. Using an oscilloscope and the schematic, verify the address decoding (A5U109, A5U82, and A5U83) and read strobe logic.

6. If the above steps are good, the processor kernel is functioning properly without the ROMs. The ROM Checksum Select Mode Test will help verify proper ROM operation.

Troubleshooting LEDs and DIP Switch Map

The two 8 bit dip switches allow manual input of test codes and data. A5DS1 and A5DS2, ten segment LED displays (see Figure 4-7), are used to indicate test status and data. The RST push button switch, A5S4, allows the processor board to be reset to a power-up condition without cycling power. A5S4 does not reset the HP-MSIB board, modules, or external systems. If the HP-MSIB board is not plugged into the processor board, A5S4 must be pressed to reset the processor board.

To initiate the Service Tests, set both A5S1 (Address Switch) and A5S2 to the appropriate positions. See Figure 4-8. Press and release the A5S4 RST switch. The switches (A5S1 and A5S2) are now available to enter data for the test as required. To initiate another test, A5S1 and A5S2 must be set and then A5S4 RST pressed again.

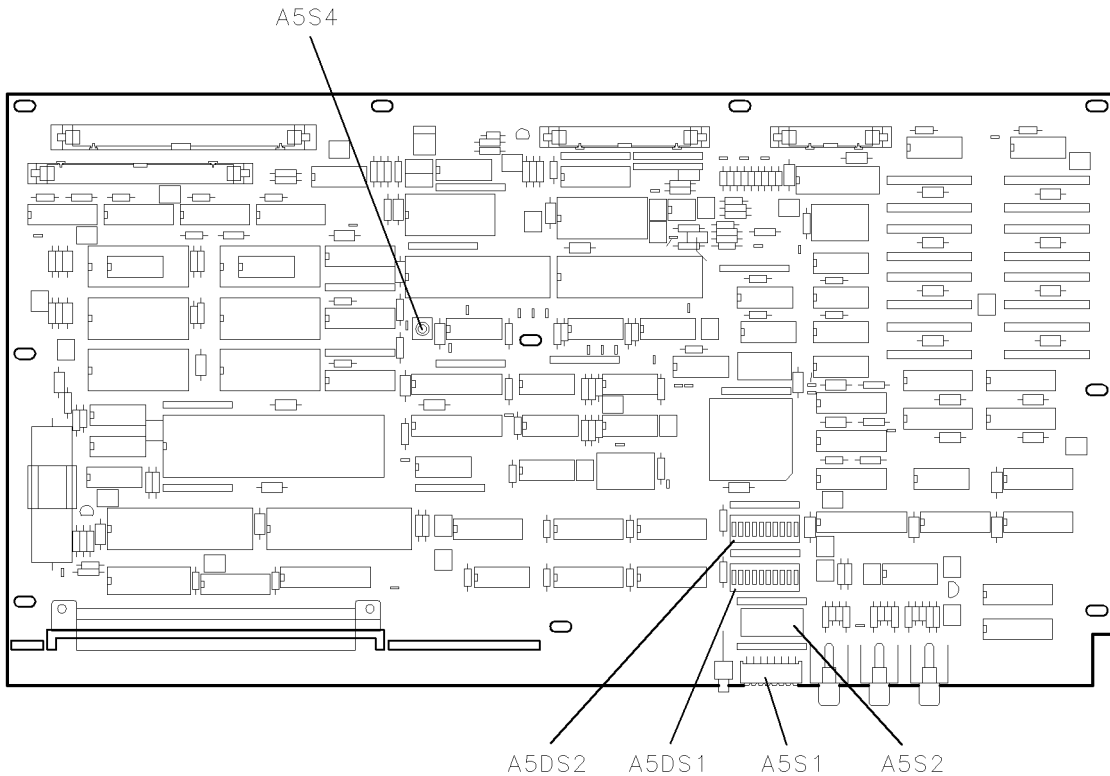


Figure 4-7. A5 Processor Diagnostics Locations

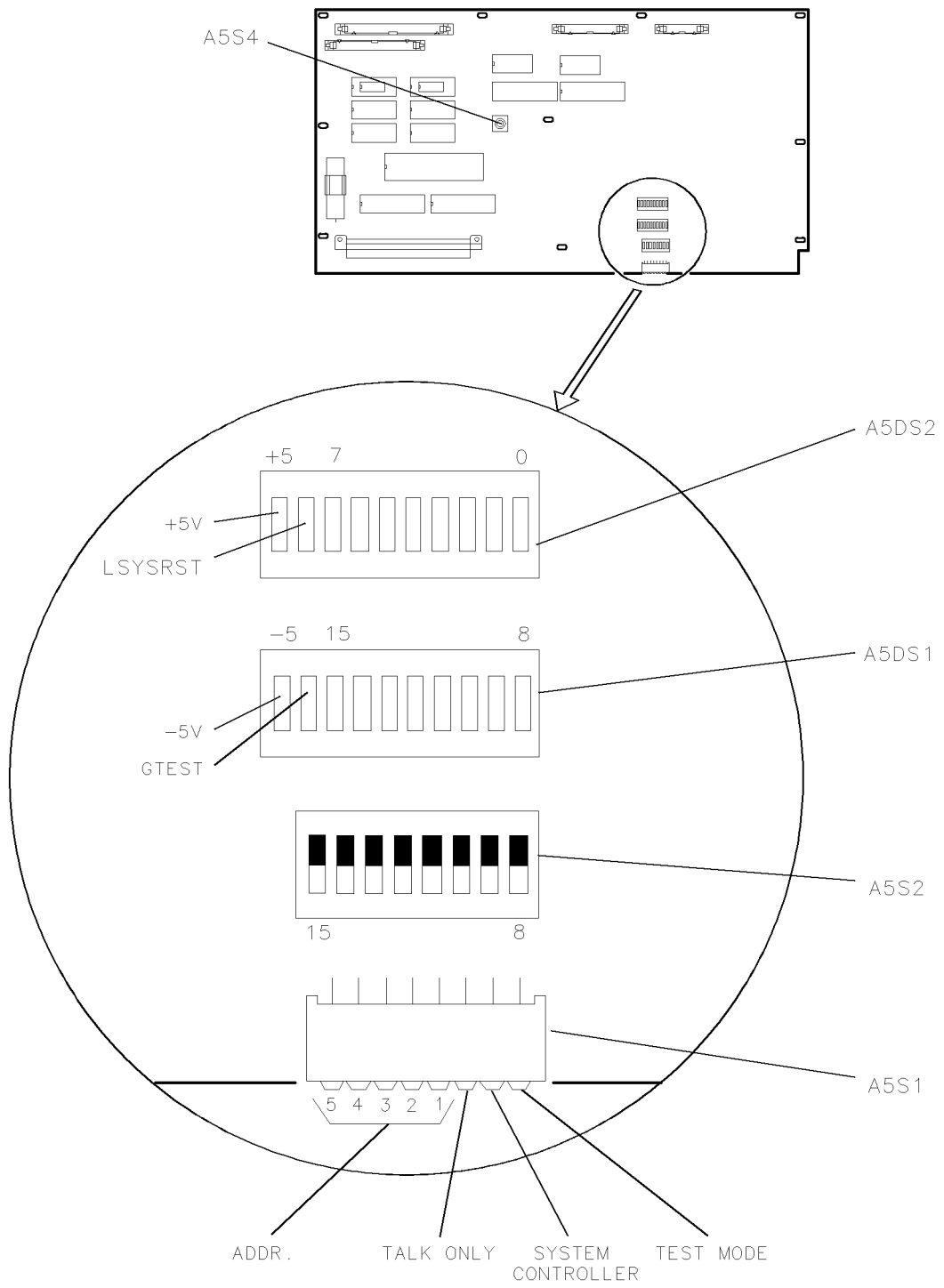


Figure 4-8. A5 Processor Switch Locations

Service Test List

Group 0

A5S1 ADDR SW:

110001X1 Group 0: RAM strobcs, RAM tests, External bus tests, Real Time Clock test, RAM and Real Time Clock battery backup tests.

A5S2 UPPER SW:

11111111 Test 0: RAM strobcs. Upper and lower byte write, word write, and word read.

11111110 Test 1: RAM data. Rotate bit pattern through RAM.

1111110X Test 2: RAM address. Write unique pattern to each location, test and write to LEDs.

111110XX Test 3: RAM data. Read dip switch, write to RAM. Test and loop on error.

11110XXX Test 4: External bus read and write strobcs. Write and read to each address rotating data bit.

1110XXXX Test 5: Real Time Clock. Initialize to 12/31/99, 23:59:50. In ten seconds all registers should roll over. Total value of registers is displayed on LEDs.

110XXXX0 Test 6: RAM battery backup. Initializes RAM with unique data in each address, waits for power cycle and bit 8 on dip to be set (A5DS2 110XXXX1) to test RAM data.

10XXXXX0 Test 7: Real Time Clock battery backup. Initializes Real Time Clock as in test 5 above, waits for power cycle, and bit 8 to be set (A5DS2 10XXXXX1), then starts Real Time Clock.

0XXXXXXX Test 8: Not used.

0 = Open 1 = Closed X = Don't care

Group 1

A5S1 ADDR SW:

11001101 Group 1: LEDs, dip switches, configuration bits, and 8041 functions.

A5S2 UPPER SW:

11111111 Test 0: LEDs. Flash LEDs alternate bytes, upper and lower, then alternate bits.

11111110 Test 1: Dip switches. Read dip switch bits and write bit pattern to LEDs. (Switch open gives LED off, switch closed gives LED on.)

1111110X Test 2: I/O strobe verification. Read dip switches for data bit pattern and write it to each I/O port with a read after write. (Switch open writes a 0, switch closed writes a 1.)

111110XX Test 3: Configuration switch. Read configuration word and write bit pattern to LEDs. (LED on indicates bit is a 0, LED off indicates bit is a 1.)

11110XXX Test 4: Brightness and contrast DAC. Ramps both DACs from min to max, max to min, and so forth

1110XXXX Test 5: 8041 output port lines. Set and clear port lines 10, 13, 25, and 27.

110XXXXX Test 6: Keyboard key scan. Scan keyboard and write binary key code to LEDs. (LED on indicates bit is a 0, LED off indicates bit is a 1.)

10XXXXXX Test 7: RPG. Take count and direction from RPG and display in binary on LEDs. (LED on indicates bit is a 0, LED off indicates bit is a 1.)

0XXXXXXX Test 8: Beeper. Beep high tone with long then short duration. Then beep low tone with long and short duration.

0 = Open 1 = Closed X = Don't care

Group 2

A5S1 ADDR SW:

110101X1 Group 2: Graphics processor memory, video, and monitor test patterns.

A5S2 UPPER SW:

11111111 Test 0: GSP DRAM and VRAM strobes. Read dip switches and write data pattern to first location in DRAM and VRAM. G-test is strobed once per cycle as a scope trigger.

11111110 Test 1: GSP DRAM. Write to the DRAM, all addresses, with a low data bit rotated through all high bits. Read, verify, and write pattern to LEDS. On failure flash all LEDs on, correct data pattern and failed data pattern.

1111110X Test 2: GSP VRAM. Write to the VRAM, all addresses, with a low data bit rotated through all high bits. read, verify, and write pattern to LEDS. On failure flash all LEDs on, correct data pattern, and failed data pattern.

111110XX Test 3: Grey scale. Initialize GSP vertical and horizontal sync. Setup VRAM with palette color codes. Fill VRAM display area with test pattern data, 16 vertical bars black to white.

11110XXX Test 4: White fill. Initialize GSP vertical and horizontal sync. Setup VRAM with palette color codes. Fill VRAM display area with test pattern data, full white screen.

1110XXXX Test 5: Default colors. Initialize GSP vertical and horizontal sync. Setup VRAM with palette color codes. Fill VRAM display area with test pattern data, 16 vertical bars of the default colors, color #0 through color #15 left to right.

110CTTTT Test 6: Fill with selected grey tone or default color. Initialize GSP vertical and horizontal sync. Setup VRAM with palette color codes. Fill VRAM display area with test pattern data.

1100CCCC = grey tones

1101CCCC = color code

TTTT = grey tone or color code in binary 0000 through 1111.

0000 = black, (grey #0), or background color #0.

1111 = white, (grey #15), or color #15.

Group 2 (continued)

10_____ Test 7: Dots, 17 X 9, superimposed on Tests 3 through 6 above. For grey tones, dots are white. For colors, dots are color #15.

Note: Dots will have black or background color dots immediately above and below them in a four dot vertical group. These will be apparent when a black or the background color is not used to fill the screen.

Pattern Key:

10000000 = 17 X 9 white dots on black screen.

1000GGGG = 17 X 9 white dots on grey #GGGG screen.

1001CCCC = 17 X 9 color #15 dots on color #CCCC screen.

101110XX = 17 X 9 white dots on 16 vertical bars of grey scale tones.

1010XXXX = 17 X 9 color #15 dots on 16 vertical bars of the default colors.

0XXXXXXX Test 8: Steps through all 4096 palette colors for color #0.

0 = Open 1 = Closed X = Don't care

Group 3

A5S1 ADDR SW:

110101X1 Group 3: HP-IB 9914

A5S2 UPPER SW:

11111111 Test 0: HP-IB data bus transmission. Setup HP-IB 9914 as a controller and transmit alternating data bit patterns on HP-IB data bus. **Note:** Remove all other HP-IB devices from the bus before using this test. An HP 59401A bus system analyzer must be plugged on the bus with REN off, LISTEN on, and FAST on. Data pattern will alternate from U125 to U252.

11111110 Test 1: HP-IB control signals. Setup HP-IB 9914 to alternately toggle control signals high and low. SRG, EOI, ATN, IFC, and REN HP-IB data lines are held low. **Note:** Remove all other HP-IB devices from the bus before using this test. An HP 59401A bus system analyzer must be plugged on the bus with REN off, LISTEN on, and FAST on. The SRQ, EOI, ATN, IFC, and REN LEDs will cycle on and off with some overlap of IFC and ATN, and EOI and ATN.

1111110X Test 2: HP-HIL self test and loop status. Reads self test byte and loop status and writes to LEDs.

111110XX Test 3: HP-HIL keycodes (requires HP-HIL keyboard). Reads keycodes and writes to LEDs.

11110XXX Test 4: HP-IB +5 V enable switch status. Reads 8041 I/O read status and writes to LEDs.

1110XXXX Test 5: Not used.

110XXXXX Test 6: Not used.

10XXXXXX Test 7: Not used.

0XXXXXXX Test 8: Not used.

0 = Open 1 = Closed X = Don't care

Group 4

A5S1 ADDR SW:

111001X1 Group 4: Interrupt tests, uses RAM for stack so RAM must be good.

A5S2 UPPER SW:

11111111 Test 0: Not used.

11111110 Test 1: HP-HIL Shift-Reset NMI (requires HP-HIL keyboard). Turns LEDs off then on when Shift-Reset is pressed.

1111110X Test 2: 8041 timer interrupt. Sets up and services 8041 timer interrupts.

111110XX Test 3: HP-HIL timer or key interrupt (HP-HIL keyboard optional). Sets up and services 8042 timer interrupts or key press interrupts, writes key code to LEDs.

11110XXX Test 4: HP-IB interrupt. Sets up 9914 to cause an interrupt then cycles interrupt line high and low. Flashes LEDs. Requires HP 59401A bus system analyzer.

1110XXXX Test 5: HP-MSIB interrupt. Sets up the HP-MSIB with same to and from address, sends data and services interrupt.

110XXXXX Test 6: Not used.

10XXXXXX Test 7: Real Time Clock interrupt. Sets up Real Time Clock for 8 ms timer interrupt interval. Real Time Clock time is displayed on LEDs.

0XXXXXXX Test 8: Not used.

0 = Open 1 = Closed X = Don't care

HP-MSIB and HP-IB Troubleshooting

This section documents troubleshooting information for the communication part of the instrument. There are two types of communication supported:

- HP-IB
- HP-MSIB

The Hewlett Packard Interface Bus (HP-IB) is used for control of instruments from system controllers. Most of the HP 70000 Series modular spectrum analyzer system do not use HP-IB internally. However, many of the systems will respond to HP-IB control.

The HP 70004A color display is capable of being controlled via HP-IB, and of using HP-IB to control plotters and printers. (Refer to the *HP 70004A Color Display User's Guide* for screen dump operations.) Both of these activities are controlled by the A5 processor. The display can also have HP-IB turned off so that all HP-IB activity is ignored. This does not remove the bus loading.

Additionally, the HP 70004A color display passes the full HP-IB interface to each module slot. Whether or not a given module uses HP-IB is dependent on the module. No processing, controlling, gating, or other operation is done with the signals.

(The A6 HP-MSIB Interface acts as an extender board connecting all HP-IB signals to the module slots.)

The HP 70004A color display is an independent element; it is neither controlled by another module, nor controls any other module, but does communicate via HP-MSIB. This high-speed, multi-user bus is fundamental to the HP 70000 Series modular spectrum analyzer system. All communication involving the display function is done by the A5 processor.

One of the *mainframe functions* of the display is to manage the local HP-MSIB interface. Each of the four module slots, or the display (A5 processor), can request permission to transmit an HP-MSIB message to another element. Permission to use HP-MSIB must be granted by the HP-MSIB controller before a message is sent. Any message addressed to an element not in the HP 70004A color display is routed on the external loop if connected. External messages received are placed on the internal bus. The A6 HP-MSIB Interface Assembly performs these functions. Communication between two modules in the HP 70004A color display, or a module in the HP 70004A color display and a module located elsewhere, is independent of the A5 processor.

Potential HP-MSIB and HP-IB failures may be categorized as below:

State 10.

HP-MSIB Fault Indicator Light is Lit.

State 11.

HP-MSIB Troubleshooting, HP-MSIB Light is Off.

State 12.

HP-IB Troubleshooting.

State 10.

HP-MSIB Fault Indicator Light is Lit.

This light indicates a problem on the HP-MSIB External Loop or low bias (+5V) to the A6 HP-MSIB. The A6 HP-MSIB has a circuit that checks to see if the external cables are connected properly. This circuit also monitors the external HP-MSIB instruments to see if they are in RESET. Whenever an instrument connected to the HP-MSIB is turned off, *all* other instrument's I/O or HP-MSIB lights will turn on and all displays will be blanked.

1. Check all the HP-MSIB cables in the system. If a cable is loose or disconnected, the HP-MSIB light will be lit. Securely connect all cables and cycle power. The problem should now be corrected (HP-MSIB light off). If the HP-MSIB light remains lit, continue with the next step.
2. If one of the HP-MSIB instruments in the loop is off, the HP-MSIB light will stay on. Turn on all the HP-MSIB instruments connected to that loop. The problem should now be corrected (HP-MSIB light off). If the HP-MSIB light remains on, continue with the next step.
3. Remove the HP-MSIB cables from the display. If the HP-MSIB light stays lit, continue with step 4. If the HP-MSIB light is now off, take a known good HP-MSIB cable and connect it from the display's HP-MSIB IN to HP-MSIB OUT connectors. If the HP-MSIB light comes on again, replace the A6 HP-MSIB. The problem should now be corrected.
4. If the HP-MSIB light is lit, even when both HP-MSIB cables are removed, then the +5 V supply on the A4 power supply may be too low.

DANGER

- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
- **Use electrostatic discharge (ESD) precautions when performing any servicing.**
- **Do not touch the A4 power supply with your hands while power is applied.**
- **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
- **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
- **Service personnel must use a $\gg 1$ M Ω resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
- **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**

-
- a. Turn off the instrument and remove the instrument cover. Turn the instrument on.
 - b. Check the +5 Vdc supply at the connector between the A5 processor and the A6 HP-MSIB. (Check the voltage between A4J5-42 and A4J5-43.) The voltage should be between 4.75 Vdc and 5.2 Vdc.
 - If the voltage is out of limits, return to State 4 in this chapter. State 4 deals with problems in the +5 Vdc supply.
 - If the voltage is within limits, but the HP-MSIB light is still lit, replace the A6 HP-MSIB. This should correct the problem; reassemble the display.

HP-MSIB
FAULT INDICATOR

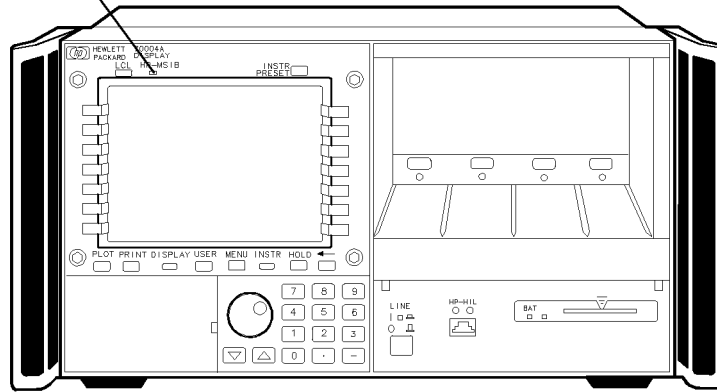


Figure 4-9. Front-Panel HP-MSIB Fault Indicator Light

State 11.

HP-MSIB Troubleshooting, HP-MSIB Light is Off.

Note The use of a good display or master module, and good HP-MSIB cables are required for HP-MSIB troubleshooting.

The flashing E fault indicator light in the display status box performs a similar function as the flashing ERR fault indicator on HP 70000 Series modular spectrum analyzer system series modules. A flashing E or ERR indicates one of the following three problems:

- An HP-MSIB backplane error (or module fault) has been detected at power-up which may prevent normal HP-MSIB communications (and normal error reporting). This problem must be repaired before any predictable system operation can occur.
- The A6 HP-MSIB is not receiving +5 V bias.
- The A6 HP-MSIB is defective.

The most probable cause for a flashing E or ERR in a new system occurs when two modules in the same system have the same HP-MSIB address (row and column). This will generate a backplane error. The display's address map will always lock-up under this condition.

1. Turn off the display to remove any HP-MSIB cables from the rear panel. (These cables are used to connect multiple mainframes or HP-MSIB instruments together.)
2. Turn on the display and check for flashing error lights. If the error lights are *not* flashing, then the problem is one of the following. Troubleshoot the system in this order.
 - A module in the display or the display itself is set to the same HP-MSIB address as one of the external elements.
 - One of the external HP-MSIB cables used is faulty.
 - An external HP-MSIB circuit is faulty (either a mainframe or a module).
 - If none of the above fix the problem, it could still be on the display's external HP-MSIB loop. The external HP-MSIB loop was disconnected when the HP-MSIB cables were removed. To verify whether the external HP-MSIB loop is the problem, connect a good HP-MSIB cable between the HP-MSIB IN and HP-MSIB OUT connectors on the display's rear panel. Cycle power. If the E or ERR indicators still flash, replace the A6 HP-MSIB Board Assembly.

CAUTION To avoid damaging the module connectors, the HP 70004A color display must be turned off before installing or removing any modules.

3. If the error light is flashing, turn off the display and remove all the modules. Verify that all the modules in the system have different address switch settings.
4. Turn on the display with all modules removed. If the flashing E fault indicator appears at power up, the problem is either the A5 processor or the A6 HP-MSIB.
5. If the error light is not flashing when no modules are installed, install a good module and turn on the display. (Be sure the module HP-MSIB address does not match the HP 70004A color display.)
6. If the E or ERR fault indicator is again flashing, then turn the display off and try the module in another slot. Turn the display on and check for the flashing E or ERR. If the fault indicator stops flashing, replace the A6 HP-MSIB.

7. If the E or ERR light is still flashing, then the +5 V HP-MSIB supply on the A4 power supply may be too low.

-
- DANGER**
- **These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.**
 - **Use electrostatic discharge (ESD) precautions when performing any servicing.**
 - **Do not touch the A4 power supply with your hands while power is applied.**
 - **The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.**
 - **Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.**
 - **Service personnel must use a $>>1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.**
 - **To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.**
-

- a. Turn off the instrument and remove the instrument cover.
 - b. Check the +5 Vdc supply at the connector between the A5 processor and the A6 HP-MSIB. (Check the voltage between A4J5-42 and A4J5-43.) The voltage should be between 4.75 Vdc and 5.2 Vdc.
 - If the voltage is out of limits, return to State 4 in this chapter. State 4 deals with problems in the +5 Vdc supply.
 - If the voltage is within limits, replace the A6 HP-MSIB . This should fix the problem, then reassembly the display. (It is possible the problem is the A5 processor. The two boards must be isolated using board substitution.)
8. Some HP-MSIB problems do not show up as a flashing E or ERR. This step involves using the display's address map as a troubleshooting tool.
- a. First install a good display or master module in the display. If an external display (typically a HP 70206A system graphics display) is used, connect the displays together with good HP-MSIB cables.
 - b. Next access the display's address map:
 - Press **(DSP)** or **(DISPLAY)**, **address map**.
 - Rotate the knob from column 0 to column 31 and back. Both the display's and master module's ID and HP-IB address should appear in the address map.
 1. If the address map freezes in one spot, then replace the display's A6 HP-MSIB.
 2. If an internal display was used and the address map has not locked-up, turn off the display and connect a good HP-MSIB cable between the display's rear panel HP-MSIB IN and HP-MSIB OUT connectors. Check the display's address map and follow the directions above.

- c. The above steps should have located the problem. If the problem still cannot be identified, the “HP-MSIB Diagnostic Tools” may be helpful.

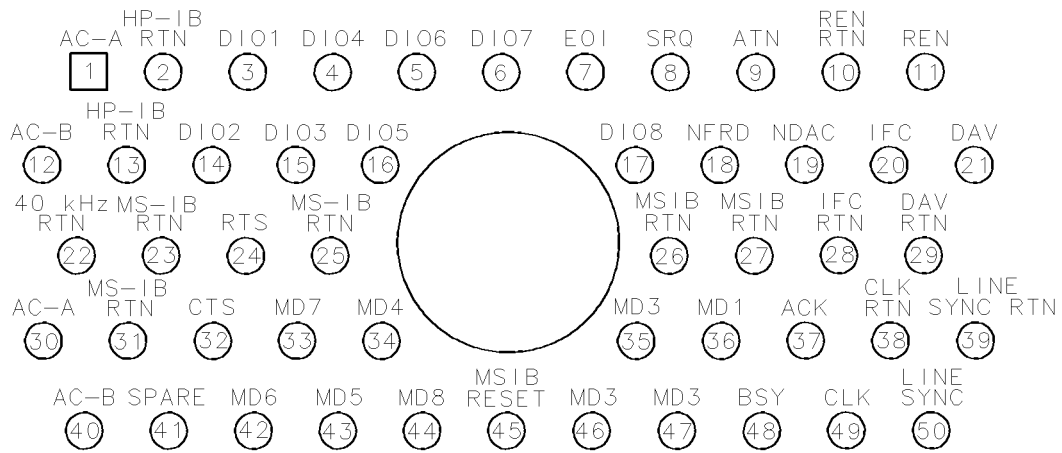


Figure 4-10. HP-MSIB Module Connector

State 12.

HP-IB Troubleshooting

The path for HP-IB signals from the HP-IB connector on the display rear panel to the modules consists of traces only (no cabling). The signals go from the HP-IB cable connector to the A6 HP-MSIB, then to the the A5 processor and to the module slots. All the module slots are connected in parallel on the A6 HP-MSIB.

Note The most common cause of problems with dumping from the display to either a plotter or printer using HP-IB is a difference in HP-IB settings. The HP 70004A color display hardcopy definition *must* match the peripheral used. (Refer to the *HP 70004A Color Display User's Guide*.)

1. If a known good master module will not talk over HP-IB, first check that the HP-IB switch on the module is set correctly (it must be on). Use a known good HP-IB cable.

Note For more information about module addressing, refer to the master module's Installation and Verification Manual.

2. Verify that the HP-IB address of the module does not match the HP-IB address of the HP 70004A color display. This is a common problem.
3. If HP-IB will not work with the known good master, turn the HP-IB off on the HP 70004A color display and try using HP-IB with the known good master.
 - a. If the problem is resolved, replace the A5 processor. This should fix the problem.
 - b. If the problem persists, either the A5 Processor Board is still interfering with HP-IB, or the A6 HP-MSIB Board has a damaged trace. Try replacing either assembly, *one at a time*. The A6 HP-MSIB Board can be checked for open traces when removed from the instrument.

Recommended Test Equipment Tables

Table 5-1. Recommended Test Equipment

Equipment	Recommended Model
Meters Digital multimeter Photometer	Range: 0 to 1000 V Accuracy: 10 mV Digital Readout: 3-1/2 digits Use one of the following: HP 3458A digital multimeter or HP 34401A digital multimeter or HP 3456A digital multimeter or HP 3466A digital multimeter Tektronics J16 0 to 110 NITS
Accessories Line-Isolated Variable Mains Transformer (VARIAC) ¹	Staco EJ401V Output: 0 to 132 Vac
Adjustment Tools	HP 8170-0033 fiber tuning tool ² HP 8710-0899 pozi-drive screwdriver (small) HP 8710-0900 pozi-drive screwdriver (large) HP 8710-1217 7 mm nut driver HP 8720-0001 3/16-inch nut driver HP 8710-0796 7/32-inch nut driver HP 8710-1392 hex key 3 mm

¹ Do not use an auto trans.

² Use this adjustment tool for adjustments requiring a nonmetallic tuning tool.

Adjustment Procedures

This chapter contains the setups for all adjustment procedures that are used to optimize module performance when assemblies are changed, repaired, or adjusted.

The HP 70004A color display adjustments are not automated; they require the user to perform step-by-step manual procedures.

A procedure is considered an adjustment when the cover plate of a module must be removed to perform a repair or an adjustment. A procedure is also considered an adjustment when a module is replaced.

Conversely, a procedure is considered a test when checks are performed on a module and cover plates and modules are not removed from a system.

Note Perform the “Power Supply Adjustments” for corrective servicing, not as routine maintenance.

Replacement A4 power supply assemblies are preadjusted at the factory and *do not* require any adjustment. Adjustments are necessary *only* if the power supply has been repaired or if the adjustments have been altered.

Power Supply Adjustments

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a >>1 MΩ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.

Table 6-1. A4 Power Supply Adjustable Components

Adjustment Order ¹	Reference Designator	Adjustment Name	Adjustment Function
1	A4R58	“Low Line Adjustment”	Adjusts low-line sense circuit.
2	A4R210	“Current Limit Adjustment”	Adjusts maximum current trip point.
3	A4R107	“Output Voltage Adjustment”	Adjusts output voltage feedback circuit.
4	A4R728	“+65 Volt Adjustment”	Adjusts +65 Vdc monitor supply.
5	A3RV510	“Monitor Adjustments”	Adjusts vertical position of display.
6	A3G2	“Monitor Adjustments”	Adjusts monitor background level.

¹ The “Power Supply Adjustments” should be performed in the order shown in this table. The first two adjustments are performed with the power supply service fuse (A4F1) removed. The initial setting for each adjustment is checked before any adjustment is made.

Test Equipment

Preferred Model Numbers

Line-Isolated Variable Mains Transformer (VARIAC) Staco EJ401V
 Digital Voltmeter HP 3466A digital multimeter

Power Supply Adjustments

The purpose of the “Power Supply Adjustments” is to adjust the A4 power supply. Table 6-1 lists the adjustable components by reference designator, name, and adjustment description.

1. Remove the four screws securing the instrument cover at the rear of the HP 70004A color display and slide the instrument cover off.
2. Position the HP 70004A color display top-side-down on the work bench and remove the nine screws securing the A4 power supply.

CAUTION Before positioning the A4 power supply onto the A5 processor, ensure that the insulator (mounted on the trace-side of the A4 power supply) is placed between the two assemblies.

3. Position the A4 power supply (component-side up) onto the A5 processor with an insulator between the two assemblies.

Note The Line-Isolated Variable Mains Transformer (VARIAC) is intended to operate on a standard 115 Vac (50/60 Hz) line source. Do not plug the Line-Isolated Variable Mains Transformer (VARIAC) into a 230 Vac line voltage source.

4. Turn the Line-Isolated Variable Mains Transformer (VARIAC) off. Adjust the Line-Isolated Variable Mains Transformer (VARIAC) to 0 Vac (turn the voltage control knob completely counterclockwise (CCW)).

Note Note that from this point on, the A4 power supply switch is in the on state at all times. The only control of line power is via the line-isolated Line-Isolated Variable Mains Transformer (VARIAC).

5. Switch A4S2 line voltage selector (located on left side of display) to the 115 V position.
6. Connect the power cord from the line module located on the rear panel of the HP 70004A color display to the Line-Isolated Variable Mains Transformer (VARIAC) isolated output.
7. Turn the HP 70004A color display **LINE** switch on.

Low Line Adjustment

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

WARNING First, verify that the Line-Isolated Variable Mains Transformer (VARIAC) is off. Next, verify that the A4DS1 indicator light on the A4 power supply is *off* (wait one minute or more after A4DS1 stops glowing). A4DS1 *on* indicates that A4C209, C210, C229, and C230 are charged to unsafe levels (refer to Figure 6-1.)

Low Line Adjustment

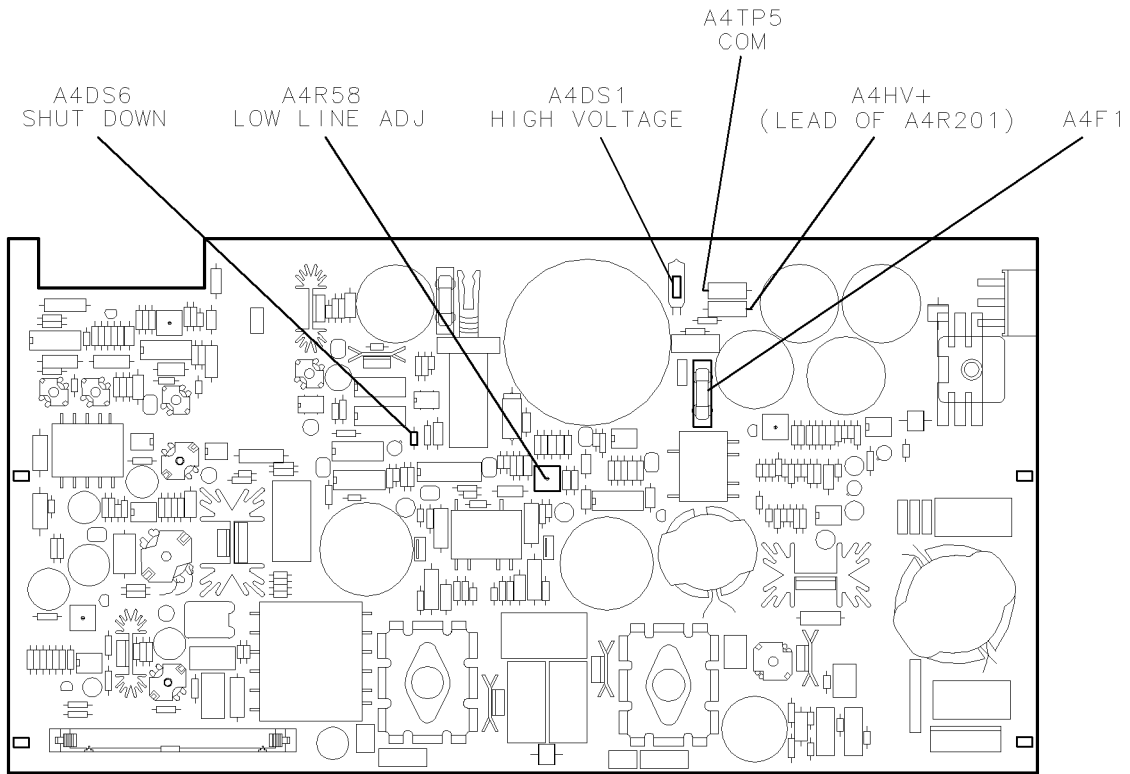


Figure 6-1. Low Line Adjustment

Low Line Adjustment

The purpose of this adjustment procedure is to adjust the trip point of the line voltage sense circuit for power supply start-up. When the range switch is set to 115 V, the trip point is equivalent to 86 Vac. When the range switch is set to 230 V, the trip point is equivalent to 172 Vac. These are the lower limits for operation of the supply.

1. Remove the A4F1 service fuse from the power supply board.
2. Connect a set of insulated test leads and clips (600 V insulation) to the DVM. Connect the DVM positive lead to A4HV+ and the DVM negative lead to A4TP5 (COM). Set the DVM to measure >325 Vdc.
3. Turn on the Line-Isolated Variable Mains Transformer (VARIAC) and slowly increase its output (turn the voltage control knob clockwise (CW)) until the DVM reads 234 Vdc (A4DS6 should still be on). Increase the Line-Isolated Variable Mains Transformer (VARIAC)'s output voltage to read 244 Vdc on the DVM. A4DS6 should go out between 234 and 242 Vdc.
 - If the Volt/Temp fault indicator LED (A4DS6) goes out, A4R58 (Low Line adjustment) is set correctly. Go to the Current Limit Adjustment.
 - If A4DS6 (Volt/Temp LED) is still on, go to step 5.
4. Set the Line-Isolated Variable Mains Transformer (VARIAC) to 0 Vdc (voltage control knob completely CCW). Turn the Line-Isolated Variable Mains Transformer (VARIAC) off.
5. Turn the A4R58 (Low Line adjustment) completely CCW. Wait one minute, turn on the Line-Isolated Variable Mains Transformer (VARIAC), then slowly increase its output until the DVM indicates 238 Vdc \pm 2 Vdc. A4DS6 (Volt/Temp LED) will now be on.
6. Slowly turn A4R58 (Low Line Adjustment) CW until A4DS6 (Volt/Temp LED) goes out. The Low Line voltage turn-on point is now set. Turn the Line-Isolated Variable Mains Transformer (VARIAC) off and wait one minute. Go to step 4 and verify that the setting is correct. If necessary repeat the adjustment until it passes.

Current Limit Adjustment

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

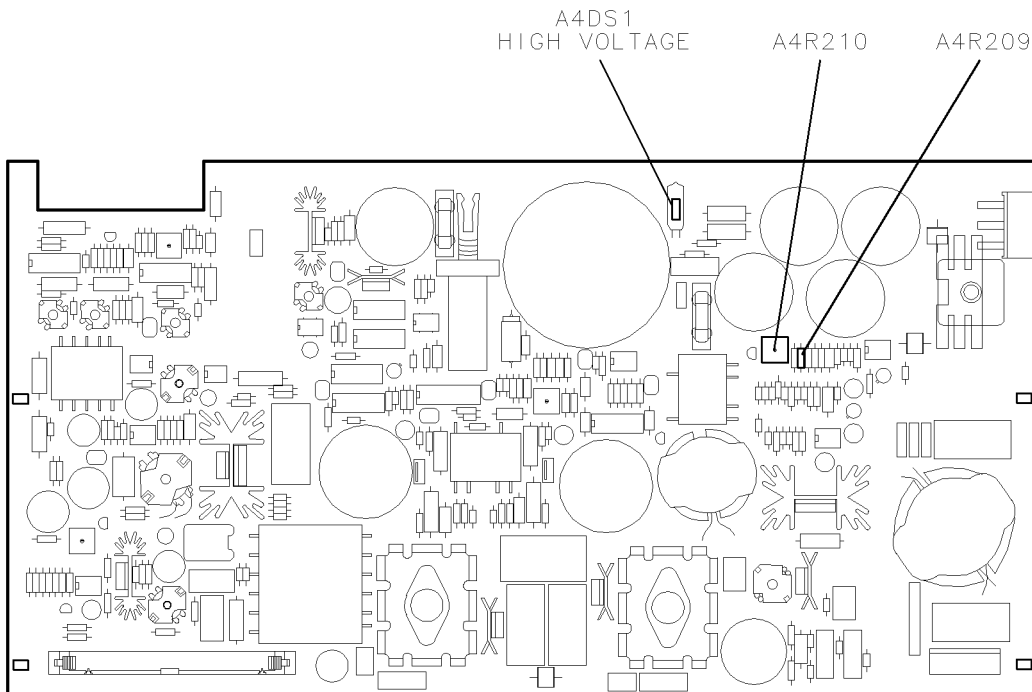


Figure 6-2. Current Limit Adjustment

Current Limit Adjustment

The purpose of this adjustment procedure is to set the current trip point for the 40 kHz output. Module load currents exceeding the current trip point cause the 40 kHz output to shut down, preventing damage to the A4 power supply.

1. Increase the Line-Isolated Variable Mains Transformer (VARIAC) output until the DVM reads $325 \text{ Vdc} \pm 10 \text{ Vdc}$. Turn the Line-Isolated Variable Mains Transformer (VARIAC) off and wait one minute or more after A4DS1 goes out.
2. Connect the DVM's leads across A4R209 (to measure the absolute voltage across A4R209).
3. Turn on the Line-Isolated Variable Mains Transformer (VARIAC). The absolute voltage (either polarity is OK) across R209 must fall between 0.88 and 0.96 Vdc. If the voltage is within specified limits, the Current Limit trip point is adjusted correctly. Go to the Output Voltage Adjustment. If the voltage is not within the specified limits, proceed with the next step.
4. Turn A4R210 (Current Limit) CW or CCW until the absolute voltage across A4R209 is measures $0.92 \text{ Vdc} \pm 0.02 \text{ Vdc}$. The current limit trip point is now set.

Output Voltage Adjustment

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

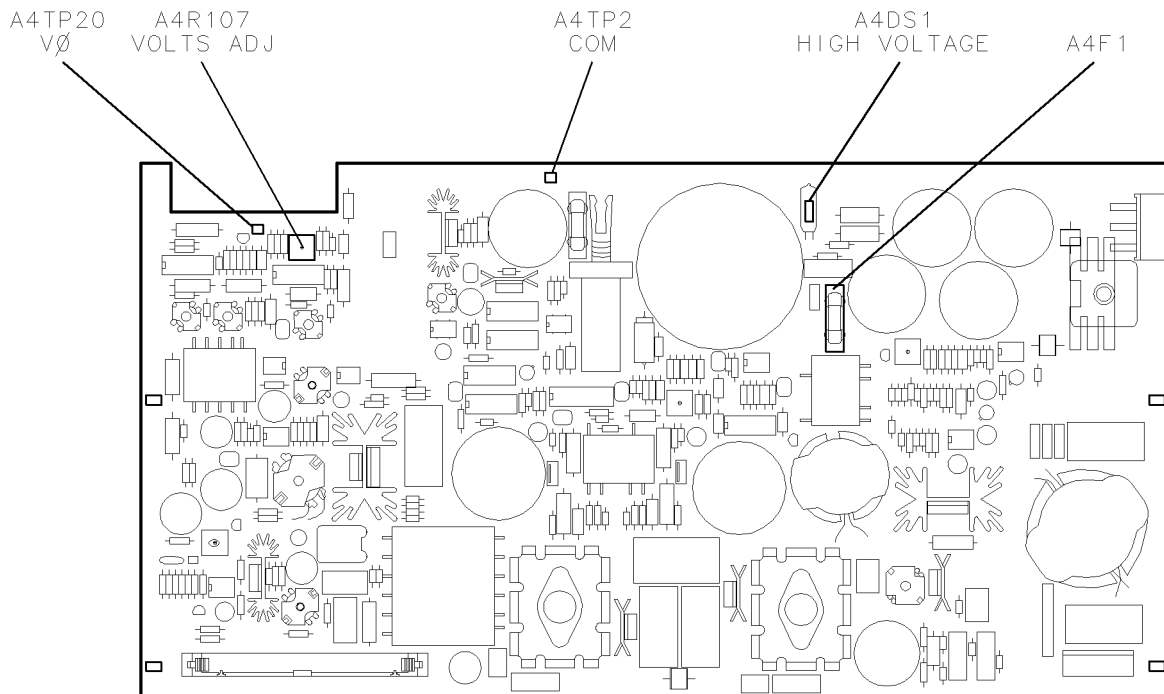


Figure 6-3. Output Voltage Adjustment

Output Voltage Adjustment

The purpose of this adjustment procedure is to adjust the output voltage of the regulated 40 kHz sine wave provided to the modules.

1. Turn the Line-Isolated Variable Mains Transformer (VARIAC) off. Wait one minute or more after A4DS1 goes out, then connect the DVM positive lead to A4TP20 (V0) and the negative lead to A4TP2 (COM).
2. Reinsert the A4F1 Service Fuse. Turn the Line-Isolated Variable Mains Transformer (VARIAC) on. Adjust the Line-Isolated Variable Mains Transformer (VARIAC) to 115 Vac. Check fan operation to verify that the power supply is running.
3. Verify a DVM voltage reading between 8.055 and 8.085 Vdc. If the voltage is within specified limits, the Output Voltage is adjusted correctly. Go to the +65 Volt Adjustment. If the voltage is not within the specified limits, go to step 4.
4. Adjust A4R107 (V_{out} Adj) until the DVM reads 8.070 Vdc ± 0.010 Vdc. Repeat the previous step to verify that the setting is correct. If necessary repeat the adjustment until it passes.

+ 65 Volt Adjustment

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $>>1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.

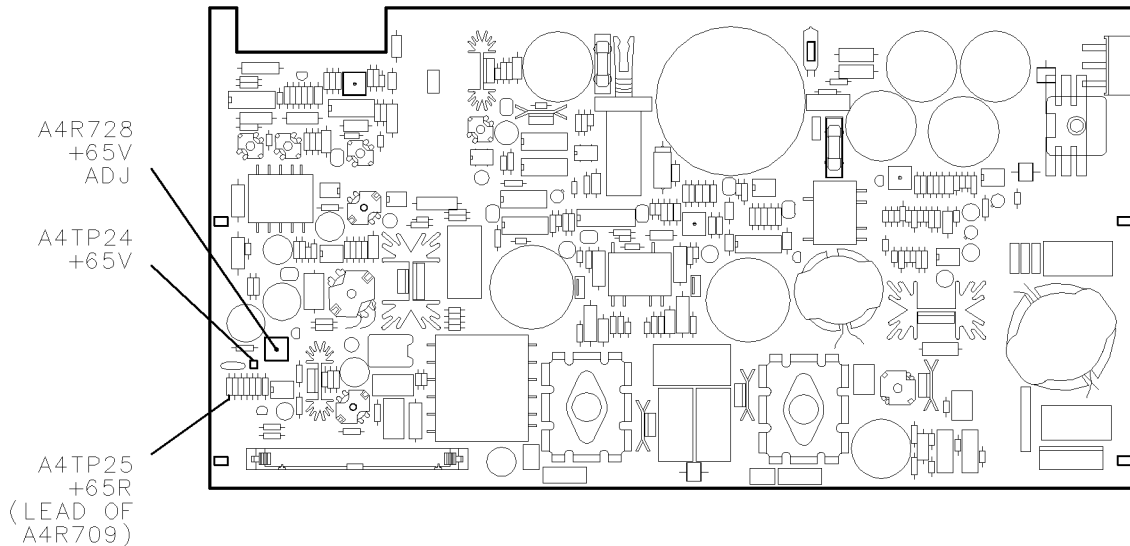


Figure 6-4. +65 Volt Adjustment

+65 Volt Adjustment

The purpose of this adjustment procedure is to adjust the +65 Vdc output voltage that provides power to the monitor.

1. Connect the DVM between TP24, +65V, and TP25, +65R. Test point TP25 is accessed by clipping to the lead of R709.
2. Turn the Line-Isolated Variable Mains Transformer (VARIAC) on. Adjust the Line-Isolated Variable Mains Transformer (VARIAC) to 115 Vac. Check for operation to verify that the power supply is functioning.
3. Adjust R728 until the DVM reads 65.05 Vdc \pm 0.05 Vdc.

Monitor Adjustments

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.

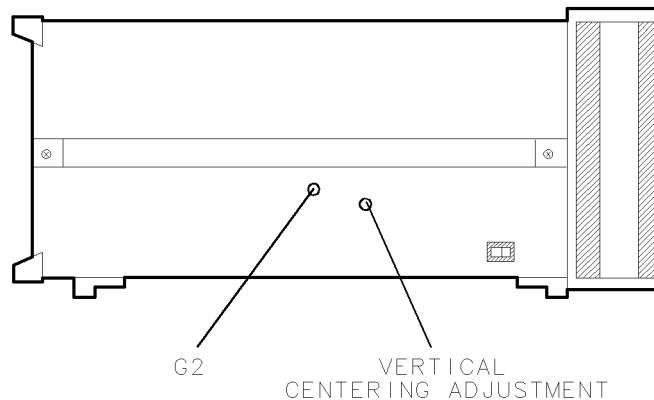


Figure 6-5. Monitor Adjustments

Test Equipment

Preferred Model Numbers

Photometer Tektronics J16

Monitor Adjustments

The purpose of this adjustment procedure is to perform the Vertical Centering Adjustment and the Display Intensity Adjustment.

Vertical Centering Adjustment

Vertical Centering Adjustment aligns the entire display simultaneously.

1. Turn the power to the HP 70004A color display on.
2. Press **DISPLAY**.
3. Adjust the Vertical Centering Adjustment on the monitor until the displayed softkey menus are properly aligned with their corresponding keys. Refer to Figure 6-5 for the location of the Vertical Centering Adjustment.

Display Intensity Adjustment

Display Intensity Adjustment adjusts the monitor drive levels. The gain is adjusted to provide the correct intensity so that all gray levels are visible, and the raster background (full black) is not visible. The maximum intensity is also verified to be within range.

Note This adjustment should only be done for aging monitors where sufficient intensity is a problem. This adjustment should not be required when the monitor is replaced.

This procedure requires the operator to make a judgement of when the raster background is not visible but all 15 gray bars are visible. This procedure is easier to perform in a room with subdued lighting.

1. Select the gray scale test pattern by pressing **DISPLAY** **display tests** **test pattern** **MORE 1 OF 3** **BLK LVL TEST**. This places the gray scale test pattern on screen. This pattern consists of 4 vertical bars, with full black on the left. The intensity setting is automatically set to 17 and Background is set to 8.
2. Adjust G2 on the monitor so that the left-most vertical bar is not distinguishable from the non-display border. The rightmost three bars should be visible. Refer to Figure 6-5 for the location of adjustment G2.
3. Select the full white, full intensity test pattern by pressing **MORE 2 OF 3** **WHITE FILL**.
4. Using a photometer, verify that full intensity is between 45 NITS (cd/m²) and 110 NITS. (Typical is 50 NITS.) If the intensity is not within the correct range, G2 may be adjusted iteratively between steps 1 and 2, and steps 3 and 4. If the acceptable intensity range still cannot be reached, or the visual image from step 2 is not acceptable, the monitor may be defective.

Module Verification Tests

This chapter would have contained the setups for all module verification tests that must be performed in order to optimize module performance when assemblies are changed, repaired, or adjusted.

Note The HP 70004A color display does not have any module verification tests.

Equipment Calibration

This chapter would have contained the setups for all equipment calibration procedures that must be performed in order to optimize module performance when assemblies are changed, repaired, or adjusted.

Note The HP 70004A color display does not have any equipment calibration procedures.

Replacing Major Assemblies

This chapter contains procedures for removal and replacement of major assemblies in your color display. Instructions are given for the following assemblies:

- “A1 Front Panel”
- “A3 Monitor/Monitor Bracket”
- “A4 Power Supply”
- “A5 Processor”
- “A6 HP-MSIB”
- “Rear Frame”
- “Custom Key-Panel Assembly”

The words “right” and “left” are used throughout the replacement procedures to indicate the sides of the display as viewed from the front panel.

Numbers in parentheses are used throughout the replacement procedures to indicate numerical callouts on corresponding figures.

This service guide is part of an Option OB3 package which consists of two manuals. To obtain a list of all versions of all assemblies available for your color display, refer to Manual 2.

A1 Front Panel

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

The A1A1 keyboard and A1A2 RPG assemblies are part of the A1 front panel.

To Remove the A1 Front Panel

1. Remove the line cord.
2. Remove the two screws securing the left-side strap handle.

Note This note applies only to HP 70004A color displays with serial numbers: 0000A00000 through 3040A01050.

The HP 70004A color display's right-side strap handle, situated on the side of the HP 70004A color display which accepts modules, may not support the weight of certain configurations.

To solve this problem, the right-side strap handle must be removed from all HP 70004A color display's. A replacement kit is available for this procedure (HP 70004-60032, *Side Strap Handle Replacement Kit*). After receiving the kit, remove the right-side strap handle and replace it with the two beveled washers and two screws that are provided in the kit. See the installation note provided in the kit for the proper location of the special beveled washers.

3. Remove the four screws securing the instrument cover at the rear of the HP 70004A color display and slide the instrument cover off.
4. Loosen (but do not remove) the four screws (1) on the top side of the monitor.
5. Remove the two screws (2) securing the A1 front panel to the front frame.
6. Remove the four screws (3) securing the A1 front panel to the monitor.
7. While holding the right side of the A1 front panel in place, remove the left side.
8. Carefully remove the right side and disconnect the ribbon cable.

To Replace the A1 Front Panel

- 1. Reconnect the ribbon cable to the A1 front panel.
- 2. Insert the right side of the A1 front panel first.
- 3. While holding the right side in place, insert the left side.
- 4. Secure the A1 front panel to the monitor using four screws (3).
- 5. Secure the A1 front panel to the front frame using two screws (2).
- 6. Tighten the four screws (1) on the top side of the monitor.
- 7. Replace the instrument cover.
- 8. Reconnect the line cord.

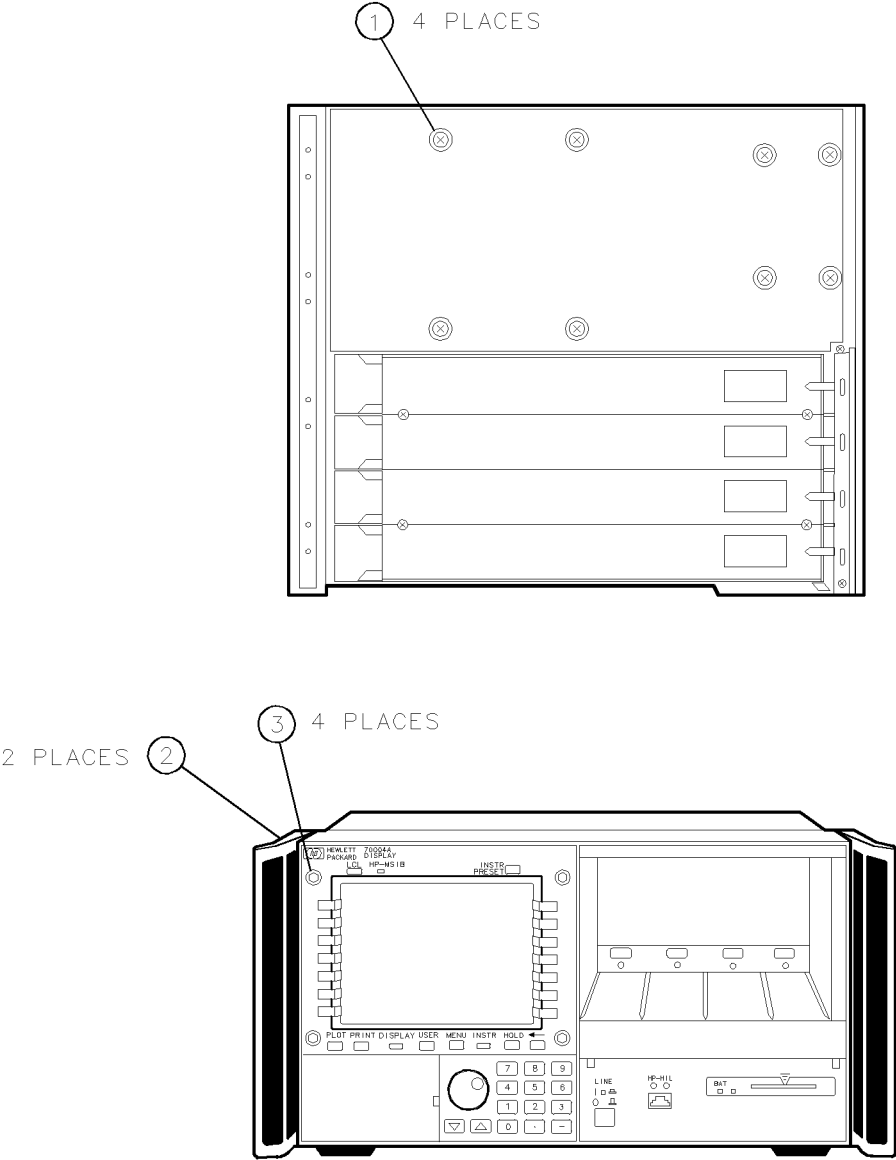


Figure 9-1. A1 Front Panel Removal/Replacement

A3 Monitor/Monitor Bracket

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

To Remove the A3 Monitor/Monitor Bracket

1. Remove the line cord.
2. Remove all modules.
3. Remove the two screws securing the left-side strap handle.

Note This note applies only to HP 70004A color displays with serial numbers: 0000A00000 through 3040A01050.

The HP 70004A color display's right-side strap handle, situated on the side of the HP 70004A color display which accepts modules, may not support the weight of certain configurations.

To solve this problem, the right-side strap handle must be removed from all HP 70004A color display's. A replacement kit is available for this procedure (HP 70004-60032, *Side Strap Handle Replacement Kit*). After receiving the kit, remove the right-side strap handle and replace it with the two beveled washers and two screws that are provided in the kit. See the installation note provided in the kit for the proper location of the special beveled washers.

4. Remove the four screws securing the instrument cover at the rear of the HP 70004A color display and slide the instrument cover off.
5. Remove the A1 front panel as described in "A1 front panel Removal," steps 3 through 7.
6. Remove the four screws (1) securing the monitor to the main deck.
7. Position the HP 70004A color display top-side-down on the work bench.
8. Remove the 10 screws (2) securing the A5 processor.

CAUTION Damage to the eighty-pin connector will result if the free end of the A5 processor is lifted beyond the necessary height. Do not lift higher than required for the A5 processor connectors to clear the main deck.

9. Carefully lift the free side of the A5 processor (side closest to A4 power supply) and disconnect it from the A6 HP-MSIB.
10. Position the A5 processor onto the A4 power supply with the component side facing up.
11. Disconnect W1 from A5J2 and W4 from A5J3.
12. Remove the three screws (3) securing the monitor cover and remove the monitor cover.
13. Slide the monitor out of the display.
14. Remove the four screws (4) securing the monitor bracket to the monitor.
15. Remove the monitor bracket.

To Replace the A3 Monitor/Monitor Bracket

1. Position the monitor bracket in the monitor.
2. Secure the monitor bracket using four screws (4).
3. Secure the ribbon cables to the rear of the monitor with masking tape. (The masking tape will be removed later in this procedure.)
4. Slide the monitor into position while being careful not to pinch the ribbon cables.
5. Remove the masking tape from the rear of the monitor.
6. Route the two ribbon cables (W1 and W4) through the slot in the monitor cover.
7. Position the monitor cover onto the main deck and secure using three screws (3).
8. Connect W1 to A5J2 and W4 to A5J3.
9. Reconnect the A5 processor's eighty-pin connector with the eighty-pin connector on the A6 HP-MSIB. Ensure that the three video connectors align with their corresponding holes in the rear panel.
10. Ensure that the ribbon cables on the A5 processor do not become damaged.
11. Secure the A5 processor using ten screws (2).
12. Position the HP 70004A color display top-side-up on the work bench.
13. Install the four screws (1) securing the monitor to the main deck but do not tighten.
14. Replace the A1 front panel as described in "A1 front panel Replacement," steps 1 through 6.
15. Replace the instrument cover.
16. Replace all modules.
17. Reconnect the line cord.

A3 Monitor/Monitor Bracket

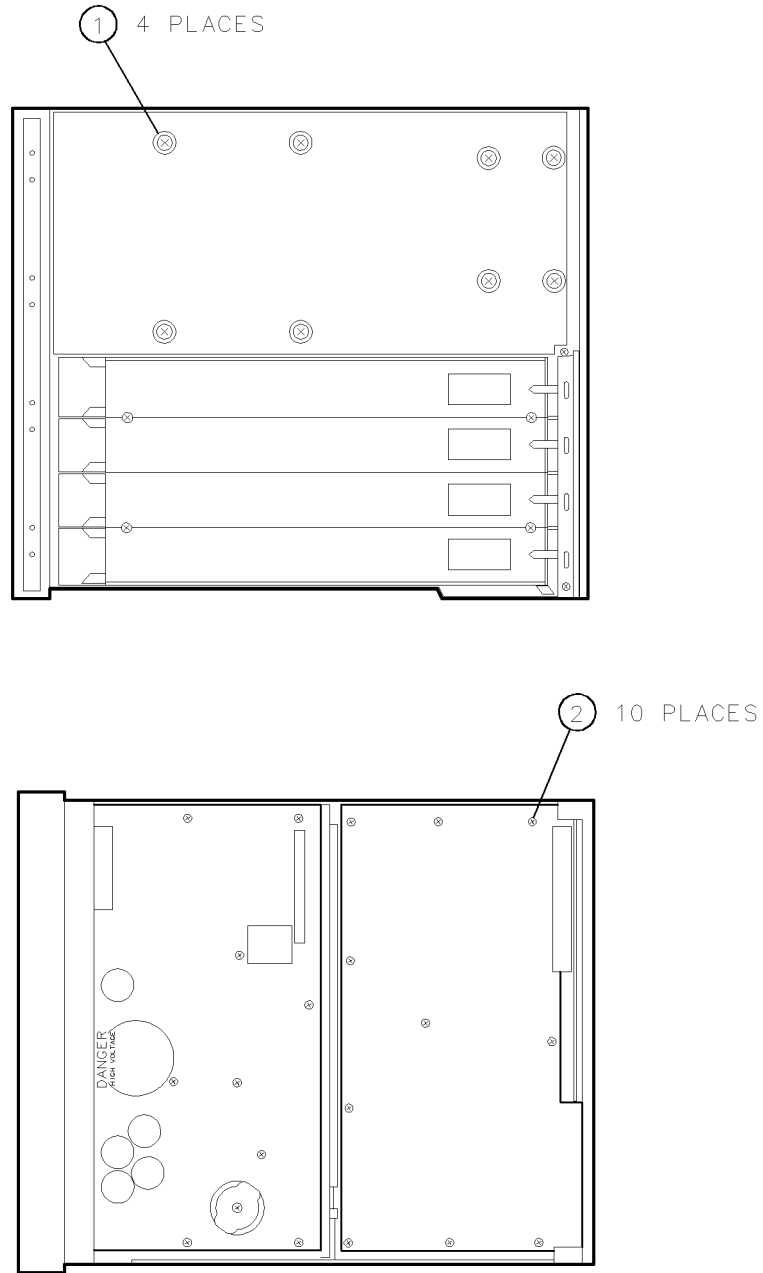


Figure 9-2. A3 Monitor/Monitor Bracket Removal/Replacement (1 of 2)

A3 Monitor/Monitor Bracket

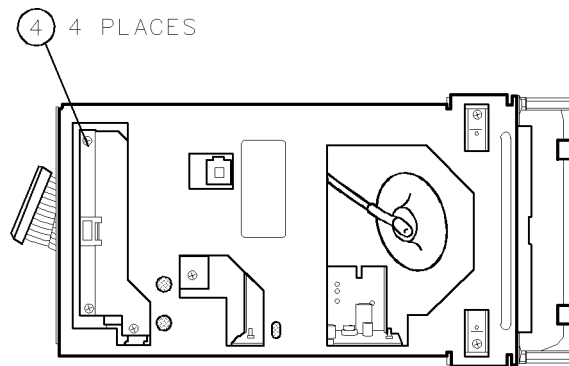
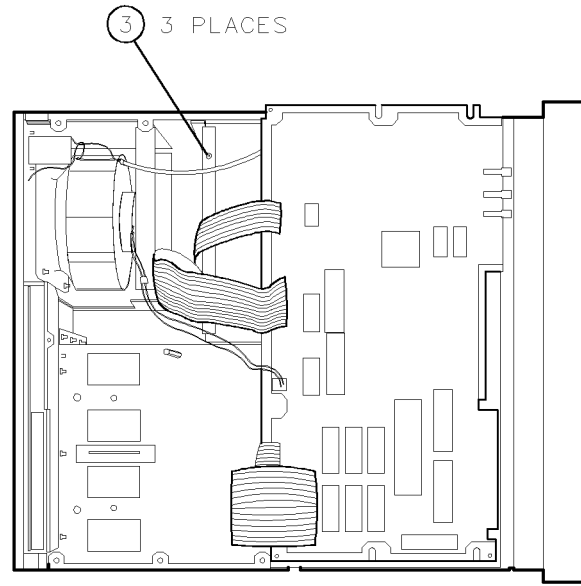


Figure 9-3. A3 Monitor/Monitor Bracket Removal/Replacement (2 of 2)

A4 Power Supply

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

To Remove the A4 Power Supply

1. Remove the line cord.
 2. Remove all modules.
 3. Remove the two screws securing the left-side strap handle.
-

Note This note applies only to HP 70004A color displays with serial numbers: 0000A00000 through 3040A01050.

The HP 70004A color display's right-side strap handle, situated on the side of the HP 70004A color display which accepts modules, may not support the weight of certain configurations.

To solve this problem, the right-side strap handle must be removed from all HP 70004A color display's. A replacement kit is available for this procedure (HP 70004-60032, *Side Strap Handle Replacement Kit*). After receiving the kit, remove the right-side strap handle and replace it with the two beveled washers and two screws that are provided in the kit. See the installation note provided in the kit for the proper location of the special beveled washers.

4. Remove the four screws securing the instrument cover at the rear of the HP 70004A color display and slide the instrument cover off.
 5. Position the HP 70004A color display top-side-down on the work bench.
-

DANGER Serious personal injury may occur if the A4 power supply is not fully discharged. Do not continue with this procedure until A4DS1, the high voltage indicator, has been off for a minimum of three minutes.

6. Remove the nine screws (1) securing the A4 power supply to the main deck.

CAUTION Before positioning the A4 power supply onto the A5 processor, ensure that the insulator (mounted on the trace-side of the A4 power supply) is placed between the two assemblies.

7. Position the A4 power supply onto the A5 processor with the component side facing up.
8. Disconnect the line cable from A4P2.
9. Disconnect W3 from A4P1.
10. Remove the A4 power supply.

To Replace the A4 Power Supply

1. Position the A4 power supply onto the A5 processor with the component side facing up.
2. Connect W3 to A4P1.
3. Connect the line cable to A4P2.
4. Position the A4 power supply onto the main deck. Insert the side closest to the front panel into the groove in the front casting.
5. Secure the A4 power supply using nine screws (1).
6. Position the HP 70004A color display top-side-up on the work bench.
7. Replace the instrument cover.
8. Replace all modules and reconnect the line cord.

A4 Power Supply

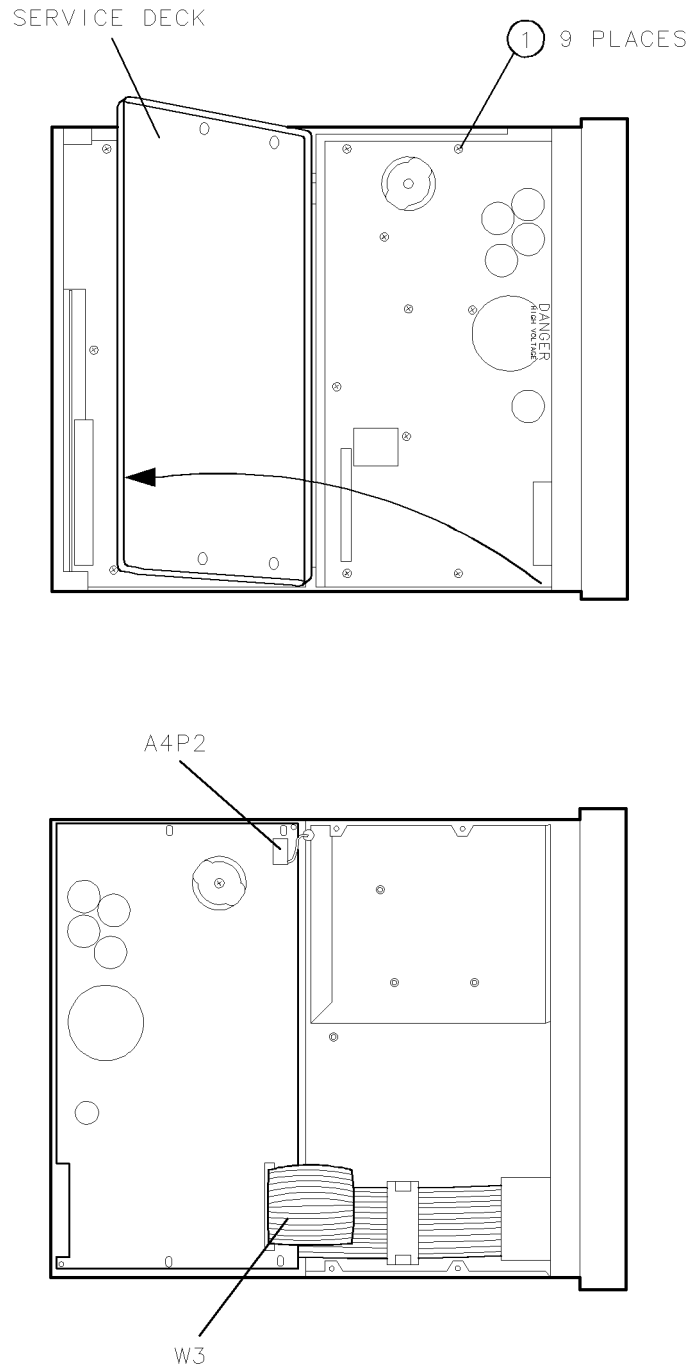


Figure 9-4. A4 Power Supply Removal/Replacement

A5 Processor

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

To Remove the A5 Processor

1. Remove the line cord.
2. Remove all modules.
3. Remove the two screws securing the left-side strap handle.

Note This note applies only to HP 70004A color displays with serial numbers: 0000A00000 through 3040A01050.

The HP 70004A color display's right-side strap handle, situated on the side of the HP 70004A color display which accepts modules, may not support the weight of certain configurations.

To solve this problem, the right-side strap handle must be removed from all HP 70004A color display's. A replacement kit is available for this procedure (HP 70004-60032, *Side Strap Handle Replacement Kit*). After receiving the kit, remove the right-side strap handle and replace it with the two beveled washers and two screws that are provided in the kit. See the installation note provided in the kit for the proper location of the special beveled washers.

4. Remove the four screws securing the instrument cover at the rear of the HP 70004A color display and slide the instrument cover off.
 5. Position the HP 70004A color display top-side-down on the work bench.
 6. Remove the ten screws (1) securing the A5 processor.
-

CAUTION Damage to the eighty-pin connector will result if the free end of the A5 processor is lifted beyond the necessary height. Do not lift higher than required for the A5 connectors to clear the main deck.

A5 Processor

7. Carefully lift the free side of the A5 processor (side closest to A4 power supply) and disconnect it from the A6 HP-MSIB.
8. Position the A5 processor onto the A4 power supply with the component side facing up.
9. Disconnect W1 from A5J2, W2 from A5J4, W3 from A5J1, W4 from A5J3, and the fan cable from A5J9.
10. Remove the A5 processor.

To Replace the A5 Processor

1. Position the A5 processor onto the A4 power supply with the component side facing up.
2. Connect W1 to A5J2, W2 to A5J4, W3 to A5J1, W4 to A5J3, and the fan cable to A5J9.
3. Reconnect the A5 processor's eighty-pin connector with the eighty-pin connector on the A6 HP-MSIB. Ensure that the three video connectors align with their corresponding holes in the rear panel.
4. Ensure that the ribbon cables on the A5 processor do not become damaged.
5. Secure the A5 processor using ten screws (1).
6. Position the HP 70004A color display top-side-up on the work bench.
7. Replace the instrument cover.
8. Replace all modules.
9. Reconnect the line cord.

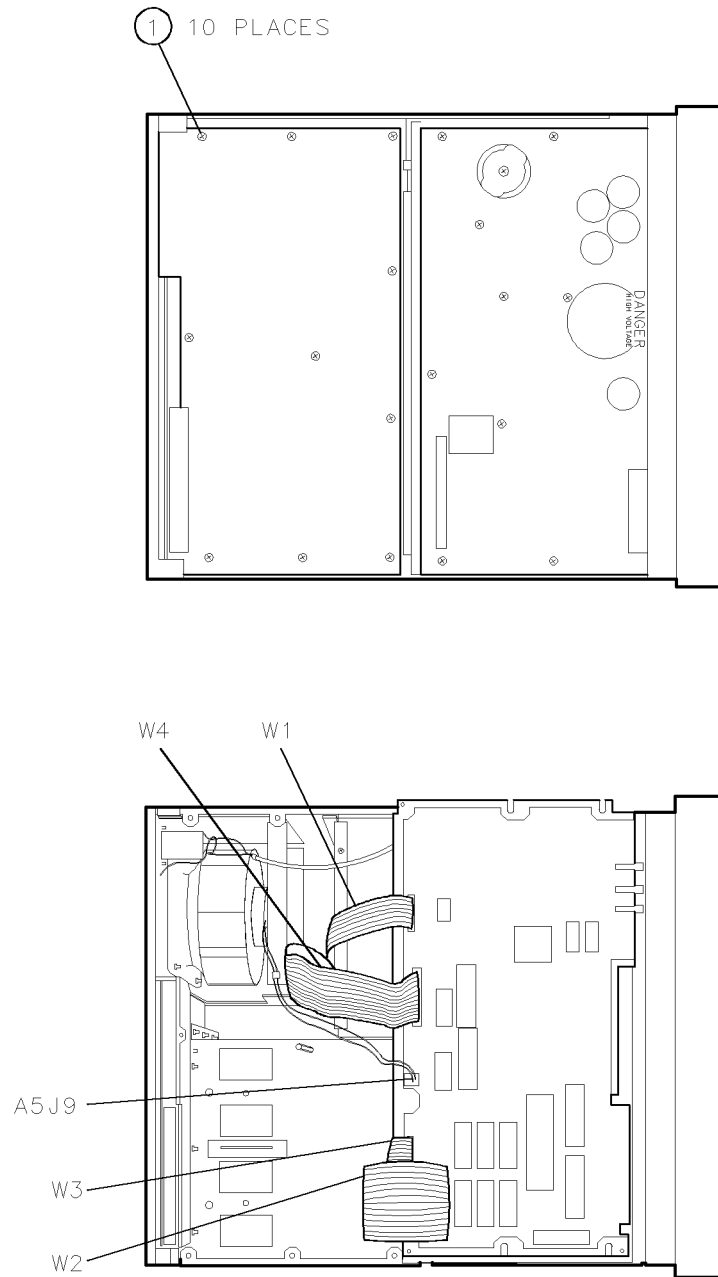


Figure 9-5. A5 Processor Removal/Replacement

A6 HP-MSIB

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

To Remove the A6 HP-MSIB

1. Remove the line cord.
2. Remove all modules.
3. Remove the two screws securing the left-side strap handle.

Note This note applies only to HP 70004A color displays with serial numbers: 0000A00000 through 3040A01050.

The HP 70004A color display's right-side strap handle, situated on the side of the HP 70004A color display which accepts modules, may not support the weight of certain configurations.

To solve this problem, the right-side strap handle must be removed from all HP 70004A color display's. A replacement kit is available for this procedure (HP 70004-60032, *Side Strap Handle Replacement Kit*). After receiving the kit, remove the right-side strap handle and replace it with the two beveled washers and two screws that are provided in the kit. See the installation note provided in the kit for the proper location of the special beveled washers.

4. Remove the four screws securing the instrument cover at the rear of the HP 70004A color display and slide the instrument cover off.
5. Position the HP 70004A color display top-side-down on the work bench.
6. Remove the four fan grill screws (1).
7. Remove the A4 power supply as described in "A4 power supply Removal," steps 5 through 7.
8. Remove the four screws (2) above the opening in the rear panel.
9. Remove the two flathead screws (3).
10. Remove the two hex screws (4) securing the HP-IB connector.
11. Remove the four Hex screws (5) securing the HP-MSIB connectors.
12. Carefully remove the rear panel.

13. Remove the two screws (6) securing the A6 HP-MSIB to the rear frame.
14. Remove the A6 HP-MSIB.

To Replace the A6 HP-MSIB

1. Secure the A6 HP-MSIB to the rear frame using two screws (6).
2. Press the HP-IB connector side of the rear panel into place first.
3. Secure the HP-MSIB connectors using four hex screws (5).
4. Secure the HP-IB connector using two hex screws (4).
5. Replace the two flathead screws (3).
6. Replace the four screws (2) above the opening in the rear panel.
7. Replace the A4 power supply as described in “A4 power supply Replacement,” steps 3 through 5.
8. Secure the fan grill using four screws (1).
9. Position the HP 70004A color display top-side-up on the work bench.
10. Replace the instrument cover.
11. Replace all modules.
12. Reconnect the line cord.

A6 HP-MSIB

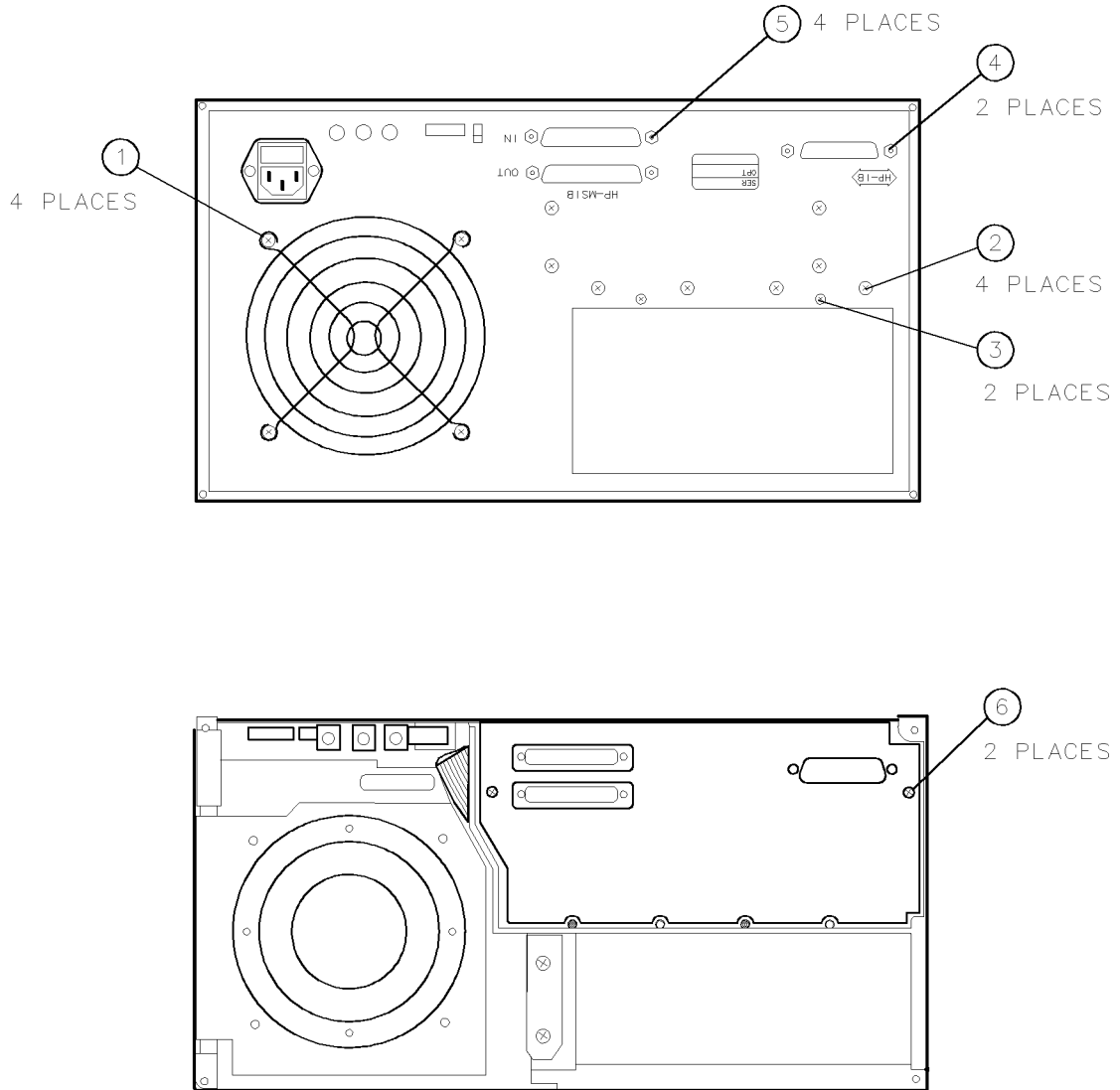


Figure 9-6. A6 HP-MSIB Removal/Replacement

Rear Frame

- DANGER**
- These procedures require access to the interior of the color display, only qualified service personnel should perform the servicing procedures.
 - Use electrostatic discharge (ESD) precautions when performing any servicing.
 - Do not touch the A4 power supply with your hands while power is applied.
 - The A4 power supply has lethal voltages, with lethal currents, in all areas for at least three minutes after power is turned off.
 - Use of a Ground Fault Interrupter (GFI), a Line-Isolated Variable Mains Transformer (VARIAC), and extreme care are mandatory when servicing the A4 power supply.
 - Service personnel must use a $\gg 1\text{ M}\Omega$ resistor-isolated wrist strap or heel strap while handling the A4 power supply.
 - To avoid damaging the HP 70004A color display module connectors, the HP 70004A color display must be off before installing or removing any modules.
-

To Remove the Rear Frame

1. Remove the rear panel and A6 HP-MSIB as described in “A6 HP-MSIB.”
2. Remove the two flathead screws (1) on the side of the rear frame.
3. Remove the seven screws (2) securing the rear frame to the main deck.
4. Remove the rear frame.

To Replace the Rear Frame

1. Secure the rear frame to the main deck using seven screws (2).
2. Secure the side of the rear frame using two flathead screws (1).
3. Replace the A6 HP-MSIB and rear panel as described in “A6 HP-MSIB.”

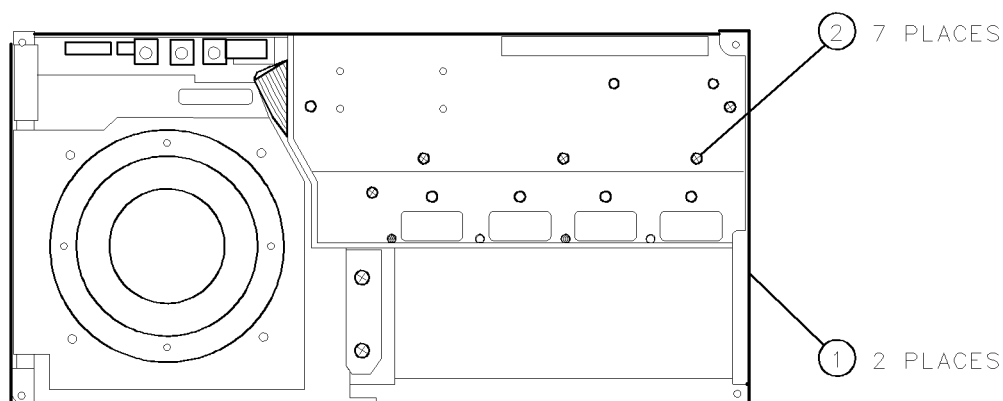


Figure 9-7. Rear Frame Removal/Replacement

Custom Key-Panel Assembly

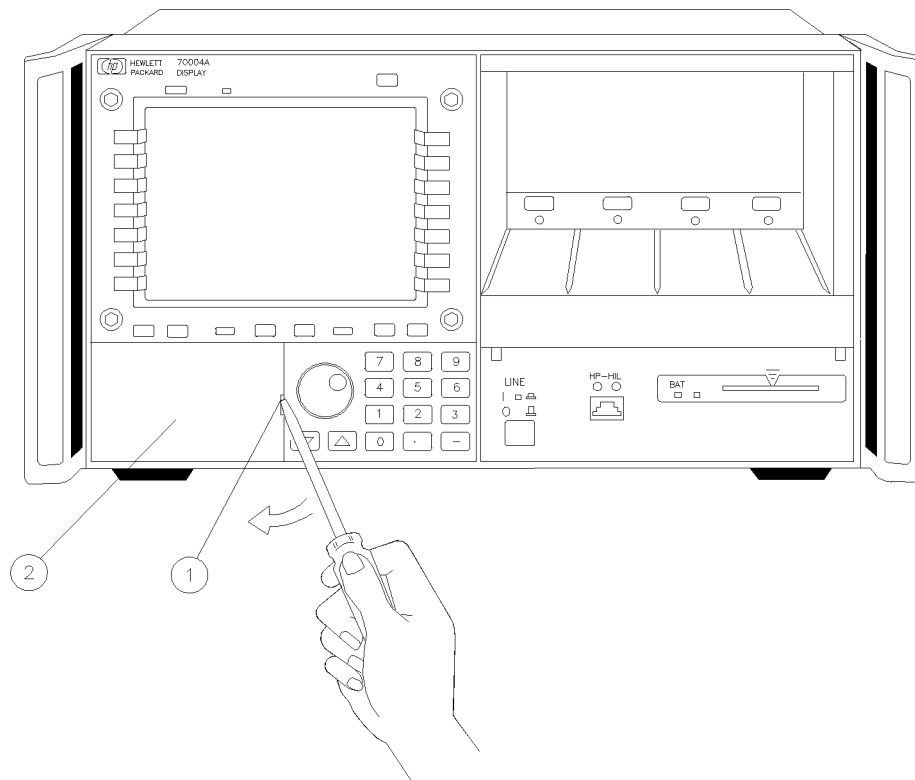
The custom keypad allows an operator to access or activate unique system functions from the front of the HP 70004A color display.

To Remove the Key Panel

1. There are two different release mechanisms for the blank panel. If the blank panel has a slot in the right-hand side, insert a slotted screwdriver into the slot (1) as shown in Figure 9-8. Gently pry the screwdriver's handle to the left and the blank panel (2) should snap out.
2. If the blank panel has a release button on the right-hand side (1) as shown in Figure 9-9, depress the release button and the panel should snap out.

To Replace the Key Panel

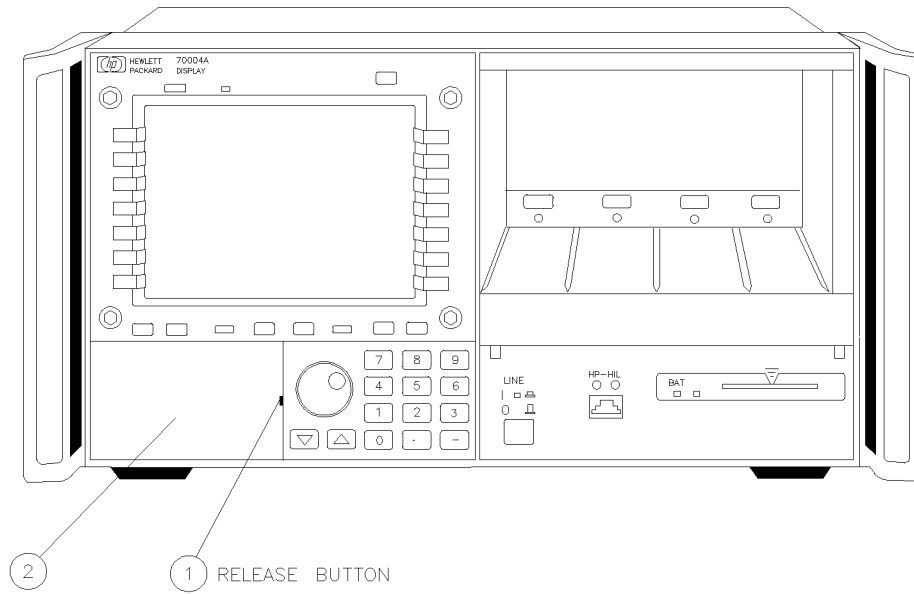
1. Holding the keypad with the lettering upright, insert the left side of the keypad into the front panel.
2. Press the right side of the keypad until it snaps into the front panel.



rrslot

Figure 9-8. Installing the Custom Keypad (Without Button)

Custom Key-Panel Assembly



rrbutt

Figure 9-9. Installing the Custom Keypad

Overall Parts Identification Drawings

This chapter contains information on all overall parts identification drawings that should be used when performing the troubleshooting procedures described in this service guide.

This chapter contains the following sections:

- “Front View Identification”
- “Top View of Monitor Identification”
- “Rear View Identification”
- “Bottom View Identification”
- “Side View Identification”
- “A5 Processor Service View Identification”

Because this service guide is part of an Option OB3 package which consists of two manuals, refer to Manual 2 of this option set for information on part listings and schematics.

Manual 2 contains packets of component-level repair information for each color display board assembly that has field-replaceable parts. Each packet includes the parts list, component-location drawing, and schematics for a specific board-assembly part number. Manual 2 also contains a table that can be used to cross reference different board assemblies that have different serial prefix breaks.

Front View Identification

Overall Parts Identification Listing, Front View

Item	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	0515-0846	5	4	SCREW, CAP SMM4.0 22SSKT- HD	28480	0515-0846
2	70004-40011	4	1	"LCL" KEY	28480	70004-40011
3	70004-40012	5	1	"INSTR PRESET" Key	28480	70004-40012
4	70004-40016	9	14	MENU KEY	28480	70004-40016
5	70004-00023	4	1	PANEL, FRONT DRESS	28480	70004-00023
6	70004-40001	2	1	DOOR	28480	70004-40001
7	70004-40009	0	1	BUTTON, LINE SWITCH	28480	70004-40009
8	5041-1835	4	1	"-" KEY	28480	5041-1835
9	5041-0808	9	1	"," KEY	28480	5041-0808
10	5041-0819	2	1	"0" KEY	28480	5041-0819
11	5041-0855	6	1	"▲" KEY	28480	5041-0855
12	5041-0855	6	1	"▼" KEY	28480	5041-0855
13	5041-0811	4	1	"1" KEY	28480	5041-0811
14	5041-0812	5	1	"2" KEY	28480	5041-0812
15	5041-0813	6	1	"3" KEY	28480	5041-0813
16	5041-0814	7	1	"4" KEY	28480	5041-0814
17	5041-0815	8	1	"5" KEY	28480	5041-0815
18	5041-0816	9	1	"6" KEY	28480	5041-0816
19	5041-0817	0	1	"7" KEY	28480	5041-0817
20	5041-0818	1	1	"8" KEY	28480	5041-0818
21	5041-0816	9	1	"9" KEY	28480	5041-0816
22	70004-40011	4	2	"INSTR" and "DISPLAY" KEY	28480	70004-40011
23	0370-3069	2	1	KNOB, RPG	28480	0370-3069
24	70004-40003	4	2	"USER" and "MENU" KEY	28480	70004-40003
25	70004-40010	3	4	"PLOT" "PRINT" "HOLD" and "←" KEY	28480	70004-40010
26	1000-0860	3	1	CRT FILTER	28480	1000-0860
27	0515-1012	9	2	SCREW SMM4.0 8 FLPDS	28480	0515-1012
28	70004-60020	7	1	BLANK KEY-PANEL	28480	70004-60020
	70004-00011	0	1	CUSTOM KEY-PANEL RETAINER STRING	28480	70004-00011

Front View Identification

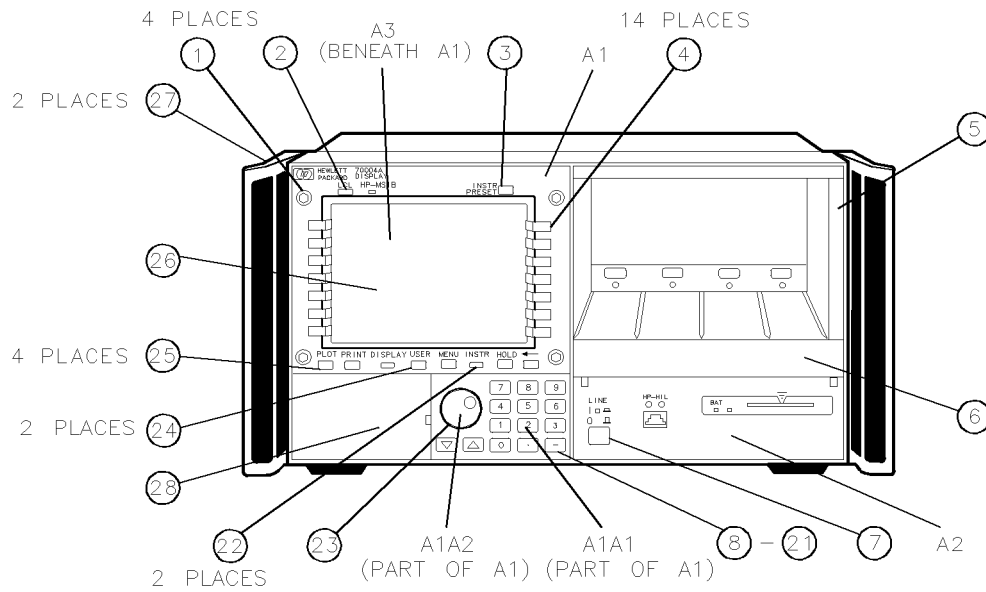


Figure 10-1. Overall Parts Identification Drawing, Front View

Top View of Monitor Identification

Overall Parts Identification Drawing, Top View

Item	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	2090-0210	7	1	A3 Monitor	28480	2090-0210
2	0515-1079	8	3	SCREW SMM3.0 8SEMPNPD	28480	0515-1079
3	0515-0866	9	1	SCREW SMM3.0 8CWPNPDS	28480	0515-0866
4	70004-20016	7	4	STANDOFF-MONITOR	28480	70004-20016
5	70004-00009	6	1	PLATE-ADAPTER	28480	70004-00009
6	0515-1069	6	4	SCREW SMM4.0 10SEMPNPD	28480	0515-1069
7	0515-1069	6	4	SCREW SMM4.0 10SEMPNPD	28480	0515-1069

Top View of Monitor Identification

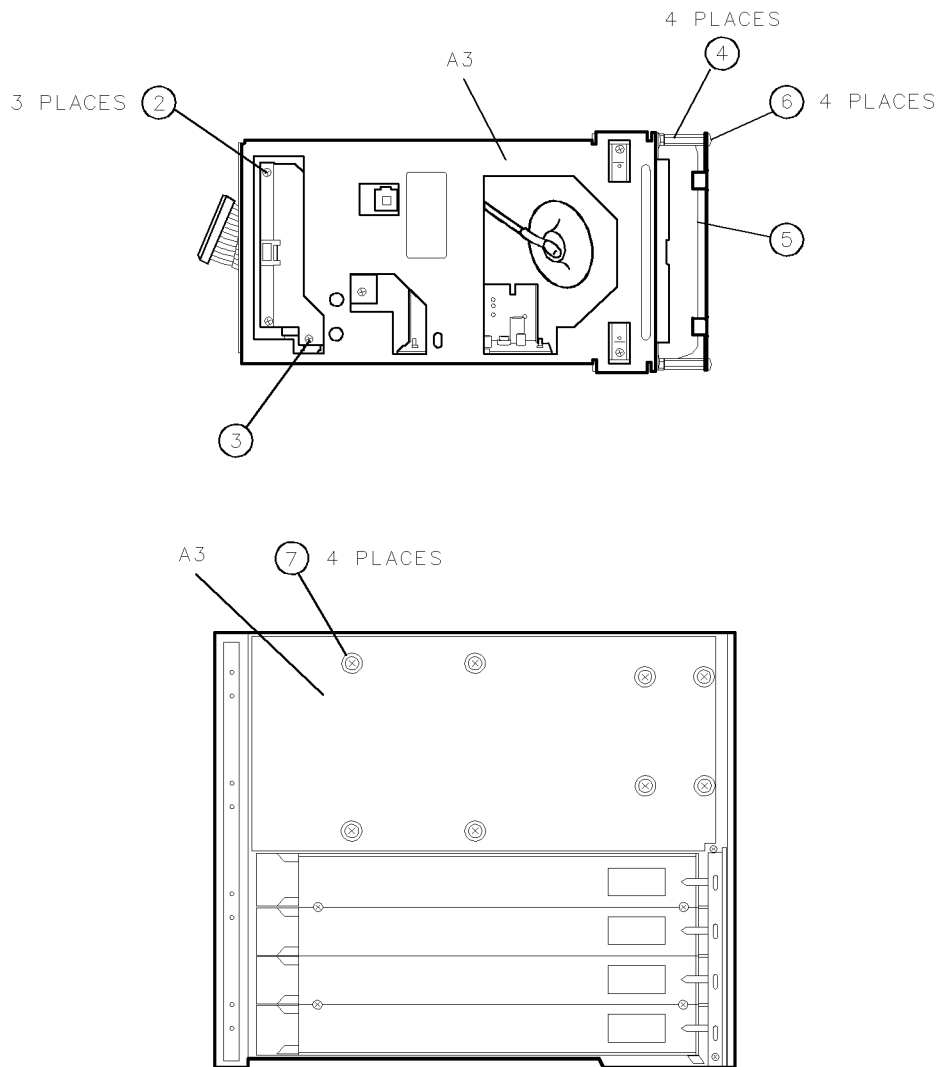


Figure 10-2. Overall Parts Identification Drawing, Top View

Rear View Identification

Overall Parts Identification Drawing, Rear View

Item	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	70004-00007	4	1	PANEL, REAR DRESS	28480	70004-00007
2	3160-0422	3	1	GRIL, FAN	28480	3160-0422
3	0515-1069	6	4	SCREW SMM4.0 10SEMPNPD	28480	0515-1069
4	0515-1005	0	2	SCREW SMM3.0 10 FLPDS	28480	0515-1005
5	0515-0914	8	4	SCREW SMM3.0 6 FLPDS	28480	0515-0914
6	70004-20020	3	1	BRACKET, STRUT	28480	70004-20020
7	70004-20013	4	1	FRAME, REAR	28480	70004-20013
8	0515-1069	6	7	SCREW SMM4.0 10SEMPNPD	28480	0515-1069
9	0515-0914	8	2	SCREW SMM3.0 6 FLPDS	28480	0515-0914
10	0380-1214	6	2	SCREW STDF 4.7MML M3.5	28480	0380-1214
11	2190-0577	1	2	WSHR LK .194ID10	28480	2190-0577
12	0515-1772	8	4	SCREW SMM2.5 4SEMPNPD	28480	0515-1772
13	0515-0914	8	2	SCREW, FLATHEAD SMM3.0 6 FLPDDS	28480	0515- 0914
14	0380-2000	0	4	SCREW LK M3.0	28480	0380-2000
15	0515-1588	4	4	SCREW SMM4.0 30SEMPNPD	28480	0515-1588
16	70004-40019	2	4	FEET, REAR	28480	70004-40019
	2110-0703	7	1	Fuse, 6.3 Amp	28480	2110-0703

Rear View Identification

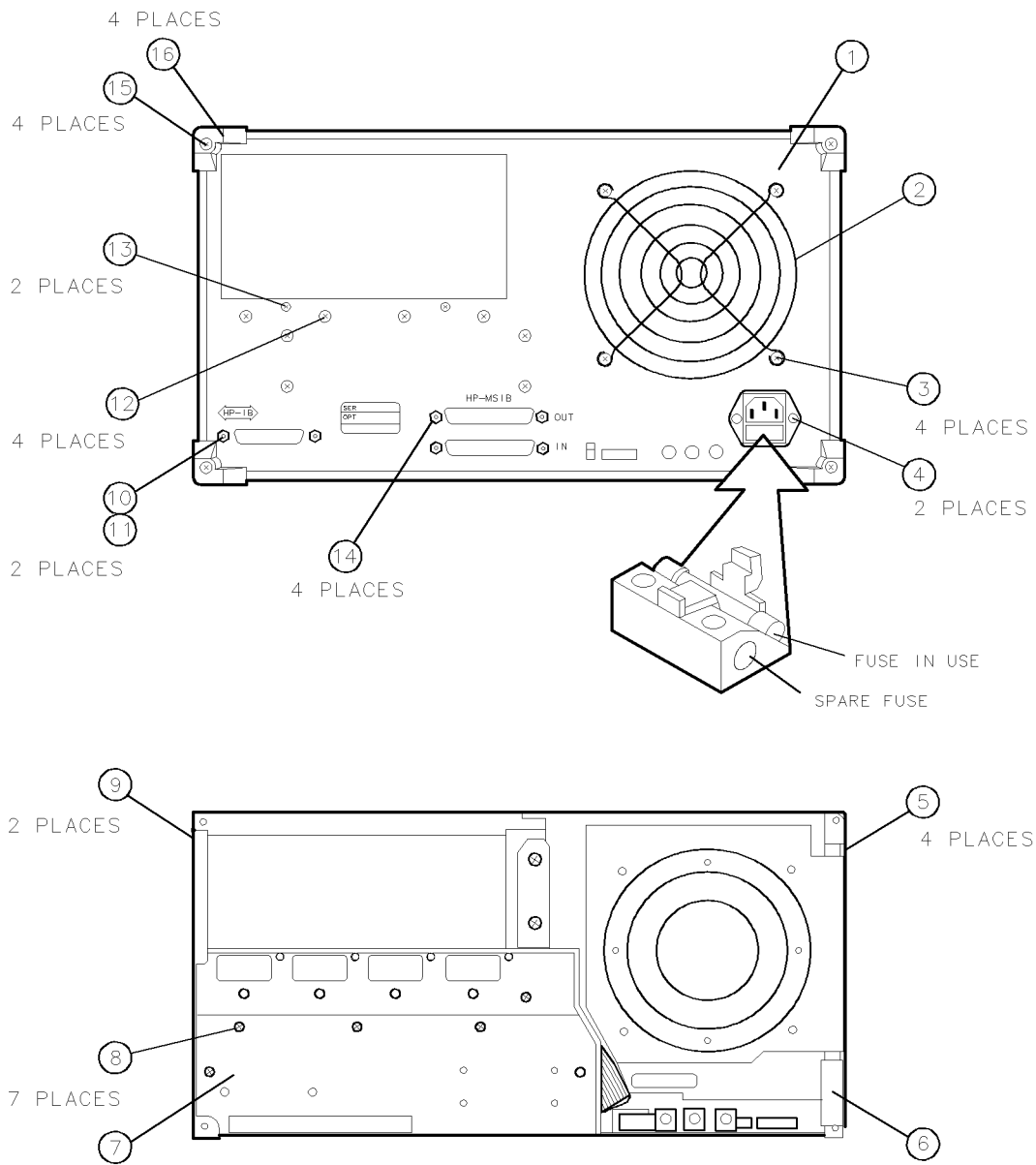
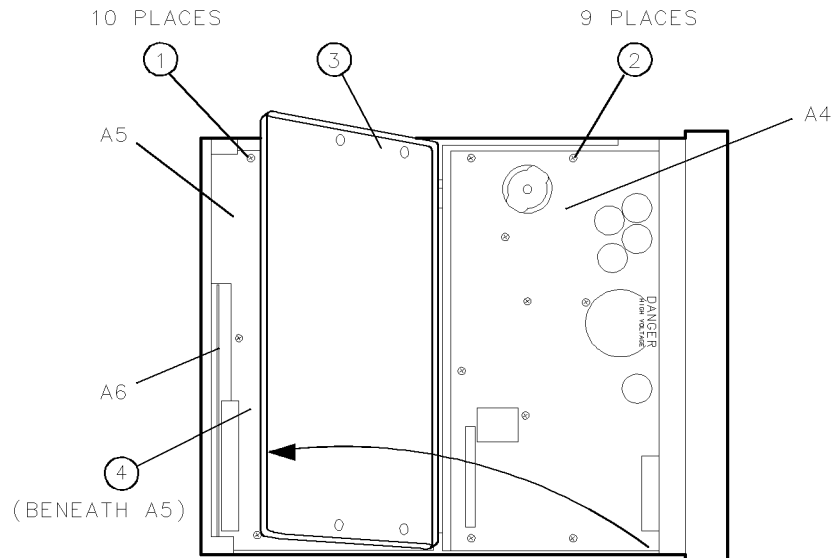


Figure 10-3. Overall Parts Identification Drawing, Rear View

Bottom View Identification

Overall Parts Identification Listing, Bottom View

Item	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	0515-0866	9	10	SCREW SMM3.0 8CWPNPDS	28480	0515-0866
2	0515-0866	9	9	SCREW SMM3.0 8CWPNPDS	28480	0515-0866
3	70004-40020	5	1	SERVICE DECK	28480	70004-40020
4	70004-00030	3	1	SCREEN GUARD	28480	70004-00030

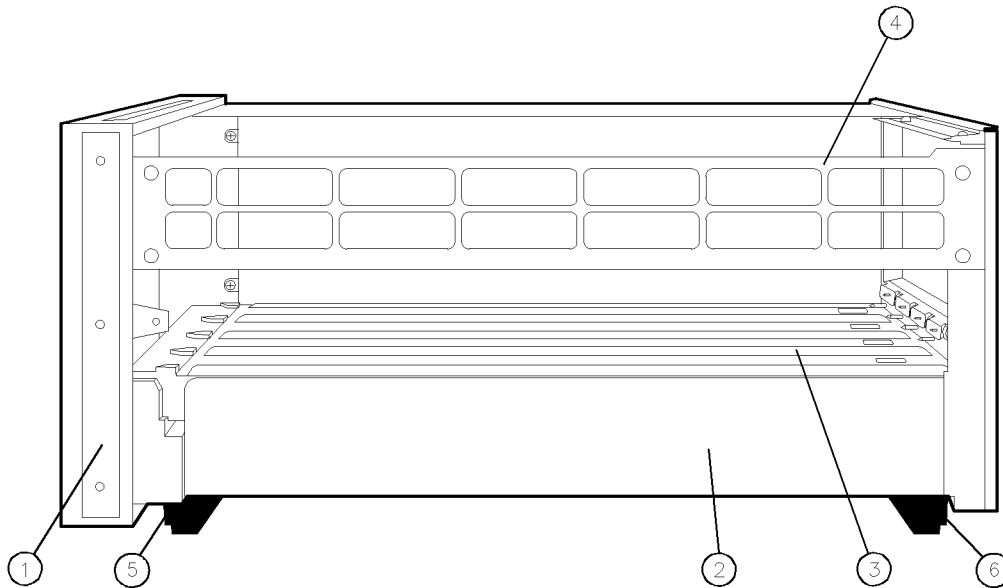


Overall Parts Identification Drawing, Bottom View

Side View Identification

Overall Parts Identification Listing, Side View

Item	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1	70004-20011	2	1	FRONT FRAME	28480	70004-20011
2	70004-00033	6	1	MAIN DECK	28480	70004-00033
3	70004-40008	9	1	MODULE GUIDE	28480	70004-40008
4	70004-00032	5	1	STRUT, SIDE	28480	70004-00032
5	5041-8801	8	2	FRONT BOTTOM FEET	28480	5041-8801
6	5041-8822	3	2	REAR BOTTOM FEET	28480	5041-8822



SV45_SL

Overall Parts Identification Drawing, Side View

A5 Processor Service View Identification

Table 10-1. Overall Parts Identification Drawing, A5 Service View

Item ¹	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				ACCESSORIES SUPPLIED		
	8710-1651	4	1	8mm Ball Driver	28480	8710-1651
	8120-1378	1	1	Power Cord	28480	8120-1378
	70800B	5	2	MS-IB Cable 1M	28480	70800B
	85700A	3	1	Card SRAM 32K	28480	85700A
B1	70004-00024	5	1	Fan Assembly (includes cable)	28480	70004-00024
FL1	70004-60019	4	1	Line Filter Assembly (includes cable)	28480	70004-60019
F1	2110-0703	7	1	Fuse, 6.3 Amp	28480	2110-0703
				CABLE ASSEMBLIES		
W1	70004-60017	2	1	Cable Assembly, Ribbon, Keyboard (A1A1P2 to A5J2)	28480	70004-60017
W2	70004-60018	3	1	Cable Assembly, Ribbon, Interface (A2J4 to A5J4)	28480	70004-60018
W3	70004-60016	1	1	Cable Assembly, Ribbon, Power Supply (A4P1 to A5J1)	28480	70004-60016
W4	70004-60015	0	1	Cable Assembly, Ribbon, Monitor (A3 to A5J3)	28480	70004-60015
				MISC. ASSEMBLIES		
	70004-00006	3	1	Instrument Cover	28480	70004-00006
	5041-8802	9	1	Top Trim Strip	28480	5041-8802
	5021-8498	7	1	Handle Trim Strip	28480	5021-8498
	5041-8835	8	2	Handle, Side Strap	28480	5041-8835
	5062-3801	2	2	Handle, Front	28480	5062-3801

¹ To obtain the HP part numbers for replaceable assemblies, refer to the *HP 70004A Component Level Information Packages* (Manual 2 of this manual set).

A5 Processor Service View Identification

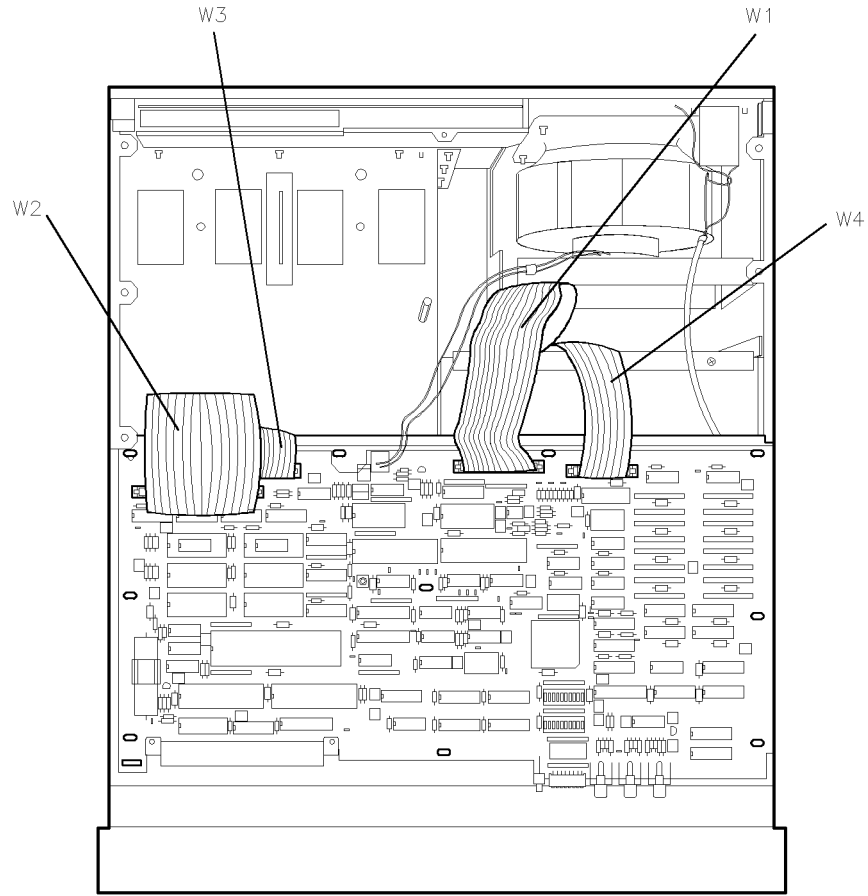


Figure 10-4. Overall Parts Identification Drawing, A5 Service View

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