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# Service Guide

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# HP 54750A High Bandwidth Digitizing Oscilloscope

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# HP 54750A High Bandwidth Digitizing Oscilloscope

The HP 54750A High Bandwidth Digitizing Oscilloscope is a modular, high-performance, full-featured, repetitive sampling, digitizing oscilloscope for characterizing and testing high speed communications and digital waveforms. The HP 54750A accepts one or two HP 54750 series plug-in modules for up to four measurement channels. The HP 54750A will also accept the HP 83480 series electrical and optical plug-ins when the optional software is installed.

The HP 54750A has a wide range of high-performance features:

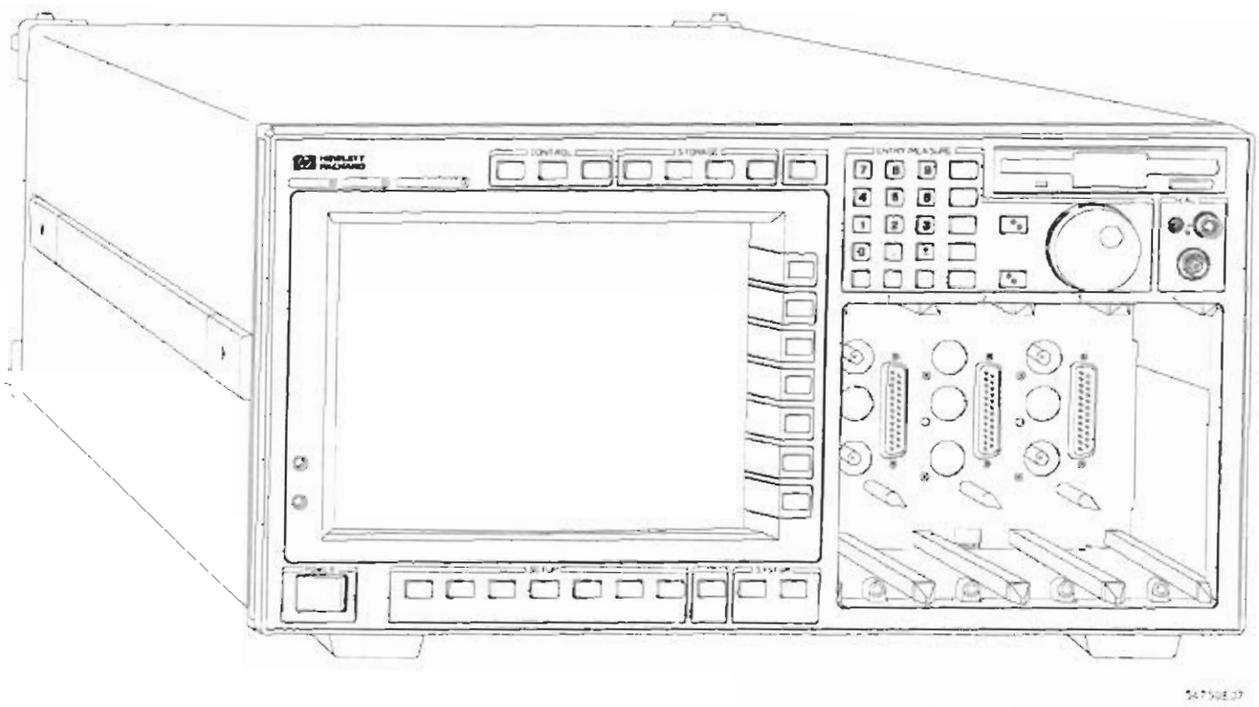
- four slots to accept one or two double-wide sampling plug-ins for up to four measurement channels
- color display that shows the captured signal, measurement results, and the selection of softkeys
- a 3.5-inch DOS compatible disk drive for storing and loading various setups and waveforms; the drive is also used for upgrading the operating system firmware
- a port for HP-IB and a parallel printer port
- failure diagnostics and self calibration in the instrument firmware
- extensive automatic measurement features



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## Service Policy

The service policy of this instrument is the replacement of defective assemblies. Some assemblies can be replaced on an exchange basis.





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# In This Book

This book provides the service documentation for the mainframe. It is divided into eight chapters.

Chapter 1 provides general information and specifications.

Chapter 2 shows you how to prepare the oscilloscope for use.

Chapter 3 gives performance tests.

Chapter 4 covers calibration and adjustment procedures, how to do them and how often they need to be done.

Chapter 5 provides troubleshooting information.

Chapter 6 gives the procedures and techniques for replacing assemblies and other parts.

Chapter 7 includes a list of exchange assemblies and other replaceable parts, part ordering information, and shipping information.

Chapter 8 briefly covers the internal operation of the oscilloscope.

At the back of the book you will find Safety information, Warranties, and Regulatory information.

Additionally, the binder for this book is oversize so you can insert several service guides for plug-ins. Plug-in service guides are provided without binders. They should be placed after the regulatory information at the back of this book.



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# General Information

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# General Information

This chapter gives you general information about the instrument. The following topics are covered in this chapter.

- Instrument identification
- Accessories
- Options
- Specifications and characteristics
- Test equipment requirements

## Accessories Supplied

- Power Cord 2.3 meter (7.5 feet) (See chapter 7 for available power cords)
- Quick Start Guide, User's Reference, Programmer's Guide, and Service Guide
- RF Accessory Kit, HP part number 54121-68701

## Accessories Available

- HP 83480K communications software package; this package provides the firmware to support the HP 83480 series of optical and electrical plug-ins, and adds standard telecom mask templates and optical/eye pattern automated measurements
- HP 3630A PaintJet option 004 (Centronics)
- HP PaintJet XC
- HP LaserJet IID, IIP, III, IIIP, 4m, and 4si
- HP DeskJet 500C, 540C, 550C, 560C
- HP 1181A system testmobile
- HP 35181A top-mounted printer stand for HP 1181A
- HP 35181C 3.5-inch drawer for HP 1181A
- HP 35181D work surface for HP 1181A

Other accessories are available. See your HP sales representative.

## Options Available

Option 907 — Rackmount kit (handles only)(HP 54710-68703) includes special long screws

Option 908 — HP Rack-mount Kit (cars only)(HP 54710-68704) includes special long screws

Option 909 — HP Rack-mount Kit (with handles)(HP 54710-68705) includes special long screws

Option 0B1 — Additional Service Guide and Operating and Programming Guide Set



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Other options are available. See your HP sales representative.



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# Performance Specifications

The specifications are the performance standards against which the product is tested. Specifications are valid after a 60 minute warm-up period.

## Time Base (Horizontal)

| | |
|---|---|
| **Scale Factor** | (full scale is 10 divisions) |
| minimum | 10 ps/div |
| maximum | 1 s/div |
| **Delay** | (time offset relative to trigger) |
| minimum | 22 ns |
| maximum | 1000 screen diameters or 10 seconds, whichever is smaller |
| **Time interval accuracy** | ≤8 ps ±0.1 % of reading (dual marker measurement) |
| **Time interval resolution** | ≤(screen diameter)/(record length) or 62.5 fs, whichever is larger |

## Trigger - External Input Only

| | |
|---|---|
| **Sensitivity** | |
| dc - 100 MHz | 40 mV peak to peak |
| 100 MHz - 2.5 GHz | Increasing linearly from 40 mV at 100 MHz to 200 mV at 2.5 GHz |
| **Pulse width** | 200 ps > 200 mV |
| **Bandwidth limit** | Trigger bandwidth reduced to approximately 100 MHz |
| **Jitter** (trigger and Time Base combined) (one standard deviation) | ≤2.5 ps + 5E-5 x delay setting (Tested using a 2.5 GHz synthesized source at 200 mV peak to peak) |
| **Trigger input** | |
| Maximum safe input voltage | ±2 Vdc + peak ac (+16 dBm) |
| Nominal impedance | 50 ohm |
| Percent reflection | ≤10% for 100 ps risetime * |
| Connectors | 3.5 mm (m) |

*This specification is checked in the respective plug-in performance verification test.

## Calibrator

| | |
|---|---|
| **Front Panel BNC Calibrator** | |
| **dc output** | |
| Adjustable output range | -2.5 V to +2.5 V when terminated into 50 Ohms |
| Output Delta Voltage Accuracy | ±(0.2% of settings) |



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# Performance Characteristics

The characteristics are not specifications, but are included as additional information.

### Time Base (Horizontal)

**Delay Between Channels** The difference in delay between channels can be nulled out with 1 ps resolution to compensate for differences in input cables or probe length. Up to 100 µs of skew can be nulled out.

**Reference Location** The reference point can be located at the left edge or center of the display. The reference point is the point where the time is offset from the trigger by the delay time. The reference point is also the point that the time base sensitivity expands and contracts around as the time base is changed.

**Triggered Mode** Causes the scope to trigger synchronously to the trigger input signal.

**Freerun** Causes the scope to generate its own triggers.

**Typical Timing Accuracy** The time base uses a series of 4 ns blocks. Time Base linearity and small discontinuities across these blocks contribute to the 8 ps accuracy specification.

**Trigger Edge Trigger** Triggers on the positive or negative edge of the trigger input.

**Hysteresis** The trigger hysteresis can be set to two modes:
Normal - the trigger hysteresis is set so instrument meets trigger sensitivity specification.
High Sensitivity - hysteresis is turned off to allow best sensitivity to high frequency signals. This mode should not be used for noisy lower frequency signals that may mis-trigger without hysteresis.

**BW Limit** Puts the trigger signal through a low pass filter of approximately 100 MHz.

**Data Display Resolution** 451 points horizontally x 256 points vertically.

**Graticules** The user may choose full grid or no graticule, and one or two graphs.

### Display Modes

**Averaging** The number of averages can be specified between 1 and 4096 using the numeric keypad. The INCrement/ DECrement keys or the knob will set averaging to; 1,2,4,16,64,256,1024,4096. On each acquisition, 1/n times the new data is added to (n-1)/n of the previous value at each time coordinate.

**Display Colors** Users may choose a default color selection or select their own colors from the front panel, or via HP-IB. Different colors are used for display background, channels, functions, background text, highlighted text, advisories, markers, overlapping waveforms, and memories.

**Documentation Aids** Waveforms, scaling information, and measurement results can be transferred directly to HP-IB or Centronics graphics printers.

Waveforms may also be stored on the internal MS-DOS compatible disc in PCX or TIFF format. This allows moving screen data into word processors for documentation purposes.



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**Programmability** Instrument settings and operating modes, including automatic measurements, may be remotely programmed via HP-IB(IEEE 488.2) HP-IB programming complies with the recommendations of the IEEE 488.2 standards. The system can be programmed to take data only at specified time points, or to return only measurement results (i.e. $t_r$, $t_f$, frequency, etc.) to speed up data acquisition.

**Data Transfer Rate** 550 Kbytes/s typical

**Measurement Times** 20 automatic measurements per second typical.

**Data Record Length** 4k points maximum per channel.

### Measurement Aids

**Markers** Dual voltage or time markers can be used for a variety of time and voltage measurements. Voltage markers can be assigned to channel data, measurements, functions, FFTs, histograms, color graded displays, and memories.

### Automatic Pulse Parameter Measurements

**Functions**

| | |
|---|---|
| magnify | differentiate |
| invert | min |
| add | max |
| subtract | FFTmag |
| multiply | histograms |
| divide | measurement limit testing |
| versus | waveform mask testing |
| integrate | color-graded display |

**Measurements**

| | |
|---|---|
| Vamptd | freq |
| Vbase | Tfall |
| Vtop | Trise |
| preshoot | Tmax |
| overshoot | Tmin |
| Vp-p | Tvolt |
| Vtime | Vavg |
| Vmin | Vupper |
| Vmax | Vmiddle |
| Vrms | Vlower |
| +width | FFTfreq |
| -width | FFTmag |
| duty cycle | FFT delta freq |
| delta time | FFT delta mag |
| period | |

**Histograms**

p-p
median
mean
std dev
  ± 1 sigma
  ± 2 sigma
  ± 3 sigma
hits
peak



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**Limit Test** Signals can be tested by up to four automatic parametric measurements and compared to user defined test boundaries. Failures tolerances can be selected independently for each of the parametric tests.

On failure actions:

1) Save channel data to memory, disk, or printer
2) Save screen to pixel memory, disk, or printer
3) Save a text log summary of all failures with time tagging to disk or printer.

Limit test can be set to run continuously, for a user selected number of waveforms, or for a defined number of failures.

**Mask Test** Acquired signals are tested for fit outside areas defined by up to 8 polygons. Any samples that fall within the polygon boundaries result in test failures. Masks can be loaded from disk, HP-IB, or created automatically or manually. For standard masks and further mask capabilities, refer to the User Manual.

Data collected during test

Total number of waveforms examined
Number of failed waveforms
Total number of samples taken
Number of failed samples
Number of hits within each polygon boundary

**Auto Mask Creation** Masks are created automatically for single-valued voltage signals. Both delta X and delta Y tolerances can be specified.

The failure actions are identical to those of Limit Testing. Both mask testing and limit testing may be used independently or simultaneously.

**FFT** Up to three Fast Fourier Transforms can be run simultaneously. The three built-in filters (Hanning, rectangular, and flattop) allow optimization of frequency resolution, transients, and amplitude accuracy. Automatic measurements can be made on frequency, delta frequency, magnitude, and delta magnitude.

Frequency Span = Sample rate /2 = record length/(2 * Time Base range)
Frequency Resolution = Time Base range / record length

**Color Graded Display** Infinite persistence display mode where color differentiates the number of times any individual pixel has been acquired. All points acquired are added to a database and then displayed as one of eight colors depending upon the frequency of acquisition.

Automatic parametric measurements may be taken on the Color Graded Display allowing parametric evaluation of multi-valued (eye diagram) waveforms.

**Autoscale** Can find repetitive signals

> 50 Hz
duty cycle > 1
amplitude > 10 mV p-p vertical
amplitude > 50 mV p-p trigger



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**Waveform Math** Two functions can be specified and displayed. Functions may be defined as:

| | |
|---|---|
| magnify | versus |
| invert | integrate |
| add | differentiate |
| subtract | minimum |
| multiply | maximum |
| divide | fft magnitude |

**Waveform Save** Four waveforms may be stored in four non-volatile memories. They may also be stored to the internal MS-DOS compatible 1.44 mb disc.

### Setup Aids

**Auto-scale** pressing the Auto-Scale key automatically adjusts the vertical of all channels, the horizontal scale factors, and the trigger level for a display appropriate to the applied signals.

**Channel Auto-scale** Auto-scale can be performed on individual channels. This mode only sets the vertical scale for the channel selected therefore saving time and keeping the automatic feature from changing other user selected settings.

**Save/Recall** Up to 10 complete instrument setups may be stored in the internal non-volatile memory. Additionally, many more setups can be stored on the internal MS-DOS compatible disc.

**Vertical Software Calibration** changes in the environmental conditions can be accommodated by performing a software calibration on the plug-ins. The calibration resets the plug-in for the current mainframe and plug-in operating temperature. Software vertical calibration is recommended prior to taking measurements requiring the best possible accuracy.

### Digitizer

**Converter** 12 bit successive approximation A/D converter.

**Resolution** Up to 15 bits with averaging.

**Digitizing Rate** The signal is sampled and digitized at a rate dictated by the trigger repetition rate and the time base range. If data acquisition is not trigger rate limited, the maximum sample rate is 40 KHz.

### Statistical Analysis

**Histograms** Time and voltage histograms may be taken with a user-specified number of samples or waveforms (between 1 and 99,999,999). The histograms are taken within a user-specified voltage window (time histogram) or time window (voltage histogram).

Data is stored in a database that mirrors the screen. Scaling of the time or voltage windows can be accomplished instantaneously without the need to acquire more data.

**Mean and Standard Deviation** Calculates the mean and standard deviation of a distribution on screen, or between the distribution limits, assuming a Gaussian distribution.



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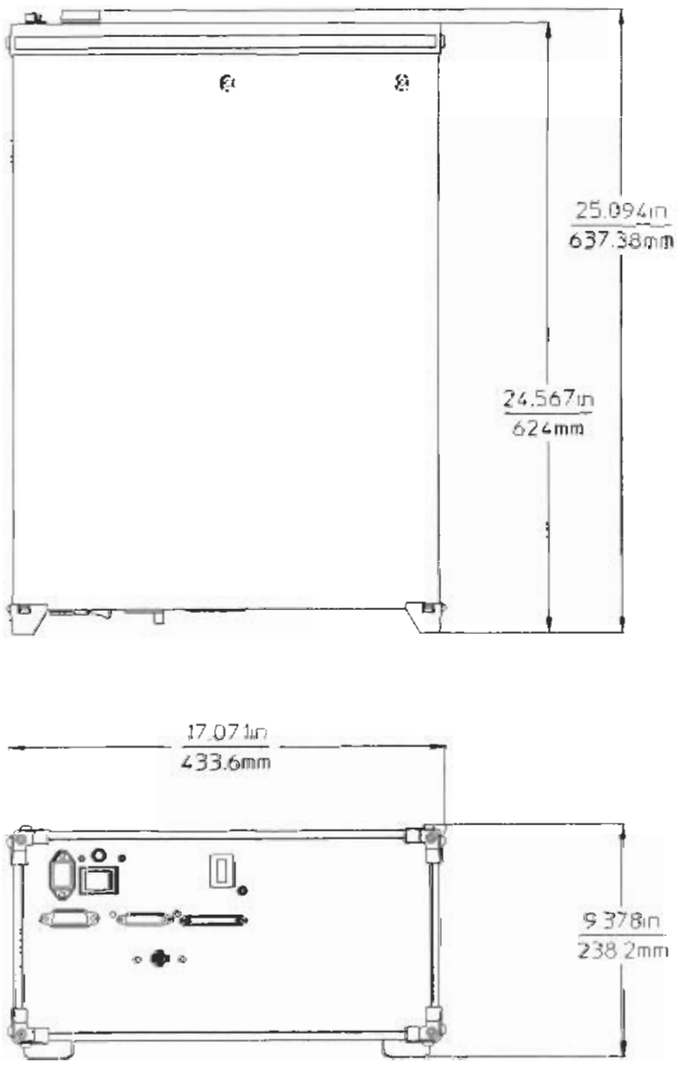
# Environmental Conditions

These environmental conditions apply to the HP 54750A:

| | | |
|---|---|---|
| **Temperature** | | |
| | operating | +10° C to +40° C |
| | non-operating | -40° C to +70° C |
| **Humidity** | | |
| | operating | Up to 90% relative humidity (non-condensing) at < +35° C |
| | non-operating | |
| **Altitude** | | |
| | operating | Up to 4,600 meters (15,000 ft) |
| | non-operating | Up to 15, 300 meters (50,000 ft) |
| **Vibration** | | |
| | operating | Random vibration 5 to 500 Hz, 10 minutes per axis, 0.3 g(rms) |
| | non-operating | Random vibration 5 to 500 Hz, 10 minutes per axis, 2.41 g(rms); resonant search, 5 to 500 Hz swept sine, 1 Octave/minute sweep rate, 0.75 g, 5 minute resonant dwell at 4 resonances/axis |
| **Power Requirements** | | |
| | voltage | 90 to 132 or 198 to 264 Vac, 48 to 66 Hz |
| | power | 1200 VA; 650 W |
| **Model Number** | | HP 54750A |
| **Weight** | | |
| | approx. net weight | 23.6 kg (53 lbs) |
| | approx. ship weight | 33.6 kg (74 lbs) |
| **Dimensions** | | |
| | (see next page) | Dimensions are for general information only. If greater accuracy is required, contact your HP field engineer. |



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**HP 54750A Dimensions**



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# Recommended Test Equipment

The following table is a list of the test equipment required to test performance, calibrate and adjust, and troubleshoot this instrument. The table indicates the critical specification of the test equipment and for which procedure the equipment is necessary. Equipment other than the recommended model may be used if it satisfies the critical specification listed in the table.

**Recommended Test Equipment**

| Equipment Required | Critical Specifications | Recommended Model | Use * |
|---|---|---|---|
| Plug-in Module | HP 54750 series or HP 83480 series with electrical input | HP 54751A or HP 83483A | P, C, T |
| Signal Generator | 20 GHz, –25 dBc harmonics, +6 dBm output power stability 0.25 ppm/yr, with 10 MHz reference output | HP 8664A | P, C, T |
| Synthesizer/Function generator | 10 MHz square wave, 120 mV output, stability 0.05 ppm/yr | HP 3325B Opt 001 | P, C, T |
| RF Amplifier | 22 dB gain at 10 MHz, 1.3 GHz bandwidth | HP 8447D/E/F | P, C |
| DMM | 6 1/2 digit, 0.1 mV resolution dc voltage accuracy 0.05% | HP 34401A | P, T |
| Attenuator | 6 dB, 3.5 mm connectors | HP 8490C Opt 6 or HP 33340C Opt 6 | P |
| Attenuator | 20 dB, 3.5 mm connectors | HP 8490C Opt.20 or HP 33340C Opt 20 | P |
| Power Splitter | 3.5 mm connectors, 10 GHz bandwidth | HP 11667B | P, T |
| Adapter (2) | 3.5 mm (m-f) | HP 1250-1866 | P, C, T |
| Adapter | N (m) to SMA (f) | HP 1250-1250 | P, C, T |
| Adapter | BNC (f) to SMA (m) | HP 1250-1200 | P, C, T |
| Adapter | 3.5 mm (f-f) precise one end | HP 5061-5311 | P, C, T |
| Adapter | BNC (f) to dual banana (m) | HP 1250-2277 | P |
| Adapter | SMA (m-m) | HP 1250-1159 | P |
| Cable (3) | SMA (m-m) 36 inch | HP 8120-4948 | P, C, T |
| Cable | BNC, 12 inch | HP 8120-1838 | C |
| Cable (2) | BNC, 48 inch | HP 10503A | P, C, T |

* P = Performance Tests, C = Calibration and adjustment, T = Troubleshooting



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# Preparing for Use

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# Preparing for Use

This chapter shows you how to prepare the instrument for use. It references the routines necessary to establish calibration levels.

The following areas are covered in this chapter.

- Inspection
- Setup
- Cleaning



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## Setting up the instrument

When ordered as a system, the mainframe is shipped from Hewlett-Packard ready to use, with the plug-ins installed and calibrations done. However, if you ordered additional plug-ins and you want to change the instrument configuration, this section will help you get the instrument ready to use.

## To inspect the instrument

- ☐ **Inspect the shipping container for damage.**

  Keep a damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.

- ☐ **Check the accessories.**

  Accessories supplied are listed in chapter 1 of this Service Guide.

  - If the contents are incomplete or damaged notify your HP sales office.

- ☐ **Inspect the instrument.**

  - If there is mechanical damage or defect, or if the instrument does not operate properly or pass performance tests, notify your HP sales office.
  - If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as your HP sales office. Keep the shipping materials for the carrier's inspection. The HP office will arrange for repair or replacement at Hewlett-Packard's option without waiting for claim settlement.

## To check power requirements

The instrument requires a power source of 90 to 132 Vac or 198 to 264 Vac, 48 to 66 Hz, 1200 VA or 650 W maximum.

**CAUTION** BEFORE CONNECTING POWER TO THIS INSTRUMENT, be sure the line voltage switch on the rear panel of the instrument is set properly. Applying a voltage excessive to the setting may open the protective fuse.

## To set the line voltage selection

Before applying power, verify the setting of the LINE SELECT switch on the rear panel.

- **If the switch is set incorrectly, set it to either 115 V or 230 V, whichever is appropriate for the voltage in your area.**

  To change the selection, remove the line voltage switch cover, turn it 180 degrees and reinstall it. The switch will change when the cover is installed.



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**CAUTION**

Use the correct fuse in this instrument. The fuse requirement is different for 100 V, 115 V, and 230 V operation. The instrument was shipped with the line voltage selection and fuse appropriate for the country of destination. If you change the line voltage selection, you will need to change the fuse or the fuse may not protect the instrument properly.

For size, type, and part number of the fuse, see the parts list in chapter 7, "Replaceable Parts."

**WARNING**



SHOCK HAZARD!
BEFORE YOU CONNECT THIS INSTRUMENT TO MAINS POWER OR LIVE MEASURING CIRCUITS, you must provide a protective earth ground. The Mains plug must be inserted in a socket outlet provided with a protective earth contact. Do not use an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet does not provide an instrument ground. Failure to provide a protective earth ground could result in a shock hazard if there is a failure in this instrument or equipment connected to it.

**CAUTION**

Be sure to use the mains power cable provided with this instrument. For shipments to Japan, this instrument is supplied with a heavy duty power cable. At lower mains voltages (approximately 90 to 100 Vac) the increased mains current will cause increased loss and therefore overheating in a standard power cable. Overheating of the power cable could cause failure of the cable and fire.

**Three-wire power cables**
This instrument is provided with a three-wire power cable. When connected to an appropriate ac power outlet, this cable grounds the instrument cabinet. The type of power cable plug shipped with the instrument depends on the country of destination.

## To install a plug-in

Plug-ins may be removed and installed without turning off the instrument.

1. Install the plug-in into slot 1-2 or slot 3-4 of the mainframe.
2. If the plug-in needs calibration, see "To calibrate the plug-ins" in chapter 4 of the plug-in Service Guide.
3. If you are using a probe or other attenuation device with your plug-in, you can do a probe calibration.

   Press the Channel key, press **`Calibrate`** softkey, then press **`Calibrate Probe`** softkey and follow the instructions on the screen.

**See Also** "Calibration Overview" in chapter 4 of the respective plug-in Service Guide.

## To clean the instrument

To clean the instrument, use a soft cloth, damp with a mild soap and water solution.



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3

To test the front panel CAL signal 3–4
To test time interval accuracy 3–5
To test trigger sensitivity 3–8

# Testing Performance

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# Testing Performance

The procedures in this chapter test the instrument's electrical performance using performance specifications given in chapter 1 as performance standards. Specifications applicable to individual tests are noted at the test for reference.

## Testing Interval

The performance test procedures may be performed for incoming inspection of the instrument and should be performed periodically thereafter to ensure and maintain peak performance. The recommended test interval is yearly or every 2,000 hours of operation. Amount of use, environmental conditions, and your experience concerning the need for testing will contribute to verification requirements.

**See Also** The calibration interval is covered in chapter 4 "Calibrating and Adjusting."

## Equipment Required

A complete list of equipment required for the performance tests is in the Recommended Test Equipment table in chapter 1. Equipment required for individual tests is listed in the test. Any equipment satisfying the critical specifications listed may be substituted for the recommended model.

## Test Record

You may record the results of the performance tests in the Performance Test Record provided at the end of this chapter. The Performance Test Record lists the performance tests and provides an area to mark test results. You can use the results recorded in the table at incoming inspection for later comparisons of the tests during periodic maintenance, troubleshooting, and after repairs or adjustments.

## Operating Hints

Some knowledge of operating the instrument is helpful; however, these procedures are written so that little experience is necessary. If you would like more help operating the instrument, you can refer to the User's Guide that was supplied with the instrument. The following hints about clearing the display and averaging will speed progress of the testing.

### Clear Display

When using many averages, it often takes awhile for a waveform display to stabilize after a change. When a control on the instrument is changed, averaging automatically restarts. When just the input signal is changed, the instrument must average new data with the old so it can take a long time for the waveform to stabilize. Pressing the Clear Display key while changing input signals will restart averaging and give a quick indication of the result of the signal change.



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**Averaging**

Averaging is used to ensure a stable signal for measurements. It is not necessary to wait for complete stability of the signal (averaging complete), as long as the measurement is well within the limits of the test. Averaging is only suitable for repetitive waveforms and cannot be used with multi-value waveforms.

## Keystroke Conventions

To guide you while setting up the instrument, the following conventions are used to represent keystrokes and other interactions with the instrument.

When you need to press a front-panel key (also called a hardkey), you will be instructed to press a specific key. For example, press the Time base key.

Bold text , such as **`Display`** or **`Calibrate...`**, represents text on the CRT screen and may be a softkey you should press or a selection you should make. For example, press the **`Scale`** softkey, and use the knob to set the scale to **`1 ns/div`**.

The blue key that has no writing on it is the shift key. It allows you access to the functions written in blue above some of the front-panel keys. For example, press the blue shift key, then press the Limit test key.

## Performance Test Procedures

Performance test procedures start with the next paragraph. Procedures may be done individually and in any order.

**CAUTION** Allow the instrument to warm up for at least 60 minutes prior to beginning the performance tests. Failure to allow warm-up may cause the instrument to fail the tests.



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# To test the front panel CAL signal

This procedure is used to test the accuracy of the front-panel calibration signal.

**Specification**

**Output delta voltage accuracy** –2.5 V to +2.5 V (into 50 Ω), Accuracy ±0.2% of delta voltage output

**Equipment Required**

| Equipment | Critical Specifications | Recommended Model/Part |
|---|---|---|
| DMM | 6 1/2 digit, 0.1mV resolution, dc accuracy 0.05% or better | HP 34401A |
| Cable | BNC | HP 10503A |
| Adapter | BNC (f) to dual banana (m) | HP 1251-2277 |

1 Set up the DMM to measure DC volts and use the cable and adapter to connect the DMM to the front-panel CAL output.

2 Press the Utility key, press the `Calibrate...` softkey, then press the `level` softkey.

3 Using either the keypad or the knob, enter 2.5 V and record the first reading.
_____ Vdc

4 Using either the keypad or the knob, enter –2.5 V and record the second reading.
_____ Vdc

5 Subtract the second reading from the first reading, then divide the result by 5.

For example: if the first reading is +2.498 V and the second reading is –2.497 V, then

$$\frac{+2.498\,V - (-2.497V)}{5\,V} = 0.999$$ (which is within specifications).

The final result should be between 0.998 and 1.002. Record the result in the Performance Test Record at the end of this chapter.



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# To test time interval accuracy

This tests the accuracy of the combined mainframe and plug-in circuitry. If this performance test fails, redo the mainframe calibration and the plug-in software calibration.

### Specifications

**Time interval accuracy** 8 ps ±0.1% of reading

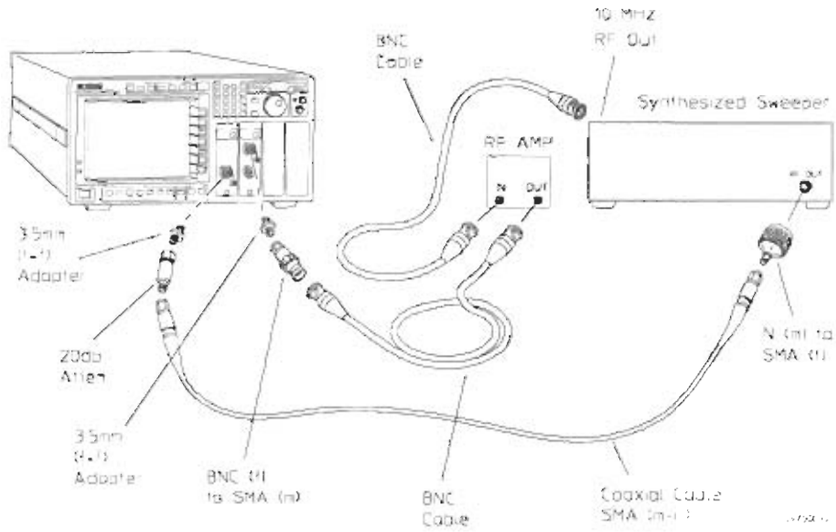
### Equipment Required

| Equipment | Critical Specifications | Recommended Model/Part |
|---|---|---|
| Plug-in Module | HP 54750 series or HP 83480 series with electrical input | HP 54751A or HP 83483A |
| Synthesized sweeper | 20 GHz, –25 dBc harmonics, output +6 dBm, stability 0.25 ppm/yr | HP 8341A/B or HP 8360 Series |
| Frequency synthesizer | 10 MHz square wave, 120 mV output, frequency stability $5x10^{-6}$, aging rate $5x10^{-8}$/week | HP 3325B opt 001 |
| 20 dB pad | 3.5 mm connections | HP 33340C/020 |
| RF amplifier | Gain 20 dB at 10 MHz, flatness ±0.7 dB,harmonic distortion–32 dB, for 0 dB output, noise 6 dB, 1.3 GHz | HP 8447D/E/F |
| Adapter | BNC (f) to SMA (m), 2 needed | HP 1250-1200 |
| Adapter | N (m) to SMA (f) (m) | HP 1250-1250 |
| Adapter | 3.5 mm (m-f), precise both ends, 26.5 GHz | HP 1250-1866 |
| Adapter | 3.5 mm (m-f), male end precise, 26.5 GHz, 2 needed | HP 1250-1866 |
| Coaxial cable | SMA (m-m), 26.5 GHz | HP 8120-4948 |
| BNC cable (2) | 48 inches | HP 10503A |



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1 Connect the equipment as shown below.




2 Set up the sweeper to the following settings.

| **Synthesized Sweeper** | |
|---|---|
| Mode | Sine wave |
| Frequency | 19.98 GHz |
| Amplitude | +6 dBm |

3 Press the Storage Setup key, then press the **`Default setup`** softkey.

4 Press the channel 2 Setup key, then set the **`Display`** softkey to **`off`**.

5 Press the channel 1 Setup key, then change the **`Scale`** to **`20 mV/div`**.

6 Press the Time base key, then change the **`Scale`** to **`10 ps/div`**.

7 Press the Acquisition key, set the **`Averaging`** softkey to **on**, then set the **`# of averages`** to **64**.

8 Press the blue shift key, press the Period key, set the **`Period`** softkey to **`channel 1`**, then press the **`Enter`** softkey.

9 Press the Time base key, then check the period at the following **`Position`** settings.

| **Position setting** | **Period test limits** |
|---|---|
| 22 ns | 50 ps ±8.1 ps |
| 25.95 ns | 50 ps ±8.1 ps |
| 33.95 ns | 50 ps ±8.1 ps |
| 57.95 ns | 50 ps ±8.1 ps |

10 Set the **`Position`** softkey to **`22 ns`**.

11 Press the channel 1 Setup key, then set the **`Bandwidth`** softkey to **`12.4 GHz`**.

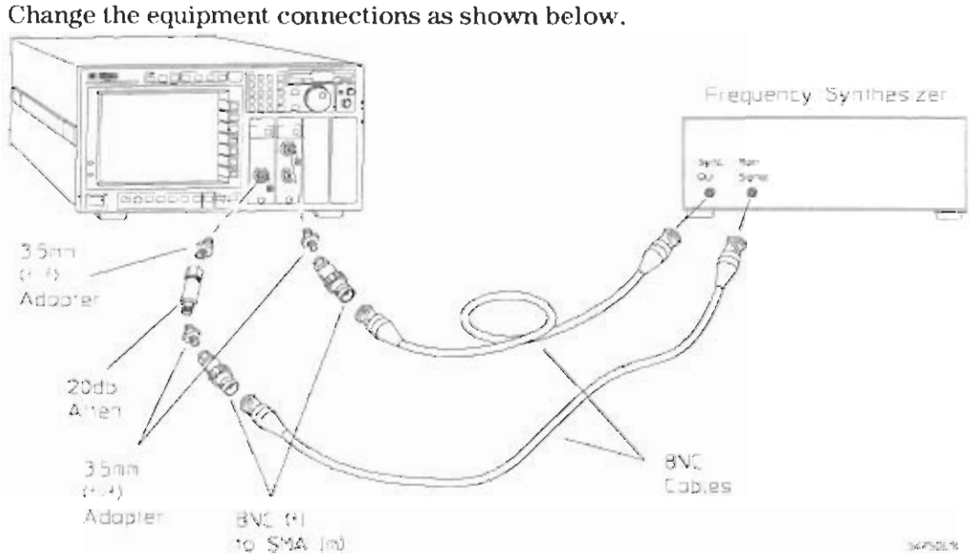


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12 Press the Time base key, then check the period at the following `Sweeper` and `Scale` settings.

| Scale setting | Sweeper setting | Period test limits |
|---|---|---|
| 50 ps/div | 10 GHz | 100 ps ±8.1 ps |
| 100 ps/div | 5 GHz | 200 ps ±8.2 ps |
| 200 ps/div | 2 GHz | 500 ps ±8.5 ps |
| 500 ps/div | 1 GHz | 1 ns ±9 ps |
| 1 ns/div | 500 MHz | 2 ns ±10 ps |
| 2 ns | 200 MHz | 5 ns ±13 ps |
| 5 ns/div | 100 MHz | 10 ns ±18 ps |
| 10 ns/div | 50 MHz | 20 ns ±28 ps |
| 20 ns/div | 20 MHz | 50 ns ±58 ps |

13 Change the equipment connections as shown below.




14 Set up the frequency synthesizer to the following settings.

| Frequency Synthesizer | |
|---|---|
| Mode | Square wave |
| Frequency | 10 MHz |
| Amplitude | 1.2 $V_{p-p}$ |

15 Press the Time base key, then change the `Scale` to `20 ns/div`.

16 Press the Trigger key, then change the `Level` to `500 mV`.

17 Press the Time base key, then check the period at the following `Synthesizer` and `Scale` settings.

| Scale setting | Synthesizer setting | Period test limits |
|---|---|---|
| 20 ns/div | 10 MHz | 100 ns ±108 ps |
| 50 ns/div | 5 MHz | 200 ns ±208 ps |
| 100 ns/div | 2 MHz | 500 ns ±508 ps |
| 200 ns/div | 1 MHz | 1 µs ±1.01 ns |
| 500 ns/div | 500 kHz | 2 µs ±2.01 ns |
| 1.0 µs/div | 200 kHz | 5 µs ±5.01 ns |
| 2.0 µs/div | 100 kHz | 10 µs ±10.01 ns |
| 5 µs/div | 50 kHz | 20 µs 20.01 ns |
| 10 µs/div | 20 kHz | 50 µs ±50.01 ns |
| 20 µs/div | 10 kHz | 100 µs ±100.01 ns |



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## To test trigger sensitivity

The sensitivity test measures the high and low frequency trigger sensitivities by applying a 100 MHz sine wave and a 2.5 GHz sine wave. If the oscilloscope triggers at 2.5 GHz, it will also trigger on a 200 ps pulse width at 200 mV.

The jitter test measures the oscilloscope's internal jitter on a 2.5 GHz sine wave. The instrument's jitter is less with fast rise time input signals. If a generator is substituted, careful consideration of the generator's horizontal jitter and vertical noise is important.

**Specifications:**

Sensitivity: dc to 100 MHz, 40 mV peak-to-peak, increasing linearly to 200 mV peak-to-peak at 2.5 GHz Jitter: Trigger and time base combined (one standard deviation)

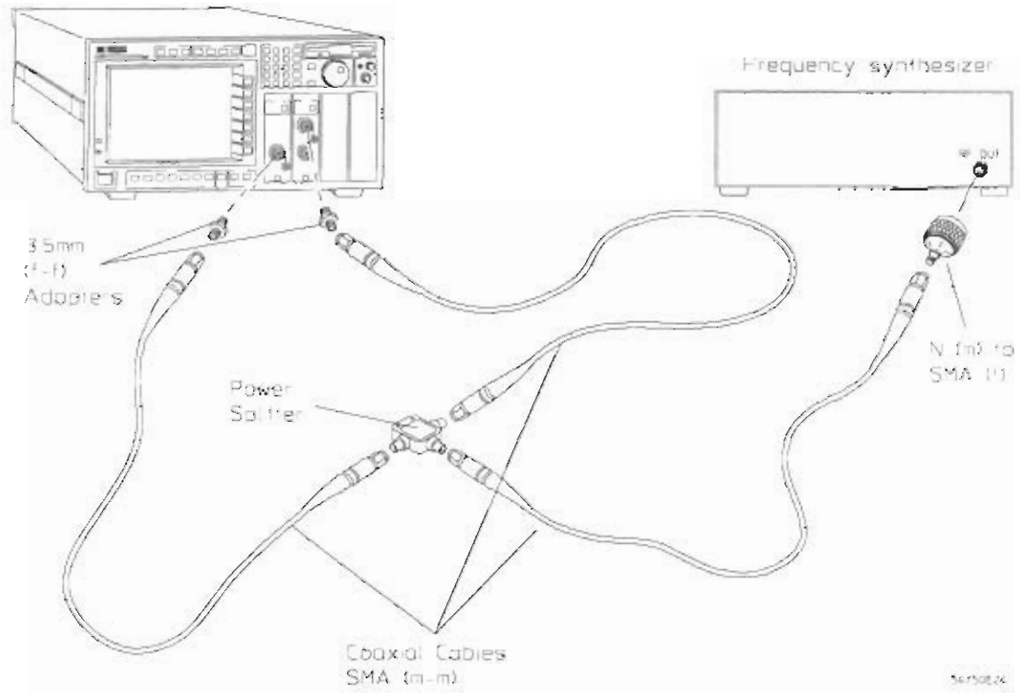
2.5 ps + 5E-5 delay setting. Testing using 2.5 GHz synthesized source at 200 mVp-p with Hysteresis at high sensitivity and BW limit off.

**Equipment required**

| Equipment | Critical Specifications | Recommended Model/Part |
|---|---|---|
| Plug-in module | HP 54571 series or HP 83480 series with electrical input | HP 54571A or HP 83480A |
| Synthesized sweeper | 2.5 GHz, +6 dBm | HP 8360 / 8340 series |
| Frequency synthesizer | 100 kHz sine wave, 200 mVp-p | HP 3325B |
| Power splitter | 10 GHz bandwidth, APC 3.5 connectors | HP 11667B |
| Delay line | 22 ns, 6 dB attenuation at 2 GHz | HP 54008A |
| Attenuator | 6 dB, APC 3.5 connectors | HP 8490C/opt 6, or HP 33340C/opt 6 |
| Adapter | N(m) to SMA(f) | 1250-1250 |
| Adapter (3) | APC 3.5 (m-f) | 1250-1866 |
| Adapter | SMA(m) to BNC(f) | 1250-1200 |
| Adapter | SMA(f-f) | 1250-1159 |
| Adapters | APC 3.5 (m-f) precise both ends | HP 1250-1866 |
| Adapter | Precise SMA, 26.5 GHz | HP 54007-61604 |
| Coaxial cables (3) | SMA (m-m), 18 GHz | HP 8120-4948 |
| BNC Cable | 48 inches | HP 10503A |



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**Low frequency trigger hysteresis**

On this test, a 100 kHz, 100 mVp-p signal is connected to Channel 1 and the Trigger inputs through a power splitter. The trigger level is adjusted positive and negative until it stops triggering. These positive and negative values are subtracted from the 100 mVp-p to give the trigger hysteresis value. The value should be ≤40 mV

1 Press the Setup key, then press the **`Default setup`** softkey.

2 Turn off channel 2.

3 Press left channel Setup key, then set the **`Scale`** softkey to **`20 mV/div`**.

4 Press the Time base and set the **`Scale`** softkey to **`1 µs/div`**.

5 Press the Acquisition key, then set the **`Averaging`** softkey to **`on`**.

5 Connect equipment as shown in the diagram and connect the frequency synthesizer to the power splitter.

6 Set the frequency synthesizer for 100 kHz. Adjust the amplitude until the screen shows 100 mVp-p ±1 mV. Use the Measure Vp-p to measure the amplitude.

7 Press the Trigger key, then adjust the **`Level`** up until it just stops triggering as indicated by the Triggered LED going out.

Note the trigger Level, this is Vpos. Vpos = _____.

8 Return the trigger Level to 0 V, then slowly adjust the trigger Level less than 0 V until the system stops triggering.

This is Vneg. Vneg = _____.

Calculate the hysteresis. Vhysteresis = 100 mV – (Vpos – Vneg). The value should be ≤40 mV.



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### 100 MHz / 2.5 GHz trigger sensitivity

On these tests, the 100 MHz and 2.5 GHz signals are used. The trigger level is adjusted positive and negative as in the preceding test. The values for the respective frequencies should respectively be ≤40 mV and ≤ 200 mV.

9 Press the Trigger key, then set the **Level** softkey to **0 V**. Press the Time base key, then set the **Scale** softkey to **2 ns/div**.

10 Connect the synthesized sweeper to the power splitter and adjust the sweeper to 100 MHz. Adjust the amplitude to 150 mVp-p ±1 mV on screen.

11 Slowly adjust the trigger Level greater than 0 V until the oscilloscope just stops triggering.

This is Vpos. Vpos = _____.

12 Return the trigger Level to 0 V. Slowly adjust the trigger Level less than 0 V until the system just stops triggering.

This is Vneg. Vneg = _____.

Calculate the sensitivity. Vsense = 150 mV – (Vpos – Vneg). This value should be ≤40 mV.

13 Return the trigger Level to 0 V, press the **Hysteresis** softkey select **high sensitivity** from the drop-down menu, then press the **Enter** softkey. Press the Time base key, then set the **Scale** softkey to **100 ps/div**. Press the Channel setup key, then set the **Scale** softkey to **50 mV/div**.

14 Change the sweeper frequency to 2.5 GHz and adjust the amplitude until the Vp-p reading is 200 mV ±2 mV.

15 Press the Trigger key, then adjust the Level above 0 V until the system stops triggering.

This is Vpos. Vpos = _____.

16 Return the **Level** softkey to 0 V. Slowly adjust the trigger the Level less than 0 V until the system stops triggering.

This is Vneg. Vneg = _____.

Calculate the sensitivity. Vsense = 200 mV – (Vpos – Vneg). This value should be ≤ 200 mV.



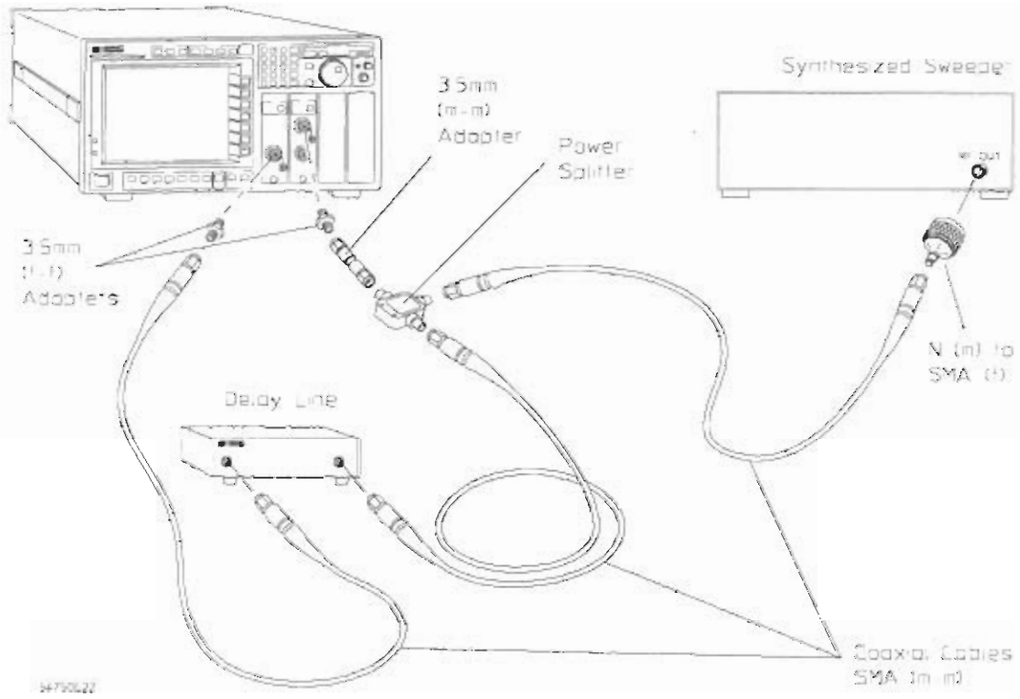
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**Jitter Test**

On this test, the signal generator is set to 2.5 GHz at 200 mVp-p. A delay line is added to delay the trigger point so it occurs on screen. Then the jitter is measured on the trigger edge to cancel out any sweeper-caused jitter.

**17** Leave the sweeper frequency at 2.5 GHz. The amplitude should be set to 200 mV/div.

**18** Add the delay line as shown in the diagram below.




**19** Press the Time base key, then set the **Scale** softkey to **500 ps/div**. Set the **Reference** softkey to **center**, and the **Position** softkey (delay) to **22 ns**.

**20** Slightly change the sweeper frequency, then select the trigger point on the waveform.

It is helpful to put the system in infinite persistence to determine where the trigger point is. The trigger point on the waveform is the part of the waveform that does not expand or contract as the frequency is varied. When you find this edge on the waveform, turn on the markers to mark the trigger edge, next change the **Position** softkey setting in the time base menu to center this on screen. Change the Reference to Center.

**21** Press the Time base key, set the **Scale** softkey to **200 ps/div**, then set the **Position** softkey to the Marker value.

Position setting = _____ ns.

**22** Adjust the **Position** softkey setting to center the positive edge of the waveform to the center of the screen. Change **Scale** softkey setting to **10 ps/div**.

**23** Press the Channel Setup key, then set the **Scale** softkey to **5 mV/div**.



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24 Press blue Shift key, press Histogram key, press **Mode** softkey to highlight waveform, press **Histogram window** softkey, and verify that the **Scale source** is channel 1. Adjust **X1 position** softkey setting to be at the left side of the screen. Adjust **X2 position** softkey setting to be on the right side of the screen. Set Y1 to 300 µV and Y2 to –300 µV. Press the Clear display key.

25 The std dev (standard deviation) value should read ≤2.5 ps + (5E-5 position (delay) setting from step 24). Example for delay setting of 21.5 ns: ≤2.5 ps + [(5 x $10^{-5}$) x (21.5 x $10^{-9}$)] = ≤2.5 ps + 1.075 ps ≤3.575 ps.

Failure of the trigger tests can be caused by the plug-in interconnections on the rear panel or the Time base and Acquisition board in the mainframe. Refer to chapter 5, "Troubleshooting" for more information.



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HEWLETT PACKARD

**HP 54750A Digitizing Oscilloscope**

Serial No._____
Recommended Test Interval - 1 Year/2000 hours
Recommended next testing_____

Tested by_____
Work Order No._____
Date_____
Temperature_____

| Test | | | Minimum | Actual | Maximum |
|---|---|---|---|---|---|
| CAL Accuracy | | | 0.998 | _____ | 1.002 |
| Time Interval Accuracy | Delay Setting | 22 ns | 41.95 ps | _____ | 58.05 ps |
| | | 25.95 ns | 41.95 ps | _____ | 58.05 ps |
| | | 33.95 ns | 41.95 ps | _____ | 58.05 ps |
| | | 57.95 ns | 41.95 ps | _____ | 58.05 ps |
| | Frequency | 10 GHz | 91.9 ps | _____ | 108.1 ps |
| | | 5 GHz | 191.8 ps | _____ | 208.2 ps |
| | | 2 GHz | 491.5 ps | _____ | 508.5 ps |
| | | 1 GHz | 0.9910 ns | _____ | 1.009 ns |
| | | 500 MHz | 1.99 ns | _____ | 2.010 ns |
| | | 200 MHz | 4.987 ns | _____ | 5.013 ns |
| | | 100 MHz | 9.982 ns | _____ | 10.018 ns |
| | | 50 MHz | 19.972 ns | _____ | 20.028 ns |
| | | 20 MHz | 49.942 ns | _____ | 50.06 ns |
| | | 10 MHz | 99.89 ns | _____ | 100.11 ns |
| | | 5 MHz | 199.79 ns | _____ | 200.21 ns |
| | | 2 MHz | 499.49 ns | _____ | 500.51 ns |
| | | 1 MHz | 0.99899 µs | _____ | 1.00101 µs |
| | | 500 kHz | 1.99799 µs | _____ | 2.00201 µs |
| | | 200 kHz | 4.99499 µs | _____ | 5.00501 µs |
| | | 100 kHz | 9.98999 µs | _____ | 10.01001 µs |
| | | 50 kHz | 19.980 µs | _____ | 20.02001 µs |
| | | 20 kHz | 49.950 µs | _____ | 50.05001 µs |
| | | 10 kHz | 99.900 µs | _____ | 100.10001 µs |

| | | | Actual | Maximum |
|---|---|---|---|---|
| Trigger | Trigger hysteresis | Vhyst | _____ | 40 mV |
| | 100 MHz trigger sense | Vsense | _____ | 40 mV |
| | 2.5 GHz trigger sense | Vsense | _____ | 200 mV |
| Jitter | | | _____ | (see specifications) |

Example: <3.575 ps with 21.5 ps delay setting



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# Calibrating and Adjusting

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# Calibrating and Adjusting

Calibration of the instrument is a semiautomatic calibration because an external signal generator is required. The only hardware adjustment is accessed through a hole in the bottom of the mainframe. The remainder of the adjustments are DAC adjustments done by software and by the front-panel knob. The adjustment for the color display is done only if the display needs correction.

## Equipment Required

Equipment required for these procedures is listed in the Recommended Test Equipment table in chapter 1 of this book. Any equipment that satisfies the critical specification listed in the table may be substituted for the recommended model. Equipment for individual procedures is listed in the procedure.

## Keystroke Conventions

To guide you while setting up the instrument, the following conventions are used to represent keystrokes and other interactions with the instrument.

When you need to press a front-panel key (also called a hardkey), you will be instructed to press a specific key. For example, press the Time base key.

Bold text , such as **`Display`** or **`Calibrate...`**, represents text on the CRT screen and may be a softkey you press or a selection you make. For example, press the **`Scale`** softkey, then use the knob to set the scale to **`1 ns/div`**.

The blue key that has no writing on it is a shift key. It allows you access to the functions written in blue above some of the front-panel keys. For example, press the blue shift key, then press the Limit test key.

## Plug-in Numbering

Plug-in slots are numbered from left to right. An empty mainframe slot counts as if it were occupied by a plug-in.



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# Calibrating the instrument

With exceptions noted where they apply, this section includes procedures needed to calibrate the mainframe with plug-ins. Plug-in calibration is part of the Service Guide for each plug-in. Because the prompts on the display direct the calibration details, the procedures in this section apply to all plug-ins.

Some plug-ins may require adjustment after certain repairs. See the plug-in Service Guide for the procedures to do after repairs.

## Calibration Overview

This section briefly explains the calibration of the instrument. It is intended to provide an understanding of available calibrations and how to use them. Calibration is accomplished by using three calibration procedures:

- Frame calibration
- Plug-in calibration
- Probe calibration

**Frame Calibration** Frame calibration allows the instrument to establish calibration factors for the time base, trigger, and mainframe's calibrator. These calibration factors are stored in nonvolatile RAM in the mainframe. These factors are protected by a switch that allows the calibration to be enabled or disabled. This switch can be accessed through a hole in the rear panel of the mainframe. See "To calibrate the time base" for additional information.

**Plug-in Calibration** Plug-in calibration allows the instrument to establish the vertical calibration factors for a particular plug-in in a particular mainframe slot that it is calibrated in. Plug-in vertical specifications only apply when the plug-in is used in the mainframe slot it was calibrated in. Typically, however, once a plug-in has been calibrated in any slot, it will meet specifications in any other mainframe slot.

For optimum measurements, it is recommended that the instrument user perform the plug-in calibration regularly. Especially if the operating temperature has changed over 5 deg C since the last plug-in cal. The plug-in calibration calibration just takes about two minutes per channel. See Calibration Interval for the warm-up time.

A switch in the plug-in is used to enable or disable plug-in calibration. The plug-in side cover must be removed to gain access to the switch. Normally this switch is set in the unprotected (enabled) position so the instrument user can do the plug-in calibration periodically.

To calibrate a plug-in, refer to the respective plug-in Service Guide.



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**See Also**

"Calibration Status Displays" in this chapter, to check the instrument temperature change.

**Probe Calibration**

Probe calibration allows the instrument to establish the gain and offset of a probe and apply those factors to the calibration of the channel that probe is connected to.

For active probes that the instrument can identify through the probe power connector, such as the HP 54701A, the instrument automatically adjusts the vertical scale factors for that channel, even if a probe calibration is not done. For passive probes or other unidentified probes, the instrument adjusts the vertical scale factors only if a probe calibration is done. Without a probe calibration, the probe attenuation factor can be entered manually, through the menus.

If a probe being calibrated has an attenuation that will allow the instrument to adjust its gain (in hardware) to produce even steps in the vertical scale factors, the instrument will do so. If the probe being calibrated has an unusual attenuation (such as 3.75), the instrument may have to adjust the vertical scale factors to an unusual number (375 mV/div). Typically probes have standard attenuation factors, such as ÷10, ÷20, or ÷100.

## Calibration Interval

Calibration is required under any of the following conditions:

- Yearly or every 2,000 hours of operation.
- If the instrument temperature is more than 5° C different than the temperature when the last calibration was done.
- If you have replaced one of the following assemblies.

  CPU assembly (calibration factors are stored on the CPU assembly)
  Time base and acquisition assembly

**CAUTION**

**Warm up the instrument for at least 60 minutes before starting these procedures. Failure to achieve a stable temperature before calibration may result in temperature shifts that void the calibration. For temperature and electrical stability, all calibration must be done with the rear panel and all rear panel hardware installed.**



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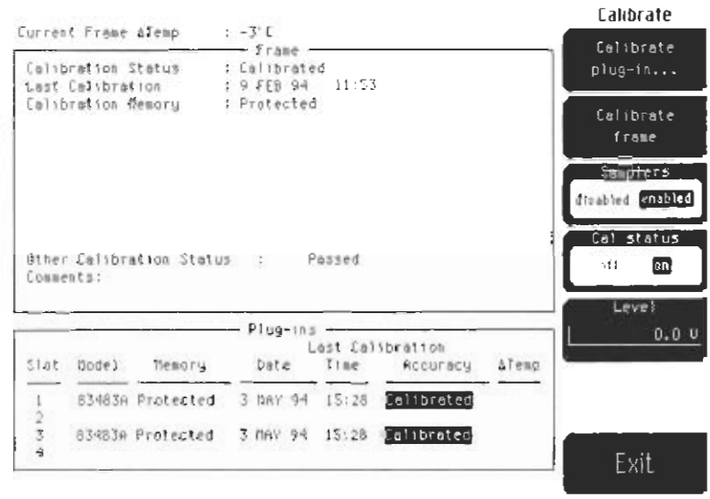
# Calibration Status Displays

The calibration status displays show the current calibration status of the mainframe and plug-ins. There are two displays, one through the Utility menu and one specifically for each plug-in through the channel setup menu.

The display of the calibration status is updated only when the Cal status display is entered.

### Frame Calibration Status

The following figure shows the display, and the table explains the features. This display also shows an abbreviated version of the plug-in status. To enter this display, press the Utility key, press the **`Calibrate...`** softkey, then set the **`Cal status`** softkey to **`on`**.




**Frame Calibration Status**

## Frame:

**Current Frame ΔTemp** Displays the current internal temperature of the instrument compared to the temperature at which the frame was calibrated, in increments of one degree Celsius.

**Calibration Status** Calibrated or Uncalibrated.

**Last Calibration** Displays the date and time of the last frame calibration.

**Calibration Memory** Shows the setting of the Frame cal memory protect switch.

**Other Calibration Status** Displays Passed, Failed, or Calibrating

**Comments** This area is for text which can be programmed over the HP-IB. See Calibrate Subsystem in the Programmers Reference supplied with the mainframe.

## Plug-ins

**Slot** The front panel plug-in position.

**Model** The model number of the plug-in currently in the slot. Unfilled slots register empty. If the mainframe does not recognize the plug-in, ~known is displayed instead of the model number. If '~known' is displayed, refer to the User's Reference for the plug-in.

**Memory** Shows the status of the calibration switch in the plug-in.
When calibration is disabled, Protected is displayed.
When calibration is enabled, Unprotected is displayed.

**Date** The date the plug-in was calibrated.

**Time** The time the plug-in was calibrated.

**Accuracy** This shows the plug-in calibration status, Uncalibrated or Calibrated.

**Δ Temp** The change in temperature since the plug-in was last calibrated.

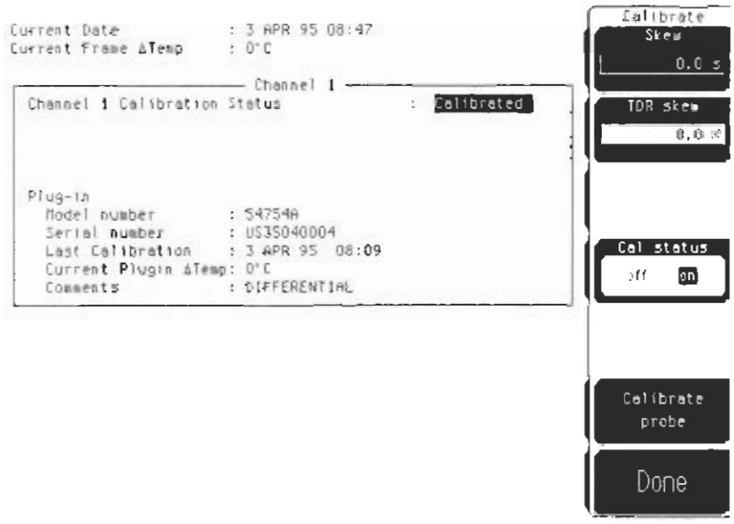


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### Plug-in Calibration Status

The following figure shows the plug-in calibration status display and the table explains the features.

To enter this display, press the Channel Setup key, press the **`Calibrate...`** softkey, then set the **`Cal status`** softkey to on.




**Plug-in Calibration Status**

| | |
|---|---|
| **Current Date** | Date and time reflected by the internal clock. |
| **Current Frame ΔTemp** | The current internal temperature of the instrument compared to the temperature at which the frame was calibrated, in increments of one degree Celsius. |
| **Channel X Calibration Status** | Displays uncalibrated or calibrated. |
| **Plug-in** | Shows other relevant plug-in data.<br>The model number is derived from a hardware identification on the PC board.<br>The serial number is set through the Utility Service menu.<br>Last calibration is the date and time of the last calibration.<br>The current internal temperature of the plug-in compared to the temperature at which the plug-in was calibrated, in increments of one degree Celsius.. |



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# To calibrate the time base

Calibration by the instrument firmware is a semiautomatic calibration in that external equipment is required. The screen prompts you to connect the equipment as needed. Specific waveform characteristics needed for this calibration are also included in this section.

**Equipment Required**

| Equipment | Critical Specifications | Recommended Model/Part |
|---|---|---|
| Plug-in | HP 54750 series or HP 83480 series with electrical input | HP 54751A or HP 83483A |
| Signal Generator | 500 MHz, 2 GHz, with 10 MHz reference output | HP 8360 series or HP 8340 series |
| RF Amplifier | 22 dB Gain at 10 MHz, 1.3 GHz bandwidth | HP 8447D/E/F |
| Attenuator | 6 dB, BNC | HP 8490C Dpt 6 or HP 33340C Dpt 6 |
| Cables | BNC, 48-inch, 3 needed | HP 10502A |

If the calibration process is canceled, the previous calibration factors are retained.

**CAUTION**

**Warm up the instrument and plug-in for at least 60 minutes before starting these procedures. Failure to achieve a stable temperature before calibration may result in temperature shifts that void the calibration. For temperature and electrical stability, all calibration must be done with the rear panel and all rear panel hardware installed.**

### Signal generator waveform characteristics

The firmware prompts you to refer to the manual for additional information on the kind of signal needed to calibrate the time base, which is a -14 dBm (120 mV pp) 500 MHz sine wave.

The trigger input of the plug-in module needs to be driven from the 10 MHz reference output of the signal generator. Unless the 10 MHz reference output meets the following specifications, the reference signal needs to be amplified to be used for the calibration.

### Trigger signal specifications

Amplitude of 2 Vpp to 4 Vpp (centered around zero)
Rise time & fall time ≥3 ns (Note: $t_r$ and $t_f$ of 10 MHz sine wave is about 30 ns)
Jitter of 2 GHz sine wave on channel 2 of the analyzer should be less than 7 ps rms (42 ps pp).

One equipment setup that meets this specification is an HP 8340/41/A/B Synthesizer with the 10 MHz reference output connected to an HP 8447E/F amplifier (22 dB amp section) and the output of the amplifier connected to the trigger input of the HP 83480 series plug-in through a 6 dB attenuator. This setup produces a trigger signal that is about 2.3 Vpp and has about 10 ns rise and fall times. The jitter on this signal on channel 2 for this setup is about 30 ps pp.

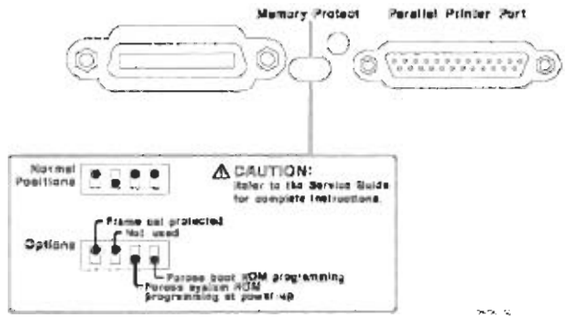
A second setup is an HP 8341B with the 10 MHz output connected through a 6 dB attenuator to an HP 8447D. This produces an approximate 2.6 Vpp, 10 ns $t_r/t_f$ signal. The jitter on channel 2 is about 4.5 ps rms and 35 ps pp.

A third setup is an HP 8664A, 8665A, or 8665B signal generator with the 10 MHz reference output connected directly to the plug-in trigger input. The 10 MHz output on these generators is about 4 Vpp and is an approximate sine wave ($t_r$ and $t_f$ about 30 ns). This setup produces a jitter on channel 2 of about 2.8 ps rms.



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1 Set the mainframe calibration protect switch to the unprotected position.
   a Using the figure below as a reference, find the cal protect switches on the rear panel.
   b Set the leftmost switch to the down position. The protection status displayed onscreen will not change unless the calibration status display is exited and reentered.




**Rear Panel Calibration Protect Switches**

2 Disconnect everything from the front panel. Press the Utility key, press the `Calibrate...` softkey, then press the `Calibrate frame` softkey.
   After a few seconds, the screen prompts you to connect a -14 dBm, 500 MHz sine wave to channel 2. The "See Manual" prompt is a reference for you to see the "Trigger signal specifications" on the previous page.
3 After the signals are connected to channel 2 and the trigger input, press the `Continue` softkey. Then, monitor the status bar for the next prompt.
4 When the message "Adjust the variable cap for a reading of 4 ns ±0.004ns" comes up onscreen, do steps a and b.
   a Turn the mainframe on its side and locate the plug covering the hole on the bottom on the mainframe. Remove the hole cover.
   b Using a very small insulated adjustment tool, take care to adjust the very small screw-type capacitor for the above reading. Because the reading will bounce around, adjust the cap so that the reading usually reads within the ±0.004 ns reading. Press the `Continue` softkey when the adjustment is completed, then monitor the status bar for the next prompt.
5 Follow the prompt by adjusting the variable cap for a flat line of ±1.5 divisions. After the adjustment, press the `Continue` softkey. Put the hole cover back on, and turn the mainframe back on its feet.
6 Wait 10 minutes for stabilization, then press the `Continue` softkey.
7 Following the prompt, adjust the front-panel knob for the best flat line. Press the `Continue` softkey when the best flat line is achieved.
8 As instructed, change the signal generator frequency to 2.0 GHz, then press the `Continue` softkey.
9 Use the front-panel knob to adjust for minimum discontinuity as displayed onscreen, then press the `Continue` softkey.



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10 Because the movement on the screen is very slight and slow, it may be difficult to notice any changes on the screen as you make this adjustment. Use the front-panel knob to adjust for minimum discontinuity as displayed on screen, then press the `Continue` softkey.

11 Use the front-panel knob to adjust for minimum discontinuity as displayed onscreen, then press the `Continue` softkey.

12 Monitor the status line while the unit completes the discontinuity adjustments.

13 When the calibration is completed and the monitor displays "calibration completed", return the mainframe calibration protect switch to the "protected" position.

## To calibrate the plug-ins

To calibrate the plug-ins, refer to the respective plug-in Service Guide.



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# Adjusting the Color CRT Module

Use these procedures to adjust the Color CRT Module to compensate for magnetic influences causing misconvergence.

**WARNING**

SHOCK HAZARD!
**Be careful with exposed circuitry while doing these procedures. Failure to take precautions around energized circuitry may result in serious shock or death. Read the Safety information at the back of this manual before performing adjustment procedures.**

DO NOT PERFORM THESE ADJUSTMENTS AS A PART OF ROUTINE CALIBRATIONS. The following procedures are provided only for the few extreme cases where either the earth's magnetic field or the user's environment cause an unusable display due to misconvergence, which cannot be corrected by degaussing the entire CRT screen.

DO NOT continue this procedure before degaussing the CRT screen using the rear panel degaussing switch. In extreme cases of magnetism, it may be necessary to degauss the CRT using a conventional external television-type degaussing coil.

These adjustments are to be performed only by qualified personnel who are familiar with color CRT convergence procedures.

Before starting the adjustments, mark the position where the potentiometers are set. This helps in returning the adjustments to their original positions if it becomes necessary to restart the procedure.

### Equipment Required

The instrument firmware supplies the display patterns necessary for adjustment. The only tool required is a nonmetallic adjustment tool:

- Sony Part Number 4-367-065-01
- HP Part Number 8710-1355

After the shields are removed, you can operate the instrument with the CRT module connected and sitting at the front of the frame. However, the cables will be very short. You can make up a longer ribbon cable (4 feet) using the following parts.

- Ribbon cable (use 4 feet), HP Part Number 8120-1613, 3M Part Number 3365-40
- Cable connector (2 each), HP Part Number 1252-3124, 3M Part Number 3417-7600

## To prepare the instrument

Note the original routing of all cabling for proper routing when the module is reinstalled in the instrument. Then, reroute the cables from inside the module to the outside (left side) of the module for reconnection to the power supply for adjustments.

1 Remove the Color CRT Module from the instrument (see chapter 6).
2 Reconnect the instrument front panel and reinstall the front panel (use two screws to temporarily hold the front panel in place).



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**WARNING**

SHOCK HAZARD!
Be careful with exposed circuitry after removing the shield. Failure to take precautions around energized circuitry may result in serious shock or death.

3 Remove the right shield.

a Disconnect the display power cable from the connection in the shield.

b Remove the screws and slide the shield off the module.

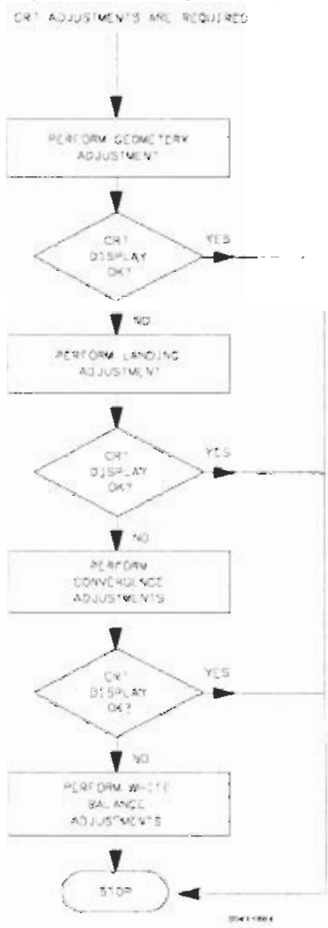
c Remove the power connector from the shield and reconnect it to the power cable from the instrument.

4 With the Color CRT Module placed in front of the mainframe, reconnect the module.

During any of the following adjustments, the CRT module must face west.

5 Use the following chart to guide the procedure.

The following adjustments are broken down into adjustment groups. The adjustment group sequence must be followed in order because of interaction and dependency. The adjustment group sequence is shown in the adjustment flow diagram below. There will be cases where not all of the adjustments groups will be used. For example, if the Geometry Adjustment Group corrects the problem, this will be the only group used.




**Color CRT Module Adjustment Flow Diagram**



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## To adjust geometry

1 Display the white crosshatch pattern on the CRT.

To display the pattern, press the Utility key, press the, **`Service`** softkey, press the **`CRT Setup...`** softkey, then set the **`CRT pattern`** softkey to **`on`**.

2 Preset the front panel brightness control (top of the two controls to the left of the display) maximum clockwise.

3 Preset the front panel contrast control (bottom of the two controls to the left of the display) to the mechanical center.

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

All of the following adjustment potentiometers are located on the PC board on the left side of the display.

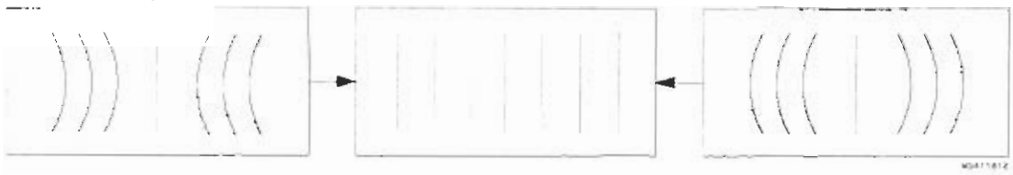
5 Adjust the display size. Measure with a flexible ruler.

- Adjust H.SIZE (RV504) for a 161 mm (6.34 in.) width.
- Adjust V.HEIGHT (RV50) for a 120.5 mm (4.74 in.) height.

6 Center the pattern.

- Adjust V.CENT (RV510) for vertical centering.
- Adjust H.CENT (RV503) for horizontal centering.

7 Adjust PIN AMP (RV506) to eliminate pincushion distortion in the vertical lines of the crosshatch pattern as shown in the next figure.



8 Adjust PIN PHASE (RV505) to eliminate pin phase distortion in the vertical lines of the crosshatch pattern as shown in the next figure.



9 Adjust TOP PIN (RV511) so that the top horizontal line is parallel with the center horizontal line.

10 Adjust BOTTOM PIN (RV512) so that the bottom horizontal line is parallel with the center horizontal line.



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## To adjust focus, landing, and convergence

Once you have started, you will have to do all three of the procedures in this group.

**Initial Preparation**

1 Loosen the deflection yoke clamp screw.

2 Apply power and allow the instrument to thermally stabilize for 20 minutes.

**Focus Adjustment**

Geometry adjustments must be performed before making the focus adjustment.

1 Display the white crosshatch pattern on the display.

To display the pattern, press the Utility key, press the, **`Service`** softkey, press the **`CRT Setup...`** softkey, then set the **`CRT pattern`** softkey to **`on`**.

2 Adjust FOCUS (RV701), located on the rear PC board, for best overall focus.



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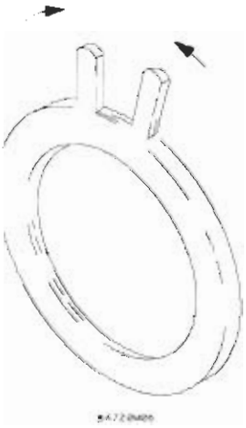
### Landing Adjustment

1 Turn the front panel BRIGHTNESS control fully clockwise.

2 Degauss the CRT by momentarily pressing the DEGAUSS switch located on the instrument rear panel.

In some cases, the user's environment or shipping environment may have caused high levels of magnetization in the CRT. In this case, to completely degauss the CRT it may be necessary to use a conventional television-type degaussing coil.

3 Set the purity magnet tabs to the mechanical center (see next figure).



4 Display a green raster on the display.

To display the pattern, press the Utility key, press the, **`Service`** softkey, press the **`CRT Setup...`** softkey, then set the **`Color purity`** softkey to **`green`**.

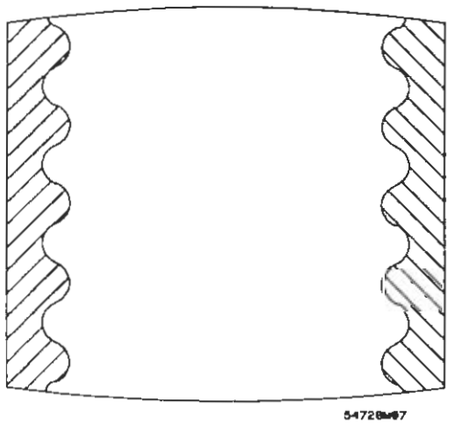
In the next steps, while moving the deflection yoke forward and rearward, rotate the yoke as necessary to keep the edges of the raster parallel to the sides of the display.

5 Move the deflection yoke rearward until the left edge of the raster turns red and the right side of the raster turns blue.

Red

Green

Blue



6 Adjust the purity magnets until green is in the center of the raster with red and blue bands evenly distributed on the sides (see above figure).



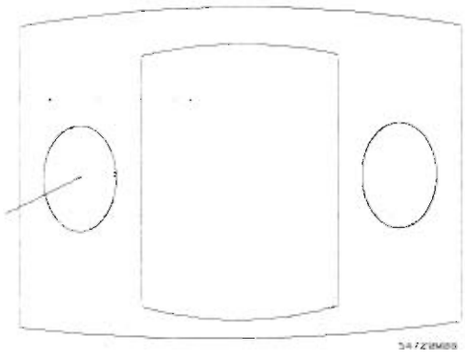
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7 Move the deflection yoke forward until the entire raster is green.

Landing adjustment is easier if the yoke is moved all the way forward and then moved back until the raster is completely green.

8 Using the Color Purity key, replace the green raster with red and then blue raster, each time checking for proper landing adjustment (color purity of each).

9 If the landing is not correct in step 8, repeat steps 5 through 8 for the best compromise.




10 If the landing is not correct in step 9, readjust purity magnets for best landing of each color.

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



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**Static Convergence**

1. Temporarily disconnect the power from the instrument.
2. Remove the PC board shield cover from the rear of the Color CRT Module by prying evenly on all four sides.
3. Reapply power.
4. Display the white crosshatch pattern on the CRT.

   To display the pattern, press the Utility key, press the, **`Service`** softkey, press the **`CRT Setup...`** softkey, then set the **`CRT pattern`** softkey to **`on`**.
5. Preset the front panel brightness control (top of the two controls to the left of the display) maximum clockwise.
6. Preset the front panel contrast control (bottom of the two controls to the left of the display) to the mechanical center.
7. Check the four dots which are located around the center intersection of the crosshatch pattern for coincidence of the blue, red, and green dots.

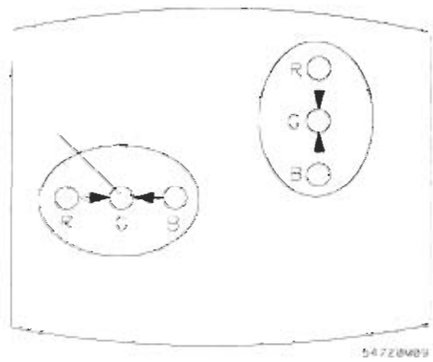
   If the dots are not coincident, adjust H.STAT (RV703) located on the rear PC board to obtain horizontal coincidence and V.STAT (RV803) located on the bottom PC board to obtain vertical coincidence (see figure below).

   Due to interaction, the BEAM LANDING will need to be readjusted if either the H.STAT or V.STAT adjustments are made. Once the BEAM LANDING is readjusted, repeat step 7 above, if necessary, to obtain the center screen coincidence of the dots.

V.STAT

Center dot

H.STAT





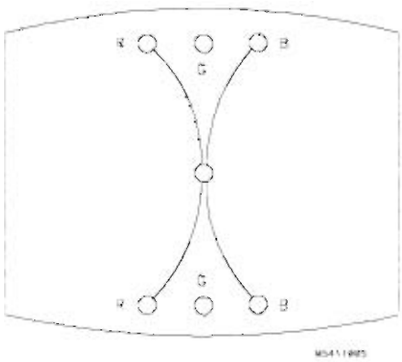

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**Dynamic Convergence**

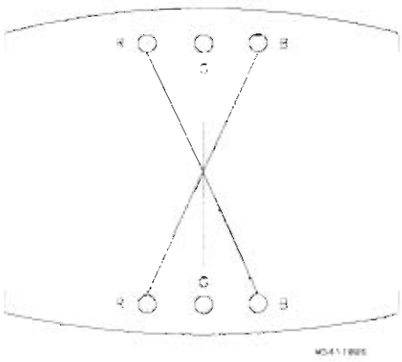
1 Display the white crosshatch pattern on the CRT.

To display the pattern, press the Utility key, press the, **`Service`** softkey, press the **`CRT Setup...`** softkey, then set the **`CRT pattern`** softkey to **`on`**.

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



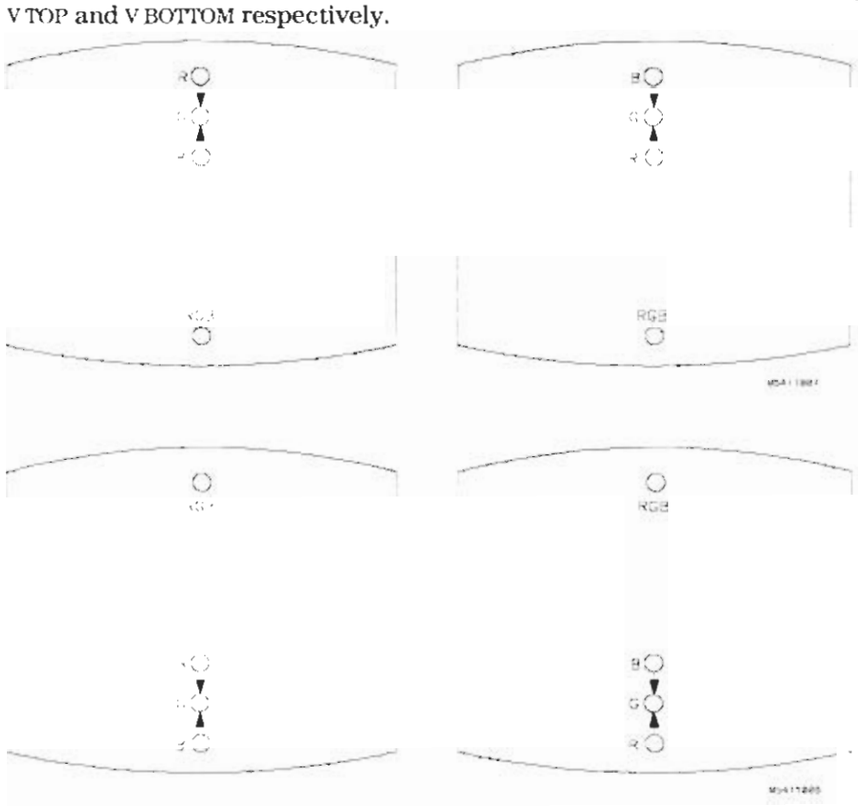
3 Adjust Y CROSS (RV804) located on the bottom PC board to eliminate red, green, and blue orthogonal misalignment at the top and bottom of the center vertical line.





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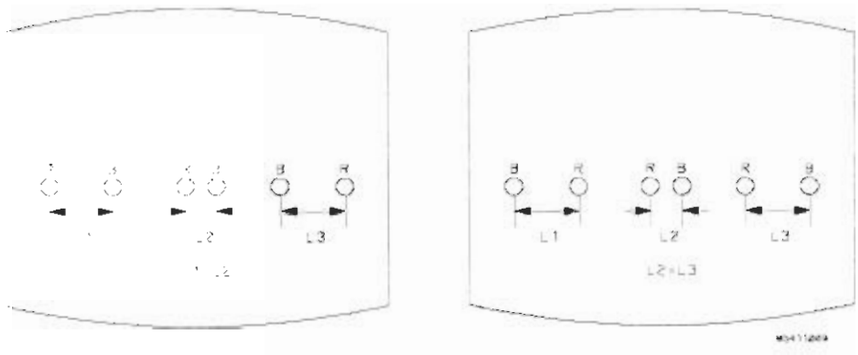
4 Adjust V TOP (RV801) and V BOTTOM (RV802) located on the bottom PC board to obtain coincidence of the red, blue, and green at the intersection of the top and bottom horizontal lines with the center vertical line. Use the next two figures for V TOP and V BOTTOM respectively.



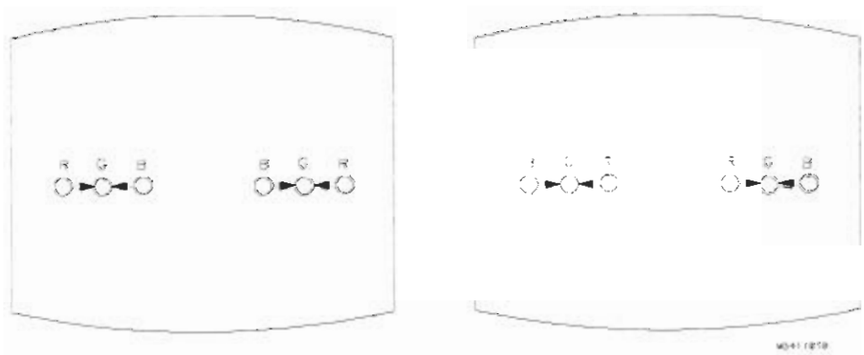



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5 Adjust H.AMP (RV807) located on the bottom PC board for equal amounts of misconvergence at the right and left sides of the screen.




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





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## To adjust white balance

1 Provide a blank display on the CRT.

To display the pattern, press the Utility key, press the **`Service`** softkey, press the **`CRT Setup...`** softkey, then set the **`Color purity`** softkey to **black**.

The completely blanked raster will contain the text for the function keys on the right side of the display; however, this will not affect the adjustment.

2 Preset front panel brightness and contrast controls to their mechanical centers.

3 On the bottom PC board, set the following adjustments to their mechanical centers.

- SUB BRT (RV901)
- SUB CONT (RV902)

4 On the bottom PC board, set the following adjustments to their mechanical centers.

- G. DRIVE (RV921)
- B. DRIVE (RV931)
- R. DRIVE (RV911

5 On the rear PC board, set the following adjustments fully counterclockwise (CCW).

- G. BKG (RV721)
- B. BKG (RV731)
- R. BKG (RV711)

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

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

8 Press the **`Color purity`** softkey as necessary to obtain the white raster.

9 Set the front panel brightness control to maximum.

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

For a white balance reference, use an average piece of white photocopy paper and compare the white on the CRT to the paper.

11 Repeat steps 6 through 10 until satisfied with the white balance.

12 Essentially, from this point the procedure is:

**a** With a blank screen, the front panel brightness set to center, and SCREEN (RV702) set for minimum background, adjust the BKG controls (G.RV721, B.RV731, and R.RV711) for the best white balance.

**b** With a white raster and the front panel brightness set to maximum, adjust the DRIVE controls (G.RV921, B.RV931, and R.RV911) for best white balance.

**c** Repeat until satisfied with the white balance.



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5

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# Troubleshooting

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# Troubleshooting

This section provides troubleshooting and other non-periodic maintenance information for the mainframe. The service strategy of this instrument is replacement of defective assemblies. Some assemblies can be replaced on an exchange basis.

This chapter is divided into two sections.

- The "Trouble Isolation" section helps you find a defective assembly when the instrument fails.
- The "Utility Menu" section describes the various features of that menu and how to use them.

## Safety

Read the safety information at the back of this manual before servicing the instrument. Before performing any procedure, review it for cautions and warnings.

**WARNING**

Maintenance should be performed by trained service personnel aware of the hazards involved (for example, fire and electric shock). When maintenance can be performed without power applied, the power cord should be removed from the instrument. Lack of training and awareness of the hazards could result in electrical shock.

## ESD Precautions

When using any of the procedures in this chapter you should use proper ESD precautions. As a minimum you should place the instrument on a properly grounded ESD mat and wear a properly grounded ESD wrist strap.

## Keystroke Conventions

To guide you while setting up the instrument, the following conventions are used to represent keystrokes and other interactions with the instrument:

When you need to press a front-panel key (also called a hardkey), you will be instructed to press a specific key. For example, press the Time base key.

Bold text , such as **`Display`** or **`Calibrate...`**, represents text on the CRT screen and may be a softkey you press or a selection you make. For example, press the **`Scale`** softkey, then use the knob to set the scale to **`1 ns/div`**.

## Default Setup

A Default Setup is provided to assure the instrument is in a known default state. The default setup prevents previous setups from interfering with the next test. The default setup also simplifies the instrument setup procedure.

To set the instrument in the default state, press the Setup key, then press the **`Default setup`** softkey.



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The trouble isolation information is provided to isolate a problem to a faulty assembly. When the faulty assembly has been located, the disassembly/assembly procedures in chapter 6 will help direct replacement of the assembly.

The primary procedural tool in this section is the flowchart. The flowchart contains the entire troubleshooting path from a failed instrument to a working one, and will direct you in an orderly manner through the possible failure symptoms. Reference letters on the flowcharts point to sections of reference text that expand on the brief prompts in the chart. Do not try to troubleshoot by following only the reference text because the text is not in the correct order for troubleshooting. Instead, simply follow the flowchart.

If you are unfamiliar with this instrument, start with the Primary Trouble Isolation Flowchart on the next page.

## Tools Required

You need the tools normally used when troubleshooting electronic equipment. A digital multimeter and an oscilloscope with about a 100-MHz bandwidth. If you need to troubleshoot the color CRT module or plug-ins you can build extender cables using the parts listed below. If you need to remove and replace assemblies, you may need some of the hand tools listed in chapter 6 "Replacing Assemblies."

### Color CRT module extender cable

This is a 40-conductor ribbon cable with 40-pin female connectors on each end. The cable should be about 4 feet long.

| | Connector | Cable |
|---|---|---|
| 3M Part No. | 3417-6640 | 3365-40 |
| HP Part No. | 1251-8231 | 8120-1613 |

### Plug-in extender cable

This is a 25 conductor cable with a 25-pin female sub-D on one end and a 25-pin male sub-D on the other. The cable should be about 2 feet long. You need to remove one conductor from the cable noted below.

| | Female Connector | Male Connector | Cable |
|---|---|---|---|
| 3M Part No. | 8325-6000 | 8225-6000 | 3365-26 |
| HP Part No. | 1252-0048 | 1251-8352 | 8120-1506 |

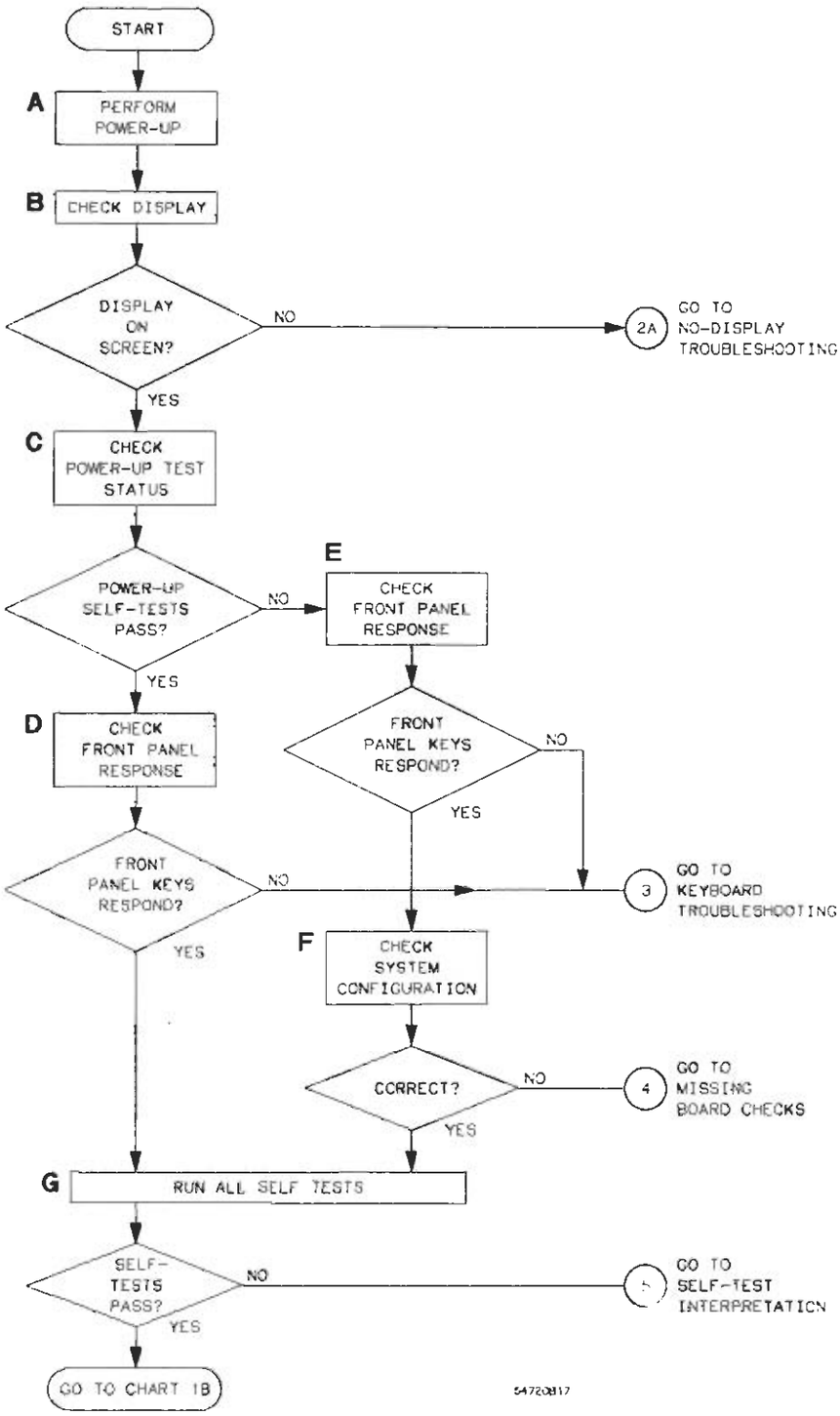
### OSP (Blindmate) extender cable

To isolate problems in the plug-in, it may be necessary to connect the strobe pulse by the OSP (Blindmate) extender cable. This cable consists of the following cables and adapters.

| | |
|---|---|
| HP Part No. E2602-61601 | Coaxial cable OSP (m) to SMA (m) |
| HP Part No. 83481-60006 | Coaxial cable OSP (f) to SMA (m) |
| HP Part No. 1252-1158 | Adapter SMA (f-f) |



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**Primary Trouble Isolation Flowchart 1A**



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# Primary Trouble Isolation

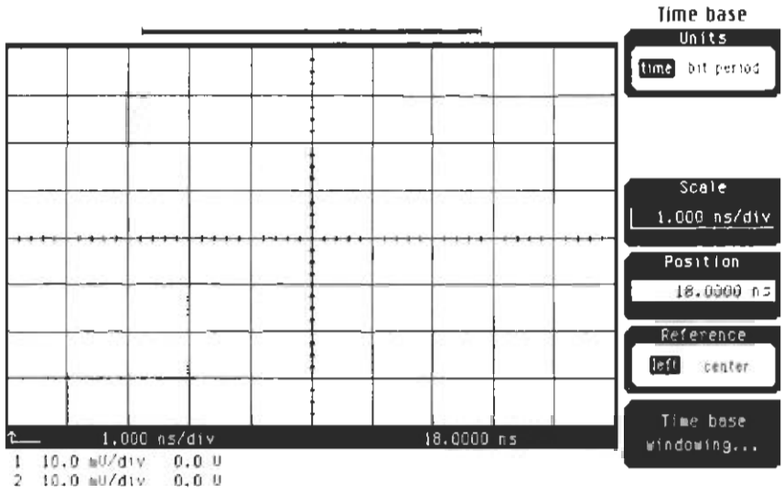
Except for moving the plug-ins between slots in the mainframe, the actions in the Primary Trouble Isolation Flowchart are performed without disassembling the instrument. Interaction of the front panel and other indications are used to help identify the problem area.

A letter is assigned to boxes in the flowchart. The letter corresponds to a specific section in the reference text. Be sure to use the flowchart itself for your troubleshooting path.

## A Perform power up.

**1** Turn on the instrument.

A few seconds after the instrument is turned on the graticule and a function menu is displayed on the screen. The screen should look similar to the next figure. Items in the softkey area will vary, depending on the setup selected before the instrument was turned off.




**Power-Up Display, Time base Menu**

If a fault occurs on power up, the screen will display "Power-On Test FAILED!." The power-on test just runs a few essential self-tests.

**2** Press the Setup key, press the **`Default Setup`** softkey, then press the Time base key.

## B Check the display.

The display onscreen should be similar to the figure above. If there is no display on the CRT screen after power up, go to the No-Display Trouble Isolation flowchart for further troubleshooting.



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**C** Check power-on test status.

When the instrument is turned on the Power On Tests are performed. If the tests fail, a power-on test FAIL message appears at the top of the CRT screen. It will stay on screen until a key is pressed. If the tests pass, no message is displayed. The Power On Test status is shown in the system configuration menu.

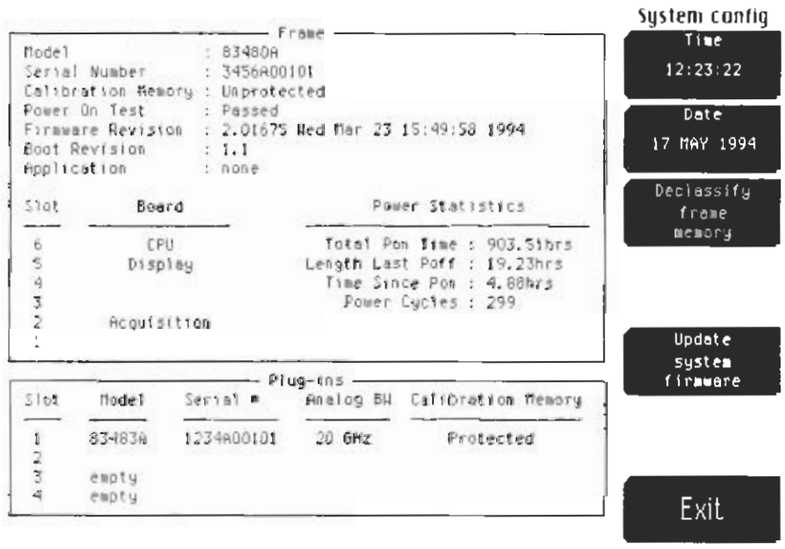
**D/E** Check the front panel response.

Try pressing the different menu keys, such as Time base or Trigger, and the Channel keys on the plug-ins. Each of these keys should change the set of softkeys on the right side of the screen.

**F** Check the system configuration.

For more information about the system configuration menu, see "Utility Menus" in this chapter.

1. In the System keys, press the Utility key, then press **`System Config...`** softkey.
2. Verify that the slots show that all the boards are installed, as in the figure below.
3. If the System Configuration is not showing a board in a slot, go to the "Missing Board Checks" section for further trouble-isolation procedures.




**System Configuration**

**G** Run all of the self-tests.

1. Press the Utility key, then press the **`Self test...`** softkey.
2. Toggle the **`Board`** softkey until **`Test all boards`** is highlighted, then press the **`Enter`** softkey.
3. Press the **`Start`** softkey, then allow the instrument to run the tests.
4. If any of the self-tests fail, go to the "Interpreting Internal Self-tests" section for further information.

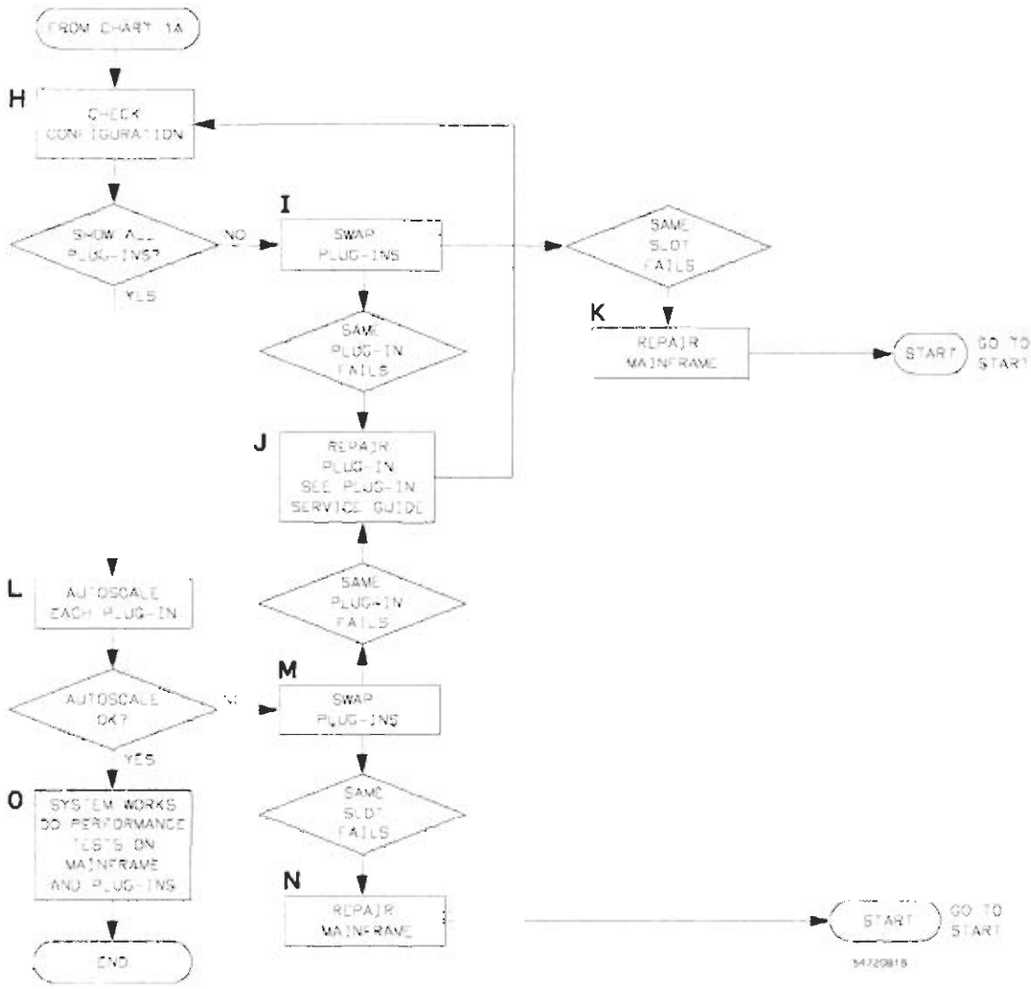


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**NOTES**



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**Primary Trouble Isolation Flowchart 1B**



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**H** Check instrument configuration.

Press the Utility key, then press the **`System Config...`** softkey. The plug-ins are listed at the bottom of the screen.

If a plug-in is not listed, it has not been recognized by the mainframe. Ensure that the plug-in is firmly seated in the mainframe, and that its memory is programmed.

**I** Swap plug-ins.

If the mainframe does not show the plug-in, swap the plug-in to the other two plug-in slots.

- If the failure follows the plug-in, the plug-in needs repair.
- If the failure is in the same slot as before, there is a problem with the mainframe.

**J** Repair the plug-in.

1 Use the trouble isolation procedures in the Service Guide for the failed plug-in.

2 Reinstall the repaired plug-in and resume troubleshooting at block H of this chart.

**K** Repair the mainframe.

For this type of mainframe problem, first try replacing the CPU board. If that does not correct the problem, replace the motherboard.

**L** Autoscale test each channel.

Using a power splitter and cables, connect a 0.5 Vp-p, 10 MHz signal to both the channel input and the trigger input, then press the Autoscale key.

**M** Swap the plug-ins.

If the autoscale for a plug-in is not successful, swap it with a plug-in that does autoscale and retry autoscale of both plug-ins.

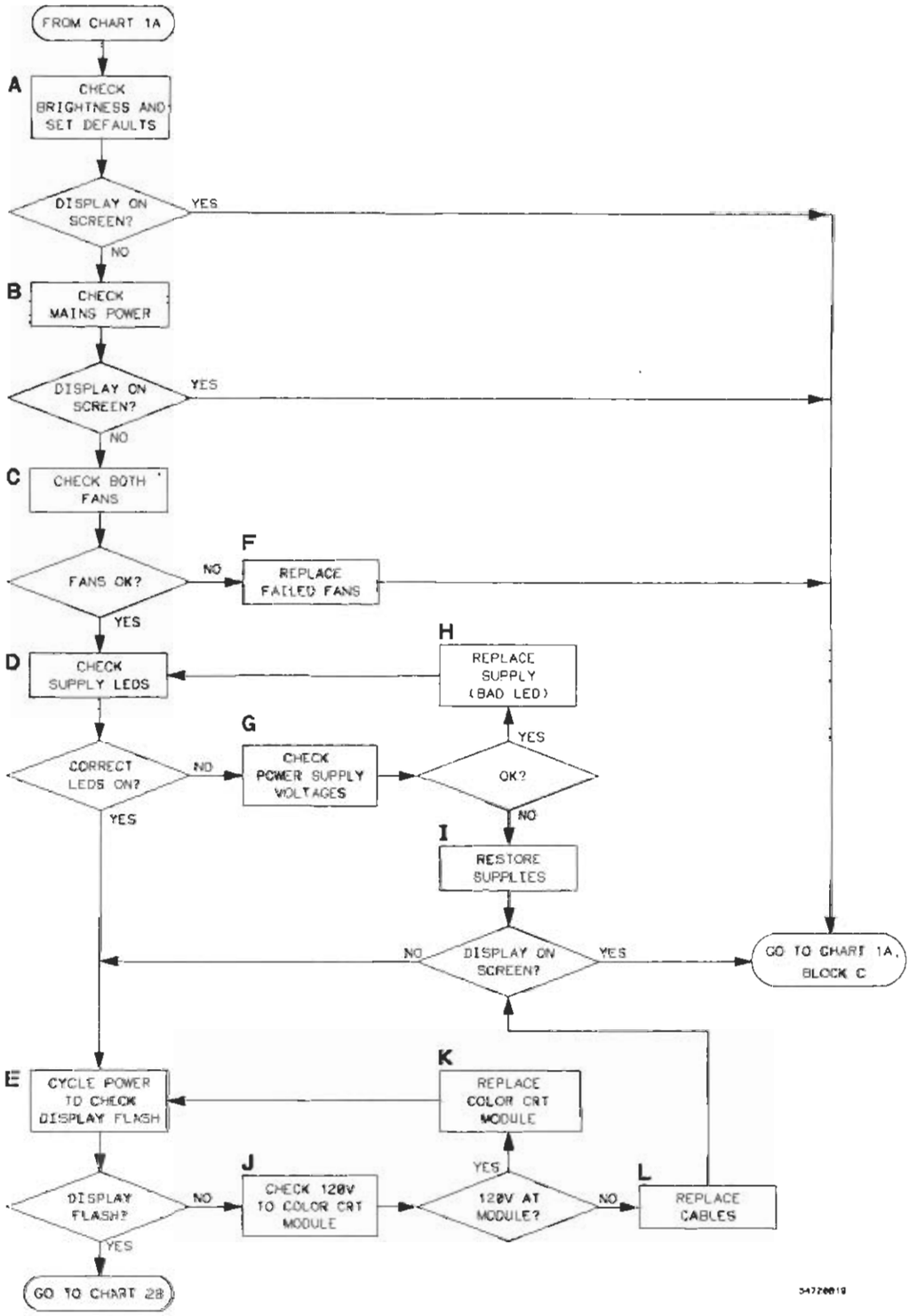
**N** Repair the mainframe.

In this case the mainframe failure is most likely in the Time base and Acquisition assembly.

**O** The system is operational. Performance test the mainframe and each plug-in according to the procedures in chapter 3 of the Service Guides.



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**No-Display, Trouble Isolation Flowchart, 2A**



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# No-Display Trouble Isolation

These trouble isolation details help isolate a problem to the assembly level when there is no display on the color module screen.

**A Check brightness and set defaults.**

1 Check that the front panel brightness control (top adjustment) is set fully clockwise.

2 Set up the instrument defaults. Press the Setup key, then press the bottom (`Default setup`) softkey.

**B Check mains power.**

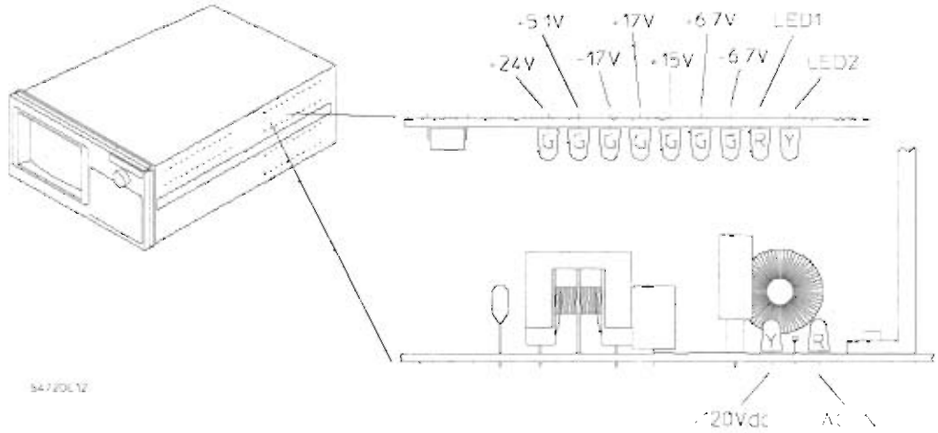
- Verify that the instrument power cable is connected.
- Verify that the line select switch on the rear panel is set to the proper line voltage, 115 V or 230 V.
- Check that the rear panel circuit breaker and the front panel Power switch are both ON.

**C Check that both the rear fan and that the front fan are operating.**

- The rear fan is located in the compartment directly behind the color CRT module.
- The front fan is located above the plug-in slots, behind the disk drive. To view the front fan, remove plug-ins from slots 3 and 4 and look into the area above the plug-in slots.

The power supply Remote Shut Down (RSD) circuit will shut the supply down if either fan is not connected or a fan does not start rotating immediately when power is turned on. One symptom of an inoperative fan is a particular sequence of LED indications on power-up.

1 Use the figure below to establish the location of the power supply LEDs. They can be viewed through the ventilation holes in the side of the instrument.




**Power Supply LED Location**

2 Cycle the power while watching the LEDs.

a The seven green LEDs and 120 V yellow LED light for 1 to 5 seconds, then go off.

b Then LED1 (red) and LED2 (yellow) come on.

3 Cycle the power while watching the fans.

If the LED sequence happens as noted in step 2, cycle the power while watching each fan in turn. A good fan should start to run as the power comes up, then stop when remote shutdown occurs. A faulty fan probably will not run at all.



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**D** Check supply LEDs.

Verify that the correct supply LED indicators are lit. Use the figure on the previous page. An unlit LED indicates that the respective power supply voltage is missing.

- The red AC IN LED is on.
- All seven green LEDs are on.
- The yellow LED for +120 Vdc is on.

Both LED1 and LED2 are normally off. When on, they indicate a supply failure or shutdown.

**Failure LED Indications**

| | |
|---|---|
| **LED1 on, LED2 off** | The power supply is in either Over-Load-Protection or in Over-Temperature- Protection condition. In this case, verify the vent holes are clear and allow the instrument to cool if necessary. If the instrument is cool and the condition persists, suspect a short circuit on one of the supplies. |
| **LED1 on, LED2 on** | The power supply is in the Over-Voltage-Protection or the Remote-Shut-Down mode. A disconnected or non-working fan will cause the power supply to go into Remote-Shut-Down mode. See step C above. The Over-Voltage-Protection condition indicates the power supply is not properly loaded or is not maintaining regulation and needs to be replaced . |

**E** Cycle the power to check for display flash.

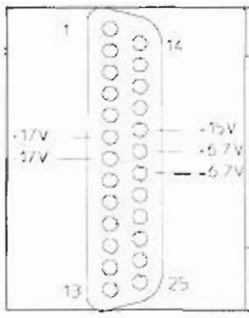
When there is no display, try cycling the power off, then on. If the screen flashes, the +120 Vdc supply voltage is reaching the color CRT module.

**F** Replace failed fan.

Replace a fan that will not attempt to run.

**G** Check the power supply voltages.

**1** Five of the seven supply voltages can be checked on any of the bus connectors in the plug-in compartment.




| Pin # | Voltage | Approx. Resistance |
|---|---|---|
| 6 | +17 V (17 V to 18 V) | 100 Ω |
| 7 | −17 V (−17 V to −18 V) | 200 Ω |
| 18 | +15 V (14.5 V to 16 V) | 500 Ω |
| 19 | +6.7 V (6.7 V to 7.7 V) | 50 Ω |
| 20 | −6.7 V (−6.7 V to −7.7 V) | 5 Ω |

**Voltages Accessible on Plug-in Connectors**

**2** Set the Power switch to Standby and measure the supply line resistance (with respect to ground) at the pins shown in the above figure. If the supply voltages are down, it can be caused by a short on an assembly.

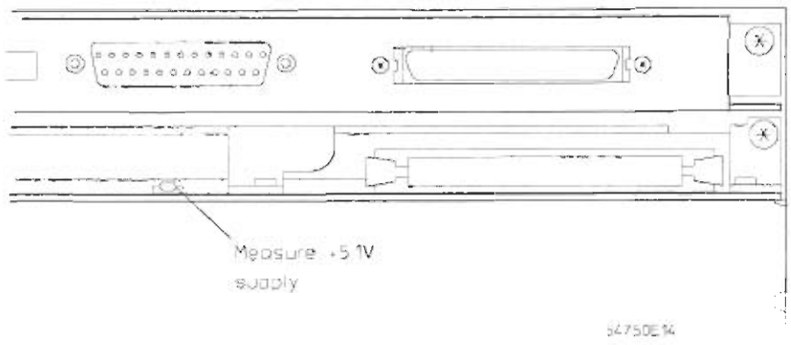
**3** Check the +5.1 V supply.

**a** Remove the rear panel and find the display assembly. It is the second assembly below the power supply.



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b Apply power and measure the +5.1 V supply voltage at the decoupling capacitor visible just to left of the center of the board.




**+5-V Supply Measurement Point**

c Set the Power switch to Standby, allow the supplies to discharge, then measure the resistance of the supply line. It should be about 20 Ω.

**H** Replace the supply.

Apparently the supply works but an LED is not lit. Replace the supply to correct the problem.

**I** Restore the supplies.

Either the power supply is faulty or an assembly is overloading the supply. Use the "Power Supply Distribution" section and other isolation techniques to isolate the excessive load on the supply.

**J** Check for 120 Vdc at the module.

If the screen does not flash when the power is cycled, extend the color CRT module and check for 120 Vdc at the module. (See "To remove and replace the color CRT module" in chapter 6.) There is an intermediate cable between the module shield and the module circuitry. You will have to remove the shield to check further.

While the module shield is off, check the ribbon cable connection.

**K** Replace the module.

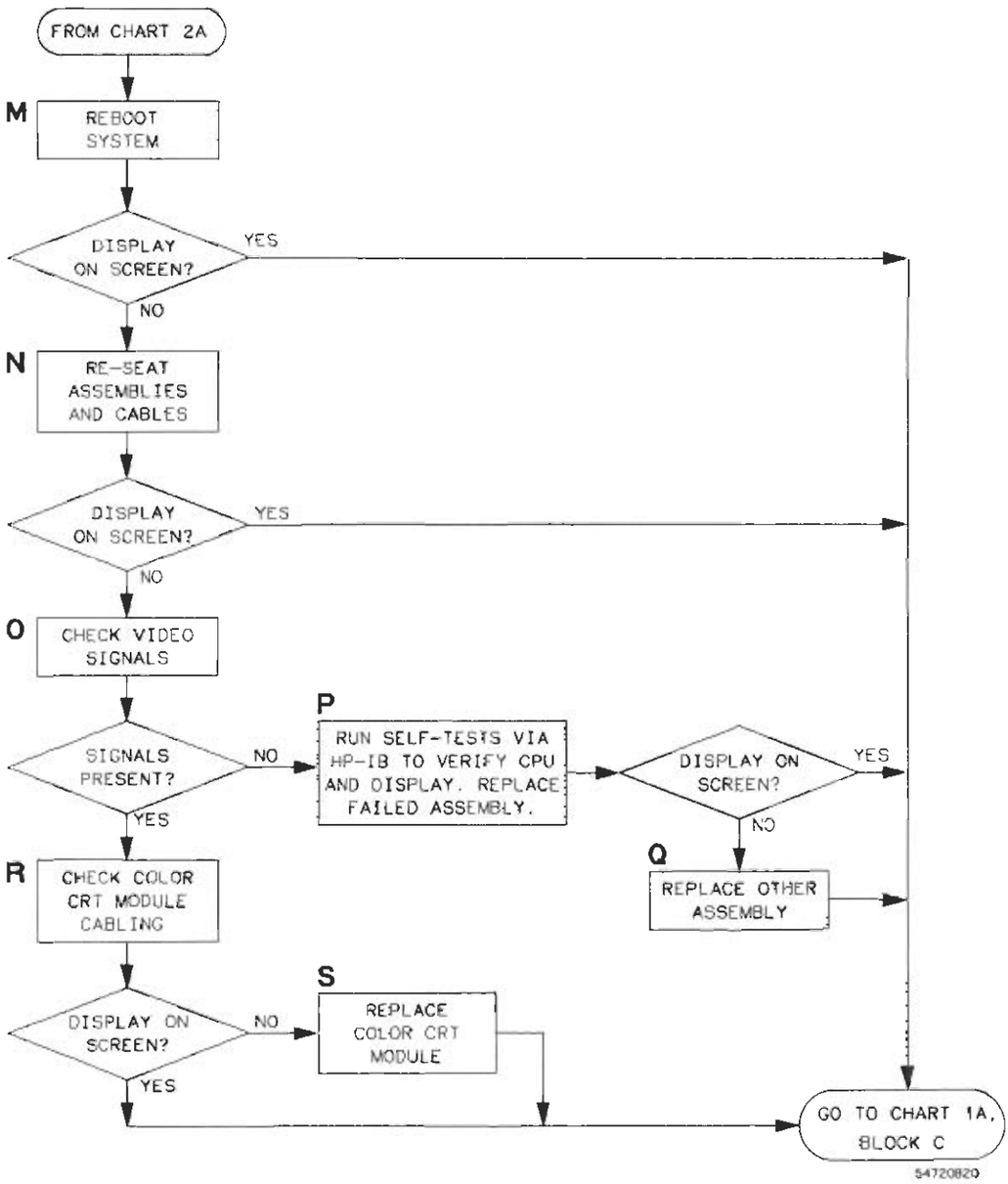
If the +120 Vdc is reaching the color CRT module but it does not flash when the power is cycled, replace it with a different one. (See "To remove and replace the color CRT module" in chapter 6).

**L** Replace cables.

The most likely cause of the lack of power is a bad cable. However, the 120 V comes through the motherboard. Check for 120 V at the motherboard connector. If 120 V is not on the motherboard connector, there is a problem on the motherboard or with the power supply connection to the motherboard.



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**No-Display, Trouble Isolation Flowchart, 2B**

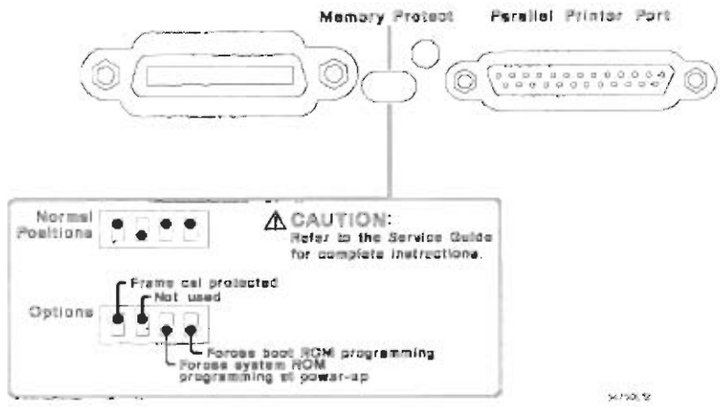


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**M** Re-boot the system.

There are three ways to force the system to load firmware when you cannot see the display.

- If the disk drive light comes on when power is applied, the instrument knows the firmware is corrupted. To load the operating system, insert the system disk and cycle the power.
- If the disk drive light does not come on, the firmware may be corrupt but the instrument is not aware of that and will not try to load new firmware. Use the following procedure.
  - **a** Set the rear panel system ROM switch down, as shown in the figure below.




**ROM Programming at Powerup**

  - **b** Install a system disk and apply power.

    The operating system loading operation takes a few minutes. When finished, the disk drive light will go out.
  - **c** Cycle the power. The display should come up on the screen.
- If the system is operating but has no display, you can load the firmware using the front panel even if you cannot see the display.
  - **a** Insert the system disk.
  - **b** Press the Utility key, press the second softkey from the top, then press the third softkey from the bottom.
- If the instrument loses its operating system when power is turned off, the battery on the CPU may be low.

**N** Reseat assemblies and cables.

A no-display condition can be caused by disconnected or improperly seated connectors. Try the following:

- Check the ribbon cable connection between the display board and the color CRT module.
- Check the ribbon cable between the CPU board and the display board.
- Reseat the CPU board and Display boards.



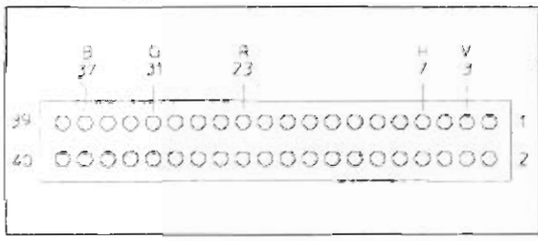
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## O Check the video signals.

The video signals are conducted from the display board to the color CRT module via a wide ribbon cable. To remove parts and assemblies, refer to procedures in chapter 6.

1 Remove the ribbon cable from the rear of the display board. The display board is the second assembly below the power supply.

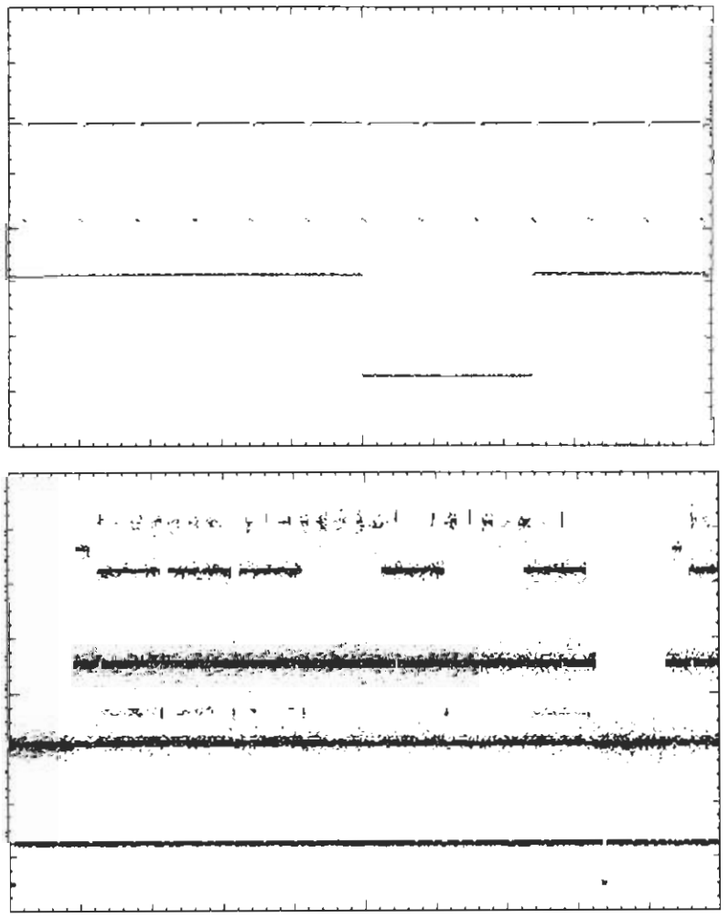
2 Use the following figure to locate the video signals on the PC board connector.




| Pin | Signal |
|---|---|
| 3 | Vertical sync, ≈60 Hz |
| 7 | Horizontal sync, ≈25 kHz |
| 23 | Red Video |
| 31 | Green Video |
| 37 | Blue Video |

**Video Signal Locations**

3 Use another instrument to check for video signals similar to the following figure.




**Video Signals**



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**P** Run self-tests over HP-IB.

If all the power supplies are running and there is no display, the problem may be caused by the CPU board or Display boards. Run the internal self-tests via the HP-IB to verify the CPU board and Display boards are running. The procedure gives an example program.

1. Connect an HP series 200/300 controller.
2. Set the HP-IB address on the instrument.

   For the following program to run, the instrument address must be set to 7. Since the display is blank, you will have to do it without seeing the softkey names on the screen.

   a. Press the Utility key.

   b. Press the **HP-IB setup...** softkey, (the top softkey).

   c. Set the **address** softkey to **7**, set the **Mode** softkey to **controller**, then press the **Enter** softkey.
3. Run this program for a CPU self-test. The test takes about 3 minutes; a much longer test indicates the test is failing.

```
10   !This program runs HP 54750 self-tests over the HP-IB
20   !and prints the pass/fail result.
30   !
40   DIM Test$[100]
50   CLEAR 707                                !Clears HP-IB interface.
60   !
70   OUTPUT 707;"SELF TEST:CPU? ALL"          !Commands HP 54750 to run a
80                                            !self-test.
90   !
100  ENTER 707;Test$                          !Returns results of
110                                           !self-test.
120  PRINT Test$
130  END
:SELF TEST: CPU PASSED
```

4. To run a Display self-test, change the program.

   a. Change line 70 so that it will run the display test. Change "CPU?" to "DISP?".

```
70   OUTPUT 707;"SELF TEST:DISP? ALL"         !Commands HP 54750 to run a
80                                            !self-test.
```

   b. When the test is finished the instrument will return to the controller:

```
:SELF TEST: DISPLAY PASSED
```

5. Replace the failed assembly.

**Q** If the display does not show after block O, replace the assembly not replaced in block O.

**R** Check color CRT module cabling.

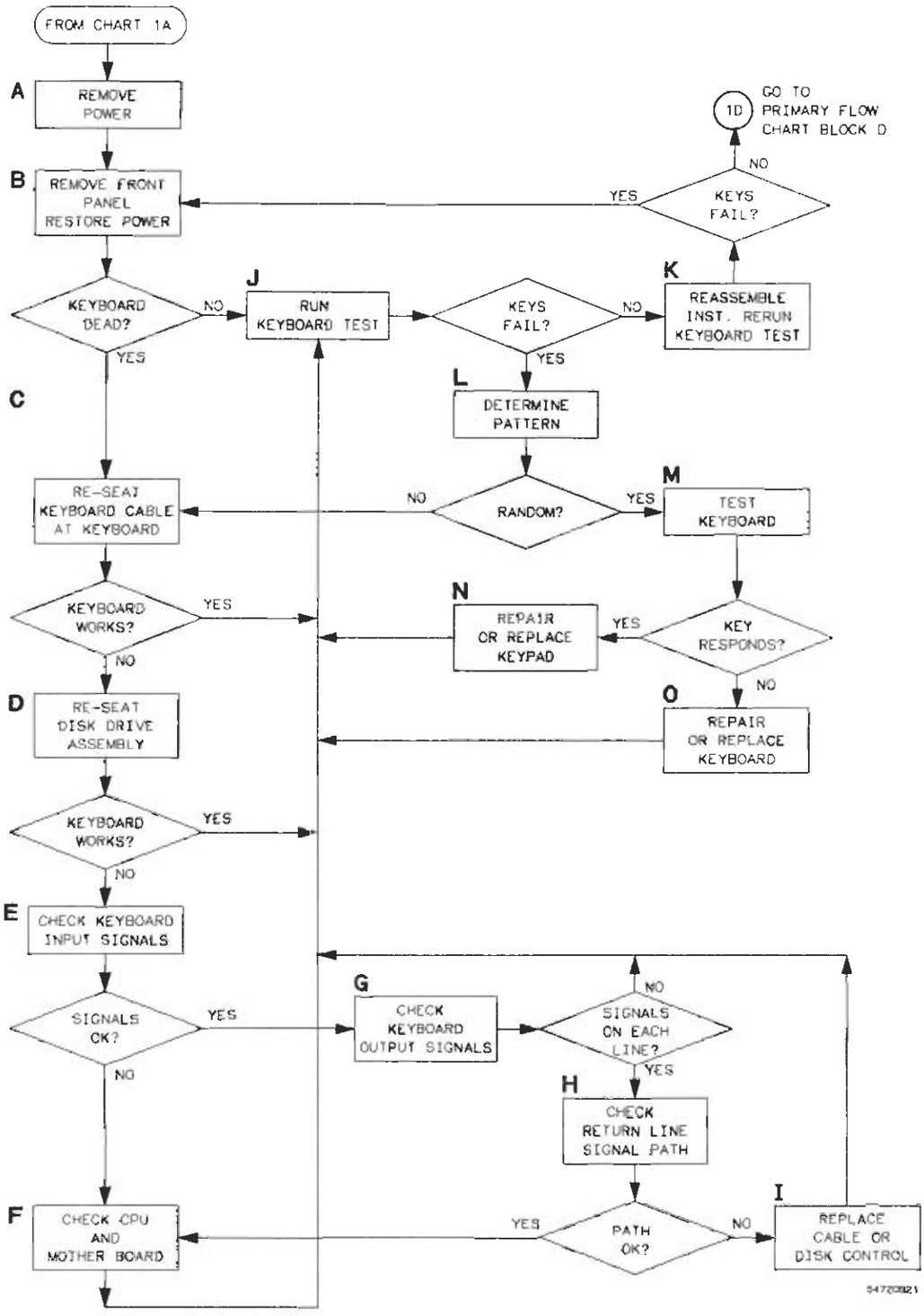
If video signals are present at the display PC board connector but there is no display, check the cabling to the module. To remove parts and assemblies, refer to procedures in chapter 6.

1. Remove the module from the instrument.
2. Remove the shields from the module.
3. Check the ribbon cable connection.
4. Connect the module cables and apply power.
5. If there is still no display, check for the video signals at the module end of the ribbon cable. Use the figures on the previous page.
6. If there are no video signals, replace the cable. If there are, replace the module.

**S** Replace the color CRT module.



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**Keyboard Troubleshooting Flowchart**



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# Keyboard Trouble Isolation

Use this section to isolate keyboard problems. Such problems can usually be isolated into two groups, those that indicate complete keyboard failure and those that indicate random key failures. However, electrically the keys on the front panel are in a six by eight array, so multiple key failures may have a pattern that is masked by the layout of the keyboard.

Refer to the instrument block diagram in chapter 8 and to the exploded views in chapter 7 for cable interconnect information. Notice that the front-panel keyboard is connected by cable to the disk control board. The disk control board plugs into the mother board. The problem can be a disconnected cable or connector in the keyboard signal path.

**CAUTION** **Always remove power before removing and replacing assemblies. Failure to remove power may result in damage to the instrument.**

**A Turn off the power and remove the power cord.**

**B Remove the front panel.**

Refer to the disassembly procedure in chapter 6.

**C Reseat the keyboard cable in the front-panel board connector and retry instrument operation.**

To remove this connector, push in the metal clips on both ends of the connector and pull the connector out.

**D Reseat the disk drive assembly.**

**1 Remove power.**

**2 Remove the disk drive and disk control board as a unit and reseat all connectors.**

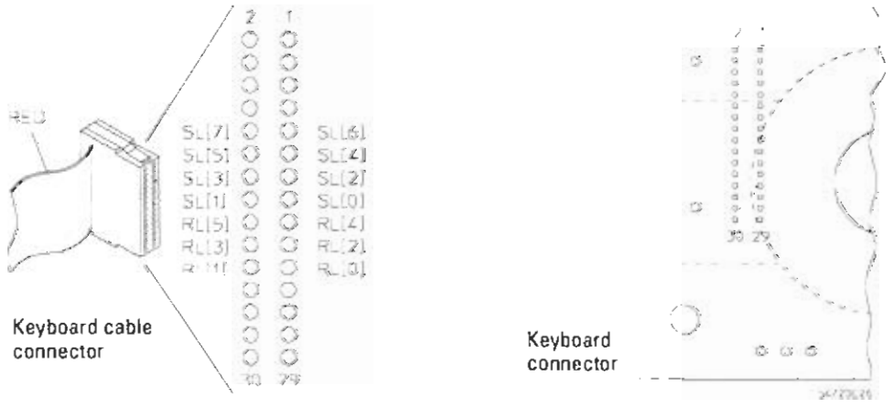
To remove this assembly, remove the one screw that holds the disk drive assembly at the front of the plug-in enclosure.

**3 Reinstall the disk drive assembly and retry instrument operation.**

**E Check the keyboard input signals.**

Refer to the figure below and the table on the next page. The keyboard input signals consist of eight strobe lines, SL[0] through SL[7]. Each line should show a negative TTL pulse 1 ms wide at about 126 Hz (7.9 ms period).

**1 Check the strobe signals on the keyboard connector. If the signals are good, go to block G.**




**Keyboard Signal Test Locations**



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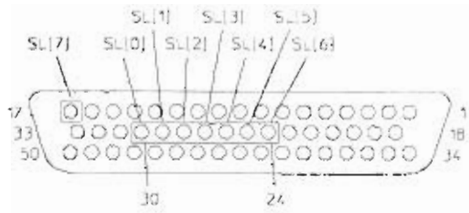
2 Check the strobe signals at the motherboard connector where the disk control board plugs in.

a Remove the disk drive assembly.

Remove the one screw that holds the disk drive assembly at the front of the plug-in enclosure.

b Apply power and check the signals.

When power is applied the signals should be present. However, the display will not come up because the front panel is disconnected.



**Motherboard connector**

- If the signals are correct, the CPU and motherboard are functioning and the problem is between the motherboard and the front-panel board connector. Check for continuity through the disk control assembly and keyboard cable.
- If the signals are not correct, the problem is with the CPU or motherboard.

F Check the CPU and motherboard.

Try the following, in this order. Use the disassembly procedures in chapter 6.

1 Remove and reseat the CPU board.

2 Replace the CPU board.

3 Replace the motherboard.

**Keyboard Signal Lines**

| Return Lines (out) | Strobe Lines (input) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SL[7] | SL[6] | SL[5] | SL[4] | SL[3] | SL[2] | SL[1] | SL[0] |
| RL[0] | Time base | Trigger | Acquisition - Acquisition | Display | Marker | Define meas | Math | Application - cation |
| RL[1] | Help | Utility | Softkey 6 (bottom) | Softkey 5 | Softkey 4 | Softkey 3 | Softkey 2 | Softkey 1 |
| RL[2] | Clear display | Run | Stop Single | Disk | Wave-form | Setup | Print | Auto-scale |
| RL[3] | Softkey 0 (top) | Shift (blue) | 0 | 1 | 4 | 7 | 8 | 5 |
| RL[4] | 2 | . | Clr | Eex | ± | 3 | 6 | 9 |
| RL[5] | — — — | pico | nano | micro | milli | Enter | ⇐ ⇓ | ⇑ ⇒ |

G Check the keyboard output signals.

1 Use the figure on the previous page and the table above.

2 While monitoring each output line in turn, (RL[0]–RL[5]) press a key on that line.

You should get the same signal as the input lines, a negative TTL pulse 1 ms wide at about 126 Hz.

H Check the return line signal path (RL[0]–RL[5]).

1 Use the figure on the previous page, the table above, and the table on the next page.

2 Use an ohmmeter to check continuity between the keyboard and the disk control connector that plugs into the motherboard.



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**Keyboard Signal Locations**

| Keyboard Connector Pin | Signal | Disk Control Connector Pin | Keyboard Connector Pin | Signal | Disk Control Connector Pin |
|---|---|---|---|---|---|
| 1 | Trig LED | 8 | 16 | SL[1] | 29 |
| 2 | Armed LED | 9 | 17 | SL[0] | 30 |
| 3 | A Trig LED | 10 | 18 | RL[5] | 31 |
| 4 | SW LED0 (Shift) | 11 | 19 | RL[4] | 32 |
| 5 | -- | 12 | 20 | RL[3] | 33 |
| 6 | -- | 13 | 21 | RL[2] | 41 |
| 7 | RPG A | 14 | 22 | RL[1] | 42 |
| 8 | RPG B | 15 | 23 | RL[0] | 43 |
| 9 | Grd | 16 | 24 | VCC +5.1 | 44 |
| 10 | SL[7] | 17 | 25 | REMOTE ON/OFF | 45 |
| 11 | SL[6] | 24 | 26 | GND | 21 |
| 12 | SL[5] | 25 | 27 | +12V | 47 |
| 13 | SL[4] | 26 | 28 | +12 RTN | 48 |
| 14 | SL[3] | 27 | 29 | Background | 49 |
| 15 | SL[2] | 28 | 30 | Brightness | 50 |

**I** Replace the keyboard cable or disk control, whichever is faulty.

**J** Run the Front Panel test.

1. Press the Utility key, then press the **`Self test`** softkey.
2. Toggle the **`Board`** softkey until **`Front Panel`** is selected.
3. Press the **`Enter`** softkey, then press the **`Start`** softkey.
   This brings up a diagram of the mainframe's front panel. The individual keys will highlight as they are pressed.
4. Press all the keys to determine if keys or groups of keys are not functioning.

**K** Reassemble the instrument and run the keyboard test again.

**L** Determine the key failure pattern.

Use the previous table to determine whether there is a pattern to the key failures.

- If failures are grouped on a specific strobe line (SL[0]-SL[7]) or return line (RL[0]-RL[5]), the failure is likely to be off the keyboard. Go to block C.
- If failures are unrelated to a specific strobe or return line, the failure is probably on the keyboard. Note which keys have failed and go to block M.

**M** Test the keyboard.

On the back side of the keyboard (the side opposite the keys) at each key position is a pair of PC pads. Each pair of pads is in a small open area of the ground pattern. These PC pads, one square and one round, are connected to the key contacts on the opposite side.

- At the failed key, use a short wire or paper clip to carefully short the square and round PC pads.

**N** Repair or replace the keypad.

Check for contamination on the PC traces or keypads. The keypads are very simple. Contamination may prevent contact between the black contact on the pad and the board.

**O** Repair or replace the keyboard.

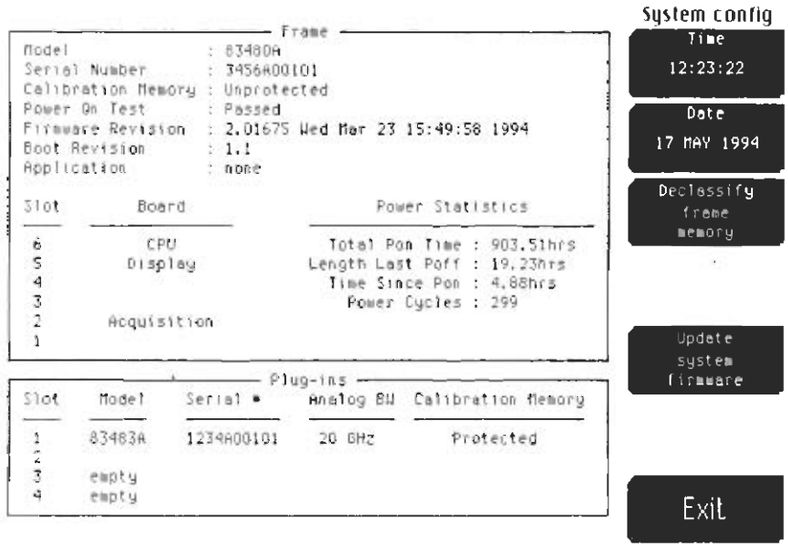
The failure may be a broken trace.



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# Missing Board Checks

The mainframe has the following system configurations.




**System Configuration**

**CAUTION** Do not remove or replace PC assemblies when the instrument is powered. Doing so may cause circuit failures. However, plug-ins can be removed and installed with power applied.

Use the procedures in chapter 6 for removing and replacing assemblies.

1. Press the Utility key, then press the **`System Config...`** softkey. You should have the display shown above.
2. If the instrument appears to be missing a board in one or more slots, turn off the power and reseat the board/assembly that is not showing.
3. Reapply power and check the configuration (step 1).
4. If there is still a missing board repeat the procedure, making the next one of the following changes at step 2 each time.
   - Reseat the microprocessor assembly.
   - Replace the board/assembly that is not showing.
   - Replace the microprocessor assembly.
   - Replace the motherboard assembly.



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# Interpreting Internal Self-tests

The internal self-tests exercise the internal circuitry on the respective mainframe assemblies. Some of the tests require that some associated circuitry on interfacing boards is working also. These tests only do limited checks on the time base and acquisition board, and they do not test the plug-ins. The time base and acquisition assembly in the mainframe and the plug-ins are checked by attempting the plug-in calibration in different mainframe slots.

### Time base and acquisition

The time base circuitry controls the sampling times and sequences for the various sweep speeds. The acquisition circuitry captures the peak levels on the bipolar pulse coming from the plug-ins. The self-test checks the sequence memory in the time base circuitry and the look through memory in the acquisition circuitry. If either of these tests fail, replace the board. The rest of the circuitry is verified by swapping the plug-in between slots and calibrating the plug-in in the different slots

If the self tests continue to fail, reseat the assemblies in the motherboard connectors and retry the tests. If the tests still fail, replace the time base and acquisition assembly.



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### CPU

If the CPU self tests pass and the Display self tests pass, the CPU is tested to the 95% level. The only circuitry not tested with these tests are the interface/port drivers. These self tests can also be run by HP-IB if the color CRT module is not functioning. See "Run self tests by HP-IB" in the "No-Display Trouble Isolation" section.

If the self tests fail:

1. Remove the CPU and display board as a unit.
2. Reseat the ribbon cable between the two assemblies.
3. Reinstall the assemblies in the mainframe.
4. Retry the self-test.
5. If the self tests continue to fail, replace the CPU assembly.

### Display

The Display self tests check the display board circuitry to a 90% confidence level. If any of the tests fail, try reseating the display and CPU assemblies as given in "CPU" above, and rerun the tests. If the test continues to fail, replace the display assembly.

### Floppy Disk

The Floppy Disk self test checks that the disk drive can be accessed by the CPU. The self test verifies operation of the disk drive to a 90% confidence level. To check the disk drive to 100% confidence level, run the self test and format a disk. To format a disk:

1. Press the Disk key.
2. Set the **Operation** softkey to select **Format**, then press the **Enter** softkey.
3. Press the **Execute** softkey.

### Front Panel

The Front Panel self test checks operation of the front panel keys and the RPG (knob). If there is a problem, check which keys are operating and refer to "Keyboard Trouble Isolation" for further procedures.

Though the front panel test is part of the list of the other self tests, it does not run when **test all boards** is run. To run the front panel test:

1. Press the Utility key, press the **self tests...** softkey, set the **Board** softkey to **front panel**.
2. Press the **Enter** softkey, then press the **Start** softkey.
3. Press each key and turn the knob.

   If they function, each key will highlight when it is pressed and the knob symbol on the display will rotate.
4. When you see that everything works, press Stop/Single key until the test exits.



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# Power Supply Distribution

You can use the following information if the power supplies are being loaded excessively and you need to know which supplies are used on each assembly.

### General Supply Distribution

The power supplies to the assemblies shown in the table below are distributed through the motherboard; shading indicates use. Two other supplies are noted in following paragraphs.

**Power Supply Distribution**

| Assembly | Supplies[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ( ) Motherboard connector | -17 | -6.7 | DGND | AGND | +5.1 | +6.7 | +15 | +17 |
| (J1) Time base Acquisition | ■ | ■ | ■ | ■ | | ■ | | ■ |
| (J4) Display | | | ■ | | ■ | | | |
| (J5) CPU | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| (J9) Disk Control | | | | ■ | | | | |
| (J10-J13) Plug-ins | ■ | ■ | | ■ | | ■ | ■ | ■ |
| Disk Drive[2] | | | | | | | | |
| Front Panel[2,3] | | | | | ■ | | | |

[1] All supplies listed in the table come from the Power Supply assembly (see note 2).

[2] The supply for this assembly comes through the Disk Control assembly.

[3] A +12-Vdc supply, used exclusively for the Background and Brightness controls, comes from the color CRT module through the motherboard and goes to the Front Panel assembly.

### Fan Supply

The rear fan is connected directly to the power supply assembly. The front fan is connected to the same supply but through the motherboard. The power supply detects fan rotation so if a fan is not connected, the power supply will not be allowed to come up and the instrument will not function. The fans are connected to a +24 V supply, which can vary between +11 V and +27.5 V depending on the temperature within the instrument.

### Color CRT Module Supply

The Color CRT Module is powered by a separate supply from the power supply assembly. This +120 Vdc supply is not distributed to any other assemblies. The +120 V supply is distributed through the motherboard.

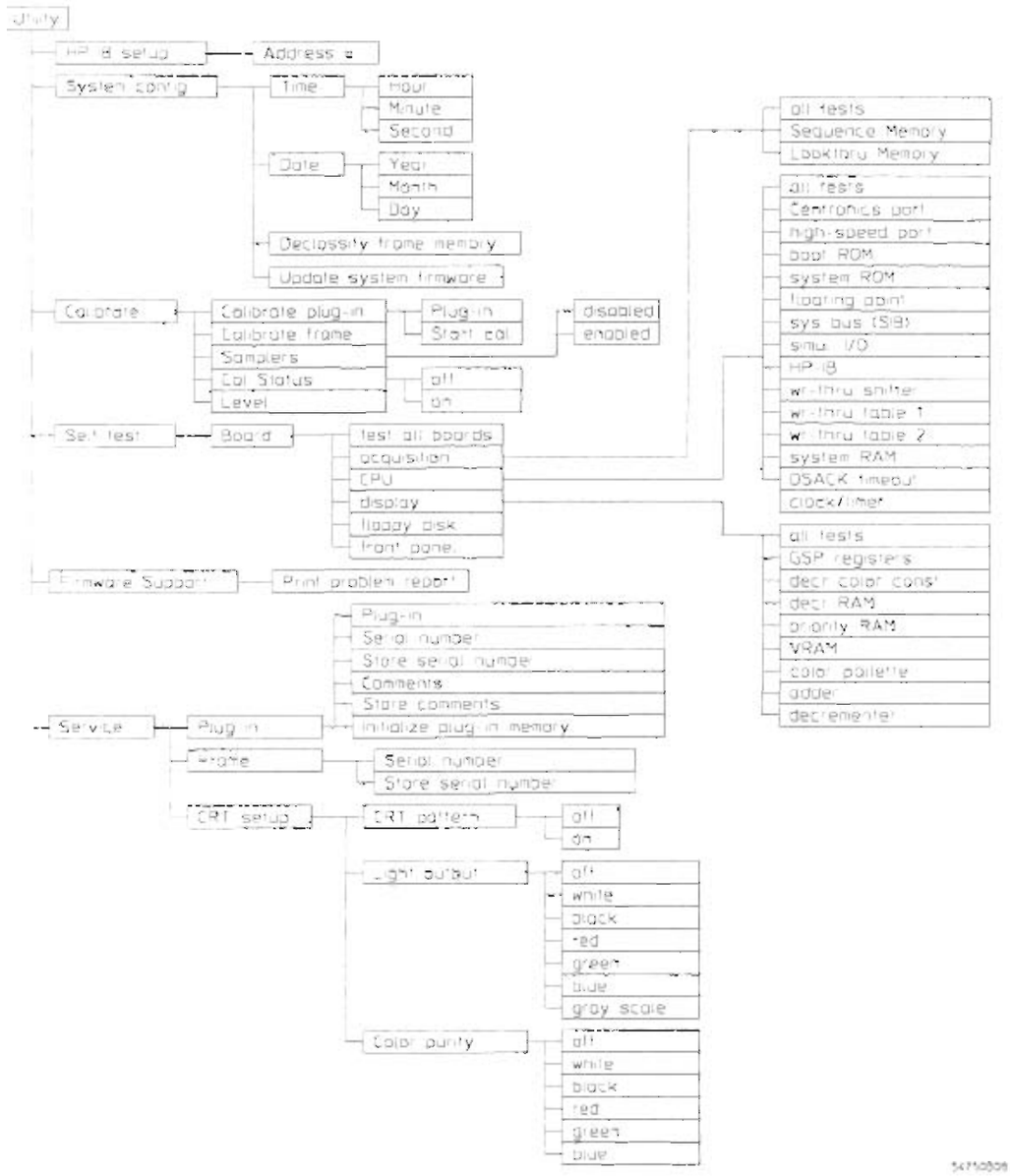
### Power Standby Switch

The front panel power switch operates as a remote control for the regulators in the power supply. To shut the supplies Off, the switch grounds a control line from the supply.

With the rear panel switch set to on and the front-panel switch set to Standby, mains power is still applied to the power supply. The AC IN LED (red) should be lit. Power supply status LEDs are visible near the top-middle of the right side of the instrument. See the figure on page 5-11.



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**Utility Menu Selections**



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# Utility Menu

The utility menu provides six additional softkey menus: HP-IB setup, System configuration, Calibrate, Self tests, Firmware support, and Service.

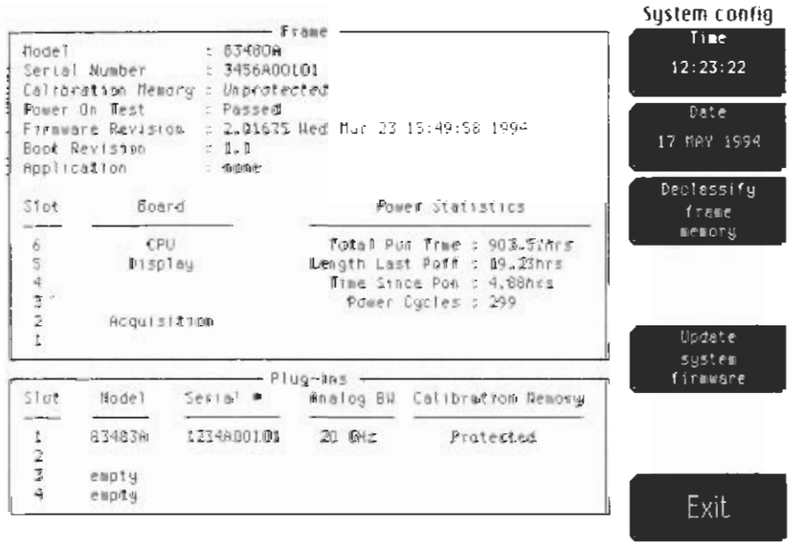
## HP-IB Setup

You may have several instruments connected by a common bus to a computer or controller. Each instrument on the bus has a separate identifying address, so that the computer or controller can communicate with only one instrument at a time. The HP-IB setup menu lets you select an address from 0 to 31. The address number you select is the address that a computer or controller uses to communicate with the instrument. The default HP-IB address for instruments is 7.

## System Configuration

The system configuration menu gives you information about the mainframe and plug-ins. It allows you to set the date and time on the instrument clock. It also allows you to update the system firmware and to declassify the memory in the mainframe.

**System Configuration**






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**System Configuration**

## Frame

| | |
|---|---|
| **Model Number** | Shows the model number of the mainframe. |
| **Serial Number** | Shows the serial number of the mainframe. |
| **Calibration Memory** | Shows the position of the Frame cal switch on the rear panel. This switch is for the memory in the mainframe that contains the calibration factors . This switch is normally set to the protected position. |
| **Power On Test** | Shows if the power-on self tests passed or failed. These power-on tests verify that the three boards are in the mainframe. A "Failed message indicates that at least one board is loose or defective. The power-up routine is kept simple to enable the instrument to power up quickly. You can execute a more complete set of self tests from the self test menu. |
| **Software Revision** | Shows the revision number of the installed system firmware. |
| **Boot Revision** | Shows the boot ROM version in the mainframe. The boot ROM uncompresses files and loads new system firmware from the disk drive. |
| **Slot and Board** | Shows the rear slot number and the board (assembly) in each slot. |
| **Power Statistics *** | |
| **Total Pon time** | The total time that the instrument has run since it was manufactured. |
| **Length Last Poff** | The total time that the instrument was off the last time it was unpowered (On Standby or no mains power). |
| **Time Since Pon** | The total time that the instrument has run since the last time it was turned on. |
| **Power Cycles** | The number of times that the instrument has been turned on since manufacture. |

## Plug-ins

| | |
|---|---|
| **Slot** | Shows the slot that the plug-in is installed in. |
| **Model** | Shows the model number of the plug-in. If there is no plug-in in a slot it reads empty. |
| **Serial number** | Shows the serial number stored in the plug-in's nonvolatile memory. |
| **Analog BW** | Shows the maximum analog bandwidth of the plug-in and mainframe combination. |
| **Calibration Memory** | Shows the position of the memory protect switch in the plug-in. |

* Power statistics are stored in battery-backed RAM on the CPU assembly. Loss of battery power or replacement of the CPU will cause loss of the statistics.

### Time and Date

The instrument has a 24-hour clock and a calendar that it uses for all time references. It stamps the time and date on the following:

- Waveforms when they are acquired.
- Files stored to the disk drive.
- Waveforms transferred over the HP-IB.
- Waveforms that are printed. The print lists both the acquired time and the print time.
- Calibration events.

To change the time or date, press the **Time** or **Date** softkey,change the entry fields with the knob, arrow keys, or keypad (when using the keypad, press the Enter key before pressing the **Done** softkey), then press the **Done** softkey.



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### Declassify frame memory

Declassify the mainframe in situations when you are concerned about the security of your work. When you declassify the memory, no one can determine what you are working on by browsing through saved setups, waveforms, and displays. Declassifying places zeros in the RAM memory. This clears:

- Setup memories
- Waveform memories
- Pixel memories
- Front-panel setups
- Channel memories
- Function memories

The following memory is not affected.

- Normal mainframe calibration
- Plug-in calibration (located in the plug-in)
- Boot and system common variables
- Clock memory
- The part of display RAM that holds the firmware for the graphics processor

**See Also** The *User's Reference* for the mainframe for more information about declassifying the mainframe.

### Update system firmware

The operating system is located in the system ROM. The instrument does not need a disk in the disk drive in order to operate. The Update system firmware softkey loads new firmware.

To install system firmware:

1. Install the system disk in the disk drive.
2. Press the Utility key, press the **`System config...`** softkey, then press the **`Update System firmware`** softkey.

**CAUTION** Check the display for any messages about the firmware or any special considerations before you continue. Failure to heed messages may result in incorrect operation of the instrument.

3. Press the **`Continue`** softkey.

**See Also** To reboot the system firmware when there is a problem with the mainframe, see the "No Display Troubleshooting," specifically block L on page 5-15.

## Calibrate

Calibration is covered in chapter 4.



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## Self Test

The self test menu is used for troubleshooting failures. With the self test menus you can test all boards, test all of one board, or individual tests on a board. Since this instrument is repaired by replacing entire boards (assemblies), failure of any board test requires replacement of the board.

Use of self tests is covered where applicable in the "Trouble Isolation" section.

**See Also** "Interpreting Internal self tests" in "Trouble Isolation" in this chapter.

## Firmware Support

If you press the **`Firmware support...`** softkey, the instrument displays an information screen and a choice of two forms. These forms are your way of communicating directly with the factory. Because both forms are stored in memory, you can print a copy of either form whenever you like.

To print one of the forms from the instrument:

1. Connect a printer to the instrument.

   You can connect it to the Centronics port or the HP-IB port, depending on your printer.

2. Set up the print.

   a. Press the (blue) shift key, then press the Setup print key .

   b. Press each softkey in turn and make the appropriate selections.

3. Press the Utility key, press the **`Firmware support...`** softkey, then press the **`Print problem report`** softkey.

   The instrument will automatically include the configuration information.

   If a printer is not available, there are similar versions of the forms at the end of this chapter. Make a copy of the appropriate pages.

   To display the instrument configuration information, press the Utility key, then press the **`System config...`** softkey.

   Mail (or FAX) the form to the address (or phone number) on the firmware support display.

**Problem report**

The problem report can be used if you encounter a problem while using this instrument.



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# Service

The Service menu provides several service functions for the instrument. When you press the Service softkey, the display shows the instrument configuration (the same as in the system configuration menu) and several new softkeys.

### Plug-in . . .

When you press the **Plug-in...** softkey, you can program the serial number of the plug-in or initialize the plug-in memory. The plug-in data is stored in flash EEPROM in the plug-in.

**Store the plug-in serial number** You need to restore the plug-in serial number if:

- It is not shown in the configuration.
- You replace the plug-in PC assembly.

- To store the plug-in serial number:

1. Remove the plug-in cover and set the protect switch to ENABLE.
2. Press the Utility key, press the **Service...** softkey, then press the **Plug-in...** softkey to select the desired plug-in.
3. Press the **Serial number** softkey to display the alphanumeric list.
4. Enter the serial number.

   - With the knob, highlight each character in turn and enter it by pressing the top softkey.

   or

   - Enter numbers directly with the keypad and, highlight letters with the knob and enter them by pressing the top softkey.

   Use the **Backspace** and **Delete** softkeys to help edit the number. You cannot insert a character.
5. Press the **Done** softkey to return to the previous menu.
6. Press the **Store serial number** softkey to store the number in the plug-in.
7. If you do not have to recalibrate the plug-in, set the protect switch to DISABLE and replace the cover.

**Store the plug-in comments** You need to store the plug-in comments if:

- You wish to change the comments.
- You replace the plug-in PC assembly.

- To store the plug-in comments:

1. Remove the plug-in cover and set the protect switch to ENABLE.
2. Press the Utility key, press the **Service...** softkey, then press the **Plug-in...** softkey to select the desired plug-in.
3. Press the **Comments** softkey to display the alphanumeric list.



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4 Enter the comments.

- With the knob, highlight each character in turn and enter it by pressing the top softkey.

or

- Enter numbers directly with the keypad and, highlight letters with the knob and enter them by pressing the top softkey.

Use the **Backspace** and **Delete** softkeys to help edit the number. You cannot insert a character.

5 Press the **Done** softkey to return to the previous menu.

6 Press the **Store Comments** softkey to store the comments in the plug-in.

7 If you do not have to recalibrate the plug-in, set the protect switch to DISABLE and replace the cover.

**Initialize the plug-in** You need to initialize the plug-in if you replace the plug-in PC assembly.

- To initialize the plug-in.

Plug-in calibration will be lost when you initialize the plug-in.

1 Remove the plug-in cover and set the protect switch to ENABLE.

2 Press the Utility key, press the **Service...** softkey, press the **Plug-in...** softkey, then press the **Plug-in** softkey to select the desired plug-in.

3 Press the **Initialize plug-in memory** softkey.

4 Recalibrate the plug-in.

5 Set the protect switch to DISABLE and replace the cover.

**Frame . . .**

When you press the **Frame...** softkey, you can enter the mainframe serial number and model number.

**Store the mainframe serial number** The mainframe serial number has the same status as the calibration factors. You need to restore the mainframe serial number if:

- You replace the CPU assembly.
- The battery fails.

- To store the mainframe serial number:

1 Go to the instrument rear panel and set the frame cal protect switch to the Unprotected position.

2 Press the Utility key, press the **Service...** softkey, then press the **Frame...** softkey.

3 Press the **Serial number** softkey to display the alphanumeric list.

4 Enter the serial number.

- With the knob, highlight each character in turn and enter it by pressing the top softkey.

or

- Enter numbers directly with the keypad, a and highlight letters with the knob and enter them by pressing the top softkey.

Use the **Backspace** and **Delete** softkeys to edit the number. You cannot insert a number.

5 Press the **Done** softkey to return to the previous menu.



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6 Press the **Store serial number** softkey to store the number.

7 If you do not have to recalibrate the mainframe, set the protect switch to the Protected position.

**CRT setup . . .**

When you press the **CRT setup...** softkey you are given several choices of special displays. These displays are used to adjust the Color CRT Module and check color purity. Use of these displays is covered in "Adjusting the Color CRT Module" in chapter 4.



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Problem Report Form

Your Name _____ Job Title _____

Company Name _____ Division _____

Telephone:Area/Country Code_____ Phone Number_____

Street Address_____ FAX Number_____

City_____ Prov/State_____ Mail Stop_____

Postal/Zip Code_____ Country_____ Department_____

Date _____

Problem Report Classification

_____Hardware/Mechanical _____Documentation

_____Software/Firmware _____Remote Programming

_____Suggested Enhancement

Problem Description _____

_____

_____

_____

_____

System Description (Remote controller, Software, Printer, Cables)_____

_____

_____

Your current configuration is:

Mainframe model no. _____ Serial no. _____ Software revision _____

Plug-in 1 model no. _____ Serial no. _____

Plug-in 3 model no. _____ Serial no. _____

How would you prefer to be contacted?

_____Mail _____FAX _____Phone _____Your local HP sales representative

Return this form to Hewlett-Packard

By Mail:

Hewlett-Packard Company
Colorado Springs Division
Software Notification Manager
P.O. Box 2197
Colorado Springs, Colorado, 80901-2197 USA

By FAX

(719) 590-3505



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# 6

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# Replacing Assemblies

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# Replacing Assemblies

Procedures in this chapter should be used when removing and replacing assemblies and parts in the instrument.

## Safety

Read the safety information at the back of this manual before servicing the instrument. Before performing any procedure, review it for cautions and warnings.

**WARNING**

**Maintenance should be performed by trained service personnel aware of the hazards involved (for example, fire and electric shock). When maintenance can be performed without power applied, the power cord should be removed from the instrument. Lack of training and awareness of the hazards could result in electrical shock.**

## ESD Precautions

Use proper ESD precautions when using any of the procedures in this chapter. As a minimum, place the instrument on a properly grounded ESD mat and wear a properly grounded ESD wrist strap. Failure to take ESD precautions can cause immediate or potential failures in the instrument.

## Tools Required

The following tools are required for these procedures. This instrument uses SMC connectors that require either a 6-mm or 1/4-inch wrench. Both connector types may be used in the instrument.

- Torx drivers: T10, T15, T20
- Nut Drivers: 5/16, 7/16
- Pozidrive screwdriver: #1
- Torque wrench, 0.565 Nm (5 in-lbs), 8 mm (5/16-inch) open end

## Instrument Structure

The instrument is built from a welded steel cabinet with four closed sides. All assemblies are inserted from the front or the rear. At the front, behind the front panel, there are separate internal compartments for the plug-ins, color CRT module, and the front fan and disk drive. At the rear, behind the rear panel, one compartment encloses the rear fan and another comprises the card cage which holds the power supply, digital control system, and acquisition system. A motherboard, located between the plug-ins and card cage, is the main connection between the front and rear of the instrument.



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## To return the instrument to HP for service

Before shipping the instrument to Hewlett-Packard, contact your nearest HP sales office for additional details.

1 **Write the following information on a tag and attach it to the instrument.**

- Name and address of owner
- Instrument model numbers
- Instrument serial numbers
- Description of the service required or failure indications

2 **Remove all accessories from the instrument.**

Accessories include all cables. Do not include accessories unless they are associated with the failure symptoms.

3 **Protect the instrument by wrapping it in plastic or heavy paper.**

4 **Pack the instrument in foam or other shock absorbing material and place it in a strong shipping container.**

You can use the original shipping materials or order materials from an HP sales office. If neither is available, place 8 to 10 cm (3 to 4 inches) of shock-absorbing material around the instrument and place it in a box that does not allow movement during shipping.

5 **Seal the shipping container securely.**

6 **Mark the shipping container as FRAGILE.**

In any correspondence, refer to the instrument by model number and full serial number.



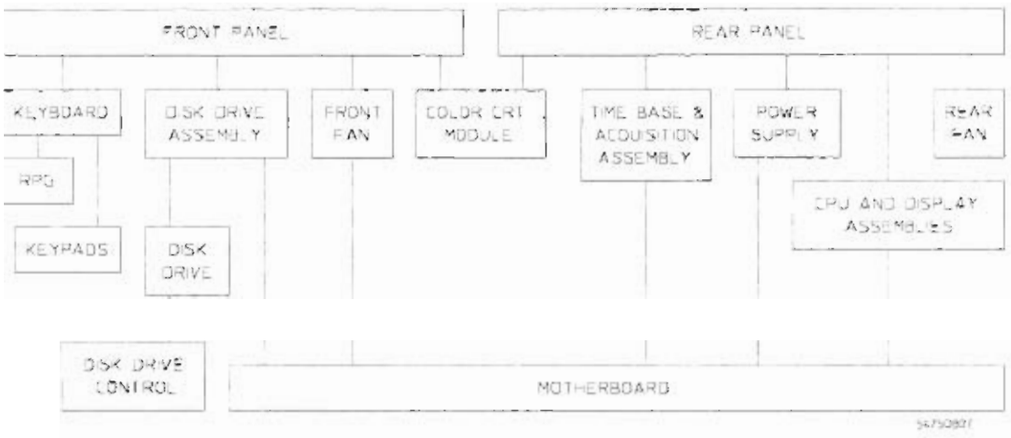
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## A Brief Order of Procedures

In general, the procedures that follow have been placed in the order they must be used to remove a particular assembly. That is, given first are the procedures for assemblies that must be removed first. The figure below shows the general flow of procedures (from top to bottom) to remove assemblies.

**CAUTION**

Do not remove or replace any circuit board assemblies in this instrument while power is applied. The assemblies contain components which may be damaged if the assembly is removed or replaced while the instrument is powered.




**Assembly Removal Flow Diagram**



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## To remove and replace the front panel

Removing the front panel exposes all assemblies located in the front compartments.

**To Remove**

Plug-ins may have been calibrated to specific slots. Record which plug-in is in each slot, so you can return the instrument to its original calibrated condition.

1. Remove the plug-ins.
2. Remove all cables from the rear panel.
3. Place the instrument on its left side (as viewed from the front).
4. On the bottom of the front panel, remove the four 8-mm flat-head screws that hold the plug-in latches.

   You may need to temporarily remove the right-front foot to remove the right side screw. Replace the foot after removing the screw.
5. Place the instrument in its normal operating position.
6. Remove the three 12-mm flat-head screws at the trim strips on each side of the front panel.
7. Pull the front panel off.

   If you don't need to disconnect the panel, you can place it on top of the instrument.
8. To remove the keyboard cable, squeeze the metal tabs on the ends of the cable connector and pull the connector out of its receptacle.

   When replacing the connector, make sure the metal tabs have latched in the keyboard connector.

**To Replace**

- To reassemble, reverse the above procedure. However, make note of the following:
  - Make sure the metal tabs of the keyboard cable connector have latched in the keyboard connector.
  - The plug-in guides must be inserted into holes in the back of the front panel. It may be helpful to set the instrument on its back feet while aligning the front panel.
  - While tightening the plug-in latches, hold them straight so the plug-in latching screws will align properly.

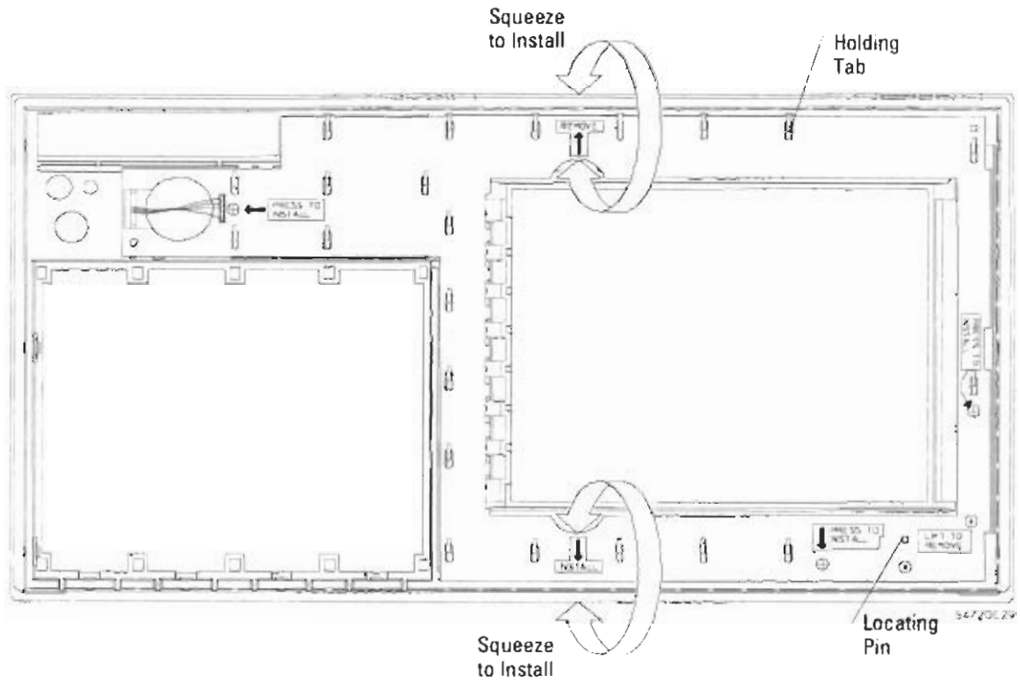


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## To remove and replace the keyboard

The keyboard is fastened by only two screws and the RPG shaft. However, it is held against the rubber keypads by many small tabs. Two locating pins position the PC board in the front panel. To remove the PC board, it must be lifted over the locating pins and then moved from under the tabs.

Several key reference points used during removal are marked on the PC board.




**Keyboard Feature Locations**

### To Remove

1. Remove the front panel from the instrument.
2. Remove the knob by pulling on it firmly.
3. Use a 7/16 nut driver to remove the nut from the RPG bushing, then remove the curved lockwasher.
4. Remove the two self-tapping screws that hold the PC board at the corner near the switch.
5. Remove the PC board.

   For this step use the finger recess at the top of the PC board. It may be helpful to turn the front panel assembly so a short side is toward you.

   **a** Put your thumb in the finger recess and your first finger at the top of the panel.

   **b** While squeezing the thumb and finger to slide the PC board toward the top of the panel, use the other hand to lift the PC board over the two locating pins. You can alternately push on the power switch and RPG from the front of the panel.



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**c** Lift the PC board off the holding tabs.

**CAUTION**

Be careful not to contaminate the key side of the PC board or the keypads. Dust and fingerprints on these parts may cause intermittent key operation.

**6** Remove the keypads if necessary.

**To Replace**

**1** Make sure the keypads are clean and in their correct locations. They are positioned by holes in the pad and pins in the front panel.

If they look contaminated, clean them with isopropyl alcohol and a lint-free cloth.

**2** Make sure the RPG is correctly installed on the keyboard.

**3** Make sure the key side of the keyboard is clean.

If the key side of the keyboard is dirty, clean it with isopropyl alcohol and a lint-free cloth.

**4** Check the green LEDs. They should be straight and perpendicular to the PC board.

**5** Install the PC board.

For these steps use the finger recess at the bottom of the keyboard.

**a** Place the keyboard over the holding tabs.

**b** Put your thumb in the finger recess and your first finger at the bottom of the panel.

**c** To make the PC board slide under the holding tabs, press it gently with your free hand at the points marked "Press to Install." Press first at the power switch, then near the RPG. Simultaneously, squeeze your thumb and finger to slide the PC board toward the bottom of the panel.

**d** If the PC board will not slide, make sure it has dropped over all of the holding tabs.

**e** Make sure the PC board has dropped over the locating pins.

**f** Install the self-tapping screws in the corner of the PC board.

**6** Place the lockwasher over the RPG bushing.

Place it on the bushing with the cupped (concave) side toward the panel.

**7** Install the RPG nut and tighten.

**8** Install the knob.

## To remove and replace the RPG

The RPG (rotary pulse generator) is driven by the front-panel knob.

**1** Remove the front panel from the instrument.

**2** Remove the keyboard from the front panel.

**3** Remove the spacer nut from the RPG bushing. It should be only finger tight so the RPG bushing can align with the hole in the panel.

**4** Disconnect the cable and remove the RPG.

**5** To install the RPG, reverse the procedure.



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## To remove and replace the front fan

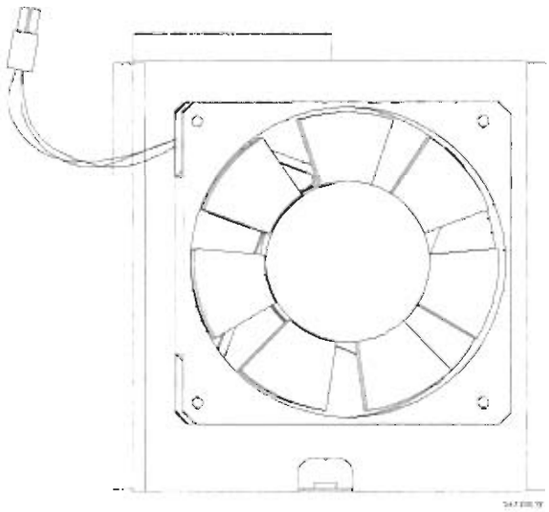
The front fan is mounted on a bracket above the plug-ins. The fan power cable plugs into the motherboard at the rear of the fan compartment.

**To Remove**

1 Remove the front panel, but do not disconnect the keyboard cable. Lay the front panel on top of the instrument.
2 Remove the top plug-in guide.
   Press up on the large locking tab at the rear of the plug-in guide and pull the guide out.
3 Use a T15 driver to remove the screw at the front of the fan bracket.
4 Push the fan bracket down at the front and slide the assembly down and out.
5 Disconnect the fan cable.
   Squeeze the locking tab on the top of the connector and pull the connector out.
6 To remove the fan from the bracket, remove the four 8-mm screws.

**To Replace**

1 Place the fan on the raised side of the bracket so that the airflow is down and the cable is on the left rear corner as shown in the figure below.




**Front Fan Alignment**

2 Install the four 8-mm screws.
3 Place the fan assembly into the plug-in compartment and connect the cable.
4 With the assembly sloping up at the back, slide it up and in so the holding tab (see figure) is above the ledge at the back of the compartment.
5 Raise the front end of the assembly into place.
6 Install the T15 pan-head screw at the front of the bracket.
7 Install the plug-in guide.
8 Install the front panel.



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## To remove and replace the disk drive assembly

The disk drive assembly includes the disk drive, disk drive control board, and the mounting bracket. It plugs into a connector at the rear of the fan compartment. The keyboard cable plugs into the disk drive control board.

**To Remove**

1. Remove the front panel, but do not disconnect the keyboard cable. Lay the front panel on top of the instrument.
2. Remove one screw that fastens the front strut of the disk drive bracket to the cabinet.
3. With a slight side-to-side motion, pull on the disk drive bracket strut and pull the assembly out.
4. Disconnect the keyboard cable at the disk drive control board.

**To Replace**

1. Connect the keyboard cable.

   You must squeeze the metal locking tabs on the side of the connector while inserting it.
2. Slide the assembly most of the way into the cabinet.
3. Lift the back of the assembly to locate the connector into the motherboard connector.
4. Push on the strut or sides of the disk drive assembly to seat the connector.
5. Install the screw at the strut.
6. Install the front panel.

## To remove and replace the disk drive

The disk drive is held by four screws.

1. Remove the disk drive assembly.
2. Remove four screws on the bottom of the disk drive assembly.
3. Separate the disk drive from the bracket slightly, and disconnect the cable from the disk drive.

   The cable is soldered to the disk drive control board.
4. To install the disk drive, reverse the procedure.

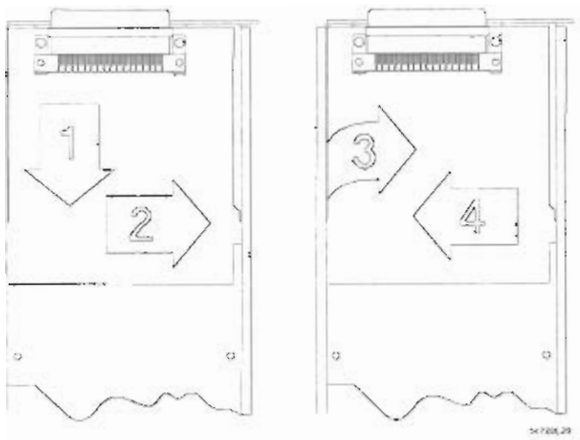


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## To remove and replace the disk drive control

The disk drive control is secured to the disk drive assembly by two tabs at the end near the disk drive and two screws at the connector.

1 Remove the disk drive assembly from the cabinet and the disk drive from the assembly.
2 Remove the two flathead pozidrive screws at the sides of the large connector.
3 Remove the PC board by moving it as shown by the four steps in the figure below.




**Disk Drive Control Removal**

4 To install the board, reverse the procedure.



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## To remove and replace the rear panel

Removing the rear panel provides access to the digital and acquisition systems and rear fan.

1 Remove the power cord and other cables.
2 Remove the four rear feet. Each has a screw and flat washer.
3 Remove the two screws that hold the cover over the fuse.
4 Remove the two large screws just above and on either side of the parallel printer port.

   Do not confuse these screws with the hex standoffs used to secure a printer cable.

5 Remove the two screws on either side of the trigger output connector.
6 To remove the cover, use a flat tool to gently pry at the corners.
7 To install the cover, reverse the procedure.

## To remove and replace the power supply

**CAUTION**

If you will be installing a new supply you must check that the fuse on the new supply is appropriate for the line voltage that you will be using. The wrong fuse may not protect the instrument properly. The fuse requirement is different for 100 V, 115 V, and 230 V operation. Refer to the Replaceable Parts list for the correct fuse rating and part numbers.

**To Remove**



1 Remove the rear panel.
2 Disconnect the rear fan cable from the connector at the side of the power supply.

   Consult the illustration on the inside of the rear panel.

3 Remove the two screws at the lower corners of the supply.

**WARNING**

SHOCK HAZARD!
Do not touch the PC board or components until you are sure there is no danger. The charge on the capacitors can be lethal, even after power has been removed. Contact with charged capacitors can result in serious shock or death.

4 Slide the supply out of the frame.

   Grip the supply at the recesses on each side of the rear panel of the supply.

**To Replace**

1 To reinstall the supply, reverse the above procedure.

   Slide the supply in gently to make the connection with the motherboard without bending connector pins.

2 If you have installed a new supply, make the following checks.

- ☐ Check that the line voltage selection is set properly.

  To change the selection, remove the line voltage switch cover, turn it 180 degrees and reinstall it. The switch will change when the cover is reinstalled.

- ☐ Check that the correct fuse is installed.

  The fuse requirement is dependent on the line voltage being used: 100 V, 115 V, or 230 V. Refer to the Replaceable Parts list for the correct fuse rating and part numbers.



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## To remove and replace the CPU and display assemblies

The CPU and display assemblies are in the rear card cage, the second and third assemblies from the top. The display assembly is just below the CPU.

The CPU and display assemblies are connected by a short cable near the rear of the assemblies. Both assemblies must be partially removed before they can be separated.

**CAUTION** Use proper ESD safety precautions. Failure to use proper ESD precautions can result in damage to the instrument.

**To Remove**

1. Remove the rear panel.
2. Disconnect the display cable (large ribbon cable) at the display assembly.

   Push to the side the clamps on either side of the cable connector and the connector will slide out of the socket.

   To get it out of the way, temporarily tuck the cable into the area beside the fan.
3. Remove four screws, two at either side of the CPU and display assemblies.
4. One at a time, and with a slight side-to-side motion, slide each assembly out until they just release at the front connector.
5. Slide the assemblies out together about 7 cm (3 inches).
6. Disconnect the ribbon cable at the center rear of the CPU.

   Push to the side the clamps on either side of the cable connector and the connector will slide out of the socket.
7. Push the cable through the opening in the CPU assembly and remove the desired assembly.

**To Replace**

1. To reinstall the assemblies, reverse the procedure.

   Slide the assemblies in gently to make the connection with the motherboard without bending connector pins.
2. If you have installed a new CPU or have had a battery problem, load the correct model operating system software, and recalibrate the mainframe. The calibration factors are stored on the CPU assembly.
3. Install the correct firmware for the model number and option.
4. Install the correct serial number and model number.

## To remove and replace the time base and acquisition assembly

The time base and acquisition assembly is in the rear card cage, the bottom assembly.

**CAUTION** Use proper ESD safety precautions. Failure to use proper ESD precautions can result in damage to the instrument.

**CAUTION** Use the correct wrench on SMC connectors. This instrument uses SMC connectors that require either a 6-mm (15/64-inch) or 1/4-inch wrench. Using a wrench that is too large may damage the connector.



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**To Remove**

1 Remove the plug-ins.

2 Remove the rear panel.

3 Remove the hole plug from the bottom of the mainframe cabinet.

4 Disconnect the display cable (large ribbon cable) at the display assembly.

Push to the side the clamps on either side of the cable connector and it will slide out of the socket. To get the cable out of the way, temporarily tuck it into the area beside the fan.

5 Disconnect the CAL cable.

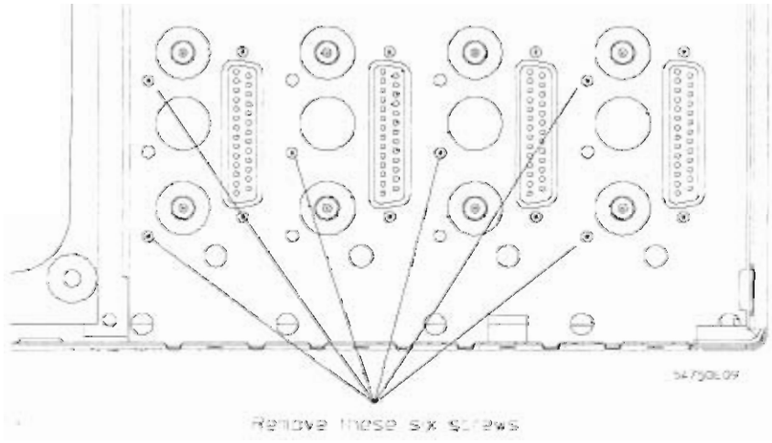
Use a 6-mm (15/64-inch) or 1/4-inch (as required) open-end wrench to disconnect the SMC connector and long-nose pliers to disconnect the wire connectors.

6 Disconnect the auxiliary load cable connector from the rear of the time base and acquisition assembly.

7 Remove 6 screws that hold the front of the time base and acquisition assembly in the mainframe.

These screws are accessible through the plug-in compartment. See the figure below

These screws have a plastic "patch lock" that comes off the threads when the screws are removed. If you use new screws when you replace the assemblies, it ensures the assemblies stay secure. For the part number, see the parts views and replaceable parts list in chapter 7.




**Time base and acquisition Mounting Screws**

8 Remove the time base and acquisition assembly from the instrument.

Be sure that all cables are out of the way, so that the time base assembly and cables do not get damaged.

**To Replace**

1 To install the time base and acquisition assembly, reverse the removal procedure.

Slide the assembly in gently, to make the connection with the motherboard without bending connector pins.

2 Recalibrate the mainframe.



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## To remove and replace the color CRT module

The color CRT module is in a compartment by itself and does not need to be removed to replace any other assembly.

If you are replacing a failed color CRT module, you will have to move several parts from the failed module to the new one.

### To Remove the Module

When necessary, use other procedures in this chapter to help remove the various assemblies.

1 Remove the rear panel.
2 Disconnect the ribbon cable from the display assembly.
3 Remove the ribbon cable from the clips that hold it in the rear fan compartment.
4 Remove the front panel and disconnect the keyboard cable at the keyboard.
5 Turn the instrument onto its left side (same side as the color CRT module).
6 Remove the two pan-head screws and washers, about half-way back on the bottom of the cabinet.

   These screws secure the color CRT module rear bracket.
7 Remove the two pan-head screws on the bottom of the cabinet, near the front.
8 Turn the instrument so that it is again right side up.
9 Remove the two pan-head screws on the top of the cabinet, near the front.
10 Slide the module part way out of the cabinet, until you can reach the power cable on the right side of the module.
11 Disconnect the cable at the module and remove the module from the instrument.

### To Exchange Parts Between Modules

If you are installing a new or rebuilt module, you need to move several parts from the old module to the new one.

The shields and rear bracket are attached to the module with self-tapping screws. If your replacement module is a new one, the screws will tap the holes when they are installed. If the replacement module is a rebuilt one, the holes may be already tapped. Start the screws carefully so they do not cross thread the holes.

1 Move the shields.

   The left shield fits around the top, left, and bottom of the module. The right shield is angled and covers the right side of the module.

   **a** Remove one screw from the upper-right rear of the module.

   Note how tabs on the shield tuck into the front of the module frame and how the shields overlap each other at the top and bottom joints.

   **b** Swing the rear of the right shield away from the module and slide the front tabs out of the module frame.

   **c** Disconnect the cable from the module at the two places on the PC board.

   **d** Remove five screws from the left shield.

   **e** Remove the left shield and place it around the new module.

   Overlap the joint between the shields as they were on the old module.

   **f** Install the five screws but do not tighten them at this time.

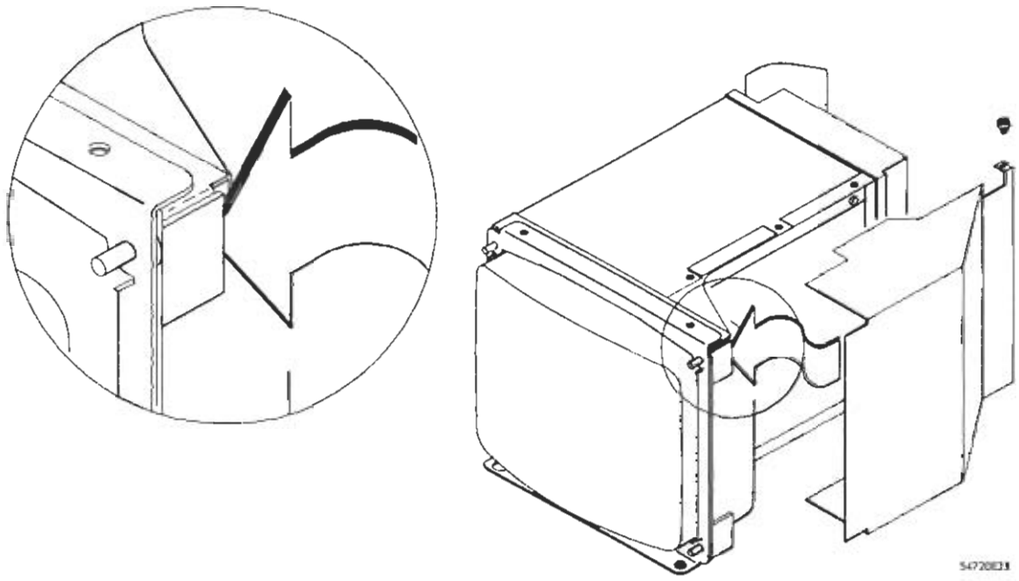


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**g** Take the right shield and connect the cables to the proper places on the PC board.

One connector has four pins and the other has five.

**h** Hold the shield at an angle and slide the front tabs of the shield about 15 mm (9/16 in) into the two slots on the module frame. (See the figure below. The bottom is the same as the top.)



**Installing the Right CRT Module Shield**

**i** As you swing the rear of the shield toward the module, make sure the cables do not get caught between the shield and frame.

**j** Install the screw. Reposition the shield if the screw hole does not line up properly.

**k** Tighten the five screws of the left shield.

**2** Move the front mounting bracket.

**a** Remove four 5/16 nuts from the studs at the front of the replacement module.

**b** Remove the two angle rails; one is between the left pair of studs and one is between the right pair. Set the rails aside.

**c** Note the position of the front bracket on the failed module.

**d** Remove the four 5/16 nuts from the front of the failed module.

**e** Transfer the front bracket to the same position on the replacement module.

**f** Install four 5/16 nuts on the replacement module and tighten them.

**g** Install and tighten the two angle rails and 5/16 nuts on the failed module.

**3** Note the position of the rear mounting bracket on the failed module, then remove it.

**4** Remove the ribbon cable from the failed module (push the connector clamps to the side), and install it on the replacement module.

**5** With the two screws and washers, install the rear bracket loosely on the replacement module.

The bracket should be able to move only slightly. It will be tightened when the module is installed in the instrument.



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**To Replace the Module**

1 Set the instrument frame in its normal operating position.

2 Position the module in front of the mainframe and thread the ribbon cable into the slot at the bottom rear of the compartment. Make sure that it is not twisted.

3 Slide the module part way into the mainframe and connect the power cable to the connector on the right side of the module.

4 Slide the module into the mainframe. Pull the ribbon cable through the mainframe as the module slides in.

Take care not to get the ribbon cable or power cable caught between the module and mainframe. If the power cable connector gets caught between the module and frame, the module may not get positioned correctly.

5 Install, but do not tighten, two screws in the oblong holes in the depressions at the top-front of the instrument cabinet.

6 Connect the keyboard cable to the front panel and install the front panel on the mainframe.

7 Place the instrument face down on the table with the left side (color CRT module side) toward you.

Use a couple of books under the left and right sides of the front panel so the instrument is stable and does not sit on the knob or the calibrator connectors.

In the next steps, the object is for the weight of the color CRT module to push it against the back of the front panel, so there is a minimal gap between the CRT and the panel.

8 Install, but do not tighten, two screws in the oblong holes in the depressions at the bottom-front of the instrument cabinet.

9 At the module rear bracket and on the cabinet bottom are two rectangular holes with a large round hole between them. Install, but do not tighten, two screws with washers at the rectangular holes.

There is a small hole in the rear bracket, aligned with the large round hole. A pointed device can be used in the small hole to move the module bracket to insert the screws or position the module so it rests properly in the cabinet.

10 Tighten all of the hardware in the following sequence.

**a** Tighten the screws at the front of the instrument, those that fasten the front bracket of the module.

**b** Ensure that the rear module bracket is flush with the inside bottom of the cabinet (bottom screws are still loose).

**c** Through the two holes in the left side of the cabinet, tighten the screws that fasten the rear bracket to the module.

**d** Tighten the two rear bracket screws on the bottom of the cabinet.

11 Set the instrument on its bottom, look at the front, and ensure that the CRT is flush with the front panel.

If the CRT is not flush, put the instrument back on its front panel, loosen the hardware, use the access holes (side and bottom) to reposition the module, then retighten the hardware in the sequence in step 10.



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## To remove and replace the motherboard

The motherboard is located between the plug-in compartment and the card cage. It connects the card cage assemblies and the plug-ins.

1 Disassemble the instrument.

**a** Remove the power cord and plug-ins.

**b** Remove the front panel, but leave the keyboard cable connected.

**c** Remove the disk drive assembly and carefully set it on top of the front panel. You do not need to disconnect the keyboard cable.

**d** Remove the front fan assembly.

**e** Remove the following assemblies in order. When you start with the power supply procedure, the other procedures follow in sequence in this chapter.

- Power supply
- CPU and display assemblies
- Time base and acquisition assembly

2 Remove and replace the motherboard.

The cable that provides power to the color CRT module is connected to the front of the motherboard. You must move the motherboard carefully until you can disconnect this cable from the rear. Otherwise, you will have to remove the color CRT module as well. Read all of the following steps before proceeding.

**a** Remove the screws that hold the motherboard. See the figures on the next page.

Three things have to be considered as the motherboard is removed.

- Three tabs on the right side of the motherboard (as viewed from the rear of the instrument) fit in slots in the cabinet.
- Eight plug-in locating pins protrude from the motherboard through the bulkhead panel.
- The color CRT module power connector also protrudes through the bulkhead panel.

**b** Swing the left side of the motherboard toward the rear until the locating pins clear the bulkhead panel.

**c** As the locating pins clear, you will be able to move the motherboard to the left slightly to clear the tabs from the slots.

**d** When the tabs are free, pull the motherboard back until the connector clears the bulkhead panel, then swing the motherboard against the right side of the card cage.

**e** Squeeze the connector locking tab at the top, and disconnect the color CRT module power cable from the upper corner of the motherboard. Do not allow the cable to fall through the opening in the bulkhead panel.

**f** If you are installing a new motherboard, use the following steps to move the torroidal springs to the new board.

**CAUTION**

Handle the springs carefully and follow the instructions. The effect of these grounding springs is very significant, and they require care in installation. Improper installation may cause poor operation of the instrument.

1 One at a time, carefully remove the springs from the posts on the old motherboard and slide them half way down the posts on the new motherboard.



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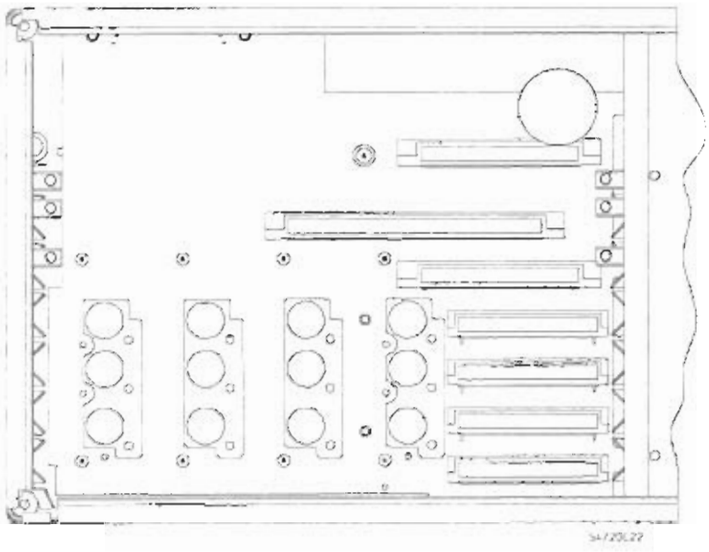
**CAUTION**

If you try to push the springs all of the way on with your fingers, they will roll and may be out of position when they come to rest on the shoulder of the pin. If they are out of position they may be crushed when the motherboard is installed or may make insufficient contact between the motherboard and the bulkhead panel, causing poor grounding.

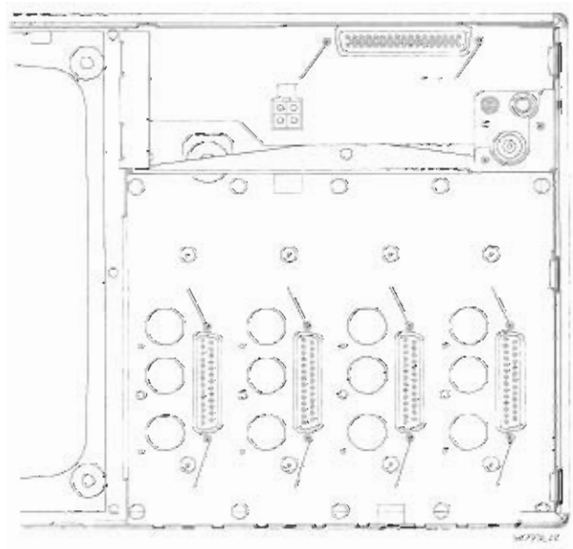
2 Use the rear end of a plug-in as a tool to slide the springs down the posts. Fit the plug-in over a pair of posts, as if you were going to plug it into the motherboard, and push it until the bus connector fully mates in the motherboard.

3 To reassemble the instrument, reverse the procedure.

Follow the appropriate steps in all procedures.




**Rear Motherboard Mounting Screws**




**Front Motherboard Mounting Screws**



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## To remove and replace the rear fan

The rear fan does not need to be removed to remove any other assemblies.

### To Remove

The fan bracket is held in the cabinet by two pins at the front and by two screws at the rear mounting tabs.



1. Remove the rear panel.
2. Disconnect the rear fan cable from the connector at the side of the power supply.

   Consult the label on the inside of the rear panel. Note the routing of the fan cable.
3. Disconnect the auxiliary load cable from the rear of the time base and acquisition assembly
4. Remove the two screws that hold the fan bracket at the top and bottom.
5. Pull the fan assembly straight back about 1 cm (3/8 in) until it clears the pins at the front of the fan compartment.
6. Rotate the fan assembly counterclockwise until it clears the rear mounting tabs and you can remove it completely.
7. Remove three screws to remove the fan from the bracket.

### To Replace

1. Mount the fan on the bracket.
   a. Place the fan bracket on the table with the largest right-angle bend down and on the left.
   b. Place the fan on the bracket with the cable at the lower left and take note that the fan rotation is clockwise and that the air flow is down.

      Airflow and rotation are marked on the side of the fan.
   c. Install three screws on left side, upper right, and lower right.
   d. Check that the temperature sensor is tied at the right-side hole, away from the fan bracket.
2. Install the fan in the instrument.
   a. Slide the fan and bracket into the cabinet with the fan to the right of the bracket.

      Tilt the fan and bracket counterclockwise so that it clears the top mounting tab to the left and the bottom mounting tab to the right (as viewed from the rear).
   b. When the assembly is about 1 cm (3/8 inch) out of the cabinet, rotate it clockwise to line up with the front pins and rear tabs, then slide it the rest of the way into the cabinet.
   c. Install two screws at the rear mounting tabs.
   d. Connect the fan cable to the power supply.
   e. Connect the auxiliary load cable to the rear of the time base and acquisition assembly
3. When you turn on the instrument, check that the airflow is from the outside, going into the cabinet.
4. Install the rear panel.



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7

Ordering Replaceable Parts 7-2
Exploded Views 7-3
Replaceable Parts List 7-8

# Replaceable Parts

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# Replaceable Parts

This chapter includes information for ordering parts. Service support for this instrument is replacement of parts to the assembly level. The replaceable parts include assemblies and chassis parts.

## Ordering Replaceable Parts

### Listed Parts

To order a part in the parts list, quote the HP part number, indicate the quantity desired, and address the order to the nearest HP sales office.

### Unlisted Parts

To order a part not listed in the parts list, include the instrument model number, instrument serial number, a description of the part (including its function), and the number of parts required. Address the order to the nearest HP sales office.

### Direct Mail Order System

Within the USA, Hewlett-Packard can supply parts through a direct mail order system. There are several advantages to this system:

- Direct ordering and shipping from the HP parts center in California, USA.
- No maximum or minimum on any mail order. (There is a minimum amount for parts ordered through a local HP sales office when the orders require billing and invoicing.)
- Prepaid transportation. (There is a small handling charge for each order.)
- No invoices.

In order for Hewlett-Packard to provide these advantages, please send a check or money order with each order.

Mail order forms and specific ordering information are available through your local HP sales office. Addresses and telephone numbers are located in a separate document shipped with the manuals.

### Exchange Assemblies

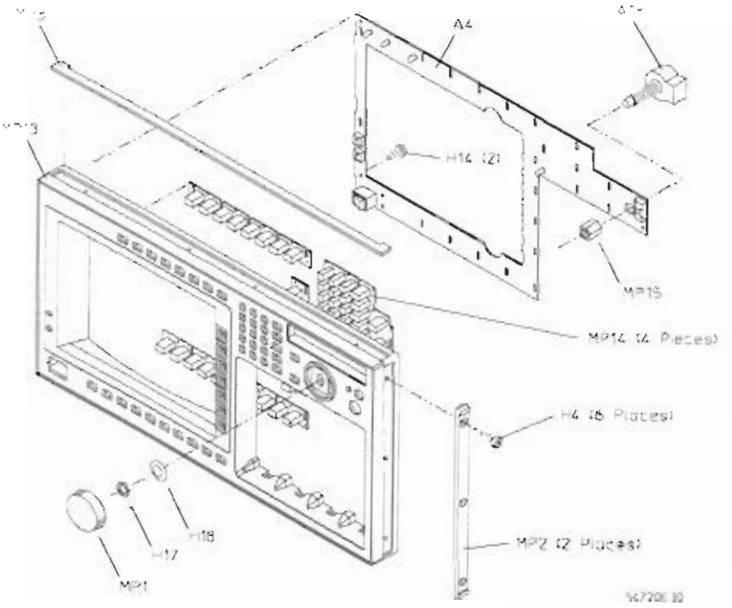
Some parts used in this instrument have been set up for an exchange program. This program allows the customer to exchange a faulty assembly with one that has been repaired, calibrated, and performance-verified by the factory. The cost is significantly less than that of a new part. The exchange parts have a part number in the form XXXXX-69XXX.

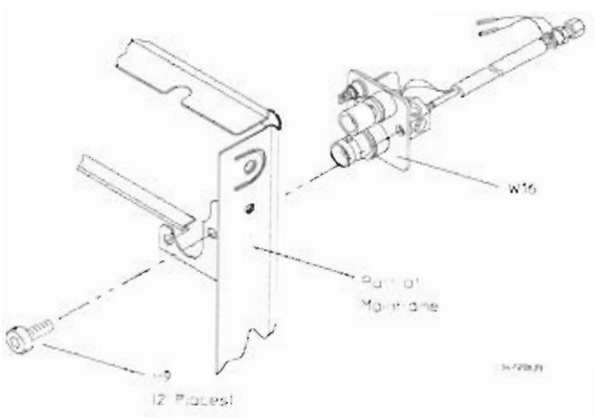
After receiving the repaired exchange part from Hewlett-Packard, a United States customer has 30 days to return the faulty assembly. For orders not originating in the United States, contact the local HP service organization. If the faulty assembly is not returned within the warranty time limit, the customer will be charged an additional amount. The additional amount will be the difference in price between a new assembly and that of an exchange assembly.



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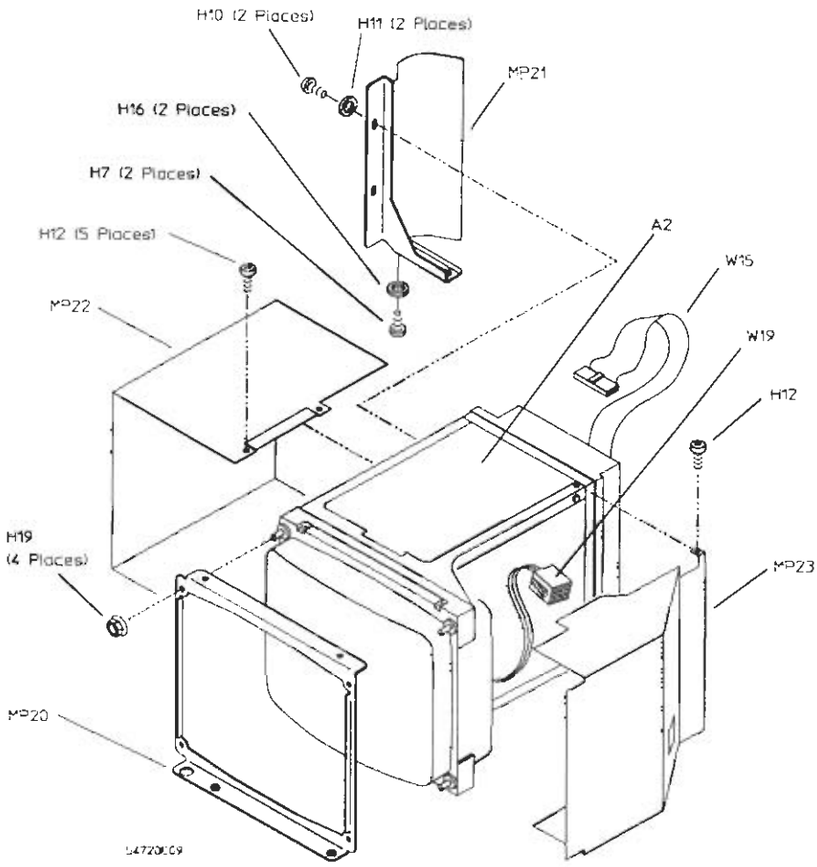
# Exploded Views



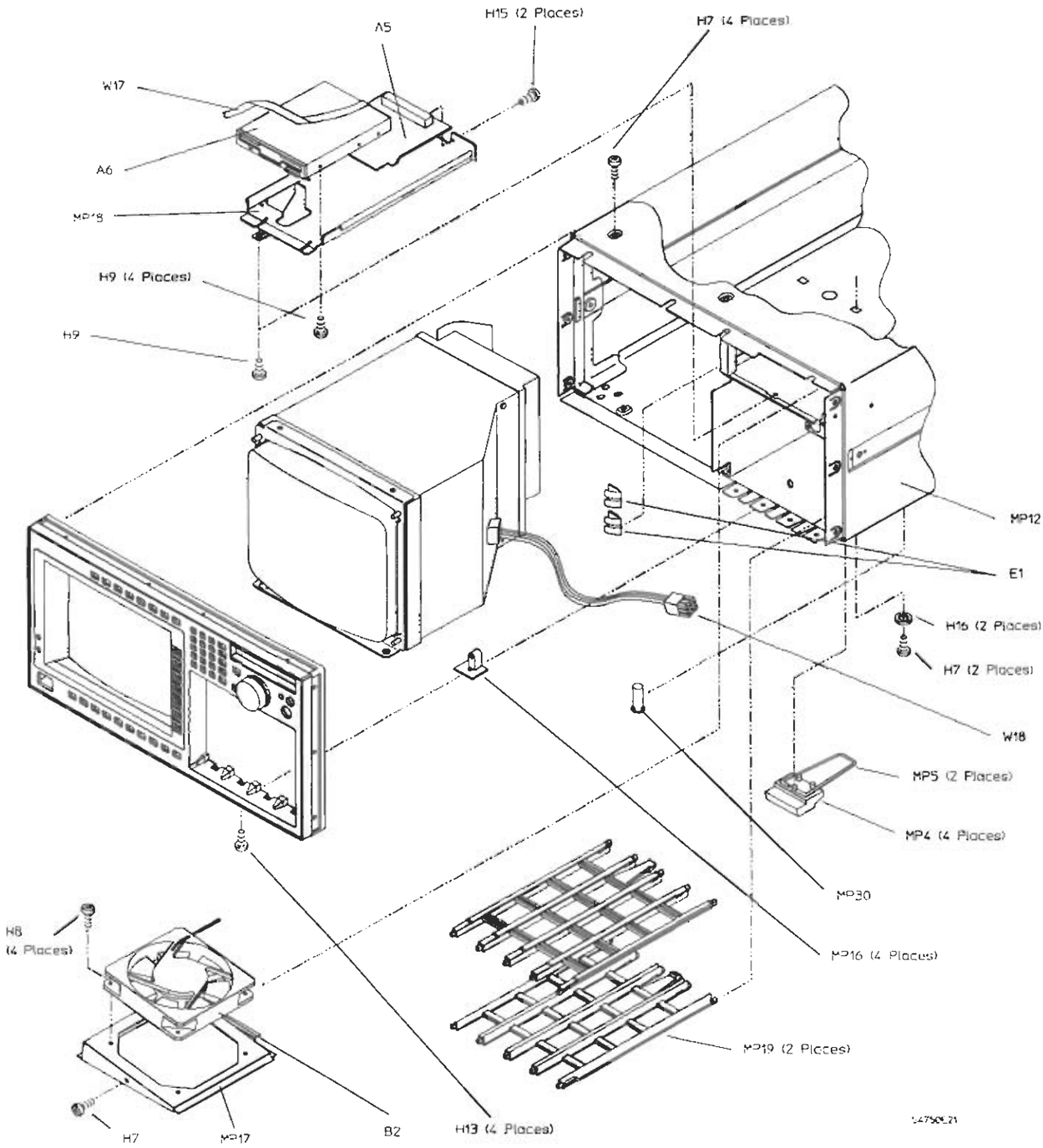



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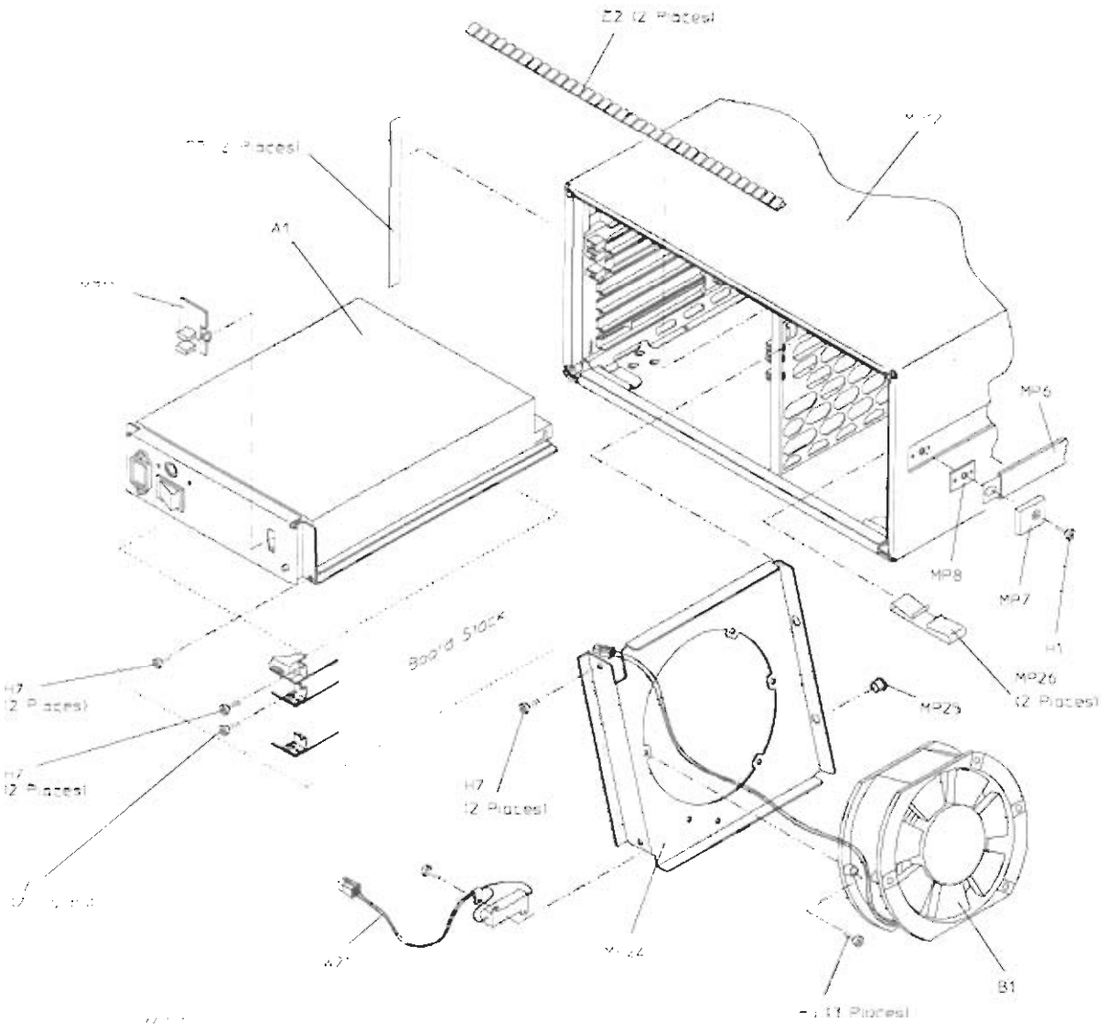


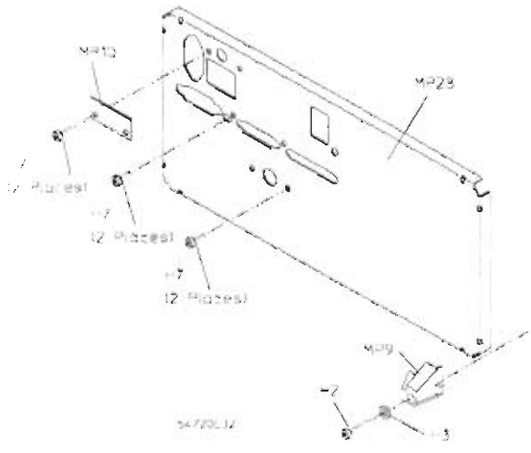

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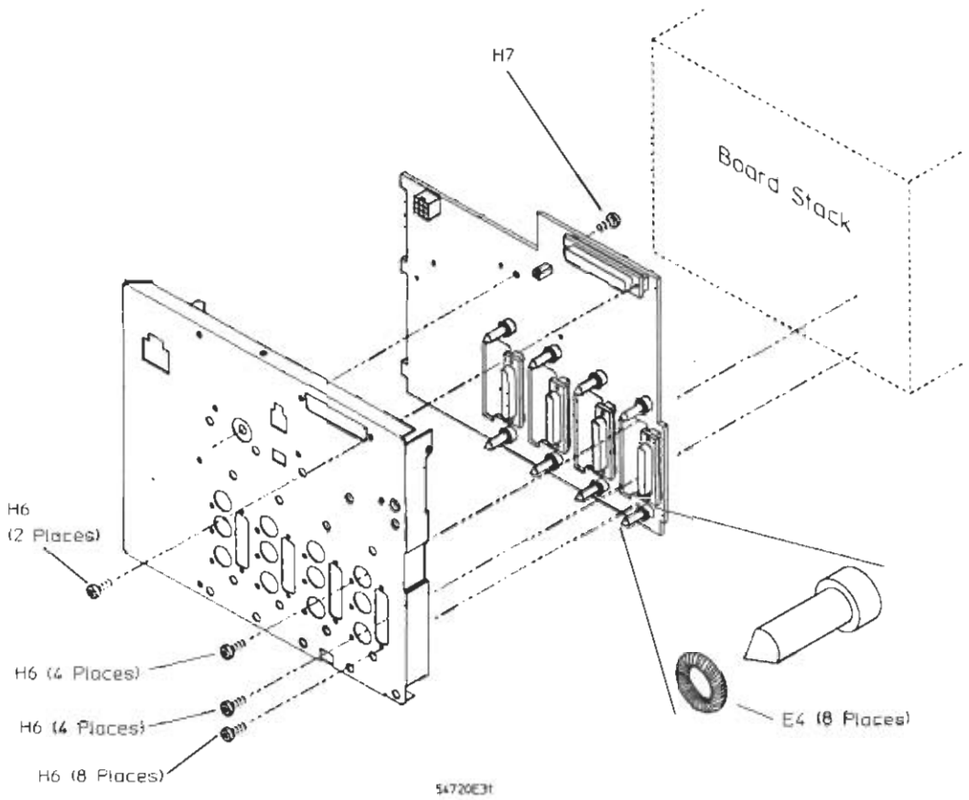

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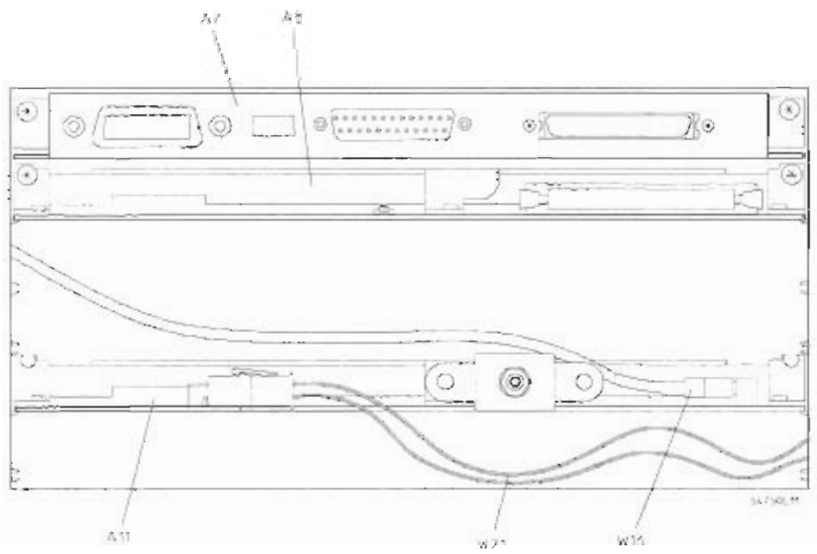





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# Replaceable Parts List

The following table is a list of replaceable parts and is organized as follows:

- Exchange assemblies in alphanumeric order by reference designation.
- External parts in alphanumerical order by reference designation. These parts are generally those that take the physical wear and tear of use.
- Internal parts in alphanumerical order by reference designation. Replacing these parts generally requires opening the cabinet.

The information given for each part consists of the following:

- Reference designation.
- HP part number.
- Total quantity (QTY) in instrument or on assembly. The total quantity is given once and at the first appearance of the part number in the list.
- Description of the part.



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## Replaceable Parts

| Ref. Des. | HP Part Number | QTY | Description |
|---|---|---|---|
| EXCHANGE ASSEMBLIES | | | |
| A2 | 2095-0001 | | COLOR CRT MODULE |
| A7 | 54710-69522 | | PC ASSEMBLY - CPU |
| A8 | 54710-69523 | | PC ASSEMBLY - DISPLAY |
| A11 | E2602-69501 | | PC ASSEMBLY - TIME BASE and ACQUISITION |
| EXTERNAL PARTS | | | |
| F1 | 2110-0342 | 1 | FUSE M8A 250V (for 230 V operation) |
| F1 | 2110-0249 | 1 | FUSE M12A 250V (for 115 V operation) |
| F1 | 2110-0054 | 1 | FUSE M15A 250V (for 100 V operation) |
| H1 | 0515-2048 | 4 | MS M5 X 0.8 12MM-LG FLAT-HD T20 (handles) |
| H2 | 0515-0456 | 4 | MS M4 X 0.7 20MM-LG PAN-HD T10 (rear feet) |
| H3 | 3050-0065 | 4 | WASHER - FLAT 0.203-IN-ID 0.375-IN-DD (rear feet) |
| H4 | 0515-2227 | 6 | MS M4 X 0.7 12MM-LG FLAT-HD T15 |
| MP1 | 01650-47401 | 1 | KNOB - RPG |
| MP2 | 54710-41002 | 2 | TRIM STRIP - SIDE |
| MP3 | 5041-8802 | 1 | TRIM STRIP - TOP |
| MP4 | 5041-8801 | 4 | FOOT - BOTTOM |
| MP5 | 1460-1345 | 2 | TILT STAND |
| MP6 | 5062-3705 | 2 | HANDLE - STRAP |
| MP7 | 54710-62501 | 4 | CAP - HANDLE |
| MP8 | 54710-01211 | 4 | SPACER - HANDLE |
| MP9 | 54710-41001 | 4 | FOOT - REAR |
| MP10 | 54710-04101 | 1 | COVER - LINE FUSE |
| MP11 | 64120-48101 | 1 | COVER - LINE VOLTAGE SWITCH |
| MP30 | E2602-64101 | 1 | HOLE PLUG - AIR BLOCK |
| W1 | 8120-1378 | 1 | CABLE - POWER |
| W1 | 8120-1351 | 1 | CABLE - POWER (Option 900-UK) |
| W1 | 8120-1369 | 1 | CABLE - POWER (Option 901-AUSTL) |
| W1 | 8120-1689 | 1 | CABLE - POWER (Option 902-EUR) |
| W1 | 8120-0698 | 1 | CABLE - POWER (Option 904-250V USA/CANADA) |
| W1 | 8120-2104 | 1 | CABLE - POWER (Option 906-SWIT) |
| W1 | 8120-2956 | 1 | CABLE - POWER (Option 912-DEN) |
| W1 | 8120-4211 | 1 | CABLE - POWER (Option 917-AFRICA) |
| W1 | 8120-4755 | 1 | CABLE - POWER (Option 918-JAPAN) |



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## Replaceable Parts (cont'd)

| Ref. Des. | HP Part Number | QTY | Description |
|---|---|---|---|
| INTERNAL PARTS | | | |
| A1 | 0950-2211 | 1 | POWER SUPPLY ASSEMBLY |
| A2 | 2090-0251 | 1 | COLOR CRT MODULE |
| A3 | E2602-66502 | 1 | PC ASSEMBLY - MOTHER BOARD |
| A4 | 54710-66516 | 1 | PC ASSEMBLY - FRONT PANEL |
| A5 | 54710-66515 | 1 | PC ASSEMBLY - DISK DRIVE CONTROL |
| A6 | 0950-2169 | 1 | DISK DRIVE |
| A7 | 54710-66522 | 1 | PC ASSEMBLY - CPU |
| A8 | 54710-66523 | 1 | PC ASSEMBLY - DISPLAY |
| A9 | | | NOT USED |
| A10 | | | NOT USED |
| A11 | E2602-66501 | 1 | PC ASSEMBLY - TIME BASE and ACQUISITION |
| A12 | | | NOT USED |
| A13 | 0960-0852 | 1 | ROTARY PULSE GENERATOR (RPG) |
| A7BT1 | 1420-0526 | 1 | BATTERY - LITHIUM 3V |
| B1 | 3160-0643 | 1 | FAN - TUBEAXIAL (rear fan) |
| B2 | 3160-0804 | 1 | FAN - TUBEAXIAL (front fan) |
| E1 | 8160-0718 | 2 | GASKET-RFI FINGER STRIP (FRONT) |
| E2 | 54710-07101 | 2 | GASKET - RFI FINGER STRIP (rear top and bottom) |
| E3 | 54710-07102 | 2 | GASKET - RFI FINGER STRIP (rear sides) |
| E4 | 1460-2337 | 8 | SPRING - RFI (motherboard) |
| E5 | | | NOT USED |
| H5 | 0515-0383 | 3 | MS M4 X 0.7 16MM-LG PAN-HD T10 |
| H6 | 0515-2305 | 18 | MS M3 X 0.5 14MM-LG PAN-HD T10 |
| H7 | 0515-0433 | 24 | MS M4 X 0.7 8MM-LG PAN-HD T15 |
| H8 | 0515-0372 | 4 | MS M3 X 0.5 8MM-LG PAN-HD T10 |
| H9 | 0515-0430 | 9 | MS M3 X 0.5 6MM-LG PAN-HD T10 |
| H10 | 0515-0641 | 2 | SCREW - THREAD-ROLLING M4 X0.7 10MM-LG PAN-HD T15 |
| H11 | 3050-0065 | 2 | WASHER - FLAT 0.203-IN-ID 0.375-IN-OD |
| H12 | 0515-1958 | 6 | SCREW - THREAD-ROLLING M3 X 0.5 6MM-LG PAN-HD T10 |
| H13 | 0515-2043 | 4 | MS M4 X 0.7 8MM-LG FLAT-HD T15 |
| H14 | 0624-0600 | 2 | SCREW - TAPPING 4-20 |
| H15 | 2200-0140 | 2 | MS 4-40 0.27-IN-LG PAN=HD-POZI |
| H16 | 3050-0071 | 2 | WASHER - FLAT 0.169-IN-ID 0.438-IN-OD |
| H17 | 2950-0043 | 1 | NUT - HEX DBL-CHAM 3/8-32 THD .093-IN-THK |
| H18 | 3050-0188 | 1 | WASHER - CURVED LOCK (rpg) |
| MP12 | 54710-04401 | 1 | CABINET |
| MP13 | 54720-60201 | 1 | FRONT PANEL (also order label, MP29) |
| MP14 | 54710-68701 | 1 | KEYPAD KIT (four pieces) |
| MP15 | 54710-05701 | 1 | NUT - SPACER (for RPG) |
| MP16 | 54710-25001 | 4 | BRACKET - PLUG-IN LATCH |
| MP17 | 54710-01220 | 1 | BRACKET - FRONT FAN |
| MP18 | 54710-01221 | 1 | BRACKET - DISK DRIVE |
| MP19 | 54710-43101 | 2 | GUIDE - PLUG-IN |
| MP20 | 54710-01215 | 1 | BRACKET - FRONT (color CRT module) |
| MP21 | 54710-01216 | 1 | BRACKET - REAR (color CRT module) |
| MP22 | 5061-6197 | 1 | SHIELD - LEFT (color CRT module) |
| MP23 | 54710-00601 | 1 | SHIELD - RIGHT (color CRT module) |
| MP24 | 54710-01219 | 1 | BRACKET - REAR FAN (includes plastic bushings) |
| MP25 | 0400-0269 | 2 | BUSHING - PLASTIC (part of MP 24) |
| MP26 | 1400-1331 | 2 | CLAMP - CABLE |
| MP27 | | | NOT USED |
| MP28 | E2602-00201 | 1 | REAR PANEL |
| MP29 | 54750-94301 | 1 | LABEL - FRONT PANEL '54750A' |
| W2-W14 | | | NOT USED |
| W15 | 54710-61601 | 1 | CABLE - RIBBON (display PC assembly to color CRT module) |
| W16 | 54710-61613 | 1 | CABLE ASSEMBLY (calibration signal) |
| W17 | 54710-61603 | 1 | CABLE - RIBBON (keyboard) |
| W18 | 54710-61604 | 1 | CABLE (color CRT module, outside) |
| W19 | 54710-61609 | 1 | CABLE (color CRT module, inside) |



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## Replaceable Parts (cont'd)

| Ref. Des. | HP Part Number | QTY | Description |
|---|---|---|---|
| W20 | 54710-61611 | 1 | CABLE - RIBBON (CPU to display PC assembly) |
| W21 | E2602-61603 | 1 | CABLE ASSEMBLY, RESISTOR |
| A11W1 | E2602-61601 | 4 | CABLE COXIAL (SMA TO OSP) INTERFACE CABLES |



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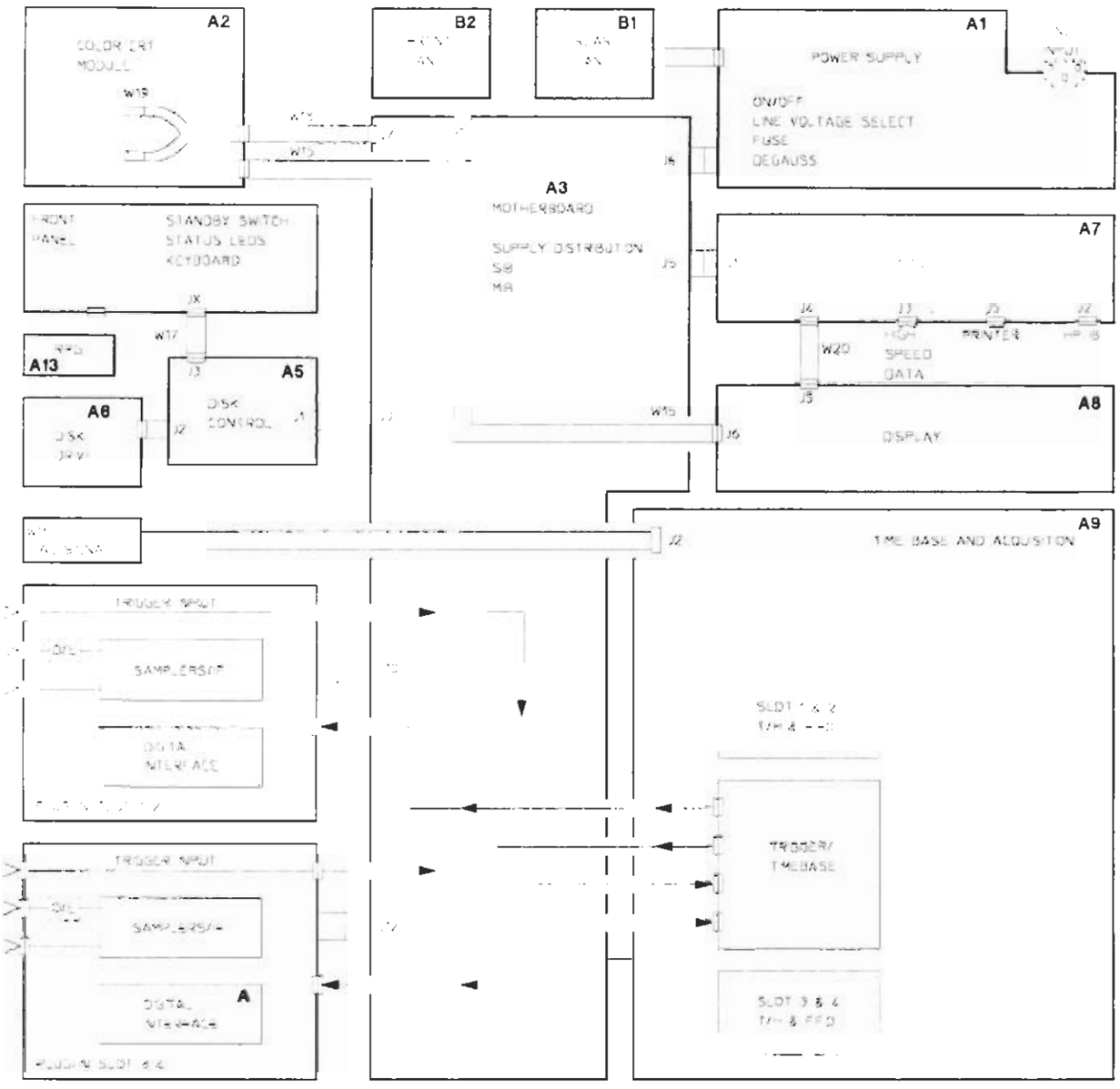
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# 8

Mainframe Block-Level Theory 8–3
Time Base and Acquisition System 8–7
Trigger 8–7

# Theory of Operation

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**Instrument Block Diagram**



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# Theory of Operation

The mainframe contains the digitizers, time base, and display circuitry. Four front-panel slots accept an assortment of electrical and optical sampling plug-ins which occupy two slots each. Seven rear-panel slots accept major assemblies of the mainframe, including the power supply, CPU, display board assembly, and time base and acquisition assembly. The color CRT module (display) is a separate assembly. The front panel consists of hard and soft keys, a knob RPG (rotary pulse generator), a 3.5-inch disk drive, and the calibrator (CAL) output.

## Mainframe Block-Level Theory

Use the main block diagram on the previous page for the following discussion.

### Acquisition

The mainframe acquisition system consists of the sampling time base, 2.5 GHz bandwidth trigger, track and hold, and A/D. They accept the trigger signal from the plug-in, control the sampler strobe, and capture the filtered and amplified sampler outputs.

The plug-ins pass the trigger signal to the mainframe and sample the signal when told by the mainframe. The amplified and filtered sampler signal (bipolar pulse) is passed on to the mainframe.

The mainframe's acquisition trigger and sampling time base circuitry controls when the plug-in sampler samples the input signal. The mainframe's track and hold circuit follows the bipolar pulse and captures the peak value.

**See also** "Time Base and Acquisition System" later in this chapter for additional information.

### Motherboard

The motherboard provides most of the common connections in the mainframe. The digital interface, some acquisition control lines, and power supplies are routed through the motherboard. The vertical plug-ins, disk controller, and front fan connect to the motherboard from the front of the instrument and the other mainframe assemblies plug in from the rear.



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### Power Supply

The 650 W switching power supply provides eight dc voltages to the instrument. A rear-panel power switch switches both sides of the ac power input. When the rear panel power switch is on, the power supply primary circuits are energized.

The front-panel power switch is a remote control for the regulators in the supply. When the front-panel switch is set to Standby, with the rear-panel switch on, the regulators are shut down and most instrument circuitry is off.

On the rear panel is a fuse as well as a switch for changing the ac voltage input range, nominally 115 Vac or 230 Vac. The rear panel of the power supply also carries the degauss push-button switch for the CRT.

One output of the power supply is a power-on-reset signal which is distributed on the bus. This is used to initialize circuitry after all of the supplies are operating.

### Fans

Fans are powered by a 24 V supply provided by the power supply assembly. The fan voltage, therefore the fan speed, varies with the internal temperature of the instrument. The power supply monitors a signal line from each fan and shuts down the supply if fan rotation stops.

### CPU

The CPU assembly controls all digital functions of the instrument other than the display. It uses an MC68020 microprocessor and an MC68882 floating-point math coprocessor. A 32 MHz oscillator output is divided by two to get a 16 MHz processor clock.

The system ROM is 2 Mbyte of flash ROM which can be programmed from the disk drive. One ROM IC is partitioned as a boot ROM. It is protected by a write protect switch. After power-up, pointers are set and the rest of ROM runs the instrument. The system RAM is 4 Mbyte of static RAM. All of the RAM has battery back-up.

The CPU assembly provides two ports to the user: an HP-IB port for instrument control and data handling, and a parallel port for a direct printer connection. Also, the hardware is present for a high-speed data port, which may be implemented with future firmware.

The CPU assembly provides separate digital interfaces to several internal functions:

- The processor sections of the system interface bus (SIB).
- The keyboard and other front panel functions.
- The display assembly.
- The digital functions of the front panel plug-ins, the module interface bus (MIB).

The CPU assembly uses a set of four switches to control firmware. One switch protects boot ROM, one protects system ROM, one protects calibration factors, and one is not used. Use of these switches is covered wherever it is appropriate.



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### Display Assembly

The display assembly handles the graphics functions of the instrument. It organizes pixel-level data for the display. Special interface circuitry on the CPU assembly connects the microprocessor to a TMS34010 graphics microprocessor on the display assembly. The main display memory is 1 MByte of dynamic RAM. A 4K by 12-bit static RAM is used for variable persistence and a 16K by 8-bit static RAM is used for color mapping. Out of a possible 256K different colors, up to 256 main colors and 15 overlay colors are available at one time.

The connection to the CPU assembly is through a dedicated ribbon cable connected between the two assemblies. The connection between the display assembly and the motherboard is not used.

### Color CRT Module

The color CRT module includes the color CRT and its associated driving circuitry. It uses vertical and horizontal sync and red, green, and blue video signals from the display processor. It gets power from a separate 120 Vdc supply in the power supply assembly. A switch to degauss the CRT is located on the rear panel of the power supply.

### Disk Drive and Control

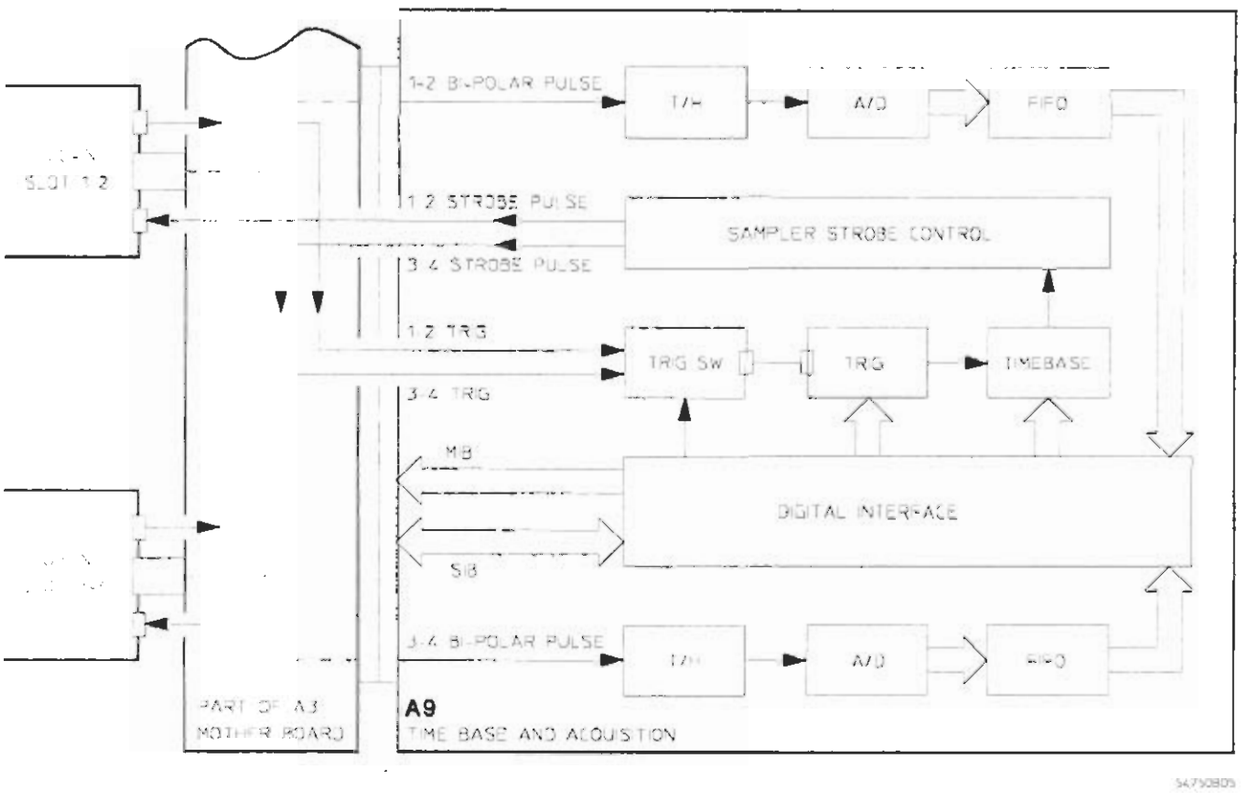
The disk drive is in the front panel of the instrument. Electronically however, it is not part of the front panel. The disk drive connects to the disk control, and the disk control connects to the SIB through the motherboard. The disk control assembly also passes the keyboard interface connections from the motherboard to the keyboard.

### Front Panel

The front panel includes the hard keys, soft keys, knob, status LEDs, display controls, and a power switch. The knob is attached to a rotary pulse generator (RPG). The microprocessor communicates with the keyboard through a separate interface on the CPU assembly. Electrical connection between the CPU assembly and keyboard is made through the disk controller assembly and the motherboard.



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**Time Base and Acquisition Block Diagram**



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## Time Base and Acquisition System

The mainframe time base and acquisition along with the plug-in sampler and sampler drive circuitry controls the input signal sampling. The system sequentially establishes the time between the input trigger and the time when the samplers are fired. The time base and acquisition assembly has the following circuitry: Trigger switch, trigger, sampling time base, track and hold, and A/D converter. The HP 83480 series plug-in modules contain the samplers, sampler drive, IF amplifier/filters, and digital interface. In addition, the HP 83480 series optical modules also contain an O/E converter and optical power measurement circuit.

The samplers measure the difference between the input signal's present amplitude and the DC offset DAC's level. The difference is amplified and converted to a bipolar pulse by charge amplifiers and IF filters located in the plug-in. This bipolar pulse signal is carried back the track and hold circuit in the mainframe.

The track and hold circuit follows the amplitude of the bipolar pulse. When the bipolar pulse reaches peak amplitude, the track and hold circuit holds the peak value. The A/D converters convert the track and hold's level to a 12-bit digital word. These 12-bit words are placed into a FIFO memory which is then read and processed by the CPU.

## Trigger

The trigger is a 2.5 GHz bandwidth trigger that provides a single trigger channel that can be switched between the plug-in front panel inputs. The switch is located in the mainframe on the acquisition/timebase assembly and switches the trigger input between the plug-in in slots 1-2 and the plug-in in slots 3-4



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# DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

**Manufacturer's Name:** Hewlett-Packard Company

**Manufacturer's Address:** 1900 Garden of the Gods Road
Colorado Springs , CO 80907
U.S.A.

**Declares, That the product**

**Product Name:** Digitizing Oscilloscope

**Model Number(s):** HP 54750A and HP 54751A

**Product Options:** All

**Conforms to the following Product Specifications:**

**Safety:** IEC 1010-1:1990+A1 / EN 61010-1:1993
UL 1301
CSA - C22.2 No. 1010.1:1993

**EMC:** CISPR 11:1990 /EN 55011 (1991): Group 1 Class A
IEC 801-2:1991 /EN 50082-1 (1992): 4 kV CD, 8 kV AD
IEC 801-3:1984 /EN 50082-1 (1992): 3 V/m, [1kHz 80% AM, 27-1000 MHz]
IEC 801-4:1988 /EN 50082-1 (1992): 0.5 kV Sig Lines, 1 kV Power Lines

**Supplementary Information:**
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Colorado Springs, 9/15/94

John Strathman, Quality Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department ZQ / Standards Europe, Herrenberger Strasse 130, 71034 Böblingen Germany (FAX: +49-7031-143143)

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# X-RAY RADIATION NOTICE

ACHTUNG

Model HP 54750A/83480A

WARNING

Wahrend des Betriebs erzeugt dieses Gerat Rontgenstrahlung. Das Gerat ist so abgeschirmt, daß die Dosisleistung weniger als 36 pA/kg (0,5 mR/h) in 5cm Abstand von der Oberflache der Kathodenstrahlrohre betragt. Somit sind die Sicherheitsbestimmungen verschiedener Lander, u.A. der deutschen Rontgenverordnung eingehalten.

Die Starke der Rontgenstrahlung hangt im wesentlichen von der Bauart der Kathodenstrahlrohre ab sowie von den Spannungen, welche an dieser anliegen. Um einen sicheren Betrieb zu gewahrleisten, durfen die Einstellungen des Niederspannungs- und Hochspannungsnetzteils nur nach der Anleitung in Kapitel Einstellvorschriften des Service Handbuches vorgenommen werden.

Die Kathodenstrahlrohre darf nur durch die gleiche Type ersetzt werden. (Siehe Kapitel Ersatzteile fur HP-Teilenummern.)

Das Gerat ist in Deutschland zugelassen unter der Nummer BW/218/86/ROE.

When operating, this instrument emits x-rays, however, it is well shielded and meets safety and health requirements of various countries, such as the X-ray Radiation Act of Germany.

Radiation emitted by this instrument is less than 0.5 mR/hr at a distance of five (5) centimeters from the surface of the cathode-ray tube. The x-ray radiation primarily depends on the characteristics of the cathode-ray tube and its associated low-voltage and high-voltage circuitry. To ensure safe operation of the instrument, adjust both the low-voltage and high-voltage power supplies as outlined in the Adjustments Section of the Service Manual.

Replace the cathode-ray tube with an identical CRT only. Refer to the Replacement Parts Section for the proper HP part number.

Number of German License: BW/218/86/ROE

X-RAY

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Hewlett-Packard shall not be liable for errors contained herein or for damages in connection with the furnishing, performance, or use of this material.

### Product Warranty

This Hewlett-Packard product has a warranty against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Hewlett-Packard.

For products returned to Hewlett-Packard for warranty service, the Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Hewlett-Packard from another country.

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

### Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

**No other warranty is expressed or implied. Hewlett-Packard specifically disclaims the implied warranties of merchantability or fitness for a particular purpose.**

### Exclusive Remedies

The remedies provided herein are the buyer's sole and exclusive remedies. Hewlett-Packard shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

### Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales Office.

### Certification

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

### Safety

This apparatus has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Measuring Apparatus, and has been supplied in a safe condition. This is a Safety Class 1 instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken. (see the following warnings). In addition, note the external markings on the instrument that are described under "Safety Symbols."

### Warning

- Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.
- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuseholders. To do so could cause a shock of fire hazard.
- Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.
- If you energize this instrument by an auto transformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the power source.
- Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.
- Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.
- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.
- Use caution when exposing or handling the CRT. Handling or replacing the CRT shall be done only by qualified maintenance personnel.

### Safety Symbols



Instruction manual symbol: the product is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the product.



Hazardous voltage symbol.



Earth terminal symbol: Used to indicate a circuit common connected to grounded chassis.

**WARNING**

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

**CAUTION**

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

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A software or firmware code may be printed before the date. This code indicates the version level of the software or firmware of this product at the time the manual or update was issued. Many product updates do not require manual changes; and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

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