Part No. 070-7133-00
Product Group 42

7250
Transient Digitizing Oscilloscope
Service

WARNING

The following servicing instructions are for use by qualified service personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to the Safety Summary prior to performing any service.

Please check for CHANGE INFORMATION at the rear of this manual.

First Printing SEP 1988

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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc. Beaverton, Oregon, USA
FR0000	France
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

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Safety Summary

Terms

In Manuals

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

Symbols

In Manuals

Static-Sensitive Devices.

This symbol indicates where applicable cautionary or other information is to be found.

As Marked On Equipment

DANGER—High Voltage.

Protective ground (earth) terminal.

ATTENTION—refer to manual.

Warnings

Power Source

This product is intended to operate from a power source that will not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

Grounding the Instrument

The 7250 is grounded through the grounding conductor of the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle, where earth ground has been verified by a qualified service person, before making connections to the input or output terminals of the instrument. A protective-ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including buttons and controls that may appear to be insulating), can render an electric shock.

Use the Proper Fuse

To avoid fire hazard, use only the fuse specified in the parts list for your product, and which is identical in type, voltage rating, and current rating.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate the instrument in an atmosphere of explosive gasses.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the protective covers. Do not operate this instrument without the panels or covers properly installed.

Instrument Weight

The 7250 weighs 60 kg (132 lb). To avoid personal injury or damage to the equipment, do not lift or handle the instrument alone.

Section One
General Information

The 7250 is a 6 GHz, GPIB-programmable oscilloscope. Scan conversion and microchannel plate technology are used to capture single, high-speed events. Repetitive waveforms can be averaged or enveloped. The captured waveform is displayed on the front-panel screen and can be transmitted over the GPIB or drawn by a plotter. Measurements, such as rise time and peak-to-peak value, can be made on the waveform, using cursors to define the measurement zone.

Contents

Introduction

The front, rear, and top cabinet panels provide protection to personnel from operating potentials present within the instrument. In addition, they reduce radiation of electromagnetic interference from the instrument. The cabinet panels are held in place by screws. To remove the front and rear panels, remove the two securing screws in the frame above each panel. To remove a top cabinet panel, remove the securing screws. Operate the instrument with the panels in place to protect the interior from dust and to maintain cooling airflow.

The 7250 includes the following features:

1. Single-shot or repetitive waveforms up to 6 GHz can be captured and stored in non-volatile memory.
2. All of the 7250 front-panel settings can be controlled by GPIB commands, except for the power **ON/OFF** and CRT **INTEN** controls. Also, waveform data can be sent to an external controller through the GPIB.
3. The RS-232 plotter interface permits sending displayed waveform data to a digital plotter without an external controller.
4. Other features include waveform measurement and processing.

Related Documentation

In addition to this service manual, the 7250 Operators Manual will also help you understand and operate the 7250.

Installation And Initial Inspection

This instrument was inspected both mechanically and electrically before shipment. It should be free of mars or scratches and meet or exceed all electrical specifications. To confirm this, inspect the instrument for physical damage incurred in transit and test the electrical performance by following the procedures in *Section Four, Checks and Adjustment*. If there is damage or discrepancy, contact your local Tektronix Field Office or representative.

WARNING

The 7250 weighs over 130 pounds (60 kg). Use extreme care to avoid personal injury when handling the unit, and seek help when lifting it.

External Sweep Input

To use an external sweep signal:

1. Disconnect the power cord and all other attachments on the rear panel.
2. Open the rear panel by removing two screws in the frame above the rear panel and tilt the panel down.

WARNING

ELECTRIC SHOCK HAZARD: Dangerous shock hazards may be exposed when the instrument covers are removed. To avoid serious injury or death, refer cabinet panel removal to a qualified service technician.

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3. Disconnect the sweep signal cable from J2 on the M7315 FAST SWEEP module, using an 8 mm (5/16 in.) open-end wrench.
4. Connect the sweep signal cable to the back of the rear panel **EXT. SWEEP INPUT** connector.
5. Close and refasten the rear panel, using care to avoid picking wires and cables.

Power Source Information

This instrument is designed for operation from a power source with its neutral at or near ground (earth) potential. It is not intended for operation from two phases of a multi-phase system, or across legs of a single-phase, three wire system. Table 1-1 shows the 7250 Line Voltage, Line Frequency, and Power consumption information.

Operating Voltage Selection

WARNING

ELECTRIC SHOCK HAZARD: Dangerous voltages exist within the 7250, even when the power is OFF. To avoid serious injury or death, refer cabinet panel removal and line voltage selection to a qualified service technician.

Disconnect the 371 from the AC power source before changing operating voltages.

The Line Voltage Selector is located inside the 7250, on the M7900A Low Voltage Power Supply module. Either 110 V or 220 V can be selected. The label plate below the power cord connector on the rear panel shows the present setting. Use the following instructions to change the setting:

1. Disconnect the power cord.
2. Remove the top center cabinet panel by removing the four screws.
3. Remove the shield on the M7900A Low Voltage Power Supply module by removing the four screws and lockwashers.
4. Remove the bracket labeled 110 V or 220 V by removing one screw and lockwasher.
5. Set each of the two switches now exposed to the opposite position.
6. Install the bracket with the appropriate line voltage visible. This orientation is possible only when the switches are in the correct position for the indicated voltage.
7. Remove the power line label plate on the rear panel and install it so that the correct line voltage is indicated.
8. Replace fuses F1 and F2 with the values shown on the power line label plate. (Replacement fuses are stored in holders mounted at the top forward edge of the M7900A Low Voltage Power Supply module.)
9. Replace the shield on the power supply and the top center cabinet panel.
10. Connect the power cord.

Table 1-1
Line Voltage Ranges

Switch Setting	Range
220	198 to 250 VAC
110	95 to 126 VAC
Line frequency range:	48 to 62 Hz
Power consumption:	Approximately 200 W

WARNING

This instrument operates from a single-phase power source, and has a detachable three-wire power cord with a two-pole, three-terminal grounding- type power plug. The voltage to ground (earth) from either pole of the power source must not exceed the 250-volt maximum rated operating voltage.

Before making connection to the power source, determine that the instrument is set for the power source voltage, and has a suitable plug (two-pole, three-terminal, grounding type).

This instrument is safety class 1 equipment (IEC designation) with a grounding contact. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.

A power cord with the appropriate plug configuration is supplied with each instrument. The color-coding of the power cord conductors is given in Table 1-2. Also, should you require a power-cord plug other than that supplied, refer to *Section Five, Options*, Table 5-1, Option A1-A5.

Table 1-2
Power-Cord Color Conductor Identification

Conductor	Color	Alternate color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Light Blue	White
Grounded (Protective Ground)	Green/Yellow	Green/Yellow

Operating Temperature

The 7250 can be operated where the ambient air temperature is between 0° C and +40° C and stored in ambient temperatures from −40° C to +65° C. After storage at temperatures outside the operating limits, allow the instrument temperature to reach the safe operating limits before applying power. Ambient air temperature must be between 20° C and 30° C when calibrating the 7250.

The 7250 is cooled by air drawn through the fans located on the side panels. To ensure proper cooling of the instrument, maintain at least 2 inches clearance at the top, bottom and sides, and six inches clearance at the rear of the instrument.

Repacking For Shipment

If the 7250 is to be shipped long distances, we recommend that the instrument be repackaged the same as when it arrived. The crate and packaging material in which your instrument was shipped should be saved and used for this purpose.

If your instrument, module, or card is to be shipped to a Tektronix Service Center for service or exchange, attach a tag showing the following:

Owner of the instrument (with address),

Name of a person at your firm to contact,

Instrument type,

Instrument serial number,

Description of the service required.

If the packaging materials are not available and the 7250 must be shipped, construct a reinforced crate from good quality plywood or clear one-inch lumber,

making the inside dimensions large enough to allow for at least three inches on all sides for cushioning materials.

When packaging the 7250, surround the instrument on all sides with polyurethane foam or other stiff padding. Securely fasten the top of the crate. We recommend securing the crate with packing bands.

Accessories

Standard Accessories

Operators Manual	070-6401-00
Fuses:	
250 V, 0.5 A, Slow-blow	159-0032-00
250 V, 1 A, Slow-blow	159-0019-00
250 V, 2 A, Slow-blow	159-0023-00
250 V, 3.2 A, Slow-blow (May be substituted for 3.15 A fuse)	159-0198-00
Power Cord	161-0066-00

Optional Accessories

Tool Kit	118-7224-00
Service Kit (cables and extenders)	118-7225-00
Service Manual	070-7133-00
RS-232 Cable	012-0911-00
GPIB Cable	012-0991-00

Options

The following options are available:

Option A1-A5	International Power Cords.

Information about the international power-cord options is provided earlier in this section, in the Operators Manual, and in *Section Five, Options*.

Option 01	External Delay Line (55 ns delay, 75 ps risetime)
Option 2D	Extended Memory (adds waveform storage blocks 15 through 30)

Section Two
Circuit Overview

This section describes the operation of the modules in the 7250. The 7250 is serviced by module replacement and the modules are exchanged for repair at the factory. This overview explains the function of each module to assist you with module-level service. Component-level circuit descriptions are proprietary and are not included in this manual.

This overview is presented in two levels:

- The Block Diagram Description is a general explanation of the four main sections of the 7250.
- The Detailed Circuit Description explains the operation of each module within the four main sections.

Contents

Block Diagram Description

A block diagram of the 7250 is shown in Figure 2-1. It has four major functional sections:

- Oscilloscope
- Camera and acquisition
- Display and interface
- Power supplies

The 7250 uses scan converter technology to capture waveforms up to 6 GHz and display them or transfer them over the general purpose interface bus (GPIB). The scan converter consists of an oscilloscope cathode-ray tube (CRT) (containing a microchannel-plate electron amplifier) connected to a camera CRT by means of a fiber optic window. The output from the camera CRT's target is amplified, digitized, and stored in memory. The memory data is then processed and displayed as a waveform on a front-panel monitor. The data can be transmitted by way of GPIB or video outputs. An RS-232C port is provided so that data can be sent to a plotter with the push of a front-panel button.

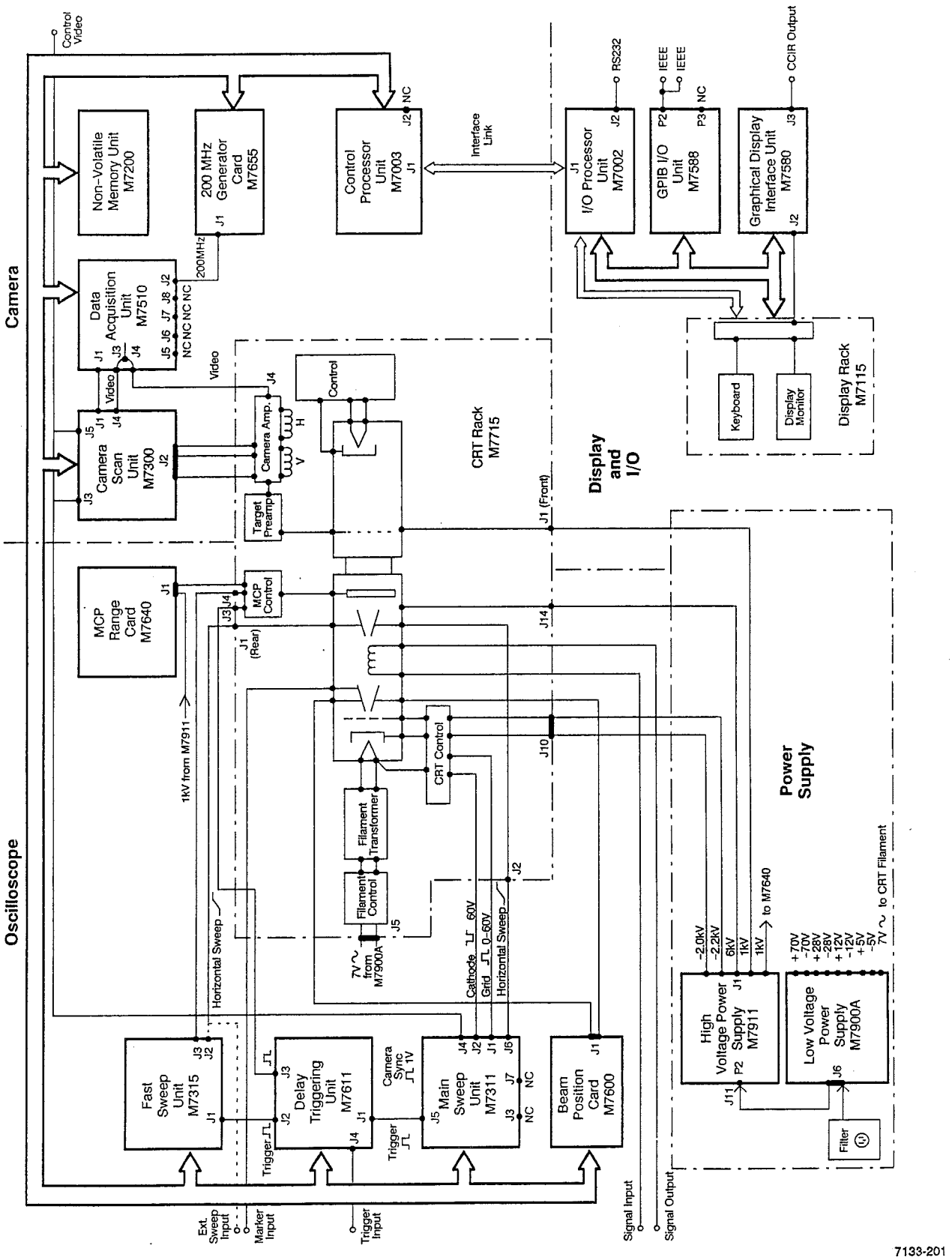


Figure 2-1. Block diagram of the 7250.

Oscilloscope Circuit

The oscilloscope circuit includes the Delay Triggering module, the Main Sweep module, the Fast Sweep module, the Beam Position Card, the MCP Range Card, and the oscilloscope section of the Scan Converter Rack module. (The Scan Converter Rack module includes the high-speed oscilloscope CRT and camera CRT that form the scan converter, plus several related circuit boards.) The signal the 7250 will acquire is presented directly to the vertical deflection plates of the oscilloscope CRT.

The horizontal electrostatic sweep for the oscilloscope CRT is generated by either the Main Sweep module or the Fast Sweep module, as determined by the sweep speed selected with the **TIME BASE** setting. Sweep triggering is controlled by the Delay Triggering module. (The delay time and trigger settings are selected with the **SWEEP DELAY**, **TRIGGER POLARITY**, **TRIGGER LEVEL**, and **TRIGGER TYPE** settings.) The Beam Position Card provides static positioning of the waveform on the screen of the oscilloscope CRT and adjusts the beam intensity to compensate for sweep speed changes. The MCP Range Card controls the amplitude of the activation pulses for the microchannel-plate (MCP) in the oscilloscope CRT. All oscilloscope activities are under the control of the Control Processor module.

Camera and Acquisition Circuits

The camera and acquisition circuits include the Camera Scan module, the 200 MHz Generator Card, the Data Acquisition module, the Non-Volatile Memory module, the Control Processor module, and the camera section of the Scan Converter Rack module.

The camera CRT is coupled to the oscilloscope CRT display by a fiber optic window that transmits a high resolution display of the waveform to the camera CRT's target. The Camera Scan module provides the horizontal and vertical signals to sweep the camera CRT's electron beam. The Target Preamplifier circuit within the Scan Converter Rack module amplifies the signal from the target of the camera CRT. The signal is further amplified by the Camera Amplifier, also within the Scan Converter Rack module. The signal is then sent to the Data Acquisition module. The Data Acquisition module digitizes the signal, using its A/D converter and a 200 MHz clock signal from the 200 MHz Generator Card. The Data Acquisition module transfers the digitized waveform to the Non-Volatile Memory module by direct memory access (DMA). All camera and acquisition activities are under the control of the Control Processor module. Output from the Control Processor is passed to the I/O Processor over the Interface Link.

Display and Interface Circuits

The display and interface circuits include the I/O Processor module, the Graphical Display Interface module, the Display Rack module (which includes the display CRT and the keyboard), and the GPIB I/O module.

The I/O Processor receives commands from the keyboard or IEEE (GPIB) port and transfers commands and/or data between the Control Processor module, Graphical Display Interface module, GPIB I/O module, or the RS-232 port. The Graphical Display Interface module stores data received from the I/O Processor in its internal display memory and displays this data (waveform and alphanumeric) on the screen of the Display Rack. It also outputs CCIR composite video and 625 line TTL video signals and, on command, transfers data from display memory to the I/O Processor. The GPIB I/O module operates the IEEE port and communicates with the I/O Processor.

Power Supply Circuits

The power supplies consist of the Low Voltage Power Supply module and the High Voltage Power Supply module.

The Low Voltage Power Supply module provides ±5 V and ±15 V internal reference voltages and a 7 V filament supply for the oscilloscope CRT. It supplies −5 V even when the 7250 is turned **OFF** and additionally provides ±5 V, ±12 V, ±28 V, and ±70 V when the 7250 is turned **ON**.

The High Voltage Power Supply module provides all oscilloscope CRT voltages except the filament voltage. These include −2170 V, −2000 V, −1190 V, −700 V, +6000 V, and +1000 V. It also supplies high voltage to the camera CRT. (The display CRT has a separate high voltage supply). Turn-on is time-delayed.

Detailed Circuit Description

This part of the Circuit Overview provides a more detailed description of each module in the 7250. Block diagrams of most modules are included to help you understand which signals are processed or generated within each module. The block diagram in Figure 2-1 shows interconnection between modules to further aid in locating problems.

Oscilloscope

The oscilloscope circuit includes the oscilloscope portion of the M7715 Scan Converter Rack module, as well as the M7611 Delay Triggering, M7311 Main Sweep, and M7315 Fast Sweep modules, and the M7600 Synchro Card.

Scan Converter Rack—Oscilloscope Section (M7715)

A representation of the oscilloscope CRT internal construction is shown in Figure 2-2.

Although the oscilloscope CRT and the camera CRT are both contained in the M7715 Scan Converter Rack module, their operation will be described separately according to their individual functions.

The input signal is presented directly to the distributed deflection system of the oscilloscope CRT without amplification or attenuation. Both an input and an output connector are provided at the rear of the 7250. The output connector can be used to continue the signal path to another instrument; otherwise it must have a 50 Ω termination attached.

Beam intensity is controlled by the M7311 Main Sweep module. The M7600 Beam Position Card supplies deflection voltage for static positioning of the oscilloscope CRT beam. The horizontal sweep signal is applied to either the right or left side of a distributed-deflection system. The Main Sweep module drives one side and the Fast Sweep module drives the other. One side is always at ground potential when the other side is driven.

The electron beam strikes the microchannel plate and is intensified before it reaches the oscilloscope CRT screen. Microchannel plate pulses are controlled by the Beam Position Card and MCP Range Card.

Trace rotation is provided by an external coil.

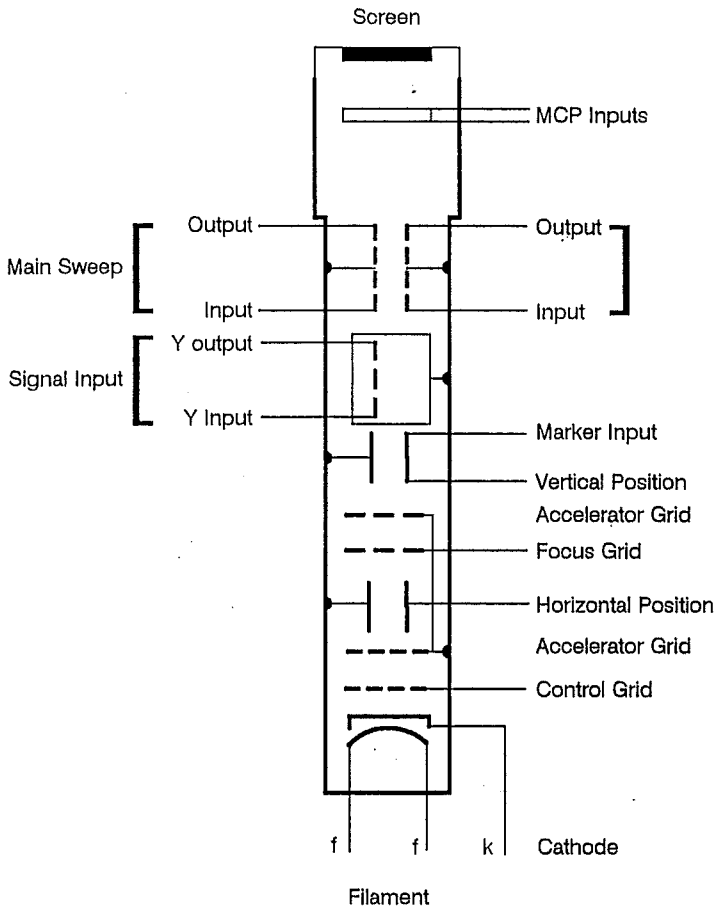


Figure 2-2. Construction of the oscilloscope CRT.

LED Fault Indications for M7715

- Filament supply is defective

M7715 (Oscilloscope Circuit) Inputs

- J1 Horizontal sweep from M7315-J2
- J3 Microchannel plate pulse from M7611-J3
- J4 Inhibit pulse from M7315-J3
- J6 Horizontal sweep from M7311-J6

Delay Triggering Module (M7611)

A block diagram of the M7611 Delay Triggering module is given in Figure 2-3.

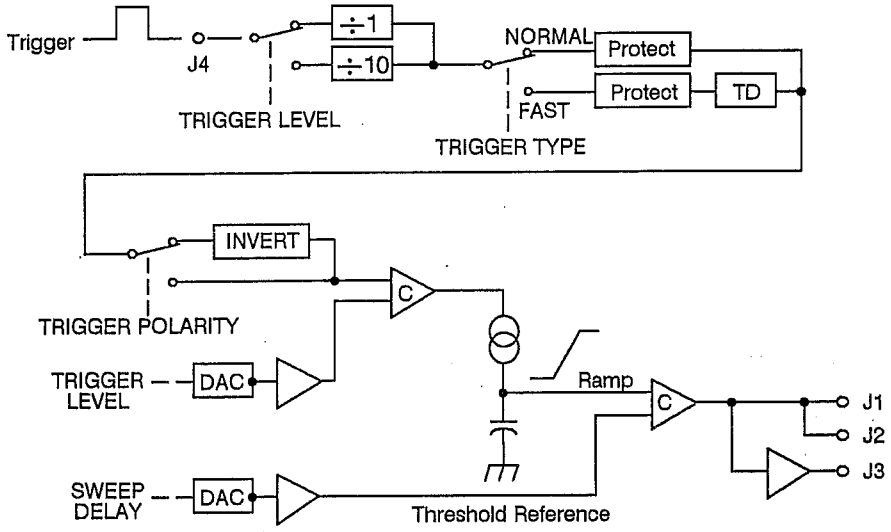


Figure 2-3. Block diagram of the M7611 Delay Triggering module.

The delay circuit is programmable and holds off the trigger for the length of time (**50 ns** to 5 μs) selected with the **SWEEP DELAY** setting. The triggering circuit initiates the oscilloscope CRT horizontal sweep and the microchannel plate unblanking pulse at the end of the delay time. The trigger signal is received from an external source through the rear panel **EXT. TRIGGER INPUT** connector. **TRIGGER POLARITY** can be set **POSITIVE** or **NEGATIVE** and **TRIGGER LEVEL** is adjustable.

The trigger signal enters connector J4 and passes through a programmable attenuator controlled by the **TRIGGER LEVEL** setting. The attenuator reduction factor is 1 (for 50 mV to 1 V signals) or 10 (for 1 V to 10 V signals). With **TRIGGER TYPE** set to **NORMAL**, the signal is sent through an over-voltage protection circuit. If the **TRIGGER TYPE** is set to **FAST**, the signal takes an alternate route through an over-voltage protection circuit and a tunnel diode (TD) pulse shaping circuit.

Next, the trigger signal passes to one input of a comparator, either directly or through an inverter. The choice is made using the **TRIGGER POLARITY** setting. The remaining comparator input is fed by the trigger threshold reference voltage produced by a digital-to-analog converter (DAC) that is controlled by the **TRIGGER LEVEL** setting. The output of the comparator triggers the start of the time delay ramp.

The duration (slope) of the time delay ramp is controlled by the **SWEEP DELAY** setting. The ramp voltage is fed to one input of a comparator. The sweep delay

setting is decoded by a DAC and output as a variable DC voltage threshold to the other comparator input. When the ramp voltage crosses the voltage threshold, the comparator generates the delayed trigger output. The delayed trigger signal is sent directly to the M7311 Main Sweep module and M7315 Fast Sweep module, and after amplification, is also sent to J4 on the Scan Converter Rack module, to generate the MCP pulse. The delayed trigger output is also used internally on the Delay Triggering module to lock out incoming trigger signals while the ramp generator is reset to zero and the delay comparator is reset.

LED Fault Indications on M7611

Trigger:

- Trigger signal is present. The LED is lit for each trigger pulse, causing it to flash or remain on continuously while the trigger signal is detected.
- Problem with the ±5 V or ±12 V power supply
- Delayed pulse is absent
- Arming error
- 180-second warm-up period is in effect

Delay:

- Problem with the ±5 V or ±12 V supply
- No trigger signal

M7611 Inputs

- J4 External trigger signal from rear panel **TRIGGER INPUT** connector

M7611 Outputs

- J1 Trigger pulse to M7311-J5
- J2 Trigger pulse to M7315-J1
- J3 Microchannel plate pulse to M7115-J3

Control Settings Affecting M7611

- **TRIGGER POLARITY**
- **TRIGGER LEVEL**
- **TRIGGER TYPE**
- **SWEEP DELAY**

Main Sweep Module (M7311)

A block diagram of the M7311 Main Sweep module is given in Figure 2-4.

The Main Sweep module generates the slower sawtooth sweep signals (500 ps/DIV to 1 μs/DIV in 1-2-5 sequence). The output is applied to one of the horizontal distributed-deflection plates of the oscilloscope CRT while the other plate remains at ground potential. The module also controls the oscilloscope CRT beam intensity and duration of unblanking at all sweep speeds. The unblanking circuit is described first.

The trigger pulse from the M7611 Delay Triggering module enters at connector J5. It is split into a negative and a positive pulse. The negative pulse (−60 V, connector J2) provides the cathode unblanking, while the positive pulse (adjustable from 0 to +60 V, connector J1) provides the grid unblanking. Oscilloscope CRT beam current (brightness) is directly related to the amplitude of the unblanking pulses. The amplitude is adjusted by a digital-to-analog converter controlled by the **BEAM CURRENT** setting.

The sweep circuit also takes its input from connector J5. The pulse triggers the sweep ramp generator. The slope of the ramp is selected with the **TIME BASE** setting. Sweep output appears on connector J6. A relay disconnects the sweep output when the Fast Sweep circuit is operating.

The camera synchronization pulse output on connector J4 sends a 5 V synchronizing pulse to trigger the M7300 Camera Scan module at the end of the unblanking pulse.

Additional trigger inputs are locked out until the digitization process is complete.

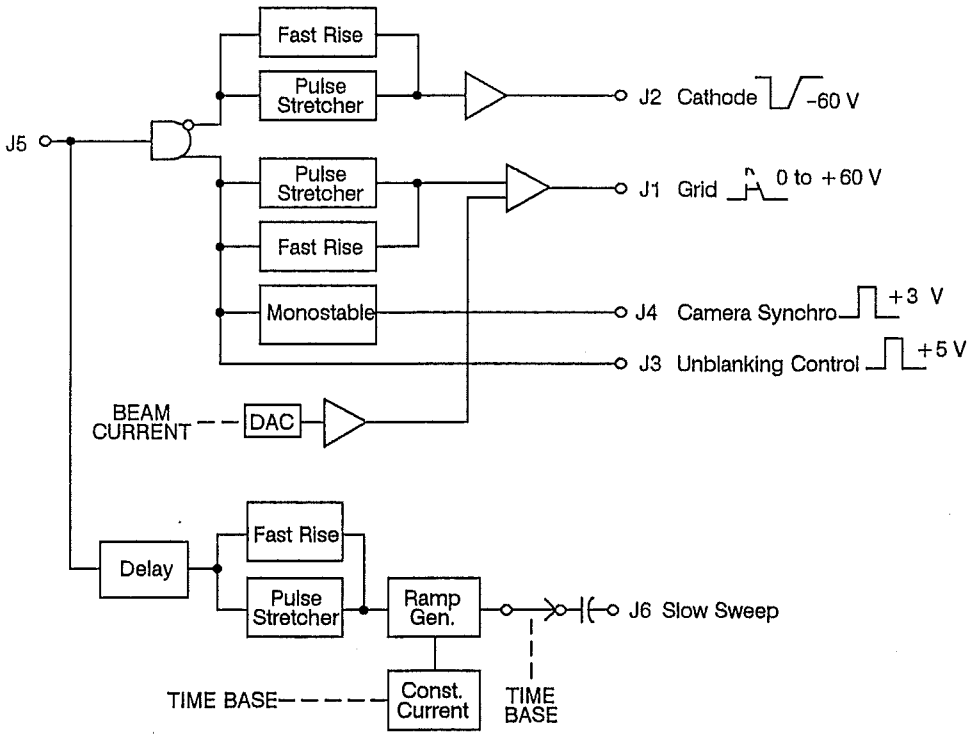


Figure 2-4. Block diagram of the M7311 Main Sweep module.

LED Fault Indications on M7311

- Power supply voltage is absent
- Unblanking or sweep circuits failed
- Trigger signal is missing
- 200 MHz clock signal missing

M7311 Inputs

- J5 Trigger pulse from M7611-J1

M7311 Outputs

- J1 Grid unblanking to the Scan Converter Rack module
- J2 Cathode unblanking to the Scan Converter Rack module
- J4 Camera CRT synchronization pulse to M7300-J3
- J6 Horizontal sweep to the Scan Converter Rack module

Control Settings Affecting M7311

- **BEAM CURRENT**
- **TIME BASE**

Fast Sweep Module (M7315)

A block diagram of the M7315 Fast Sweep module is given in Figure 2-5.

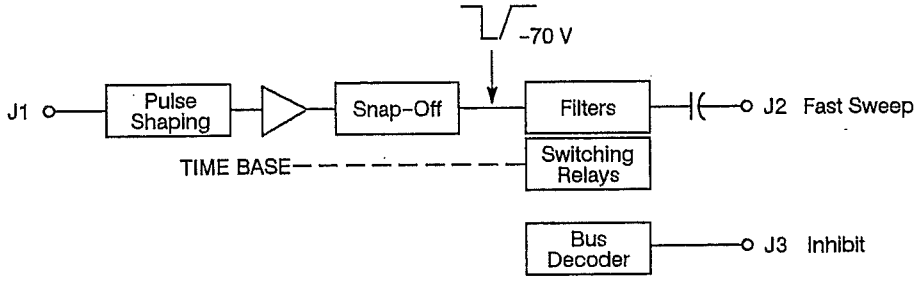


Figure 2-5. Block diagram of the M7315 Fast Sweep module.

The fast sweep provides the sawtooth signals for the **200 ps/DIV**, **100 ps/DIV**, and **50 ps/DIV TIME BASE** settings.

The delayed trigger signal from the M7611 Delay Triggering module enters at connector J1 and is shaped and amplified to form a negative pulse of about −60 V with a rise time of about 4 ns. A snap-off diode circuit further shapes the

pulse so that the amplitude is greater than –70 V and the rise time is about 200 ps.

Switchable filters, selected by the **TIME BASE** setting, slow the leading edge of the pulse to form sweep outputs of 500 ps, 1 ns, and 2 ns. The output at connector J2 is fed to one horizontal deflection plate of the oscilloscope CRT.

An inhibit command from the Control Processor locks out trigger signals and holds connector J2 at the low logic state when the Main Sweep circuit is in use.

When the **EXT. SWEEP INPUT** is used, the sweep signal cable is removed from J2 and attached to the rear of the **EXT. SWEEP INPUT** connector

LED Fault Indications on M7315

- Power supply voltage is incorrect
- No sweep trigger

M7315 Inputs

- J1 Trigger pulse from M7611-J2

M7315 Outputs

- J2 Horizontal sweep to M7115-J1
- J3 Inhibit pulse to M7115-J4

Control Settings Affecting M7315

- **TIME BASE**

Beam Position Card (M7600)

A block diagram of the M7600 Beam Position Card is given in Figure 2-6.

The Beam Position Card consists of the framing circuit and the microchannel plate (MCP) calibration circuit. The framing circuit determines the static horizontal and vertical position of the beam on the oscilloscope CRT screen and controls beam focus. The MCP calibration circuit provides the biasing pulses for the microchannel plate.

Address information is passed through bus buffers and registers. One register output is the calibration signal for the MCP pulse. Other outputs control the data bus buffer and three digital-to-analog converters (DACs). One DAC drives an amplifier to generate the focus signal, as selected by the **FOCAL VOLTAGE** setting.

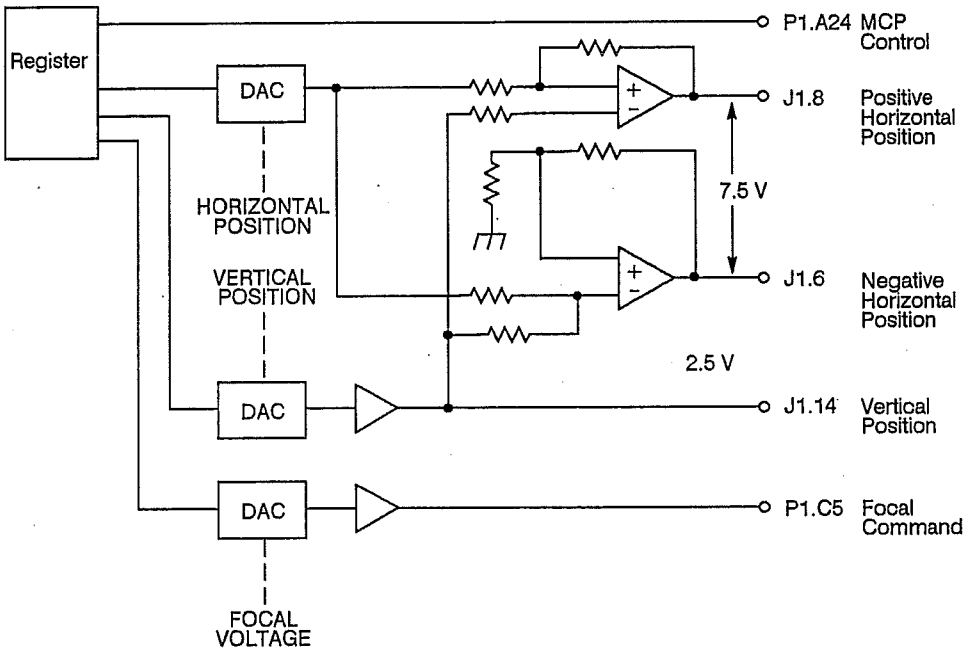


Figure 2-6. Block diagram of the M7600 Beam Position Card.

The other two DACs produce the vertical and horizontal framing signals. The output of one DAC is amplified and becomes the vertical framing signal. This signal, in combination with the amplified output of the other DAC, drive two more amplifiers to produce the positive and negative horizontal framing signals.

The circuit also enables startup of the High Voltage Power Supply upon software command (delay after power-on).

Control Settings Affecting M7600

- FOCAL VOLTAGE

MCP Range Card (M7640)

A block diagram of the M7640 MCP Range Card is given in Figure 2-7.

The MCP Range Card adjusts the MCP voltage to a value between 500 and 900 V. This is accomplished using a digital to analog converter controlled by the **MCP VOLTAGE** setting. The 1 kV input from the High Voltage Power Supply and the MCP voltage output both appear on conductors at J1.

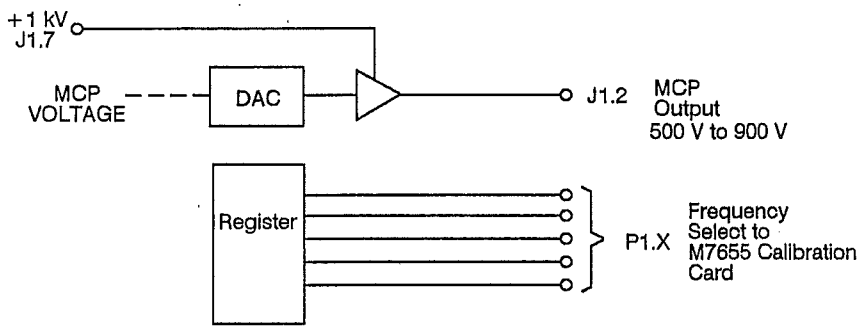


Figure 2-7. Block diagram of the M7640 MCP Range Card.

M7640 Inputs

- J1.7 1 kV from M7911

M7640 Outputs

- J1.2 MCP voltage output to the Scan Converter Rack module

Control Settings Affecting M7640

- MCP VOLTAGE

Camera and Acquisition

The image of the oscilloscope CRT waveform is transmitted to the the camera CRT target through a fiber optic "window." The target is scanned and the resulting video signal is amplified by the Target Preamplifier board and Camera Amplifier board. The video signal is transferred from the M7715 Scan Converter Rack to the M7510 Data Acquisition module for analog to digital conversion. The X and Y position data found by the Data Acquisition module is stored in the M7200 Non-Volatile Memory module. Scanning control signals are generated by the M7300 Camera Scan module. Scanning drive is developed by the Camera Preamplifier board. All functions are controlled by the M7003 Control Processor module.

Scan Converter Rack – Camera Section (M7715)

A block diagram of the M7715 Scan Converter Rack module camera circuit is given in Figure 2-8.

The oscilloscope CRT image is optically transferred to the camera target. The camera CRT uses magnetic deflection and its target is scanned at a normal television rate. The target signal is amplified by two circuits and sent to the M7510 Data Acquisition module.

The video signal from the camera target is fed to the Target Preamplifier board. A filter decreases the bandwidth of the preamplifier output to reduce noise. The signal travels to the Camera Amplifier board, where it is again amplified. An attenuator decreases signal amplitude up to 6 dB for slow sweeps. The amplifier output is connected to the M7510 Data Acquisition module and the M7300 Camera Scan module.

Sawtooth waveforms that drive the vertical and horizontal magnetic deflection coils of the camera CRT are generated on the Camera Amplifier board. (The M7300 Camera Scan module provides the control signals.)

Target, focus, and alignment bias, as well as grid, cathode, and filament voltage for the camera CRT are all supplied by circuit boards attached to the Camera Amplifier board.

A temperature monitoring circuit on the Camera Amplifier board monitors camera CRT temperature. If the temperature rises excessively, power to the CRT is cut off until it cools.

M7715 Camera Circuit (Camera Amplifier) Output

- J4 Video output to M7510-J4

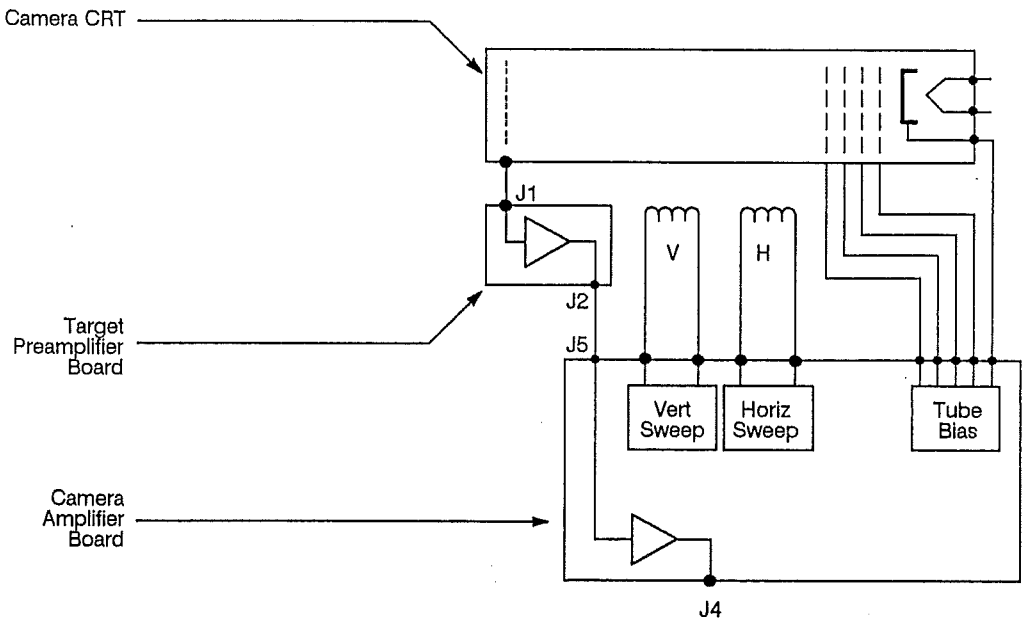


Figure 2-8. Block diagram of the M7715 Scan Converter Rack (camera CRT circuit).

Camera Scan Module (M7300)

A block diagram of the M7300 Camera Scan module is given in Figure 2-9.

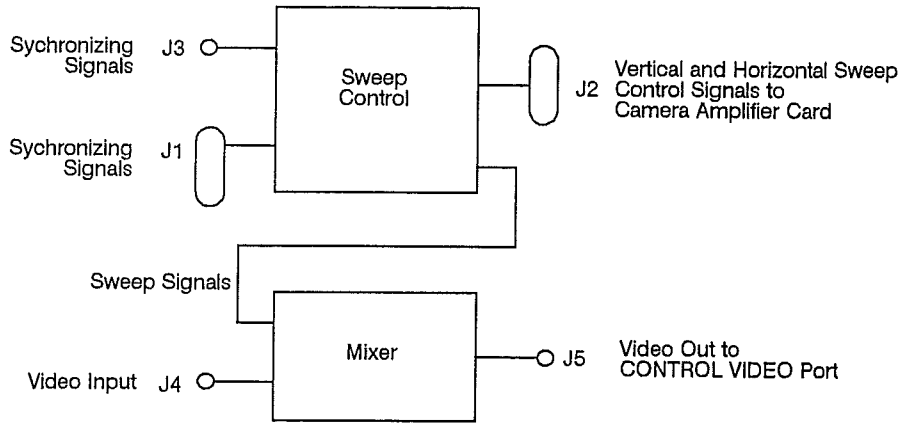


Figure 2-9. Block diagram of the M7300 Camera Scan module.

The Sweeping module provides the horizontal and vertical magnetic deflection control signals for scanning the camera CRT target. It also amplifies the video signal from the M7715 Scan Converter Rack module.

The synchronizing signal from the M7311 Main Sweep module is received at connector J3. Sweep control signals to the camera preamplifier board leave from connector J2.

The video input is applied to connector J4 and the amplified video signal is output from connector J5 to the **CONTROL VIDEO** connector on the rear panel of the 7250. This is the oscilloscope screen analog waveform, and not the processed digital waveform viewed on the front panel display screen.

LED Fault Indications on M7300

- No synchronization signal from the Main Sweep module
- Scan error from the Scan Converter Rack module

M7300 Inputs

- J1 Synchronizing signal from M7510-J1
- J3 Synchronizing signal from M7311-J4
- J4 Video input from M7510-J3

M7300 Outputs

- J2 Sweep control to M7115
- J5 Composite video output to rear panel **CONTROL VIDEO**

Data Acquisition Module (M7510)

A block diagram of the M7510 Data Acquisition module is given in Figure 2-10.

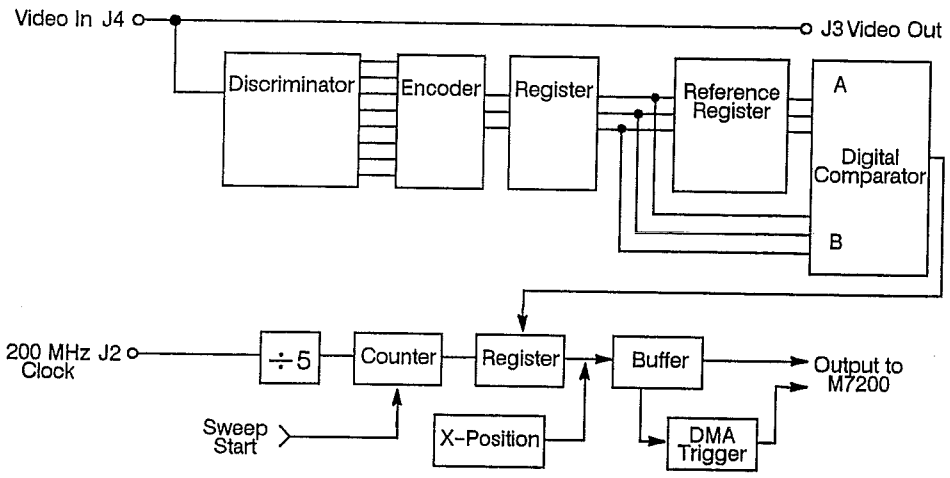


Figure 2-10. Block diagram of the M7510 Data Acquisition module.

The Data Acquisition module consists of an 8-level discriminator and an 11-bit digital comparator that locates the Y-axis position of the waveform image at fixed intervals along the X-axis. The module stores the Y-axis and X-axis position information in waveform memory. It also triggers each sweep of the camera target.

The camera CRT sweeps the waveform image on its target 512 times during each full scan. These sweeps are along the vertical amplitude axis (rather than the horizontal time axis) of the image. The amplitude of the analog video signal from the camera CRT represents the varying target brightness during each scan. This signal is amplified and received at connector J4 of the Data Acquisition module.

The resolution of the Data Acquisition module is 512 points horizontally and 2048 points vertically. There is one vertical sweep for each of the 512 horizontal points. The position of the waveform is found by dividing the sweep into 2048 precise increments of time and locating the increment at which the sweep crosses the waveform.

At each time increment the video signal amplitude is digitized by an 8-level fast discriminator. The video signal amplitude (brightness level) reaches a peak as the sweep crosses the waveform image. Whenever the output of the discriminator exceeds a reference level, the time increment at that instant is recorded. This usually results in one vertical amplitude point for each sweep, but may give none or several points, depending on the waveform image. An example is shown in Figure 2-11. A waveform image is scanned and on sweep number 210 the sweep

crosses the waveform image at time interval 1284. This corresponds to an X position of 210 and a Y position of 1284.

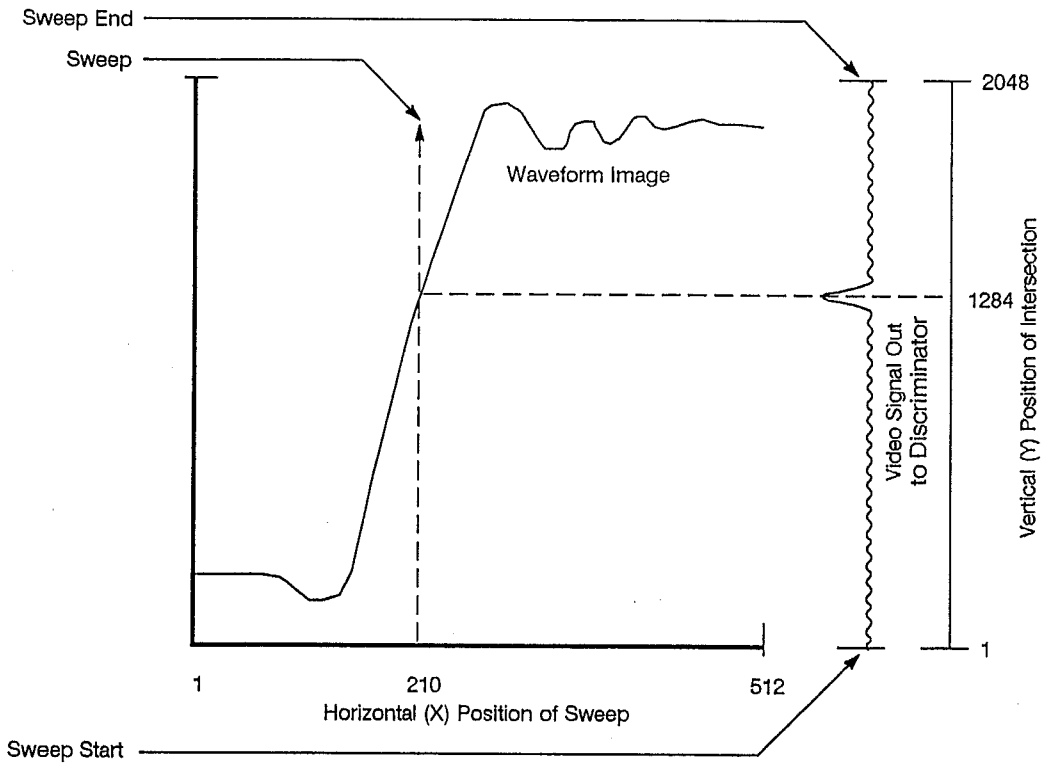


Figure 2-11. Vertical position is found to be 1284 during sweep number 210.

The X position at the start of each sweep is stored in a buffer, followed by any Y positions which exceeded the brightness threshold. When the buffer is full its data is transferred by direct memory access (DMA) to the M7200 Non-Volatile Memory module. This process is repeated until data for all 512 lines is transferred. Sweeps are delayed and processor activity is halted until each DMA is complete. The address for DMA transfer is always memory block 0, except when operating in **BURST** mode. The acquisition parameters are stored along with the waveform.

Acquisition enable, acquisition reset, and various synchronizing signals are transferred between the M7300 Camera Scan module and the Data Acquisition module from connector J1.

LED Fault Indications on M7510

- No 200 MHz clock signal
- Acquisition reset signal is missing
- Acquisition enable signal is missing
- First-level discriminator signal is missing

M7510 Inputs

- J2 200 MHz clock from M7655-J1
- J4 Video from M7115

M7510 Outputs

- J1 Synchronization signal to M7300-J1
- J3 Video to M7300-J4

200 MHz Generator Card (M7655)

This board generates 100 MHz and 200 MHz clock signals for the camera and acquisition circuits.

The output of a 100 MHz oscillator is amplified. The amplified signal is sent to four buffers to produce four 100 MHz outputs, and to a frequency doubler and buffers to form two 200 MHz outputs. The 200 MHz signal appears at connector J1.

LED Fault Indication on M7655

- Inoperative 100 MHz oscillator

M7655 Outputs

- J1 200 MHz clock signal to M7510-J2

Non-Volatile Memory Module (M7200)

The data memory is made of CMOS static RAM and can retain its stored data for up to two years using the built-in battery backup. Access to the memory is limited to the Control Processor and (by DMA) the Data Acquisition module. A portion of the memory space is assigned to storage for front-panel setups and a table of camera target defect locations. The remainder of the memory space can hold as many as 15 waveforms. An optional memory module can be added to increase the total to 31 waveforms.

The 64 Kilobyte memory is partitioned into 16 blocks of 4 Kilobytes each. One block is reserved for stored settings and for a table of camera target defect locations. The current settings and three additional setups can be held in this block for future or repeated use. The other 15 blocks (numbered 0 through 14) are used to store acquired waveforms. In each block, space is reserved for storing acquisition parameters such as sweep speed, trigger settings, etc. Block 0 is used for all DMA transfers, so it cannot be used for long-term waveform storage. In **BURST** mode, blocks 1 through 31 can also receive DMA transfers from the M7510 Data Acquisition module.

Buffers isolate the data, address, and control lines from the bus. A DMA controller is located on the board. The 64 Kilobyte memory also contains a parity check.

The module has a power supply detect circuit that disables all input to the board in the event of power supply failure. The board is returned to operation when it receives a message from the M7003 Control Processor module.

Errors are detected and reported to the processor whenever the battery voltage is low, the 5 V supply is low, or there is a parity error.

LED Fault Indication on M7200

- Parity error

Control Processor Module (M7003)

This is the central processor that controls the oscilloscope, camera, and digitizing activities. It sets sweep speed, beam intensity, trigger level and polarity, and all other functions necessary for acquisition and storage of waveform data from commands received from the I/O Processor. It transfers setting and waveform data to and from the Non-Volatile Memory module. All communication between the Non-Volatile Memory module and the I/O Processor module passes through the Control Processor module.

LED Fault Indication

- The processor is disabled

M7003 Input/Output

- J1 Interface Link to M7002-J1

Display and Interface

The Display and Interface circuit includes the M7002 I/O Processor, M7580 Graphical Display Interface, M7115 Display Rack, M7518 GPIB I/O, and M7405 Mainframe Chassis modules.

I/O Processor Module (M7002)

This processor handles commands as well as data input and output for the 7250. Commands from the front-panel keyboard or rear-panel GPIB (IEEE) port are interpreted and routed to the appropriate destination. Data transfer to and from the display memory, the IEEE port, and the RS 232 port are controlled by the M7002 I/O Processor module.

A cable connects J1 on the I/O Processor module to connector J1 on the M7003 Control Processor module. This is the Interface Link, which carries all communication between the two processors. Connector J2 is connected to the RS 232 port on the rear panel of the 7250. A plotter can be attached to the RS 232 port to create hard copies of front-panel screen displays.

LED Fault Indication on M7002

- The processor is disabled

M7002 Input/Output

- J1 Interface Link to M7003-J1
- J2 Rear-panel RS 232 port

Graphical Display Interface Module (M7580)

The Graphical Display Interface module generates the video signal that becomes the waveform, alphanumerics, and other graphics displayed on the front-panel screen. It contains a 16 Kilobyte display memory and receives commands and data from the I/O Processor.

There are two CCIR 625-line non-interlaced video outputs. One is connected to the COMPOSITE VIDEO output on the rear panel and the other is a TTL-level video output that goes to the M7115 Display module.

Display resolution is 512 horizontal and 256 vertical points. Compression of the 2048 vertical data levels from the acquisition circuits to the 256 points shown on the display is performed by the M7002 I/O Processor module.

M7580 Outputs

- J2 TTL video output to M7115
- J3 CCIR video output to rear panel **CCIR OUTPUT**

Display Rack (M7115)

A block diagram of the M7115 Display Rack module is given in Figure 2-12.

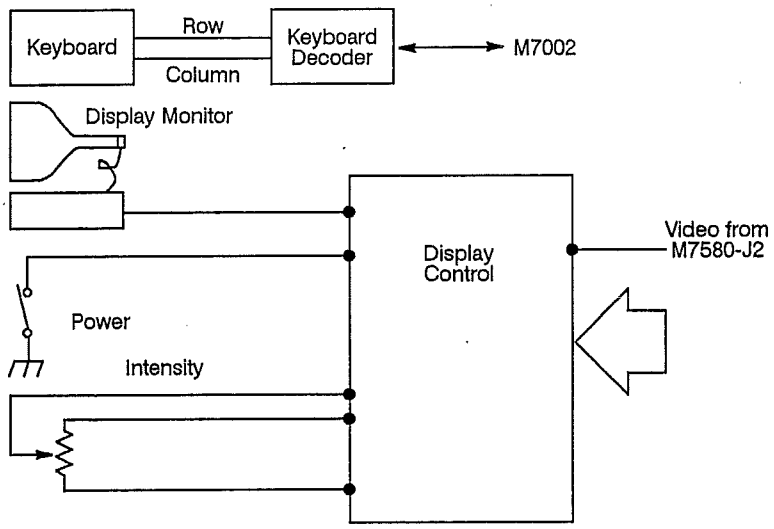


Figure 2-12. Block diagram of the M7115 Display Rack.

This includes the display control board, keyboard, and display monitor circuitry. The display control board decodes keyboard scanning signals and provides an interface between the display monitor and the bus. The display monitor generates the raster scan display from the video signal received from the M7580 Graphical Display Interface module. It also develops the high voltage for the front-panel display CRT.

GPIB I/O Module (M7588)

Both IEEE ports on the rear panel of the 7250 are standard general purpose interface bus (GPIB) ports. They are connected to the GPIB I/O module, which in turn is connected to the I/O Processor module through the main interface bus. The 7250 uses the GPIB to respond to commands and reply to queries sent from an attached controller. Waveforms and front-panel setups can be transferred to other devices connected to the GPIB.

M7588 Outputs

- P2 GPIB signals to rear panel IEEE ports.

Power Supplies

The power supply circuits include the M7900A Low Voltage Power Supply module and the M7911 High Voltage Power Supply module.

Low Voltage Power Supply (M7900A)

A block diagram of the M7900A Low Voltage Power Supply module is given in Figure 2-13.

The low voltage power supply consists of a linear supply and a switching supply.

The linear supply provides ±5 V and +15 V for internal reference and control. The -5 V supply is always **ON** when the 7250 is connected to the power line, regardless of the front panel power switch setting. The +5 V and +15 V supplies are turned **ON** with the front-panel power switch.

A switching supply provides ±5 V, ±12 V, ±28 V, ±70 V, and filament power for the oscilloscope CRT. These supplies are turned **ON** by the front panel power switch.

LED Fault Indications on M7900A

- Under- or over-voltage condition is detected on any of the switching supply outputs
- Failure of the +5 V or -5 V reference supply

M7900A Inputs

- J6 AC input from line filter

M7900A Outputs

- J6 Output to M7911-P2

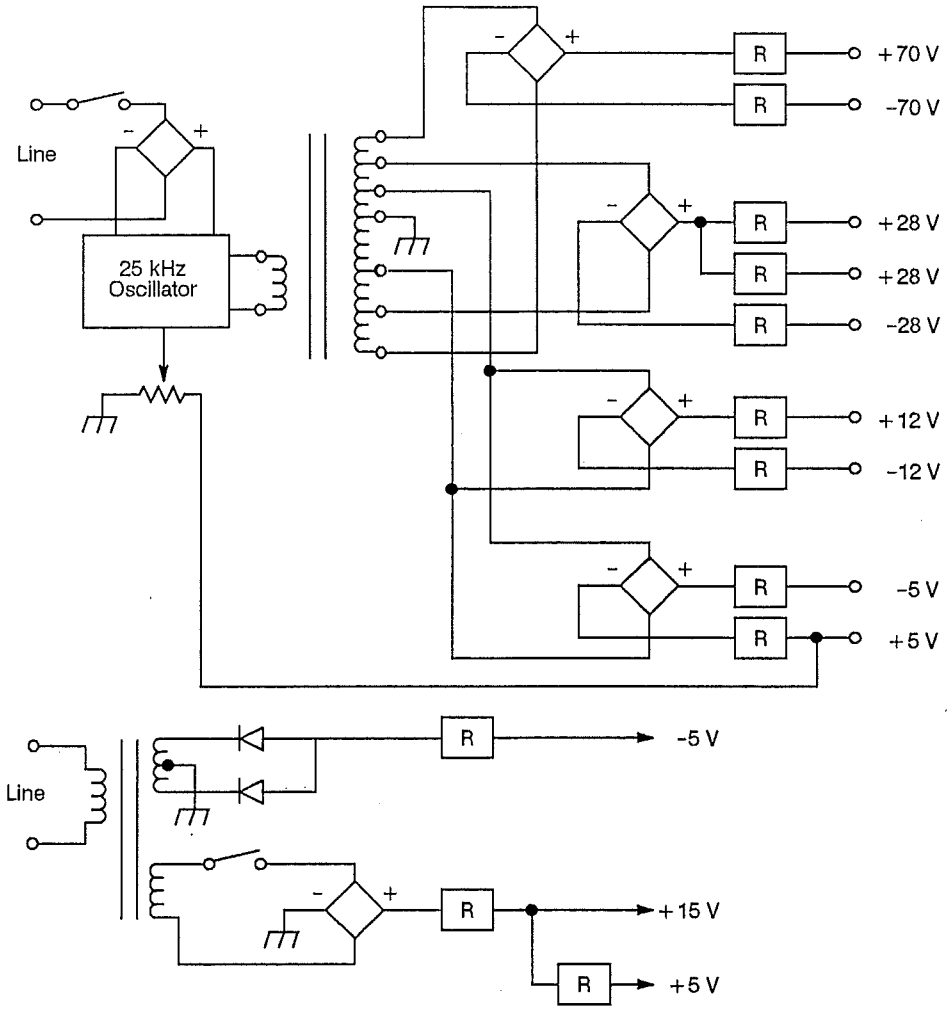


Figure 2-13. Block diagram of the M7900A Low Voltage Power Supply.

High Voltage Power Supply (M7911)

A block diagram of the M7911 High Voltage Power Supply is given in Figure 2-14.

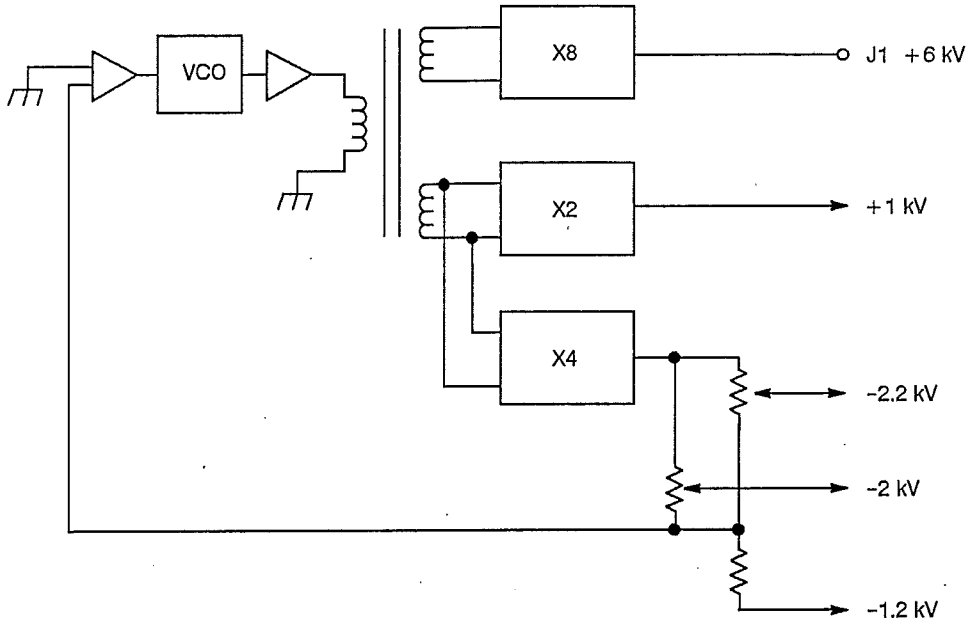


Figure 2-14. Block diagram of the M7911 High Voltage Power Supply.

This supply provides high voltage for the oscilloscope CRT and camera CRT. The display monitor has its own internal high voltage supply.

M7911 Outputs

- Oscilloscope CRT cathode −2 kV
- Oscilloscope CRT grid −2.2 kV
- Oscilloscope CRT focus −1.2 kV
- Oscilloscope CRT screen +6 kV
- MCP regulator +1 kV
- Camera CRT +1 kV

The high voltages are created by driving a transformer with a 25 kHz voltage controlled oscillator (VCO). The transformer secondary is connected to voltage multipliers. Feedback to the VCO is derived from the output of the negative voltage multiplier.

LED Fault Indications on M7911

- Failure of the negative high voltage output
- During the 180-second countdown after the power has been switched on. The LED is extinguished by the high voltage enabling command.

Section Three Maintenance

This section contains information for performing preventive maintenance, corrective maintenance, and troubleshooting.

- **Preventive maintenance** includes cleaning, visual inspection, and a recommended schedule for checking electrical performance.
- **Corrective maintenance** includes removing and replacing defective electrical modules and other components.
- **Troubleshooting** includes use of the 7250's on-board diagnostics as well as external test equipment to isolate electrical problems.

Contents

Removing the Cabinet Panels

All maintenance except exterior cleaning requires the removal of the cabinet panels.

WARNING

ELECTRIC SHOCK HAZARD: High voltages are present inside the 7250. Electric shock can cause severe personal injury or death. **DO NOT** touch exposed connections or components when the instrument is operated with the covers removed.

Disconnect the power cord before cleaning the instrument or replacing parts.

WARNING

ELECTRIC SHOCK HAZARD: As long as the power cord is connected, several power supplies are active—even when the front-panel power switch is set to **OFF**.

The cabinet panels provide protection from operating potentials present within the instrument. In addition, they reduce radiation of electromagnetic interference from the instrument.

The front and rear panels of the 7250 tilt out from the top after the removal of the two recessed fillister-head screws from above each panel, on the top of the instrument. For access to the central part of the instrument, remove the center panel from the top of the instrument by removing the four screws.

Unless interior access is needed for maintenance, operate the instrument with the panels in place to provide cooling air flow and to protect the interior from dust.

Preventive Maintenance

Regularly performed preventive maintenance can prevent instrument breakdown and may improve the reliability of the instrument. The severity of the environment to which the instrument is subjected will determine the frequency of maintenance. A convenient time to perform preventive maintenance is before electrical adjustment of the instrument.

Cleaning the 7250

The 7250 should be cleaned as often as operating conditions require. Accumulation of dirt on components acts as an insulating blanket and prevents efficient heat dissipation, which can cause overheating and component breakdown. Dirt also provides an electrical conduction path that can result in instrument failure.

CAUTION

Avoid the use of chemical cleaning agents which might damage the materials used in this instrument. Use only isopropyl alcohol or totally denatured ethyl alcohol. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

Cleaning the Exterior

Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small brush.

Cleaning the Interior

Cleaning the interior of the instrument should seldom be necessary. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air, such as from a vacuum cleaner. Remove any dirt that remains with a soft brush or a cloth dampened with a mild solution of detergent and water. A cotton-tipped swab is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components.

CAUTION

To prevent damage from electrical arcing, circuit boards and components must be dry before applying power.

Visual Inspection

The 7250 should be inspected occasionally for loosely-seated or heat-damaged components. The corrective procedure for most visible defects is obvious; however, take particular care if heat-damaged parts are found. Overheating usually indicates other problems with the 7250; therefore, correcting the cause of overheating is important to prevent recurrence of the damage.

Periodic Electrical Adjustment

To ensure accurate measurements, check the electrical performance of this instrument after every 12 months or 2000 hours of operation. Instructions are given in *Section Four, Checks and Adjustments*.

Corrective Maintenance

Corrective maintenance consists of module replacement and instrument repair. Special techniques required to replace modules in the 7250 are given here.

Tools

Table 3-1 contains a list of tools required for replacing modules. Additional equipment may be required for the checks and adjustments following module replacement; a list of such equipment is given in *Section Four, Checks and Adjustment*.

TABLE 3-1
Tools for Replacing Modules

Description	Specification	Examples
Slotted screwdrivers	Use screwdrivers which fit closely to avoid damage to screw heads	
Metric hex key wrenches	4 mm, (2.5 mm)	
Nutdriver or wrench	5.5 mm (7/32 in.)	
Torque wrench	8 mm (5/16 in.) Click-type, open-end	Radiall R282320*
Wire hooks	For extracting power supplies and circuit boards	MT 90052* MT 90126* MT90127*
Static Control Mat		Tektronix Part No. 006-3414-00
Wrist Strap		Tektronix Part No. 006-3415-00
Adjustment Shield		Included in Tool Kit

* From Tektronix Part No. 118-7224-00 Tool Kit

Static Discharge Precautions

CAUTION Static discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge.

Observe these precautions to avoid static discharge damage:

1. Minimize handling of static-sensitive assemblies.
2. Transport and store static-sensitive assemblies in their original containers, on a metal rail, or conductive foam. Label any package that contains static-sensitive assemblies.
3. Discharge the static voltage from your body by wearing a wrist strap while handling static-sensitive assemblies. Perform service on static-sensitive assemblies only at a static-free work station and only if qualified to do so. We recommend use of the Static Control Mat, Tektronix Part No. 006-3414-00, and Wrist Strap, Tektronix Part No. 006-3415-00.
4. Allow nothing capable of generating or holding a static charge on your work station surface.
5. Keep the assembly leads shorted together whenever possible.
6. Pick up assemblies by the body, never by the leads.
7. Do not slide the assemblies over any surface.
8. Avoid handling assemblies in areas that have a floor or work-surface covering capable of generating a static charge.

Ordering Replacement Parts

When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type
2. Instrument serial number
3. Description of the part (If electrical, include circuit number)
4. Tektronix part number

Removing and Installing Modules

The instructions for replacing modules are grouped according to whether the module is accessible from the front, rear, or top of the instrument. Consult Table 3-2 to determine the location of a module.

TABLE 3-2
Access to Modules

Module	Tektronix Part No.	Description	Access
M7002	118-6299-00	I/O Processor	Rear
M7003	118-6300-00	Control Processor	Front
M7115	118-6306-00	Display Rack	Front
M7200	118-6301-00	Non-Volatile Memory	Front
M7300	118-6302-00	Camera Scan	Front
M7311	118-6303-00	Main Sweep	Rear
M7315	118-6292-00	Fast Sweep	Rear
M7510	118-6295-00	Data Acquisition	Front
M7580	118-6294-00	Graphical Display Interface	Rear
M7588	118-6293-00	GPIB I/O	Rear
M7600	118-6297-00	Beam Position Card	Top
M7611	118-6296-00	Delay Triggering	Rear
M7640	118-6304-00	MCP Range Card	Top

TABLE 3-2 (cont)
Access to Modules

Module	Tektronix Part No.	Description	Access
M7655	118-6305-00	200 MHz Generator Card	Top
M7715	118-6307-00	Scan Converter Rack	Rear
M7900	118-6308-00	Low Voltage Power Supply	Top
M7911	118-6309-00	High Voltage Power Supply	Top
J905222	118-7949-00	Keyboard Assembly	Front

Accessing Front Panel Modules

WARNING

SHOCK HAZARD: Dangerous shock hazards may be exposed when the instrument covers are removed. Before proceeding, ensure the front-panel power switch is in the OFF position. Then, disconnect the instrument from the power source. Disassembly should be attempted only by qualified service personnel.

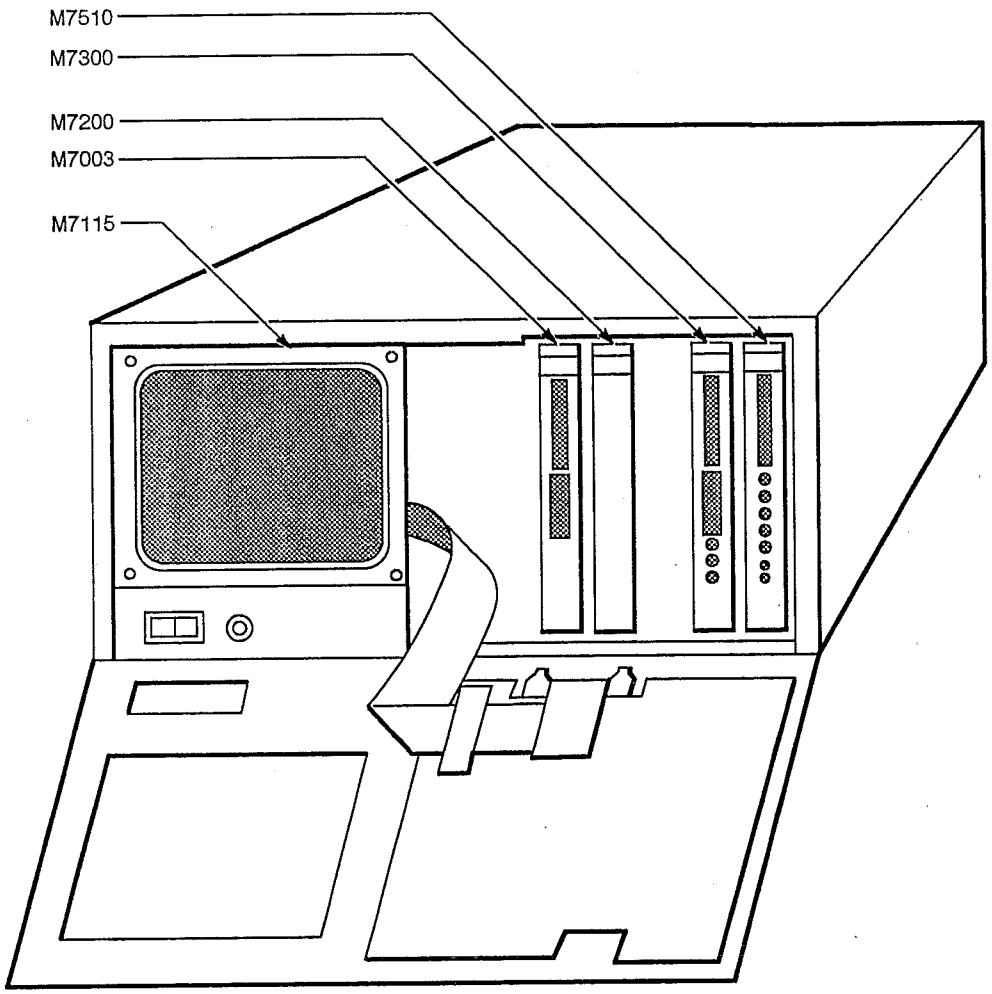


Figure 3-1. Modules accessed from the front panel.

To gain access to the front panel modules:

1. Set the front panel power switch to **OFF**.
2. Disconnect the power cord.
3. Remove the two recessed fillister-head screws from the top of the instrument above the panel. Hold the panel as you remove the second screw so the panel doesn't fall and stress the cables.
4. Tilt out the front panel.

Replacing M7003, M7200, M7300, and M7510

1. Remove the plastic retainer bar holding the modules.
2. Carefully remove the cables from the module to be replaced. Ensure the cables are properly identified by a marked sleeve.
3. Remove the module to be replaced by pulling on its handle.
4. For M7200, to set the jumper positions:
   a. Remove the two slotted screws and slide the cover shield off the replacement module.
   b. Move the battery jumper S-13 from the storage ("0") to the operating position ("1").
   c. Set the report line jumper SC-1 and the address jumper SC-6 for operation as a primary or secondary memory unit as shown in Figure 3-2:
      - Set SC-1 to position "1" for memory 1 or position "0" for memory 2.
      - Set SC-6 to position "1" for memory 1 or position "2" for memory 2.
   d. Replace the cover shield.
   e. Install M7200 Non-Volatile Memory modules in card cage positions two and three (the left-most position is number one).
   f. In the module being removed, move the battery jumper S-13 from the operating ("1") to the storage ("0") position.

CAUTION

This module contains batteries. **DO NOT** lay the module on a conducting surface when the cover shield is off. Observe the *Static Discharge Precautions* listed on page 3–5.

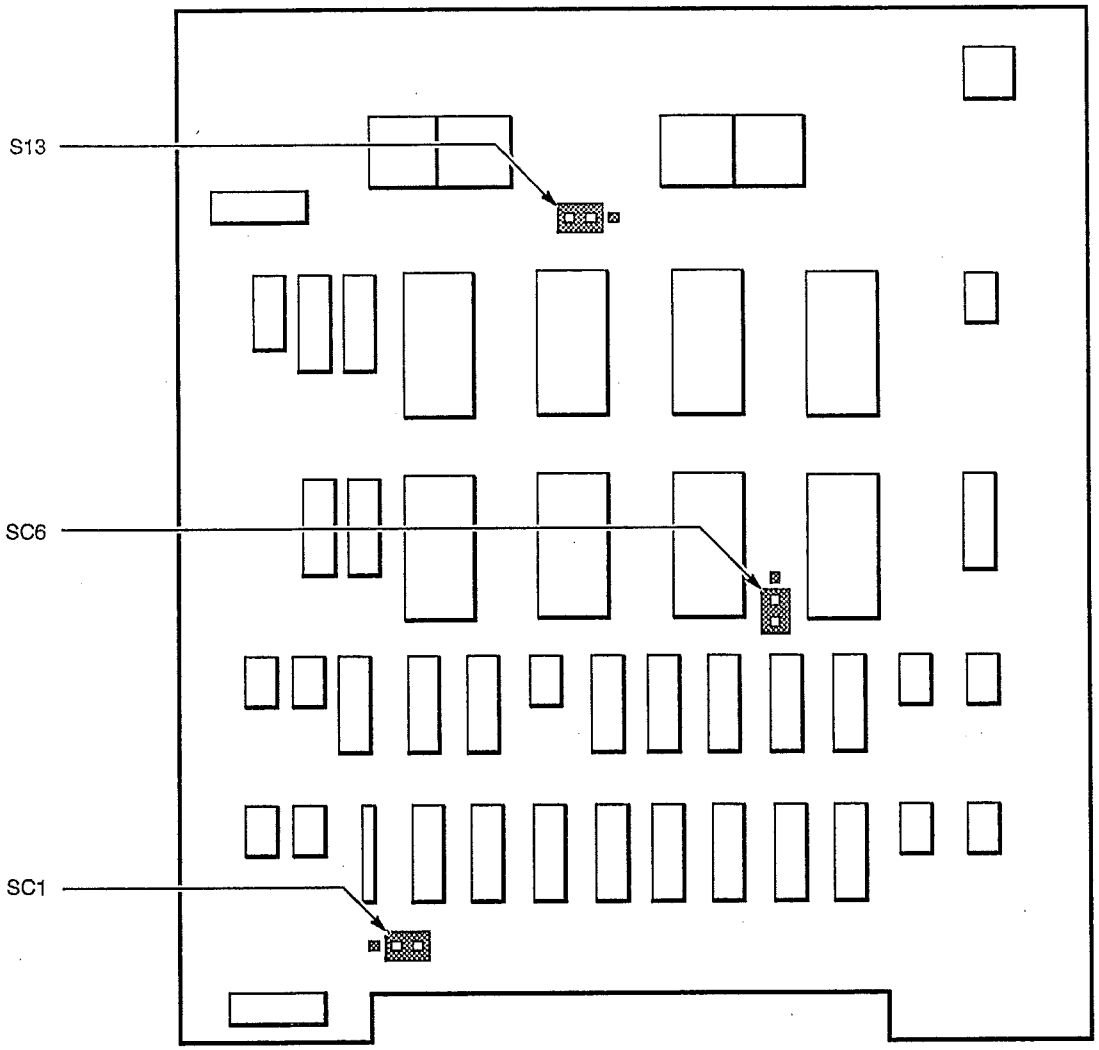


Figure 3-2. M7200 jumper position in primary and secondary use.

5. For M7300, to set the jumper position:

   a. Remove the two slotted screws and slide the cover shield off the replacement module.

   b. Set the jumper position in the replacement module as shown in Figure 3-3.

   c. Replace the cover shield.

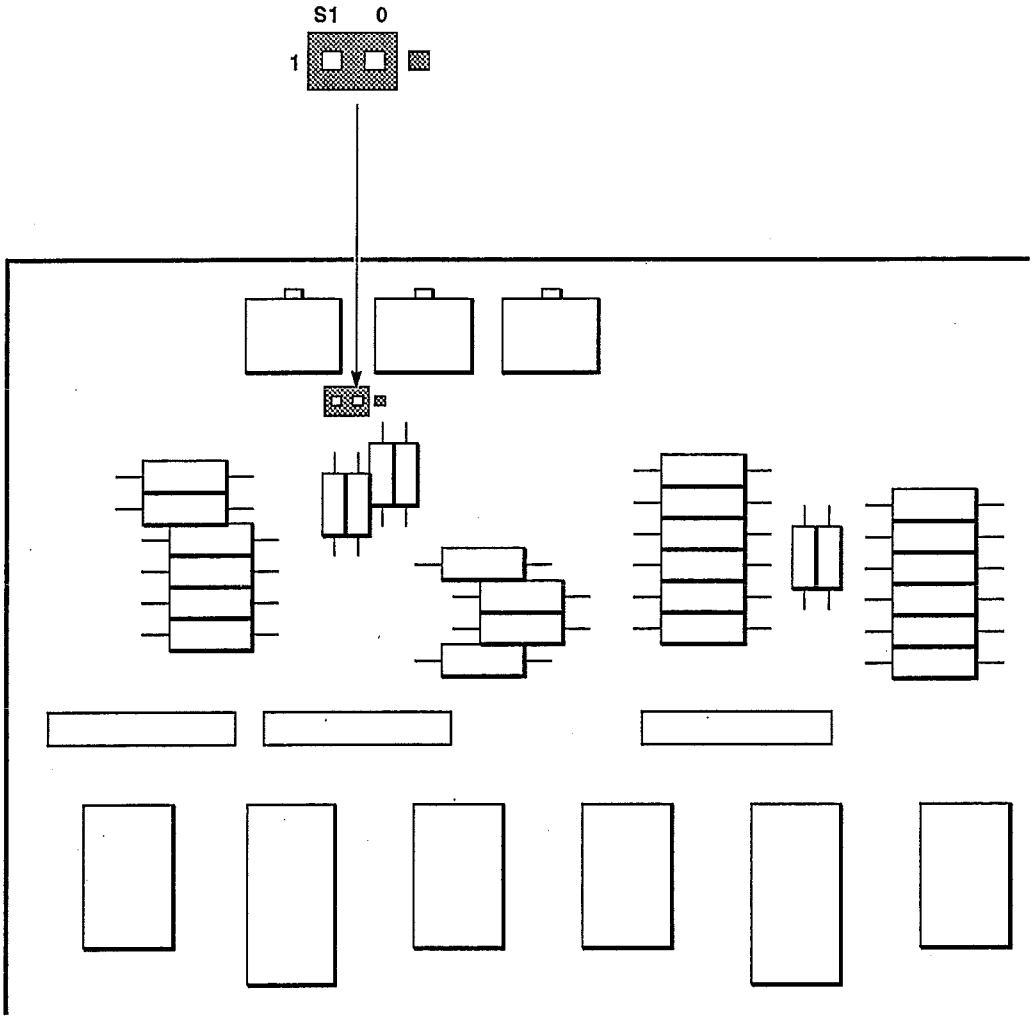


Figure 3-3. M7300 jumper position.

6. Replace the module by using the removal instructions in reverse order. Remember to position the plastic retainer bar so that it is offset towards the inside of the instrument.

7. After replacing M7200, restore the secondary parameters and **MAIN MENU** settings.

   a. Press **3 ENTER**, then **4 ENTER**.

   b. Perform the setup for the *Acquisition Test*, described later in this section under *Troubleshooting*.

   c. Select **ACQUISITION MODE** in the **MAIN MENU**, and set it to **BURST**.

d. Press **1 5 ACQUIRE** (if the instrument has one M7200 module) or **3 1 ACQUIRE** (if the instrument has two M7200 modules).

e. Verify the memory contents.

8. After the M7003 module is replaced, restore secondary settings and menu data:

CAUTION

The following instruction replaces all factory-set EEPROM values with the new values shown in the **MAIN MENU, SECONDARY MENU,** and **RESERVED MENUS**. Incorrect values in some menu locations can cause damage to the M7715 Scan Converter Rack module.

---

a. If the RAM is known to contain good data, press **1 9 6 4 ENTER** and **1 9 6 5 ENTER** and verify the entries in the **MAIN MENU, SECONDARY MENU,** and **RESERVED MENUS**.

b. If RAM does not contain good data, secondary settings and reserved menu data must be entered manually using the procedures for M7611 trigger delay offset (found later in this section), and M7715 secondary parameters, vertical sensitivity, and sweep delay (*Section Four, Checks and Adjustment*).

Replacing the Keyboard

1. Disconnect the ribbon cable from the keyboard.
2. Remove the ribbon cable from the tie-down on the insulating shield.
3. Remove and save the seven 5.5 mm (7/32 inch) nuts and washers.
4. Remove the insulating shield.
5. Remove the spacers.
6. Pull the keyboard up carefully.
7. Install the keyboard by using the removal instructions in reverse order.

Replacing the M7115 Display Rack

1. Disconnect the ribbon cable from the M7115 Display Rack at the keyboard.
2. Remove the four flat-head screws and pull out the M7115 Display Rack.
3. Install the M7115 module by using the removal instructions in reverse order.

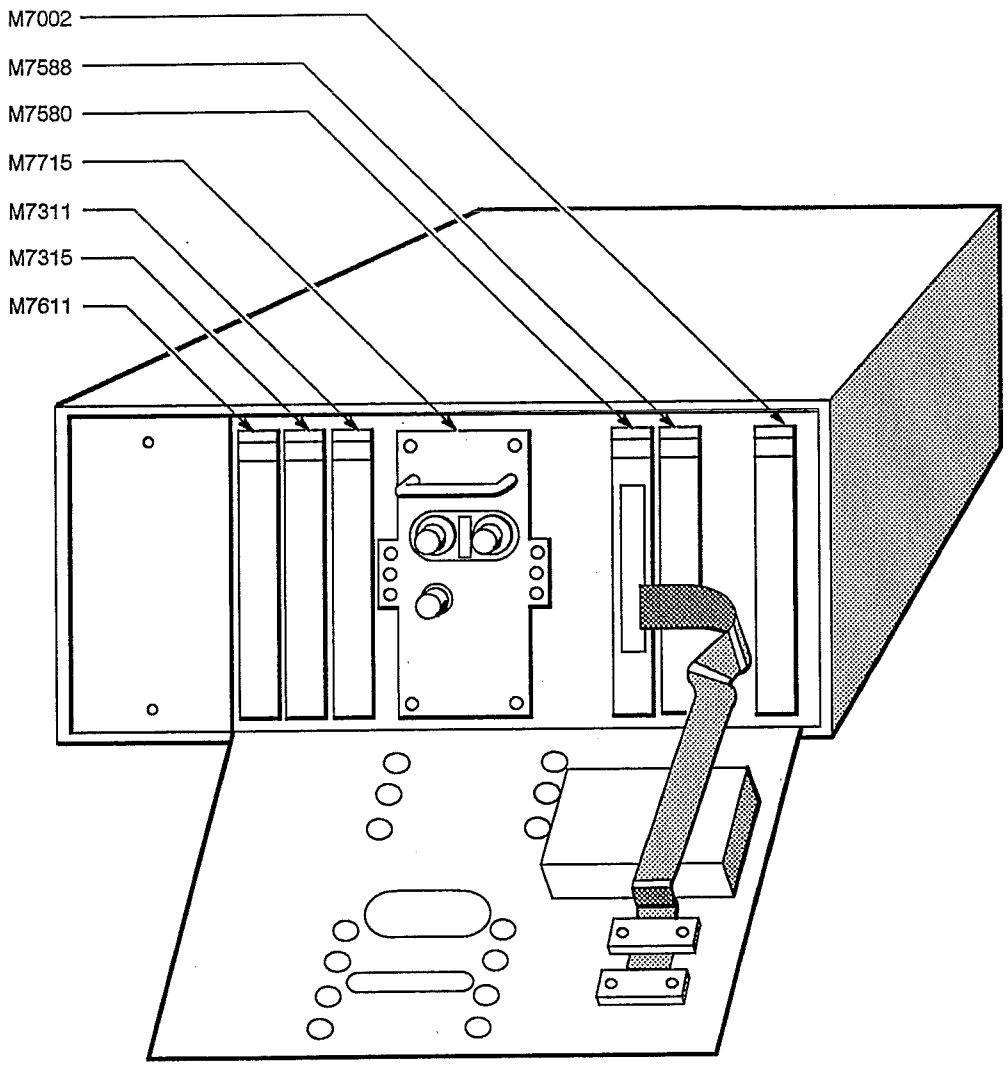


Figure 3-4. Modules accessed through the rear panel.

Accessing Rear Panel Modules

Use the following steps to access the rear panel modules:

1. Set the front-panel power switch to OFF.
2. Disconnect the power cord.
3. Remove all connections from the rear panel.
4. Remove the two recessed fillister head screws from the top of the instrument above the panel. Hold the panel as you remove the second screw so the panel doesn't fall and stress the cables.
5. Tilt out the rear panel.

Replacing M7002, M7311, M7315, M7580, M7588, and M7611

1. Remove the plastic retainer bar holding the modules. On the left side, remove the spacer plate to gain access to the second screw of the bar retaining M7611, M7311, and M7315.
2. Carefully disconnect the cables from the module to be replaced. Ensure the cables are properly identified. For M7315, use an 8 mm (5/16 in.) open-end wrench (or the torque wrench) to remove J2.
3. Remove the module to be replaced by pulling on its handle.
4. If M7611 is being replaced, record the offset values from the chart on the replacement module (see Figure 3-5). Refer to instruction 7 to record the values.
5. Replace the module by using the removal instructions in reverse order. Remember to install the plastic retainer bar so that it is offset towards the inside of the instrument and use the torque wrench to tighten J2 of M7315 to 0.8 to 1.1 Nm (7 to 10 in.lb).
6. If the M7311 or M7315 module has been replaced, perform the steps in *Part 4—Time Base* and *Part 7—Sweep Delay* in *Section Four, Checks and Adjustment*.

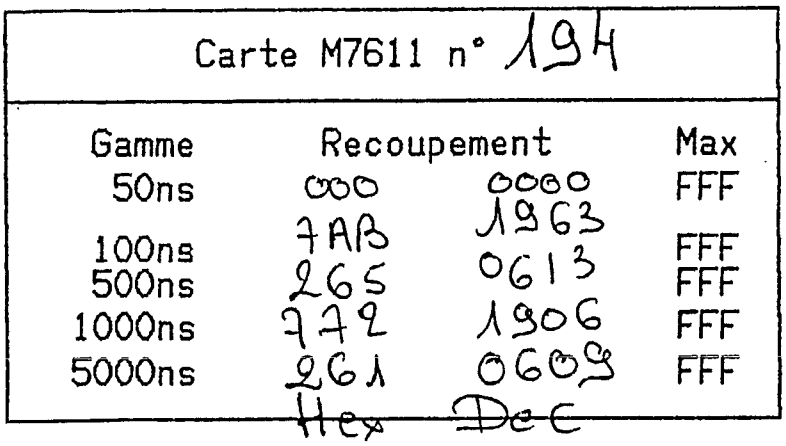


Figure 3-5. M7611 Offset chart.

7. If the M7611 module has been replaced, use the following instructions to set the trigger delay offset:

   a. Copy the values listed in the Offset Chart on the M7611 module into the columns in Table 3-3.

   b. Convert the hexadecimal values in the Offset Chart to decimal form and record them in Table 3-3.

TABLE 3-3
M7611 Hexidecimal to Decimal Conversion

"Gamme"	"Recoupement" (hex)	(decimal)	(line)	"Max" (hex)	(decimal)	(line)
50 ns			R33			R34
100 ns			R35			R36
500 ns			R37			R38
1000 ns			R39			R40
5000 ns			R41			R42

To convert hexadecimal to decimal, first convert each digit of the hex number to decimal (1 through 9 are as usual, but A = 10, B = 11, C = 12, D = 13, E = 14, F = 15), then multiply the first digit by 256, the second by 16, and add those two products to the third.

For example:

$$FFF = (15 \times 256) + (15 \times 16) + (15) = 4095$$

$$7D6 = (7 \times 256) + (13 \times 16) + (6) = 2006$$

c. Install the M7611 module, close the rear panel, and connect the power cord.

d. Set the front-panel power switch to **ON** and wait for completion of the 180-second countdown.

e. Press **3 ENTER** to recall menu entries from EEPROM into RAM memory.

f. Press **1 2 4 MENU** to display **RESERVED MENU 2.**

g. Select **R33** and enter the decimal form of the offset value, using the figure immediately to the left of "R33" in the chart above.

h. Repeat instruction g for **R34** through **R42.**

CAUTION

The following instruction replaces all factory-set EEPROM values with the new values shown in the **RESERVED MENUS.** Incorrect values in some menu locations can cause damage to the M7715 CRT Rack module.

---

i. Press **1 9 6 4 ENTER** to store these values in EEPROM.

j. Press **3 ENTER**, then **1 2 4 MENU** to recall the values from EEPROM and to display **RESERVED MENU 2.** Verify the data displayed.

Keep a record of the data by one of three methods: copy the contents of **RESERVED MENU 2**, connect a plotter and press **1 9 6 7 ENTER** (see the *Operators manual* for plotter compatibility information), or make a video hardcopy of the screen.

k. Press **MENU** to return to the **MAIN MENU.**

8. If the M7002 module has been removed to change the baud rate of the **RS232** port, use the following instructions:

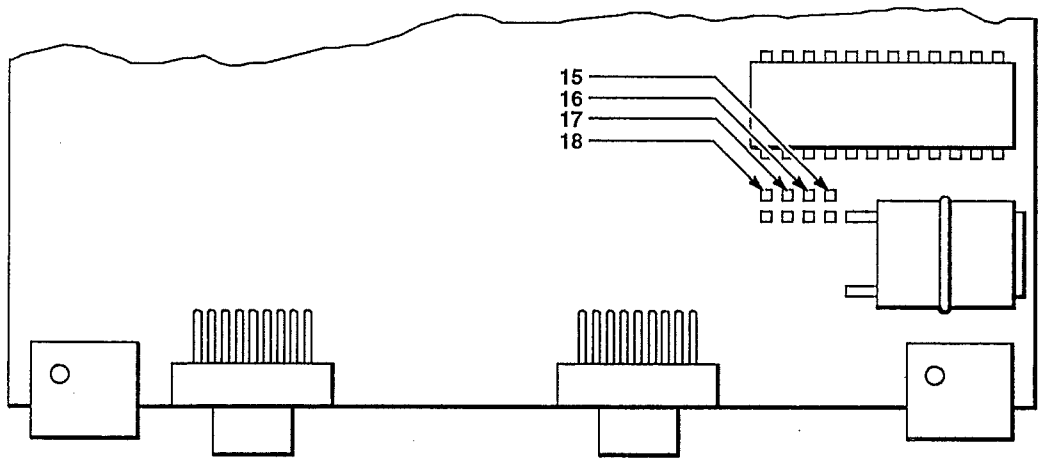
a. Remove the circuit board from the M7002 module by following the instructions given under Accessing Module Circuit Boards, appearing later this section.

b. Locate the baud rate solder pads near the bottom front corner of the circuit board, shown in Figure 3-6. These are marked 15, 16, 17, and 18.

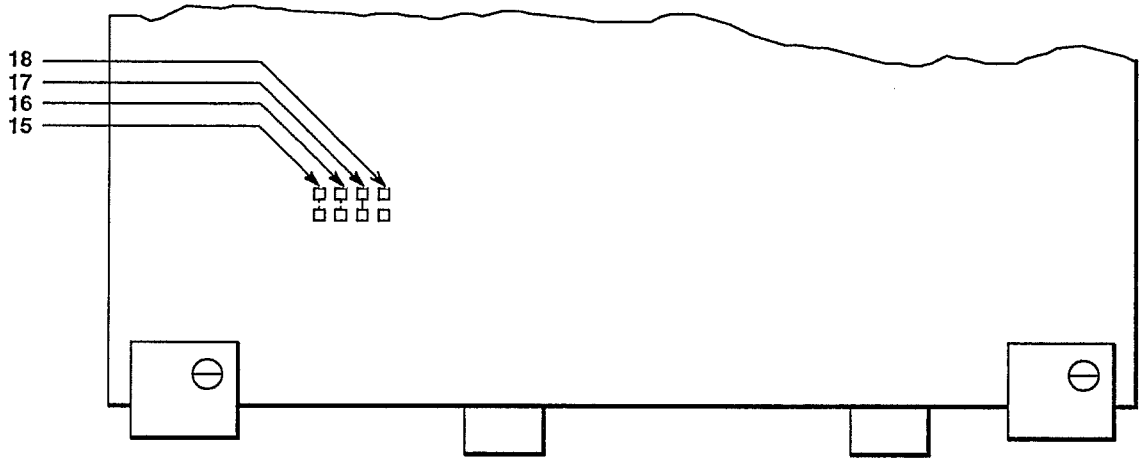
c. Turn the board over and locate the position of these solder pads on the back of the board. These are also shown in Figure 3-6.

d. Cut the runs between solder pads or solder wires between solder pads to set the baud rate. The settings are listed in Table 3-4.

e. Reassemble the module by using the disassembly instructions in reverse order.



M7002 Front



M7002 Back

Figure 3-6. Front and back views of M7002 circuit board, showing baud rate solder pads.

TABLE 3-4
RS-232 Baud Rate Solder Pads

Baud Rate	15	16	17	18
9600	Shorted	Shorted	Shorted	Open
4800	Open	Shorted	Shorted	Open
2400	Open	Open	Open	Shorted
1800	Shorted	Open	Shorted	Open
1200*	Open	Open	Shorted	Open

*Factory setting.

9. If the M7588 module has been removed to change the default GPIB address, use the following instructions:

   a. Remove the two slotted screws and slide the cover shield off the module.

   b. Locate the GPIB address switch, shown in Figure 3-7.

   c. Select the default address by setting to **ON** those switches whose binary sum equals the GPIB address.

      Example: For an address of 23 you would set switches 1(1), 2(2), 3(4), and 5(16) to **ON** (1+2+4+16=23, ON-ON-ON-OFF-ON). Factory set address is 17 (1+16, ON-OFF-OFF-OFF-ON).

   d. Select Listener and Talker modes by setting the remaining two GPIB switches to **ON**.

   e. Reassemble the module by using the disassembly instructions in reverse order.

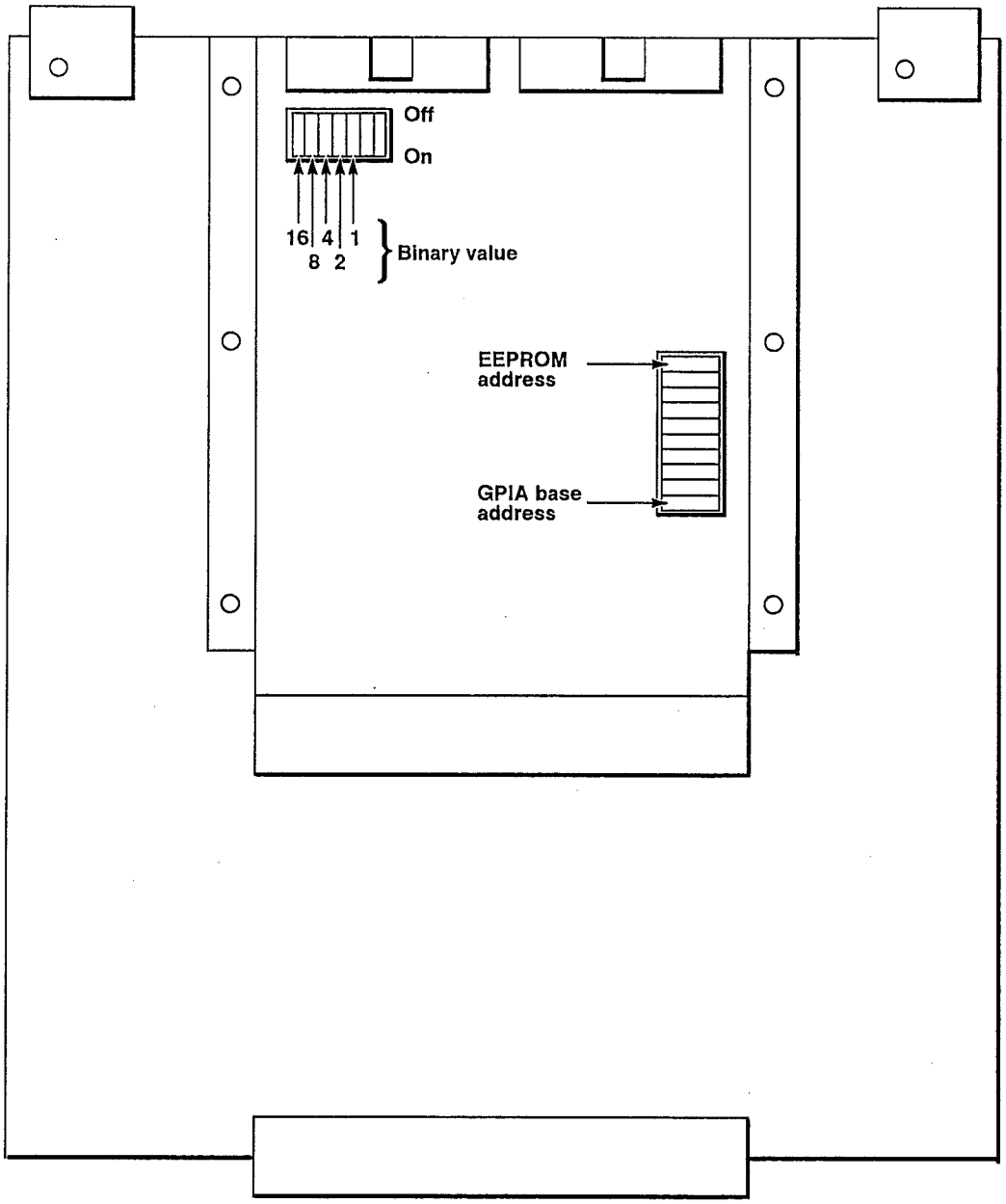


Figure 3-7. M7588 board showing GPIB default address switch.

Replacing the M7715 Scan Converter Rack Assembly

1. Disconnect the cables on the right side of the Scan Converter Rack assembly. Check that they are identified by a sleeve. Use the torque wrench (Radiall 282320) to disconnect the cable at J1.
2. Remove the ground wire from the lower right corner.
3. Remove cables J1 and J2 from module M7311.
4. Loosen the captive screw in the middle of each side of the Scan Converter Rack assembly (see Figure 3-8).

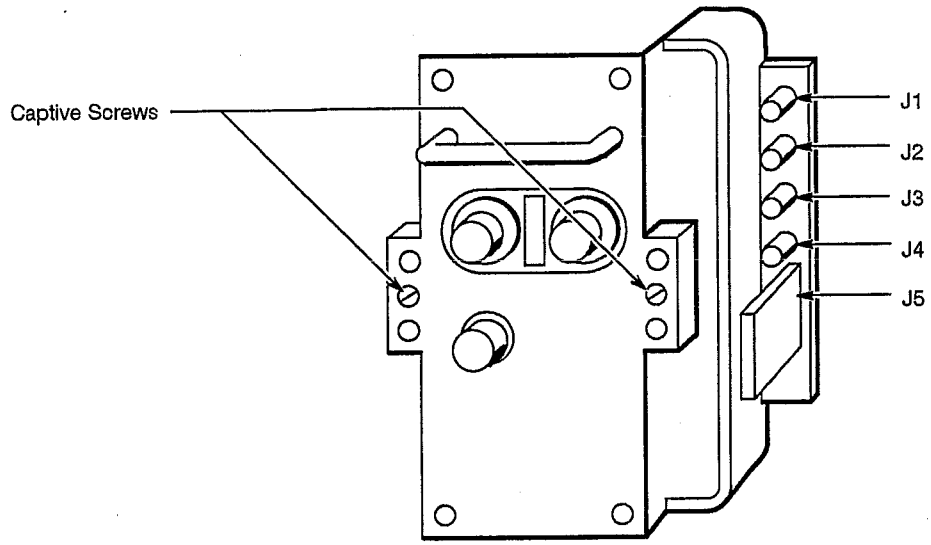


Figure 3-8. Scan Converter Rack assembly right-side connectors and captive screws.

5. Slide out the Scan Converter Rack assembly until it is stopped by the spring latch.
6. Remove the HV cable (red) from the Scan Converter Rack assembly by pulling out on the outer barrel to release the locking mechanism.
7. Release the spring latch by pushing up on the spring from beneath the CRT-Camera assembly, and pull out the Scan Converter Rack assembly .
8. Install the Scan Converter Rack assembly by using the using the removal instructions in reverse order. Use the torque wrench (Radiall 282320) to tighten connector J1. Be sure that the CRT identification sheet serial number is the same as the serial number on the Scan Converter Rack assembly (see Fig. 3-9).

TIROIR TUBE M7715 N.198

FICHES REGLAGES SECONDAIRES TIROIR TUBES

Realise le : 11-12-87
par : QUOIREZ D.

Tube N. 397
Cut-off : 185V
Sensibilite Verticale : SV1 = 5,17V
SV2 = 5,31V
* Vcm : +1,94V
* VcH : +8,10V
* CADH Volts min : +6,95V max : +5,33V
* CADV Volts min : +2,62V max : -1,61V

Bdt	FOC			GMC		ALL		CADRAGE	
en nS	HEX	DEC	VOLTS	HEX	DEC	HEX	DEC	HEX	DEC
0,5	0622	1570	-1214	0096	150	01F0	496	0100	256
1	0622	1570	-1214	0078	120	01F0	496	0100	256
2	0640	1600	-1216	0050	80	01F0	496	0100	256
5	062C	1580	-1215	0096	150	01F0	496	0100	256
10	062C	1580	-1215	006E	110	01F0	496	0100	256
20	062C	1580	-1215	0050	80	01F0	496	0100	256
50	05F0	1520	-1212	002D	45	01C2	450	012C	300
100	05DD	1501	-1211	002D	45	017C	380	0300	768
200	028A	650	-1163	002D	45	00F0	240	0300	768
500	026C	620	-1161	002D	45	00AA	170	0300	768
1000	0258	600	-1160	002D	45	0096	150	0300	768
2000	0244	580	-1159	002D	45	0087	135	0300	768
5000	0244	580	-1159	002D	45	007D	125	0300	768
10000	0244	580	-1159	002D	45	0073	115	0300	768
MIRE	0280	640	-1163	002D	45	0078	120	0100	256

* Suivant specification IN2

Figure 3-9. The CRT identification sheet (attached to the Scan Converter Rack).

9. Use the following instructions to write the secondary parameters of the CRT into EEPROM:

   a. Connect the voltmeter with the high-voltage probe to the FOC1 test point on the M7911 High Voltage module.

   b. Press **3 ENTER** to recall the menu entries from EEPROM. Record the settings for **SWEEP DELAY** and **TIME BASE**.

   c. Select **SWEEP DELAY**, and set it to **1050 ns**.

   d. Select **TIME BASE** and set it to **1 µs/DIV**.

   e. Press **MENU** to display the **SECONDARY MENU**.

   f. Press **2 ENTER** to unlock the secondary parameters.

   g. Set **FOCAL VOLTAGE, MCP VOLTAGE, BEAM CURRENT**, and **HORIZONTAL POSITION** to the values listed on the CRT identification sheet for the selected **TIME BASE** setting.

The CRT identification sheet may list decimal values or hexadecimal values. Use the decimal values if they are provided. If only hexadecimal values are given, convert them to decimal before entering them.

To convert hexadecimal to decimal, first convert each digit of the hex number to decimal (1 through 9 are as usual, but A=10, B=11, C=12, D=13, E=14, F=15), then multiply the first digit by 256, the second by 16, and add those two products to the third.

For example:

$$FFF = (15 \times 256) + (15 \times 16) + (15) = 4095$$

$$7D6 = (7 \times 256) + (13 \times 16) + (6) = 2006$$

The CRT identification sheet may list **TIME BASE** settings as "per division" or "full screen" values. If the range of values is from 0.5 ns to 10000 ns, divide the values by 10 to obtain "per division" values which correspond to the screen display.

The CRT identification sheet may have column headings in French, possibly abbreviated. The translations are as follows:

French	**English**
Focale; Foc	Focal Voltage
G.M.C.	MCP Voltage
Cadrage	Horizontal Position
Allumage; All	Beam Current
Vitesse; Base de temps; Bdt	Time Base
Sensibilite Verticale	Vertical Sensitivity
Mire	Matrix

If the CRT identification sheet data are handwritten, a North American reader should look carefully to correctly interpret characters written in continental European handwriting style.

h. Read the voltmeter and verify that the reading is within ±1 V of the Focus Voltage on the CRT identification sheet. If not, change the **SECONDARY MENU** entry for **FOCAL VOLTAGE** until the voltage is correct. Note this numeric value on the CRT identification sheet.

i. Return to the **MAIN MENU** and reset the **TIME BASE** to the next value listed on the CRT identification sheet.

j. Repeat steps g through i for each **TIME BASE** value.

k. After setting the values for **50 ps/DIV**, set the **TIME BASE** to **10 * 10 MATRIX**, and set the **FOCAL VOLTAGE**, **MCP VOLTAGE**, **BEAM CURRENT**, and **HORIZONTAL POSITION**. If the CRT identification sheet does not have an entry for **10 * 10 MATRIX**, use the values for 1 µs/DIV.

l. Press **1 ENTER** to lock the secondary parameters.

m. Set the **SWEEP DELAY** and **TIME BASE** to the values noted in instruction a.

CAUTION

The following instruction replaces all factory-set EEPROM values with the new values shown in the reserved menus. Incorrect values in some menu locations can cause damage to the M7715 CRT Rack module.

---

n. Press **1 9 6 4 ENTER** to store the CRT secondary parameters in EEPROM.

o. Press **3 ENTER** to recall the data from EEPROM.

p. For each **TIME BASE** setting, verify that the values displayed in the **SECONDARY MENU** are correct.

Keep a record of the data in one of three ways: copy the contents of **RESERVED MENU 2**, or connect a plotter and press **1 9 6 7 ENTER** (see the *Operators manual* for plotter compatibility information), or make a video hardcopy of the screen.

10. If Vertical Sensitivity values are shown on the CRT identification sheet, write the vertical sensitivity in **RESERVED MENU 1**: on line **R28** enter VS1 (one gate) and on line **R29** enter VS2 (two gates).

11. Set the grid voltage using the instructions under *Examining/Adjusting The Grid Voltage*, found in *Part 2—High Voltage Power Supply* in *Section Four, Checks and Adjustment.*

Accessing Module Circuit Boards

Front and rear panel modules are enclosed in a metal frame and cover shield to reduce electromagnetic interference. This shield must be removed before jumpers can be changed. Both the frame and shield must be completely removed before the module can be inserted in an extender card. Use the following steps to remove the shield and frame.

1. Remove two slotted flat-head screws near the rear of the module frame to release the cover shield.

2. Slide the cover shield to the rear and remove it.

3. Remove the module name plate from the module handle by sliding it to the side.
4. Remove the hex head screw, second from the bottom of the module front panel, using a 2.5 mm (7/64 inch) hex wrench and remove the slotted screw from inside the handle to release the circuit board and handle.
5. Slide the circuit board to the rear and remove it from the frame.
6. Reassemble the module by using the disassembly instructions in reverse order.

Accessing Top Panel Modules

WARNING

ELECTRIC SHOCK HAZARD: Dangerous shock hazards may be exposed when the instrument covers are removed.

DO NOT proceed before ensuring the front-panel power switch is in the **OFF** position. Then, disconnect the instrument from the power source. Disassembly should be attempted only by qualified service personnel.

Use the following instructions to access the top panel modules and cards:

7. Set the front-panel power switch to **OFF**.
8. Disconnect the power cord.
9. Remove the center panel from the top of the instrument by removing the four screws.

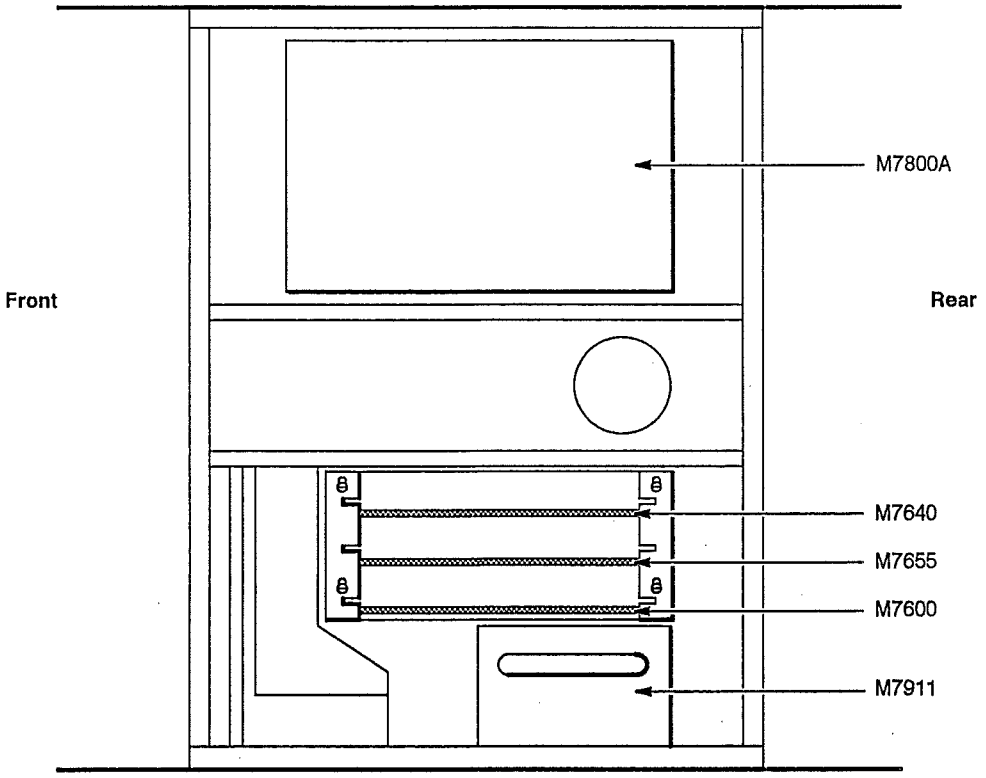


Figure 3-10. Modules and cards accessed through the top panel.

Replacing the M7900A Low Voltage Power Supply Module

CAUTION

DO NOT damage the thermal conductive sheet that is bonded to the side of the 7250 during removal and installation.

1. Loosen the four screws fastening the power supply cover and remove the cover.
2. Loosen the four screws fastening the left-side fan grill.
3. Unplug the fan from connector J8 and remove the fan.

4. Use a 4 mm hex key wrench to remove the four screws holding the power supply to the side of the 7250.
5. Lift out the power supply using one end of the two double hooks (MT 90126, MT 90127). Holes are provided in the power supply housing, at the top of the front and rear panels.
6. To install the power supply, temporarily insert a sheet of paper between the frame and the power supply to protect the thermal conductive sheet, then use the instructions for removal in reverse order.
7. Perform the instructions under *Part 1—Low Voltage Power Supply* in *Section Four, Checks and Adjustment*.

Replacing the M7911 High Voltage Power Supply Module

1. Remove the four screws holding the right-side fan grille.
2. Move the fan and air duct to the rear about 1/2 inch and pull up.
3. Unplug the fan at the white Molex plug and remove the fan.
4. Use a 4 mm hex key wrench to loosen the three screws holding the power supply to the side of the instrument.
5. Disconnect the cable from the power supply to module M7640.
6. Disconnect the HV red coaxial cable.
7. Lift out the power supply.
8. Install the power supply by using the removal instructions in reverse order. Ensure the connectors are aligned facing those in the bottom of the box.
9. Perform the instructions under *Part 2—High Voltage Power Supply* in *Section Four, Checks and Adjustment*.

Replacing the M7600, M7640, and M7655 Cards

1. Loosen the screws holding the locking bars (see Fig. 3-11).
2. Slide the bars aside.
3. Disconnect the cable from the card to be replaced.
4. Use a MT 90127 double hook to remove the card.
5. Install the card by using the removal instructions in reverse order.
6. Fasten the cable latches using the MT 90052 single hook.

7. If card M7600 has been replaced, perform the instructions under *Part 3 – Static Calibration* in *Section Four, Checks and Adjustment.*

8. If card M7640 has been replaced, perform the *Examining/Adjusting the MCP Voltage* portion of *Part 2 – Very High Voltage Power Supply* in *Section Four, Checks and Adjustment.*

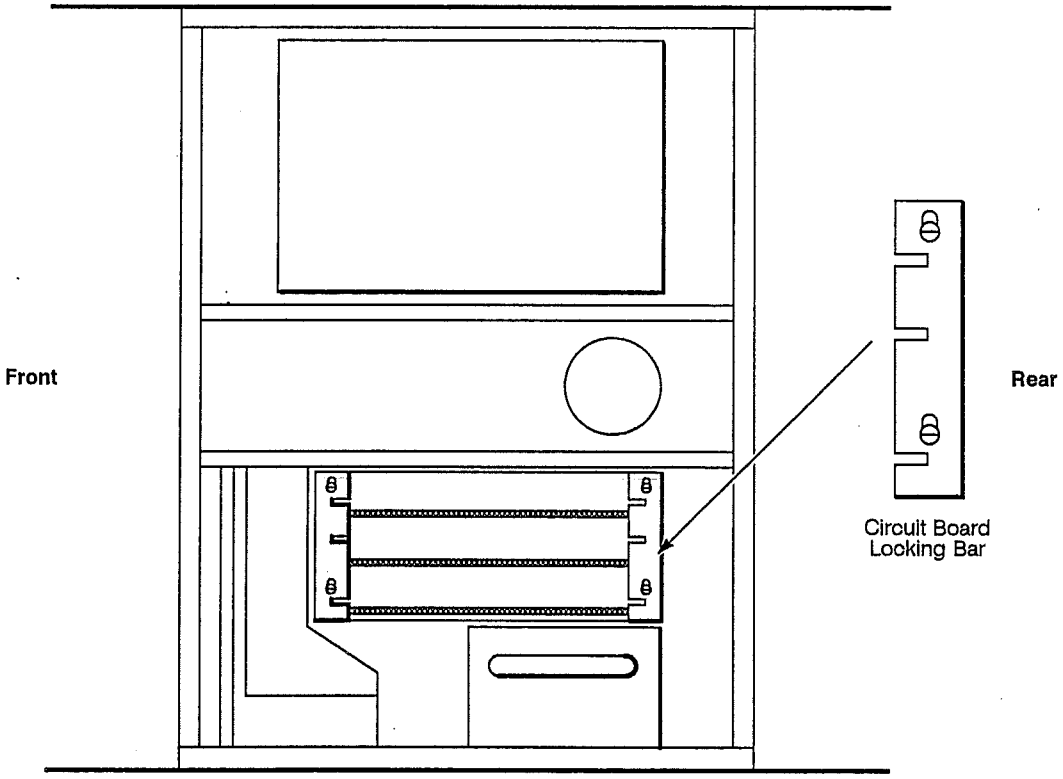


Figure 3-11. Circuit board locking bars.

Replacing the Line Fuses

The line fuses are located on the rear panel. To remove a fuse, push in and rotate one-eighth turn counterclockwise, then release.

Replace the line fuses with slow-blow fuses of the proper type and rating.

	110 V	220 V
F1	D8TD/3.15 A (159-0198-00)*	D8TD/2 A (159-0023-00)
F2	D8TD/1 A (159-0019-00)	D8TD/0.5 A (159-0032-00)

***A 250 V, 3.2 A, Slow-blow fuse may be substituted for the 3.15 A fuse that came with the 7250.**

Setting the Line Voltage Selector

1. Disconnect the power cord.
2. Remove the top-center panel. Refer to Cabinet Panel Removal on page 3-1.
3. Remove the shield on the Low Voltage Power Supply.
4. Remove one screw holding the bracket labeled **110 V or 220 V.**
5. Set each of the two switches to the opposite position.
6. Install the bracket with the appropriate line voltage visible. This orientation is possible only when the switches are in the correct position for the labeled voltage.
7. Remove the power line label on the rear panel and install it so the appropriate line voltage label is visible.
8. Change fuses F1 and F2 on the rear panel to the appropriate values. (Replacement fuses are stored in holders mounted at the top forward edge of the M7900A Low Voltage Power Supply module.)
9. Install the Low Voltage power supply shield.
10. Replace the top cabinet panel.
11. Connect the power cord, set the front-panel power switch to **ON**, and verify that the instrument operates.

Checking Modules After Replacement

After replacing a module, perform the checks for that module listed in *Table 4-2, Procedures After Module Replacement*, in *Section Four, Checks and Adjustment*.

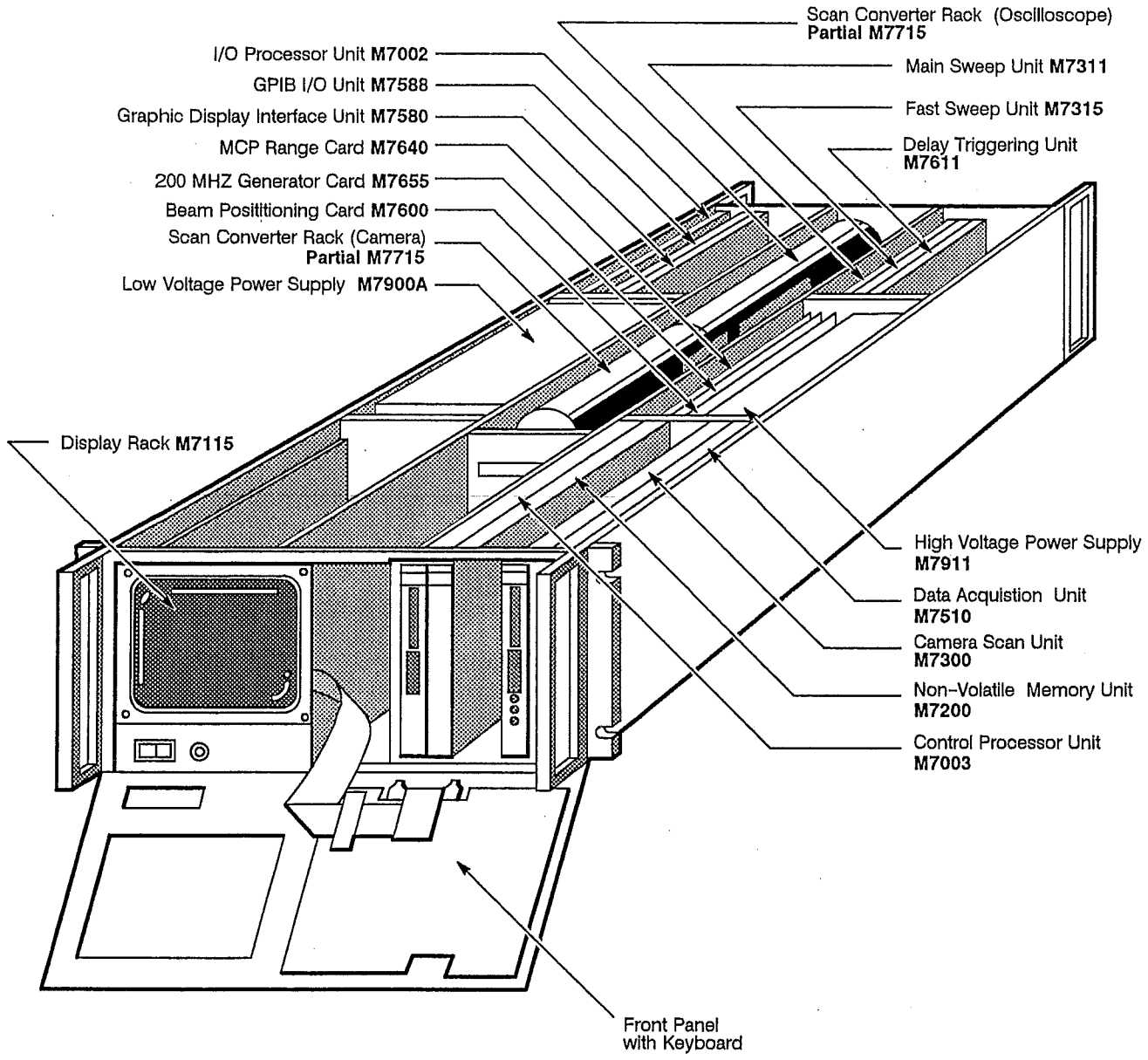


Figure 3-12. Locations of modules and cards in the 7250.

Troubleshooting

This section provides the information necessary to troubleshoot a faulty instrument to the module level.

Five methods are used:

1. Selftests, performed automatically when power is switched on.
2. LED fault indicators.
3. Symptomatic diagnosis (with a reference list).
4. Acquisition test to functionally check the instrument.
5. Diagnostic tests for use when the methods above do not isolate the faulty module.

Test Equipment Used

The following equipment is required to perform the diagnostic tests:

TABLE 3-5
Test Equipment for Troubleshooting

Description	Minimum Specification	Examples
Test Oscilloscope	300 MHz bandwidth; high writing speed	TEKTRONIX 2465 or 2467 Oscilloscope
Pulse Generator		TEKTRONIX PG 502 Pulse Generator with a TM 500-Series Power Module
Probe (2)	1 MΩ, 10X	TEKTRONIX P6136
Probe Cable		TEKTRONIX P6041
Battery-powered Voltmeter		Fluke 77 Digital Multimeter
High Voltage Probe	1% Accuracy, 6 kV max.	Fluke 80 K-6
Tool Kit	Wire Hooks Torque Wrench "T" connector (SMB)	Tektronix Part 118-7224-00

TABLE 3-5 (cont)
Test Equipment for Troubleshooting

Description	Minimum Specification	Examples
Service Kit	Extension Cable MT90074 Extension Cable MT90078 Extension Cable MT90076 Extension Cable MT90085 Filament Cable MT90067 Extender Card MT8700	Tektronix Part 118-7225-00
Resistor	100 Ω, 0.25 W, 5%	Tektronix Part 315-0101-00
The P6041 probe cable and "T" connector are used only in Diagnostic Test 3 to check the signal at J4 of M7311.		

Selftests

1. Check the rear-panel power line label for the correct voltage and remove all other external connections.

2. Set the front-panel power switch to **ON**. The following should occur:

   a. The buzzer should sound for one or two seconds. If the buzzer stays on, there may be a problem with the M7002 I/O Processor.

      If the Selftests do not detect a fault in the M7200 Non-Volatile Memory Unit, a persistent buzzer indicates a power supply fault. (The buzzer switch is next to the **INTENSITY** control, and can be accessed by tilting out the front panel.)

   b. The screen should display the message "SELFTEST V 4.3."

   c. After ten to twenty seconds, the **MAIN MENU** should appear. If a fault is detected, the **SELFTESTS MENU** is displayed instead of the **MAIN MENU**. Some faults will prevent menu display. If there is no display, go to *LED Fault Indicators* on page 3–37.

SELFTESTS

TESTS	I/O	ACQ
COMPUTER BOARD	GOOD	GOOD
GPIB BOARD	BAD	
NON VOLATILE RAM 1 ..		GOOD
NON VOLATILE RAM 2 ..		

Figure 3-13. Selftests menu.

3. If the **SELFTESTS MENU** is displayed, note the **BAD** indications:

TABLE 3-6
Selftests Menu Display to Module Number Cross Reference

Selftests Menu Display	Module Number
I/O COMPUTER BOARD	M7002
ACQ COMPUTER BOARD	M7003
GPIB BOARD	M7588
NON VOLATILE RAM 1	M7200 (1)
NON VOLATILE RAM 2	M7200 (2)

4. Press **1 9 6 0 HELP ENTER** to display the maintenance level of the **SELFTESTS MENU** and again record any **BAD** indications.

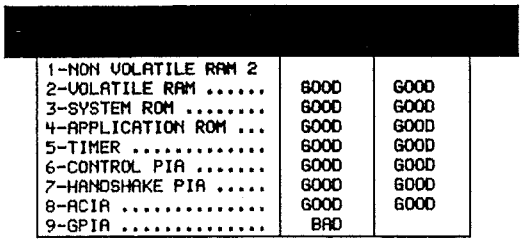


Figure 3-14. Selftests menu, extended.

5. Enter the number (0 through 9) of any line with a **BAD** indication to display the corresponding submenu, and again record the **BAD** indications. Press the **ENTER** key to return to the **SELFTESTS MENU**.

6. Replace the faulty module following the directions in the *Corrective Maintenance* portion of this section, and include the record of the **BAD** indications when returning the faulty module to the factory for repair.

NON VOLATILE RAM 1

TESTS	I/O	ACQ
PARITY		GOOD
MEMORY VOLTAGE		GOOD
BATTERY 2		GOOD
BATTERY 1		GOOD
CHIP 1		GOOD
CHIP 2		GOOD
CHIP 3		GOOD
CHIP 4		GOOD
CHIP 5		GOOD
CHIP 6		GOOD
CHIP 7		GOOD
CHIP 8		GOOD

NON VOLATILE RAM 2

TESTS	I/O	ACQ
PARITY		
MEMORY VOLTAGE		
BATTERY 2		
BATTERY 1		
CHIP 1		
CHIP 2		
CHIP 3		
CHIP 4		
CHIP 5		
CHIP 6		
CHIP 7		
CHIP 8		

VOLATILE RAM

TESTS	I/O	ACQ
SHIP 1	GOOD	GOOD
SHIP 2	GOOD	GOOD

SYSTEM ROM

TESTS	I/O	ACQ
CHECKSUM	GOOD	GOOD

Figure 3-15. Selftests submenus.

APPLICATION ROM

TESTS	I/O	ACQ
TASKS C.R.C.	GOOD	GOOD

TIMER

TESTS	I/O	ACQ
AVAILABILITY	GOOD	GOOD
FUNCTIONALITY	GOOD	GOOD

CONTROL PIA

TESTS	I/O	ACQ
AVAILABILITY	GOOD	GOOD

HANDSHAKE PIA

TESTS	I/O	ACQ
AVAILABILITY	GOOD	GOOD
HANDSHAKE	GOOD	GOOD

ACIA

TESTS	I/O	ACQ
AVAILABILITY	GOOD	GOOD

GPIA

TESTS	I/O	ACQ
AVAILABILITY	BAD	

Figure 3-15 (cont). Selftests submenus.

LED Fault Indicators

Use the following instructions to observe the LED fault indicators:

1. Set the power switch to **OFF**.
2. Disconnect the power cord.
3. Remove the middle panel from the top of the instrument, and tilt out the front and rear panels.
4. Restore power, and switch **ON** the instrument.

WARNING

ELECTRIC SHOCK HAZARD: Dangerous voltages may be exposed when the instrument covers are removed.

Electric shock can cause serious personal injury or death. **DO NOT TOUCH** anything except the front-panel power switch while the power cord is connected unless you are a qualified service person.

Generally when an LED is on, it is an indication that there is a fault. There are exceptions:

- The LEDs on the M7300, M7611, and M7911 modules go off only after the 180-second countdown.
- The LED on module M7611 is on and flashing when a trigger signal has been applied to the trigger input. It flashes at the frequency of the trigger signal and will appear steady at high trigger rates. The LED is off when there is no trigger signal.

TABLE 3-7
LED Fault Indicators

Module	LED Indication
M7002	Processor inhibited
M7200	Parity fault
M7300	Image sweeping or line sweeping fault
M7311	Power supply fault Sweep circuit fault Unblanking fault No sweeping trigger 200 MHz clock signal missing
M7315	Power supply fault No sweeping trigger
M7510	Acquisition fault 200 MHz clock signal missing Discriminator circuit fault
M7611	(Normally flashing or steady ON during operation) Power supply fault: ±5, ±12 V No trigger signal at input No delayed pulse Arming error
M7655	Clock inoperative
M7715	CRT filament fault
M7900A	Voltage fault
M7911	Voltage fault

TABLE 3-8
Diagnosis by Symptom

Symptom	Suspect module
No video display, video absent at CCIR output of rear panel	M7580
No video display, video absent at CCIR and buzzer intermittent	M7002
No video display, video correct at CCIR output of rear panel	M7115
Excessive jitter	M7611
No acquisition display, signal correct at Control Video output	M7510, M7300, M7311, M7315
Incorrect characters or images	M7115, M7002, M7580
RS232 malfunction	M7002
GPIB malfunction	M7002, M7588
Loss greater than 3 dB at 6 GHz	M7715
Blurring during external sine wave sweeping	M7715
Low Voltage power supply LED on, Low Voltage measurements bad	M7900A
Persistent buzzer after power switch on	M7900A
Intermittent buzzer (about 20 second loop)	M7002
No MCP voltage control, wrong voltage at GMC1 in High Voltage Power Supply	M7640
No acquisition storage	M7200
No updating of adjustable parameters	M7200
Linearity fault, slow sleeping	M7311
Linearity fault, fast sweeping	M7315
Unblanking fault, fast sweeping	M7315
Unblanking fault, slow sweeping	M7311
Framing, digitization	M7600, M7510, M7300

Acquisition Test

The Acquisition test will confirm proper operation of the M7611 and M7315 modules, as well as the consistency of the secondary settings.

1. Connect the pulse generator to the **TRIGGER INPUT** connector on the back panel and connect a 50 Ω terminator to the **SIGNAL OUTPUT** connector (see Figure 3-16). The generator serves only as a trigger source.

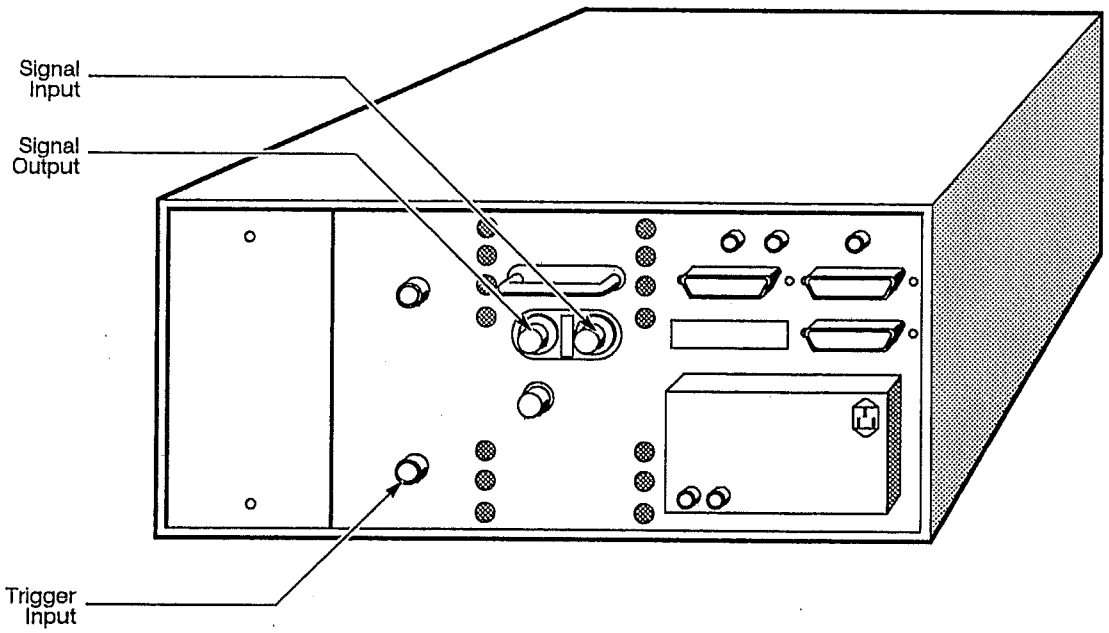


Figure 3-16. 7250 rear panel.

2. Set the pulse generator as follows:

Period	1 ms
Duration	100 ns
Output Level, High	2.5 V
Output Level, Low	-2.5 V

3. Access the **MAIN MENU** and select the following settings:

TRIGGER POLARITY	**POSITIVE**
TRIGGER LEVEL	**0.50 V**
TRIGGER MODE	**NORMAL**
SWEEP DELAY	**1100 ns**
TIME BASE	**500 ps/DIV**
SWEEP TYPE	**INTERNAL**
VERTICAL POSITION	**50**
ACQUISITION MODE	**CONTINUOUS**

4. Press the **ACQUIRE** key.

5. The acquisition should be displayed as a horizontal line in the center of the screen with the following characteristics:

   - Constant brightness
   - No holes (fewer than five missing points); use a cursor to examine the Y value at dim locations on the horizontal line.
   - No doubling (only one Y value for each horizontal point)
   - No slant greater than 1% (the trace is horizontal within 0.1 division over the width of the screen; use 10X magnification and check for tilt less than or equal to 1 division.)

6. Position the trace to the bottom of the screen by setting the **VERTICAL POSITION** to **1**, and then to the top of the screen by setting the **VERTICAL POSITION** to **100**. Verify that the quality of the displayed trace is maintained for all positions.

7. Return the **VERTICAL POSITION** to **50** and set the **TIME BASE** to **1 ns/DIV**.

8. Test all sweep speeds from **1 ns/DIV** to **1 µs/DIV**, and then all sweep speeds from **50 ps/DIV** to **200 ps/DIV**. A problem in only the three fast ranges indicates a fault in module M7315 or card M7600.

Diagnostic Tests

When the Selftests are satisfactory but a fault is present, check the operation of the modules not tested by the Selftests. *Section Two, Circuit Overview,* describes the signals examined in these tests. Reading it will help you understand the results of the tests.

WARNING

ELECTRIC SHOCK HAZARD: These procedures require working near dangerous voltages. Electric shock can cause serious personal injury or death!

DO NOT attempt these procedures unless you are a qualified service person.

Setting Up

Use the test equipment setup specified in the *Acquisition Test* when performing diagnostic tests.

TABLE 3-9
Diagnostic Tests

Test Procedure	Module Tested
1. Low Voltage	M7900A
2. High Voltage	M7911
3. Video Signals	M7300, M7510
4. 200 MHz Signal	M7655
5. Slow Sweep and Unblanking Signal	M7311
6. Fast Sweep Signal	M7315
7. Trigger and Time Base Signals	M7611
8. Framing Voltage Range	M7600
9. Input Voltages and Time Base	M7715

NOTE

To preserve equipment settings, follow this procedure when troubleshooting:

1. Press 1 **STORE SETUP**.
2. Perform the diagnostic tests.
3. Press 1 **RECALL SETUP**.

Diagnostic Test 1: Low Voltage Power Supply (M7900A)

Test the M7900A Low Voltage Power Supply module following the procedure steps in *Part 1 – Low Voltage Power Supply* in *Section Four, Checks and Adjustment*.

Diagnostic Test 2: Very High Voltage Power Supply (M7911)

Perform the procedure steps in *Part 2 – Very High Voltage Power Supply* in *Section Four, Checks and Adjustment*. Measure all voltages, even if the defect LED is off. When the LED is off it indicates only that the high voltage is available, not that the individual voltages are correct.

Make the measurements after the end of the 180-second countdown; time is counted as of the end of the selftests, provided they were satisfactory.

Diagnostic Test 3: Video Signals (M7300 and M7510)

1. Connect the test oscilloscope to the **CONTROL VIDEO** output on the rear panel.
2. Examine the test oscilloscope display for a composite video signal (see Figure 3-17).

   If the composite video signal is present, skip to *Diagnostic Test 5*.

   If the signal is absent, continue.
3. Remove the cable at J5 of M7300, and connect the test oscilloscope to J5.
4. Examine the test oscilloscope display for a composite video signal (see Fig. 3-17).

   If the composite video signal is present, check the cable from M7300-J5 to the rear panel **CONTROL VIDEO** connector.

   If the signal is absent, continue.

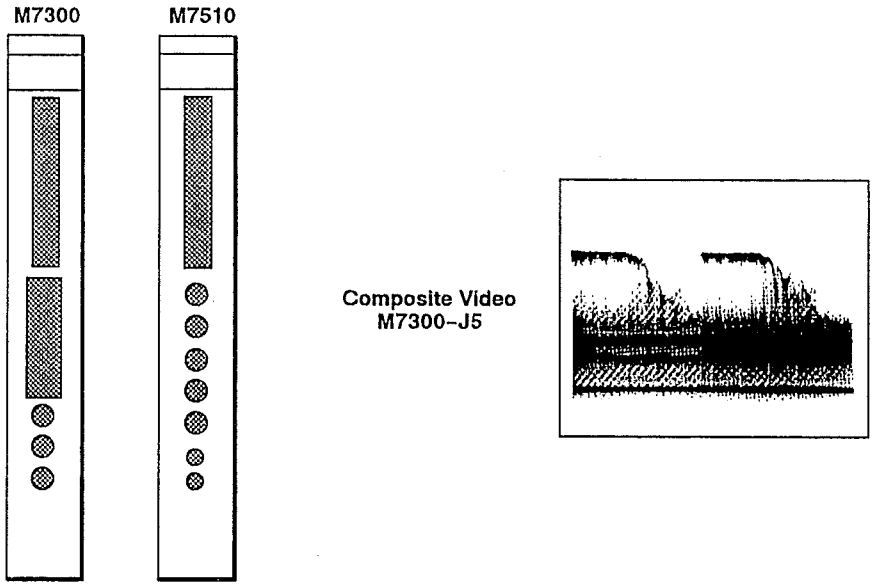


Figure 3-17. Video test points and signals, M7300 and M7510.

5. Reconnect the cable to J5 of M7300.
6. Remove the cable at J3 of M7510, and connect the test oscilloscope to J3.
7. Examine the test oscilloscope display for a video signal (see Fig. 3-17).

   If the video signal is present, M7300 may be defective or the cable between M7510-J3 and M7510-J4 may be defective.

   If the signal is absent, continue.
8. Reconnect the cable to J3 of M7510.
9. Remove the cable at J4 of M7510, and connect the test oscilloscope to the cable.
10. Examine the test oscilloscope display for a video signal (see Fig. 3-17).

    If the video signal is present, M7510 may be defective.

    If the signal is absent, M7715 or the cable from M7715 to M7510-J4 may be defective.
11. Reconnect the cable to J4 of M7510.

Diagnostic Test 4: 200 MHz Signal (M7655)

1. Remove the cable at J2 of M7510 and connect the test oscilloscope to the cable.
2. Examine the test oscilloscope display for arrival of the 200 MHz signal from M7655 (0.6 V amplitude; see Fig. 3-18).

   If the signal is absent, check at J1 of M7655.

   If the signal is absent at M7655, the M7655 module is probably defective.

   If the signal is present at J1 of M7655, check the cabling.
3. Reconnect the cable to J2 of M7510.

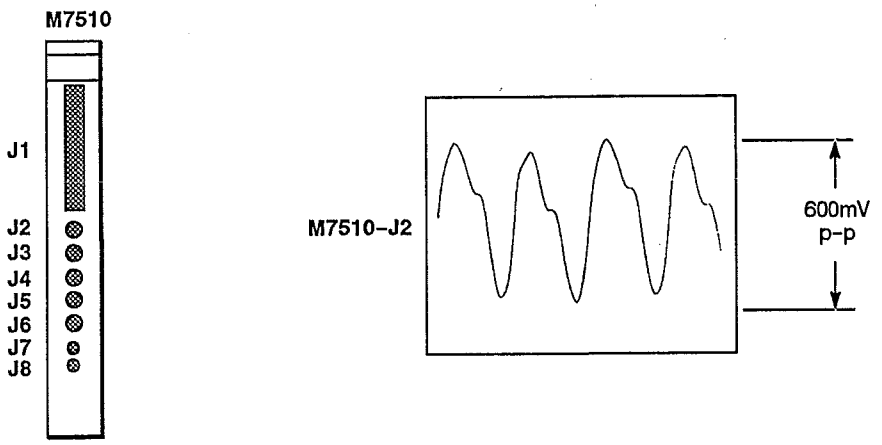


Figure 3-18. 200 MHz test points and signals, M7510.

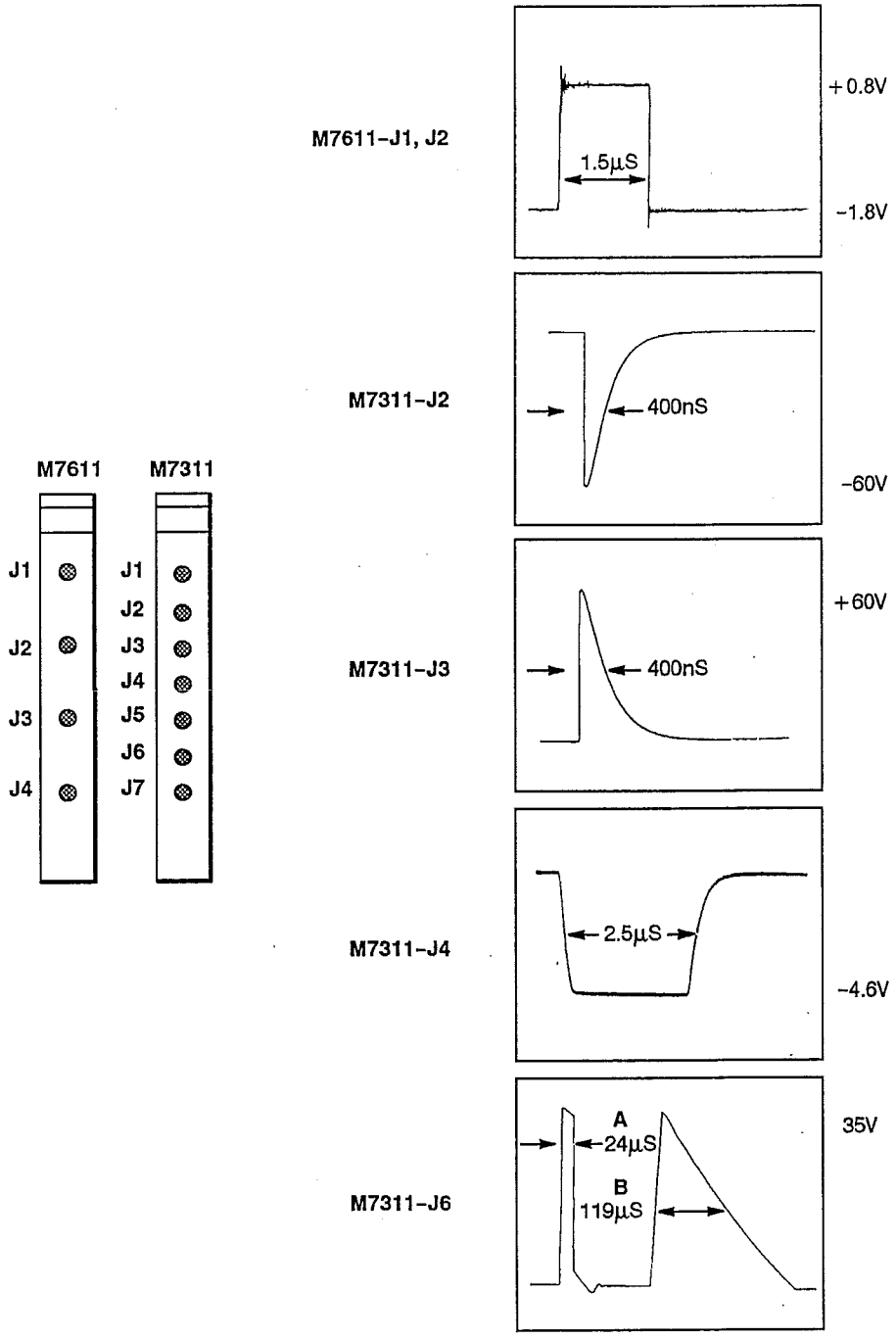
Diagnostic Test 5: Slow Sweep and Unblanking Signal (M7311)

Signals observed in this test have very low repetition rates and must be displayed at fast sweep speeds. Therefore, we recommend use of a digital storage oscilloscope or an oscilloscope with a microchannel-plate CRT.

1. Set the **TIME BASE** to **1 ns/DIV**.
2. Remove the cable to J1 of M7611.
3. Examine the test oscilloscope display for a triggering pulse signal (see Fig. 3-19).

   If the triggering pulse is absent, M7611 may be defective.

   If the pulse is present, M7311 may be defective or the cable from M7611 to M7311 may be defective.
4. Reconnect the cable to J1 of M7611.
5. Remove the cable at J2 of M7311, and connect the test oscilloscope to J2.



M7311-J6
A Time Base = 50ns/DIV
B Time Base = 1µs/DIV

Figure 3-19. Test points and signals on M7311.

6. Examine the test oscilloscope display for the unblanking signal (see Fig. 3-19).

   If the unblanking signal is absent, M7311 may be defective.

   If the signal is present, continue.

7. Reconnect the cable to J2 of M7311.

8. Remove the cable at J1 of M7311, and connect the test oscilloscope to J1.

9. Examine the test oscilloscope display for the unblanking signal (see Fig. 3-19). Press **2 ENTER** to unlock the secondary settings. Note the **BEAM CURRENT** value. Vary the **BEAM CURRENT** value from **0** to **511**, and observe the amplitude of the unblanking pulse. Set the **BEAM CURRENT** to its original value, then press **1 ENTER** to lock the secondary settings.

   If the unblanking signal is absent, M7311 may be defective.

   If the unblanking signal is present, continue.

10. Reconnect the cable to J1 of M7311.

11. Remove the cable from J4 of M7311, connect the Selectro 51-085-0000 "T" connector and attach the cable to one arm of the "T" connector. Connect the test oscilloscope to the other arm using the Tektronix P6041 probe cable.

12. Examine the test oscilloscope display for a digitizer synchronizing pulse (see Fig. 3-19).

    If the pulse is absent, M7311 may be defective.

    If the pulse is present, continue.

13. Reconnect the cable to J4 of M7311.

14. Remove the cable at J6 of M7311, and connect the test oscilloscope to J6.

15. Examine the test oscilloscope display for a sweep signal (see Fig. 3-19).

    If the sweep signal is absent, M7311 may be defective.

    If the sweep signal is present, reconnect the cable to J6 of M7311 and go to *Diagnostic Test 6*.

Diagnostic Test 6: Fast Sweep Signal (M7315)

Perform this test if the M7311 Slow Sweeping Unit module is operating correctly and the fault appears only at fast sweeping speeds.

Signals observed in this test have very low repetition rates and must be displayed at fast sweep speeds. Therefore, we recommend use of a digital storage oscilloscope or an oscilloscope with a microchannel-plate CRT.

1. Remove the cable at J2 of M7315.
2. Examine the test oscilloscope for a signal at J2 as shown in Figure 3-20.

   If the signal is present, M7715 may be defective or the cable between M7315 and M7715 may be defective.

   If the signal is absent, continue.
3. Reconnect the cable to J2 of M7315.
4. Remove the cable at J2 of M7611.
5. Examine the test oscilloscope for the triggering pulse (see Fig. 3-20).

   If the pulse is present, M7311 may be defective or the cable from M7611 to M7311 may be defective.

   If the pulse is absent, M7611 may be defective.

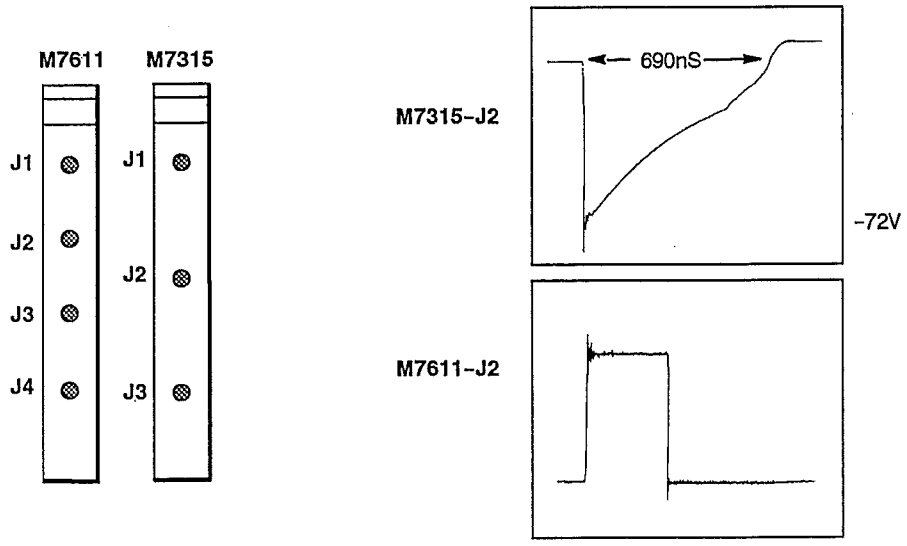


Figure 3-20. Test point and signal on M7315.

Diagnostic Test 7: Trigger and Time Base Signals (M7611)

Signals observed in this test have very low repetition rates and must be displayed at fast sweep speeds. Therefore, we recommend use of a digital storage oscilloscope or an oscilloscope with a microchannel-plate CRT.

See Figure 3-21 for the location of test points and examples of waveforms on M7611.

1. Remove the cable at J3 of M7611 and connect the test oscilloscope to J3.
2. Examine the test oscilloscope display for the MCP control signal output at J3.

   If the signal is absent, go to instruction 5.

   If it is present, continue. (Reconnect the cable to J3 before you proceed.)
3. Remove the cables at J1 and J2 of M7611 and connect the test oscilloscope to J1 and then J2.
4. Examine the test oscilloscope display for the time base control signals output at J1 and J2.

   If the signals are absent, go to instruction 5.

   If the signals are present, M7611 is probably not defective. Reconnect the cables to J1 and J2 before you proceed.
5. Remove the cable at J4 of M7611 and connect the test oscilloscope to the cable.
6. Examine the test oscilloscope display for the arrival of the trigger signal at J4.

   If the trigger signal is absent, check the cable to the rear panel **TRIGGER INPUT** connector.

   If the trigger signal is present, M7611 is probably defective.
7. Reconnect the cable to J4.

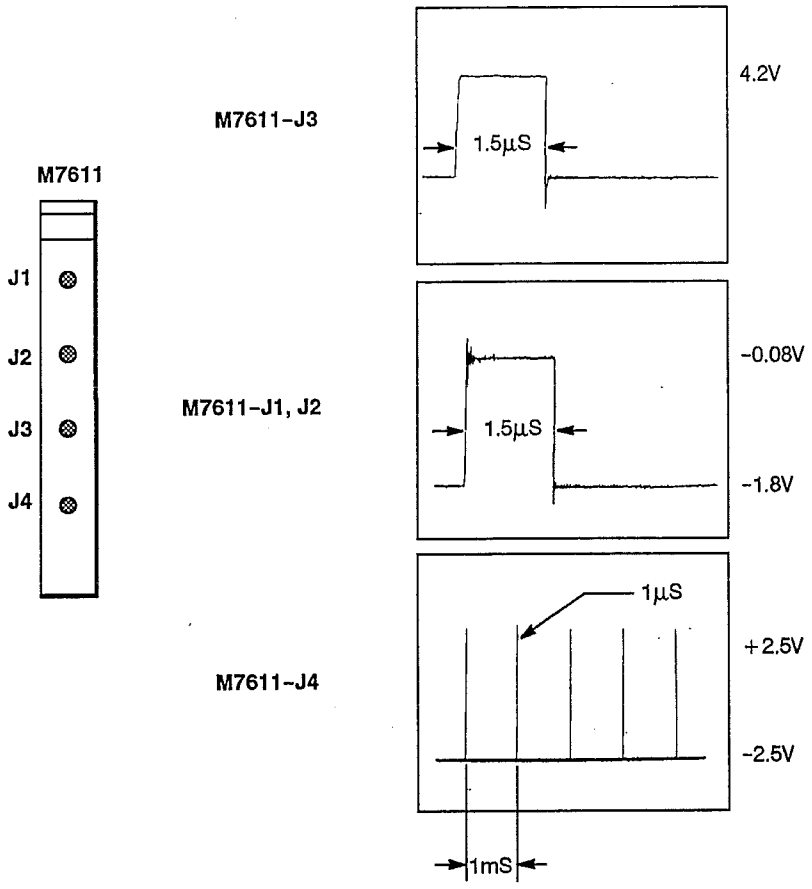


Figure 3-21. Test points and signals on M7611.

Diagnostic Test 8: Framing Voltage Range (M7600)

See Figure 3-22 for the location of test points and waveform examples on the M7600 card.

1. Place the M7600 card on the MT 8700 extension card, as shown in Figure 3-23.
2. Use the MT90078 and MT90074 extension cables to connect M7600 to M7911 and M7640 to the interior of the 7250.
3. Select the **VERTICAL POSITION** function.
4. Press **2 ENTER** to unlock the settings.
5. Vary the **VERTICAL POSITION** from **0%** to **100%**.

6. Examine the test oscilloscope display for the voltage at J1-14 to vary from −2.5 V to +2.5 V.
7. Set the **VERTICAL POSITION** to **50%**.
8. Press the **MENU** key twice to access the **SECONDARY MENU**.
9. Select the **HORIZONTAL POSITION** function and note its value.
10. Press **2 ENTER** to unlock the settings.
11. Vary the **HORIZONTAL POSITION** setting in the **SECONDARY MENU**.
12. Examine the test oscilloscope display for the voltages at J1-8 and J1-6 to be symmetrical (equal magnitude and opposite polarity) and that they vary from approximately −5 to +5 V over the entire **HORIZONTAL POSITION** range.
13. Restore the **HORIZONTAL POSITION** to the original setting.
14. Press **1 ENTER** to lock the settings.
15. Remove extension cables and extension card, then replace the M7600 card and reconnect its cable.

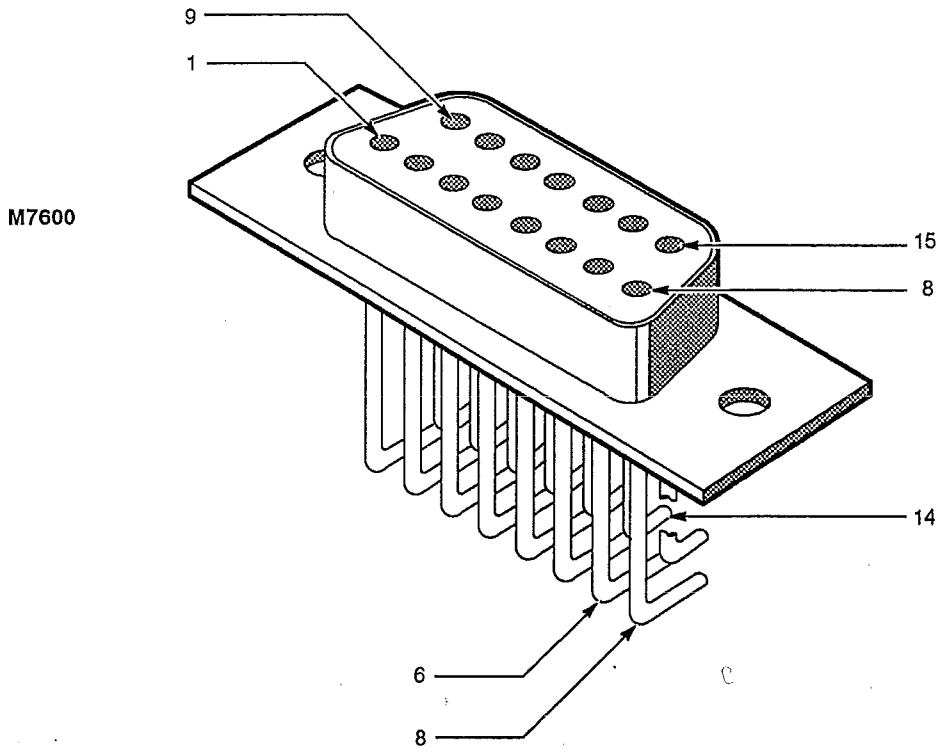


Figure 3-22. Test points on M7600-J1.

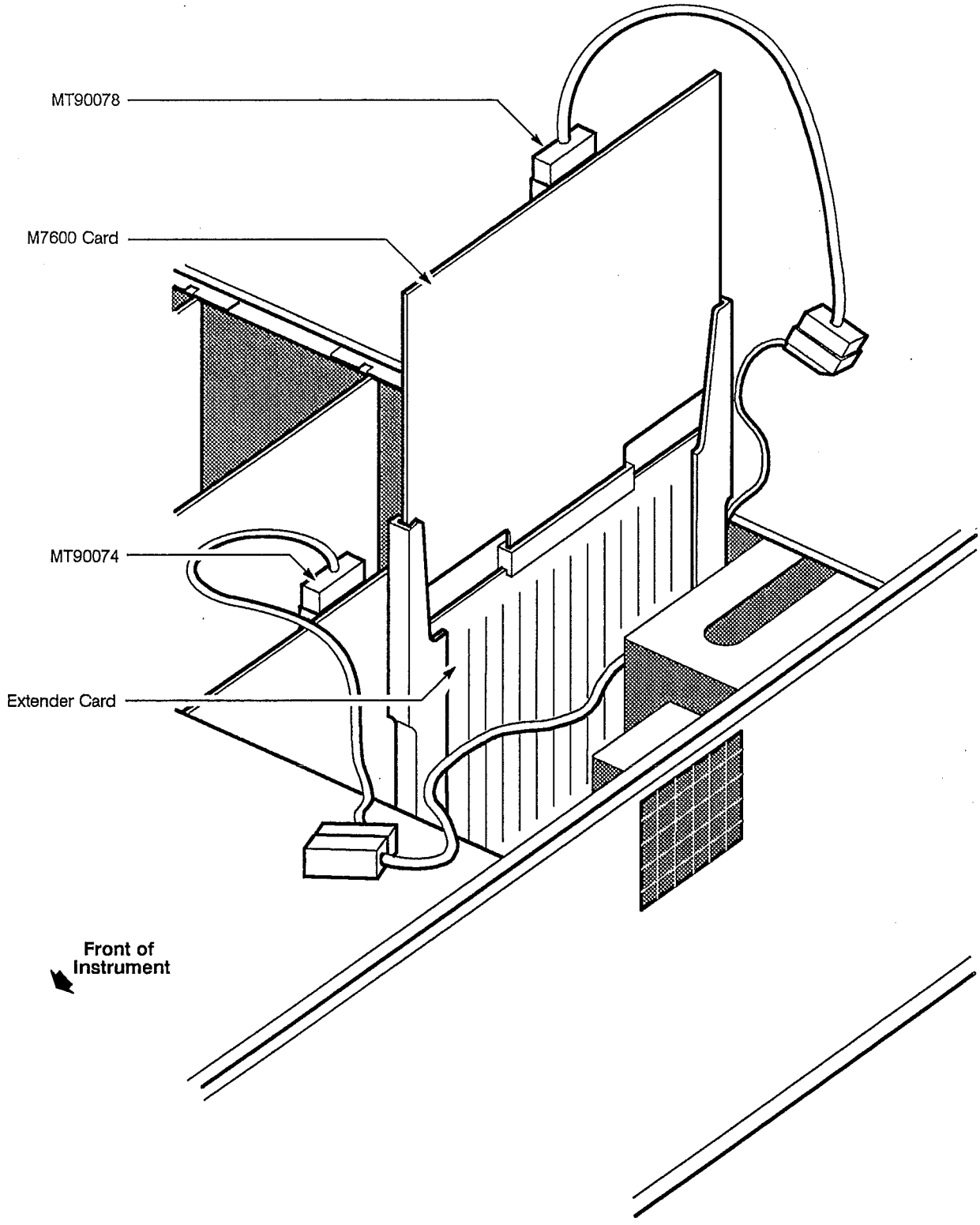


Figure 3-23. M7600 mounted on extender card.

Diagnostic Test 9: Input Voltages and Time Base (M7715)

Perform this test if the video signal is absent from the cable at M7510-J4, or if all other signals tested appear good but the acquisition test fails.

1. Remove the M7715 Scan Converter Rack assembly and place it in the center on top of the instrument to prevent interference from the power supply modules.
2. Connect extension cables MT90085 and MT90076 into J1 and J10 (behind the assembly; see Fig. 3-24).
3. Examine all voltages on J1 and J10 (see Tables 3-10 and 3-11).

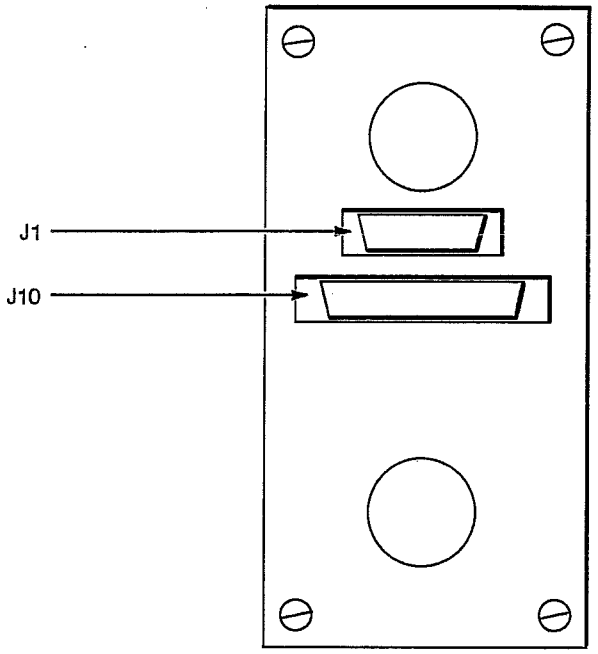


Figure 3-24. Connectors J1 and J10 of M7715.

TABLE 3-10
Pin Voltages at Connector J10

Pin	Signal	Voltage
1	GMC1	+500 V to +900 V
11	H- Framing	-7.5 V max.
10	Ground	0 V
12	V- Framing	±2.5 V max.
13	H+ Framing	+7.5 V max.
A1	K1	-2.0 kV
A4	FOC1	-1150 V to -1350 V
A6	W1	-2.2 kV

TABLE 3-11
Pin Voltages at Connector J1

Pin	Voltage
1	+28 V
2	-28 V
7	+70 V
8	+12 V
9	-12 V
10	Ground
15	-70 V
A2	+1000 V

4. Set the front-panel power switch to OFF.

WARNING

ELECTRIC SHOCK HAZARD: Switch OFF the 7250 before connecting or disconnecting the filament extension cable and the meter leads.

5. Connect the MT90067 filament extension cable.
6. Connect the battery-powered voltmeter between F1 and F2 (near the CRT cap). Place insulation suitable for 3 kV under the voltmeter and its leads, since the CRT filament carries high voltage.
7. Switch **ON** the 7250 power.

WARNING **ELECTRIC SHOCK HAZARD: DO NOT** touch the meter leads while the 7250 is **ON**.

---

8. Examine the voltmeter readout for 6.3 VDC ±0.5 V.
9. Switch **OFF** the 7250 power and disconnect the voltmeter.

WARNING **ELECTRIC SHOCK HAZARD:** Switch **OFF** the 7250 before connecting or disconnecting the filament extension cable and the meter leads.

If all of the test results are satisfactory, the M7715 Scan Converter Rack module is probably defective and should be replaced.

Section Four
Checks and Adjustment

This section contains procedure steps for verifying the performance of the 7250. It also contains functional check steps and electrical and software adjustment steps for use after a defective module is replaced.

In addition to **performance check and adjustment procedure steps**, this section contains valuable information about the scope and purpose of these steps:

- **Procedure options**—Which steps to perform for performance check, functional check, and adjustment procedures
- **Module replacement**—Which steps to perform after modules are replaced
- **Performance check schedule**—How often 7250 performance should be checked
- **Adjustment criteria**—When adjustment is needed and when it is not
- **Necessary equipment**—Which special tools and equipment are required

Contents

Using This Section

You can save considerable time and expense by better understanding the scope and purpose of each type of step in this section. Please read the following introduction before attempting any of these steps. This introduction defines the skill level required to perform these procedure steps, helps you choose the steps that will be most useful for your application, and lists the test equipment needed for each step.

Knowledge and Skill Requirements

This section is for qualified service personnel who are familiar with digitizing oscilloscope technology and with operation of the 7250. The procedure instructions in this section do not give details on menu selection or measurement techniques, nor do they give details on test equipment operation.

First-time operators of the 7250 should read the *Operators* manual and perform the demonstration exercises given there. In this manual, *Section Two, Circuit Overview*, gives a functional overview of circuits in the 7250. Consult the documentation provided with your test equipment for details about test equipment operation.

Knowing Which Steps to Perform

Since these procedure steps are multipurpose and it is unlikely that you will ever encounter a situation where all steps in this section are needed, it is important to understand the purpose of each group of steps and how to identify them. This will help you choose steps for a procedure that is most appropriate for your application.

Procedure steps are of three functional groups: performance check, adjustment, and functional check.

Performance Check Steps

Performance check steps are used to verify that the 7250 is operating as specified. These steps contain instructions to compare the performance of the 7250 against specifications given at the beginning of the step.

Complete Performance Check. Successful completion of all performance check steps verifies that the 7250 meets or exceeds all specified performance parameters. Table 4-1 contains a list of steps to perform (in sequence) for a complete performance check procedure.

Finding Performance Check Steps. Two cues are used at the beginning of performance check steps to help identify them: a check mark (✓) appears at the left end of the shaded title bar and the step title begins with the word "Checking."

TABLE 4-1
Performance Check Steps

Procedure Part	Step	Page
Part 3—Static Calibration	Checking Static Calibration.	4-47
Part 4—Time Base	Checking/Adjusting Sweep Accuracy and Linearity (perform the performance check instructions only).	4-59
Part 5—Vertical	Checking Vertical Sensitivity.	4-69
Part 6—Trigger Jitter	Checking Trigger Jitter. Checking Trigger Stability.	4-77 4-81
Part 7—Sweep Delay	Checking Minimum Delay Before Start of Sweep.	4-84
Part 8—Bandwidth	Checking Bandwidth without the Option 01 Delay Line. Checking Bandwidth with the Option 01 Delay Line.	4-96 4-100

Adjustment Steps

Adjustment steps are used to return the 7250 to proper operation after repair or when it is not operating within specifications or measurement limits. Adjustment steps should be performed only when a problem is indicated or after repair by module replacement; there is no need to perform adjustment steps on a routine basis.

Before making any changes to Reserved Menu values, record the original factory settings for reference.

Adjustment Criteria. Most adjustment steps also contain "examine" or "check" instructions to determine whether adjustment is needed. Never optimize adjustments if the procedure indicates that an adjustable parameter is operating within its acceptable range. Unnecessary adjustment may cause unwanted interaction with other circuits, requiring additional checks and adjustments.

Types of Adjustment. There are two types of adjustment: Some adjustments physically set electrical components such as variable resistors and capacitors, while others are menu settings entered via the front panel to compensate for the characteristics of instrument components such as the CRT system.

Finding Adjustment Steps. Two cues are used at the beginning of adjustment steps to help identify them: A screw head symbol (⊖) appears at the left end of the shaded title bar and the word "Adjusting" appears in the step title.

Functional Check Steps

Functional check steps examine newly installed modules for proper operation by comparing test results against measurement limits. The measurement limits used for this purpose represent typical instrument operation and are not specifications; this is the difference between functional check steps and performance check steps.

Functional Check Criteria. Functional check steps should not be performed routinely. They begin with a "STOP" notice which defines the conditions under which the step should be performed.

Finding Functional Check Steps. Functional check steps are identified by the word "Examining" in the step title.

Performance Check Schedule

A complete performance check procedure should be performed at least once a year or after each 2000 hours of use to ensure continued high performance. See Table 4-1, Performance Check Steps, for a list of steps included in a complete performance check procedure. A Performance Check Record is given on pages 4-18 and 4-19. This form may be photocopied and used to file performance check results.

Procedures After Module Replacement

Electrical repair to the 7250 is generally accomplished by module replacement. After module replacement it may be necessary to verify that the module is operating correctly and, in some cases, that there is no unwanted interaction with other circuits.

Table 4-2 contains a list of replaceable modules for the 7250 and a corresponding list of procedure parts to perform after each module is replaced. These procedure parts may contain performance check, functional check, and adjustment steps. See the information under *Knowing Which Steps to Perform* for details on each type of step and guidelines for their use.

TABLE 4-2
Procedures After Module Replacement

Module Replaced	Necessary Procedure Parts
M7002 I/O Processor Unit	Tested by power-on selftests. No test procedure is required.
M7003 Control Processor Unit	Tested by power-on selftests. No test procedure is required.
M7115 Display Rack	Tested by power-on selftests and observation of menu and graphic displays. No test procedure is required.
M7200 Non-Volatile Memory Unit	Tested by power-on selftests. No test procedure is required.
M7300 Camera Scan Unit	Part 3—Static Calibration
M7311 or M7310 Main Sweep Unit	Part 3—Static Calibration, Part 4—Time Base, Part 6—Triggering, Part 7—Sweep Delay
M7315 Fast Sweep Unit	Part 3—Static Calibration, Part 4—Time Base, Part 6—Triggering, Part 7—Sweep Delay Unit
M7510 Data Acquisition Unit	Part 3—Static Calibration
M7580 Graphical Display Interface Unit	Tested by power-on selftests and observation of menu and graphics displays. No test procedure is required.
M7588 GPIB I/O Unit	Tested by operating the instrument via the GPIB. No test procedure is necessary.
M7600 Beam Position Card	Part 3—Static Calibration
M7611 Delay Triggering Unit	Part 6—Triggering, Part 7—Sweep Delay
M7640 MCP Range Card	Part 3—Static Calibration

TABLE 4-2 (cont.)
Procedures After Module Replacement

Module Replaced	Necessary Procedure Parts
M7655 200 MHz Generator Card	Part 3—Static Calibration
M7715 Scan Converter Rack	Complete performance check (see Table 4-1)
M7900A Low Voltage Power Supply	Part 1—Low Voltage Power Supply
M7911 High Voltage Power Supply	Part 2—High Voltage Power Supply

Identifying Controls, Connectors, and Menu Selections

The controls, connectors, and menu selections for the 7250 are presented in small capital letters in the procedure instructions (e.g., **MAIN MENU**). Test equipment and their controls are described with generic names (e.g., pulse generator amplitude) to allow the use of test equipment other than the examples given in Table 4-3, Test Equipment. Please read the information under *Test Equipment* for details on test equipment substitution.

Test Equipment

Table 4-3 contains a list of test equipment used in the procedure. Steps in the procedure are based on the test equipment examples given, but other equipment with the minimum specifications given in Table 4-3 may be substituted. Test results, *Setup Conditions*, and related connectors and adapters may be altered by the use of different equipment. Consult the test equipment manuals for details concerning test equipment setup and interconnection.

Table 4-3 lists all test equipment required to perform all procedure steps. To help determine which items are needed for the steps you've chosen, each item in Table 4-3 lists the procedure steps in which it is used. The equipment required for each step is also given at the beginning of the step as part of the *Setup Conditions* illustration.

A check mark is used in Table 4-3 to identify test equipment not needed for a complete performance check.

TABLE 4-3
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Adapter, BNC Female to Dual Banana Male (two required)	One female BNC and two banana plugs	Tektronix Part No. 103-0090-00 *Checking Vertical Sensitivity (two required).* *Adjusting Vertical Sensitivity (two required)..*
Adapter, BNC Female to N Male (up to five required)	One female BNC and one male N connector	Tektronix Part No. 103-0045-00 *Checking Static Calibration (one required).* *Adjusting Horizontal and Vertical Gain and Offset (one required).* *Checking/Adjusting Sweep Accuracy and Linearity (two required).* *Checking Vertical Sensitivity (two required).* *Adjusting Vertical Sensitivity (two required).* *Checking Attenuation of the Option 01 Delay Line (three required).* *Checking Trigger Jitter (five required).* *Checking Trigger Stability (five required).* *Checking Minimum Delay Before Start of Sweep (two required).* *Adjusting Minimum Sweep Delay for the Fast Time Base setting (two required).* *Adjusting Delay for the Slow Time Base Settings (two required).* *Checking the Time Delay of the Option 01 Delay Line (three required).* *Checking Bandwidth without the Option 01 Delay Line (one required).* *Checking Bandwidth with the Option 01 Delay Line (four required).* *Examining Digitizing Noise (one required).* *Examining Waveform Digitization (two required).*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Adapter, BNC Male to Probe Tip	One BNC male connector and one subminiature probe tip connector; Compatible with Tektronix P613X-Series Probe used in Test Oscilloscope system.	Tektronix Part No. 013-0195-00 *Checking Attenuation of the Option 01 Delay Line.* *Checking Minimum Delay Before Start of Sweep.* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings.* *Adjusting Delay for the Slow Time Base Settings.*
Adapter, SMA Male to BNC Female (three required)	One male SMA and one female BNC connector.	Tektronix Part No. 015-1018-00 *Checking Minimum Delay Before Start of Sweep.* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings.* *Adjusting Delay for the Slow Time Base Settings.*
Adapter, SMA Male to N Male (three required)	One male SMA and one male N connector.	Tektronix Part No. 015-0369-00 *Checking Bandwidth Without the Option 01 Delay Line (three required).*
Adjustment Shield	For modules M7311 and M7315	Available from your Tektronix Service Center. *Checking/Adjusting Sweep Accuracy (required for adjustment only).*
Attenuator, 5X	50 Ω ±1 Ω impedance; 14 dB attenuation; 1.2:1 VSWR at 2 GHz Feed-through type; One male and one female BNC connector.	Tektronix Part No. 011-0060-02 *Checking the Time Delay of the Option 01 Delay Line.*
Attenuator, 10X	50 Ω ±1 Ω impedance; 20 dB attenuation; 1.2:1 VSWR at 2 GHz One male and one female BNC connector; Feed-through type.	Tektronix Part No. 011-0059-02 *Checking/Adjusting Sweep Accuracy and Linearity.*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
✓ Battery Powered Voltmeter	DC voltage measurement; 320 V (or equivalent) range.	Fluke 77 Digital Multimeter *Examining/Adjusting the Grid Voltage.*
Coaxial Cable, 1 ns (up to two required)	One male and one female SMA connector; 1 ns signal delay.	Tektronix Part No. 015-1019-00 *Checking Minimum Delay Before Start of Sweep (two required).* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings (two required).* *Adjusting Delay for the Slow Time Base Settings (two required).* *Checking Bandwidth without the Option 01 Delay Line (one required).* *Checking Bandwidth with the Option 01 Delay Line (one required)*
Coaxial Cable, 42-inch (one required)	50 Ω, 42-inch, two male BNC connectors	Tektronix Part No. 012-0057-01 *Checking/Adjusting Sweep Accuracy and Linearity.* *Checking Trigger Jitter.* *Checking Trigger Stability.* *Checking Minimum Delay Before Start of Sweep.* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings.* *Adjusting Delay for the Slow Time Base Settings.* *Checking the Time Delay of the Option 01 Delay Line.* *Checking Bandwidth without the Option 01 Delay Line.* *Checking Bandwidth with the Option 01 Delay Line.* *Examining Digitizing Noise.* *Examining Waveform Digitization.*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Coaxial Cable, 18-inch (up to two required)	50 Ω; 18-inch; two male BNC connectors	Tektronix Part No. 012-0076-00 *Checking/Adjusting Sweep Accuracy and Linearity (two required).* *Checking Vertical Sensitivity (two required).* *Adjusting Vertical Sensitivity (two required).* *Checking Attenuation of the Option 01 Delay Line (one required).* *Checking Trigger Jitter (two required).* *Checking Trigger Stability (two required).* *Checking the Time Delay of the Option 01 Delay Line (two required).* *Checking Bandwidth with the Option 01 Delay Line (one required).* *Examining Waveform Digitization (one required).*
Connector, BNC Male to Male (two required)	Two male BNC connectors	Tektronix Part No. 103-0029-00 *Checking Minimum Delay Before Start of Sweep.* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings.* *Adjusting Delay for the Slow Time Base Settings.*
Connector, BNC T	Two female and one male BNC connectors	Tektronix Part No. 103-0030-00 *Checking Vertical Sensitivity.* *Adjusting Vertical Sensitivity.* *Checking Attenuation of the Option 01 Delay Line.* *Checking Minimum Delay Before Start of Sweep.* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings.* *Adjusting Delay for the Slow Time Base Settings.*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Connector, SMA Female to Female (three required)	Two female SMA connectors	Tektronix Part No. 015-1012-00 *Checking Minimum Delay Before Start of Sweep.* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings.* *Adjusting Delay for the Slow Time Base Settings.* *Checking Bandwidth without the Option 01 Delay Line.* *Checking Bandwidth with the Option 01 Delay Line.*
Counter/Timer	Capable of counting sine waves in the range of 1 MHz to 1 GHz; ±0.1% accuracy; Capable of measuring 50 ns width.	Tektronix DC 503A Universal Counter/Timer with a DP 501 Digital Prescaler and a TM 500-Series Power Module *Checking/Adjusting Sweep Accuracy and Linearity. (May be omitted if the sine wave generator frequency indicator is accurate to within ±0.25%.).* *Checking Minimum Delay Before Start of Sweep (not necessary if a test oscilloscope is used).* *Adjusting Minimum Sweep Delay for the Fast Time Base settings (not necessary if a test oscilloscope is used).* *Adjusting Delay for the Slow Time Base Settings (not necessary if a test oscilloscope is used).*
Delay Line	55 ns to 100 ns time delay; Less than 75 ps risetime; 4.5 GHz minimum bandwidth; Input, output, and trigger output connectors.	Tektronix Part No. 118-6445-00 (7250 Option 01). *Checking Attenuation of the Option 01 Delay Line.* *Checking Trigger Jitter.* *Checking Trigger Stability.*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Delay Line (cont.)		*Checking the Time Delay of the Option 01 Delay Line.* *Checking Bandwidth with the Option 01 Delay Line.*
Digital Voltmeter	At least 0.05% accuracy for DC voltages between 0 and 1000 V.	Tektronix DM 501A Digital Multimeter with a TM 500-Series Power Module. *Examining/Adjusting the Low Voltage Regulators.* *Examining the Cathode, Grid, Focal, MCP, and Camera Voltages.* *Examining/Adjusting the MCP Voltage.* *Checking Vertical Sensitivity.* *Adjusting Vertical Sensitivity.*
Power Divider	6 dB nominal load isolation; 50 Ω; Three male SMA connectors.	Tektronix Part No. 015-1014-00 *Checking Minimum Delay Before Start of Sweep.* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings.* *Adjusting Delay for the Slow Time Base Settings.* *Checking Bandwidth without the Option 01 Delay Line.* *Checking Bandwidth with the Option 01 Delay Line.*
Power Meter	50 MHz to 6 GHz frequency range; dBm mode available; 20 dBm range available; ±0.02 dB ±0.001 dB/°C accuracy.	Hewlett-Packard 436A Power Meter *Checking Bandwidth without the Option 01 Delay Line.* *Checking Bandwidth with the Option 01 Delay Line.*
Power Supply, Low Voltage	Output settable for +2 VDC.	Tektronix PS 501 Power Supply with a TM 500-Series Power Module *Checking Vertical Sensitivity.* *Adjusting Vertical Sensitivity.*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Pulse Generator	Top pulse level adjustable to +2.5 V, bottom level to −2.5 V; Period adjustable for 100 ns, 1 ms; Duration adjustable for 15 ns, 50 ns, 1 μs, 0.5 ms.	Tektronix PG 502 250-MHz Pulse Generator with a TM 500-Series Power Module *Checking/Adjusting Sweep Accuracy and Linearity.* *Checking Attenuation of the Option 01 Delay Line.* *Checking Trigger Jitter.* *Checking Trigger Stability.* *Checking Minimum Delay Before Start of Sweep.* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings.* *Adjusting Delay for the Slow Time Base Settings.* *Checking the Time Delay of the Option 01 Delay Line.* *Checking Bandwidth without the Option 01 Delay Line.* *Checking Bandwidth with the Option 01 Delay Line.* *Examining Digitizing Noise.* *Examining Waveform Digitization.*
Sensor, Power Meter	Compatible with the Hewlett-Packard 436A Power Meter	Hewlett-Packard 8485A Power Meter Sensor *Checking Bandwidth Without the Option 01 Delay Line.* *Checking Bandwidth with the Option 01 Delay Line.*
Sine Wave Generator , Medium Frequency	Frequency variable for 250 kHz, 2 MHz; Amplitude variable for 2 Vp-p, 4 Vp-p.	Tektronix SG 503 Signal Generator with a TM 500-Series Power Module *Checking/Adjusting Sweep Accuracy and Linearity.* *Examining Waveform Digitization.*
Sine Wave Generator, High Frequency		Tektronix SG 504 Signal Generator with a TM 500-Series Power Module. *Checking/Adjusting Sweep Accuracy and Linearity.*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Sweep Oscillator	Frequency variable for 50 MHz, 1 GHz, 3 GHz, 4.5 GHz, 5 GHz, 10 GHz; Amplitude variable for 2 Vp-p, 2.5 Vp-p.	Hewlett-Packard 8350B Sweep Oscillator with an 83525A/B RF Plug-In Unit *Checking/Adjusting Sweep Accuracy and Linearity.* *Checking Bandwidth without the Option 01 Delay Line.* *Checking Bandwidth with the Option 01 Delay Line.*
Termination, 50 Ω (up to two required)	50 Ω impedance; One male and one female BNC connector; Feed-through type	Tektronix Part No. 011-0049-01 *Checking Static Calibration (one required).* *Adjusting Horizontal and Vertical Gain and Offset (one required).* *Checking/Adjusting Sweep Accuracy and Linearity (one required).* *Checking Vertical Sensitivity (one required).* *Adjusting Vertical Sensitivity (one required).* *Checking Attenuation of the Option 01 Delay Line (two required).* *Checking Trigger Jitter (one required).* *Checking Trigger Stability (one required).* *Checking Minimum Delay Before Start of Sweep (one required).* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings (one required).* *Adjusting Delay for the Slow Time Base Settings (one required).* *Checking the Time Delay of the Option 01 Delay Line (two required).* *Checking Bandwidth without the Option 01 Delay Line (one required).* *Checking Bandwidth with the Option 01 Delay Line (one required).*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Termination, 50 Ω (cont.)		*Examining Digitizing Noise (one required).* *Examining Waveform Digitization (one required).*
✓ Test Leads, Voltmeter	One black, one red; 3 kV insulation; Compatible with the Battery Powered Voltmeter input	Tektronix Part No. 012-0427-00. *Examining/Adjusting the Grid Voltage.*
Test Oscilloscope (with 10X probe)	±2% deflection factor accuracy: ±1% sweep accuracy; Vertical deflection factor adjustable for 100 mV/div, 1 V/div; 2 μs/div, 0.5 ms/div sweep available; auto trigger; Trigger source, slope, and coupling selectable; Two vertical channels.	Tektronix 2465A 350 MHz Oscilloscope with P6136 10X probe. *Examining/Adjusting the Power Supply Signal.* *Checking Attenuation of the Option 01 Delay Line.* *Checking Minimum Delay Start of Sweep Before (not necessary if a counter/timer is used).* *Adjusting Minimum Sweep Delay for the Fast Time Base Settings (not necessary if a counter/timer is used).* *Adjusting Delay for the Slow Time Base Settings (not necessary if a counter/timer is used).* *Checking the Time Delay of the Option 01 Delay Line.*
Service Kit	Items used in this section include:	Tektronix Part No. 118-7225-00
	MT90074 Extension Cable for module M7640	*Adjusting Horizontal and Vertical Gain and Offset.*
	MT8700 Extender Board for module M7600	*Adjusting Horizontal and Vertical Gain and Offset.*
	MT90078 Extension Cable for module M7600	*Adjusting Horizontal and Vertical Gain and Offset.*
	MT8650 Extender Board for modules M7311 and M7315	*Checking/Adjusting Sweep Accuracy (required for adjustment only).*

TABLE 4-3 (cont)
Test Equipment

Description	Minimum Specifications	Examples of Typical Test Equipment *(and Where Used)*
Probe, High Voltage	±1% accuracy, up to 2.4 kV	Fluke 80K-6 *Examining/Adjusting the High Voltages.* *Examining/Adjusting the MCP Voltage.*

Preparing for the Procedure

The following instructions prepare the 7250 for consistent procedure results and for access to internal components. Always begin the procedure with these instructions—even if the procedure consists of only a few steps. Once these instructions are complete, follow the *Setup Conditions* instructions for the first step (and all subsequent steps) chosen.

Environmental Considerations

Although the 7250 will operate within specified accuracy in a temperature range of 0° C to +40° C, adjustment steps are valid only if performed while the ambient temperature is between +20° C and +30° C.

Power-up Sequence

1. Make sure the 7250 is disconnected from the power source.

WARNING

ELECTRIC SHOCK HAZARD: Dangerous voltages exist within the 7250, even when the power is OFF. To avoid serious injury or death, refer cabinet panel removal and line voltage selection to a qualified service technician.

---

2. Remove the top center cabinet panel from the 7250 (see *Accessing Top Panel Modules* in *Section Three, Maintenance*, for details).

3. Check that the 7250 Line Voltage Selector has been set to match local power. If not, set the selector to the appropriate setting (see *Power Source Information—Operating Voltage Selection* in *Section One, General Information*, for details).

4. If only performance check steps will be performed, replace the top panel; access to internal components is not necessary for performance check steps.

   If adjustment steps or functional check steps will be performed, do not replace the 7250 top panel; access to internal components may be required for adjustment or functional check steps.

5. Check that a power cord suitable to local power requirements is attached to the 7250 rear panel.

6. Connect the 7250 to the power source.

7. Switch ON the 7250 front-panel power switch.

Warm-up Time

Minimum warm-up time before beginning the procedure depends on how much time has elapsed since the last time the 7250 was operated (i.e., had the power switched ON):

- If it has been two weeks or more since the 7250 was last operated, let it warm-up for at least four hours before proceeding.
- In all other instances, allow at least twenty minutes.

After the appropriate warm-up time, you may begin the first procedure step you've selected. If at any time the procedure instructs you to switch OFF the power, perform an operation, then switch the power back ON, allow twenty minutes warm-up time before continuing (unless instructed otherwise).

Default Settings

Most steps in this section require specific settings of the 7250.

To minimize the number of changes to settings, the settings stored in EEPROM are used to initialize the 7250. These settings are copied to RAM and then changed as required for each step.

The default settings are as follows:

MAIN MENU

TRIGGER POLARITY ..... POSITIVE
TRIGGER LEVEL ..... 0.05 V
TRIGGER TYPE ..... FAST
SWEEP DELAY ..... 1100.00 ns
TIME BASE ..... 500 ns/DIV
SWEEP TYPE ..... INTERNAL
VERTICAL POSITION 50
VERTICAL SENSITIVITY ..... 5.000 V
ACQUISITION MODE ..... AVERAGING
DATA PROCESSING ..... SMOOTHING WITH CALIBRATION
DATA OUTPUT ..... TEK/4662 PLOTTER WITH AXIS
DISPLAY MODS ..... FULL SCREEN
WAVEFORM MEASUREMENT ..... PEAK TO PEAK VALUE

SECONDARY MENU

MAX TRACE THICKNESS	200
MAX THICKNESS VARIANCE	100
CONSEC. INTERPOL POINTS	50
SMOOTHING NB OF POINTS	9
FOCAL VOLTAGE	*
MCP VOLTAGE	*
BEAM CURRENT	*
HORIZONTAL POSITION	*
GPIB ADDRESS	17

*Values Locked

Check the settings of the **MAIN** and **SECONDARY MENU**. Change them to match the settings listed above. Store them in EEPROM using the following instruction:

CAUTION

The following instruction will replace calibrated settings with those settings now in RAM. Be sure that all changes are correcct before proceeding. Incorrect settings can damage the scan converter.

---

1. Press **1964 ENTER** on the **KEYBOARD** to transfer the parameters from RAM to EEPROM.

The settings listed above are copied from the EEPROM to RAM in the Check and Adjustment steps in the setup instructions using the following method:

1. Press **3 ENTER** on the **KEYBOARD** to copy the parameters from EEPROM to RAM.

2. Change these settings to the values listed in the Setup Conditions, if any.

Performance Check Record

Tektronix 7250 Transient Digitizing Oscilloscope
Serial Number: _____

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Tested by: _____

Date tested: _____

Next performance check due: _____

Environmental data

Temperature: _____

Humidity: _____

Parameter	Specification	Test Results
Static Calibration (positioning error)	After running the static defaults elaboration, the number of static correction terms must be not less than 92.	
Sweep Accuracy	Before dynamic calibration, ±15% (±0.16 division) over the center 8 divisions	
Sweep Linearity	After dynamic calibration, ±2% (±0.15 division) of full scale over the center 8 divisions	
Vertical Sensitivity		
Measured	0.5 V/division ±15%	
Displayed	Measured vertical sensitivity is within ±1% of displayed vertical sensitivity.	

Performance Check Record (cont.)

Tektronix 7250 Transient Digitizing Oscilloscope
Serial Number: _____

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Parameter	Specification	Test Results
Option 01 Delay Line		
Signal Attenuation	4.5 dB ±0.5 dB attenuation at the Signal Output connector	
	20 dB ±1 dB attenuation at the Trigger Output connector.	
Time Delay	The time delay between the Trigger Output and Signal Output is 55 ns ±2 ns.	
Trigger Jitter	For a triggering signal with 1 ns risetime, jitter is no more than 100 ps peak to peak in at least 95% of the tests.	
Trigger Stability	The trigger is stable within 250 ps or less.	
Minimum Delay Before Start of Sweep	The minimum delay for the four fastest **TIME BASE** settings, must be 50 ns ±2 ns.	**50 ps/DIV:** **100 ps/DIV:** **200 ps/DIV:** **500 ps/DIV:**
	Difference in delay between settings: **50 ps/DIV** to **100 ps/DIV**, ≤250 ps **100 ps/DIV** to **200 ps/DIV**, ≤250 ps **200 ps/DIV** to **500 ps/DIV**, ≤500 ps	**50 ps/DIV** to **100 ps/DIV:** **100 ps/DIV** to **200 ps/DIV:** **200 ps/DIV** to **500 ps/DIV:**
Vertical Bandwidth		
Without the Option 01 Delay Line	At least 3.5 divisions at 6 GHz with a 5 division, 50 MHz reference signal.	
With the Option 01 Delay Line	At least 3.5 divisions at 4.5 GHz with a 5 division, 50 MHz reference signal.	

Part 1—Low Voltage Power Supply

No specifications are checked in this part. These steps examine the low voltage power supply for proper operation and provide adjustment instructions for correcting supply levels that are outside the given measurement limits.

Examining/Adjusting the Power Supply Signal

DO NOT perform this step unless the M7900 Low Voltage Power Supply module has been replaced or a power supply problem is suspected. **DO NOT** perform this step as part of a normal functional check or performance check procedure.

Description

This step examines the pulse width (duration) of the power supply signal at TP 24 with a test oscilloscope and if necessary adjusts the signal.

Measurement Limits

The duration of the power supply signal at TP 24 should be less than 8 μs to indicate proper operation.

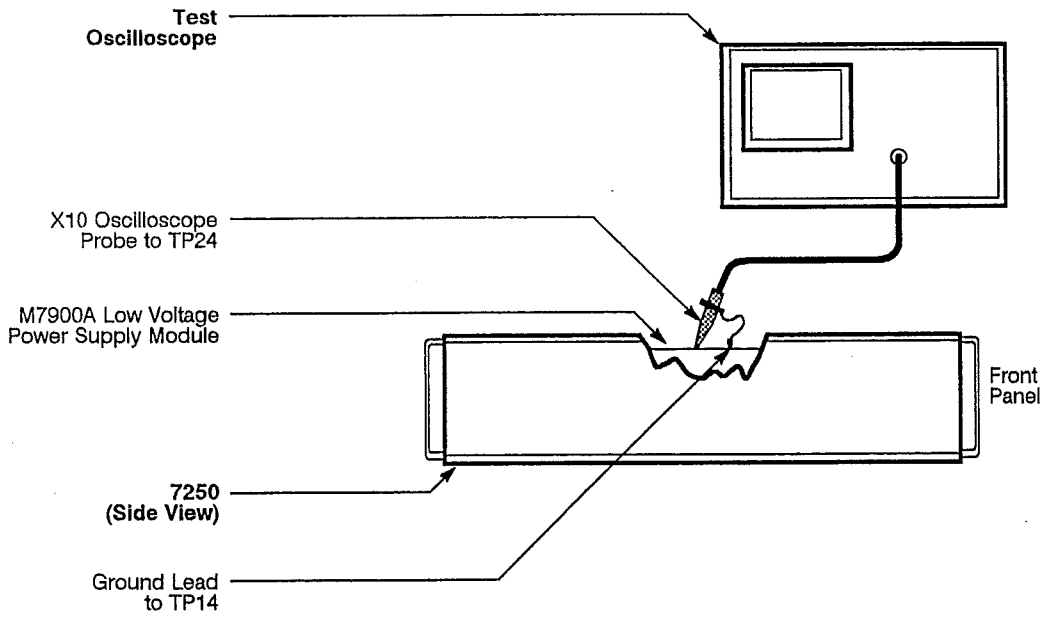
Accessing the Low Voltage Power Supply Module

1. Switch **OFF** the 7250 power.
2. Remove the 7250 top center panel and the cover to the M7900A Low Voltage Power Supply module, following the instructions given under *Accessing Top Panel Modules* and *Replacing the M7900A Low Voltage Power-Supply Module* in *Section Three, Maintenance*.

Use Figure 4-1 to locate the test points and adjustments for this step.

3. Switch **ON** the 7250 power.

Setup Conditions



7250 settings:

Press **3 ENTER** on the **KEYBOARD**.

Test Equipment settings:

Test Oscilloscope

Volts/div	1 V
Time/div	2 μs
Trigger Source	CH 1
Trigger Slope	+

Determining Whether Adjustment is Necessary

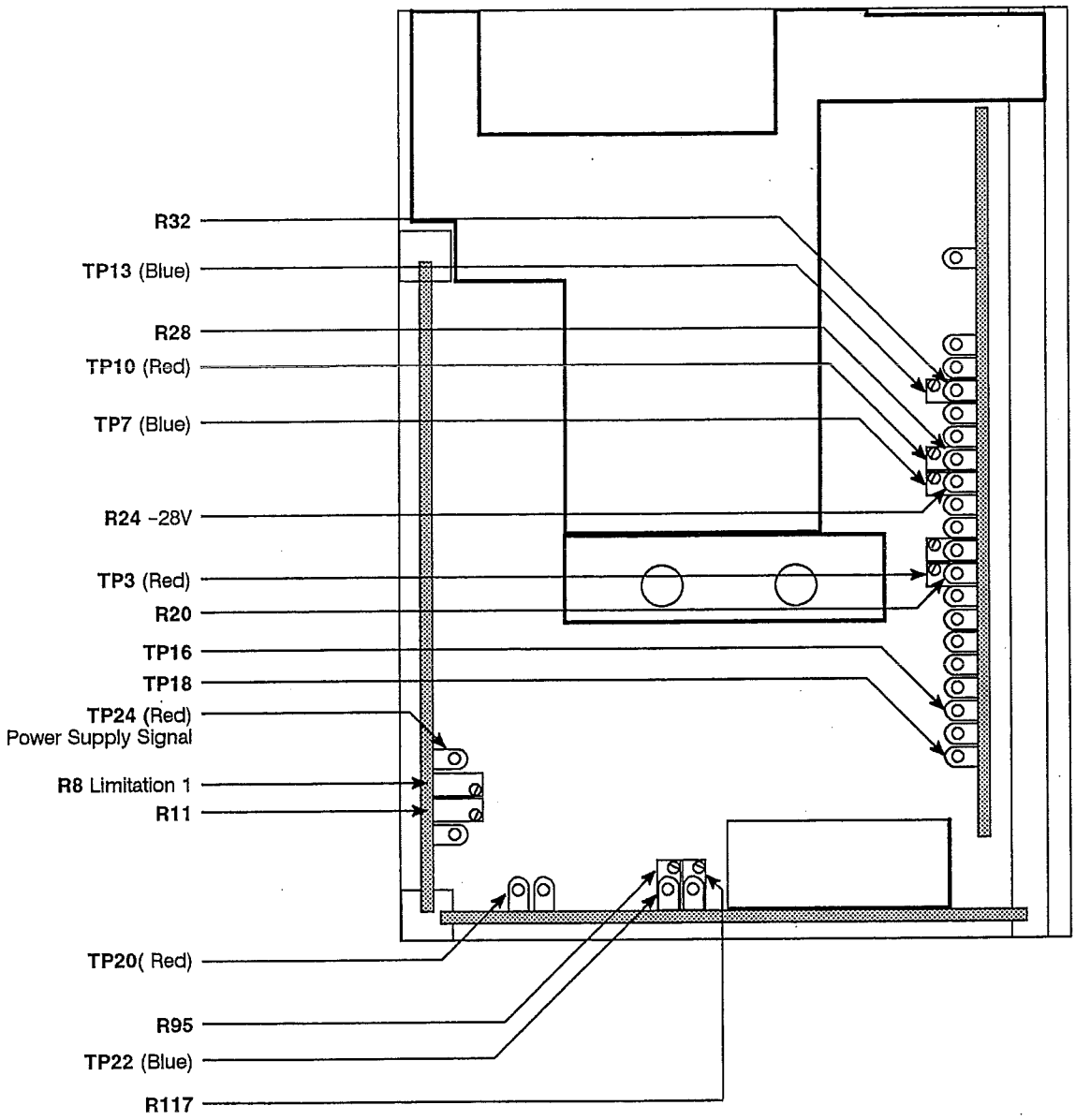
4. **EXAMINE** the test oscilloscope display for 8 μs or less of (high level) pulse duration for the power supply signal at TP 24.

If the reading is 8 μs or less, skip over the following adjustment instruction.

If the reading is not within this limit, the following adjustment is necessary.

Adjusting the Power Supply Signal

5. **ADJUST** power supply signal adjustment R8 for less than 8 μs of (high level) pulse duration for the signal at TP 24.



DO NOT change the setting of any adjustments unless instructed to do so in the procedure.

Figure 4-1. Adjustment locations on the M7900A Low Voltage Power Supply module.

Removing the Setup and Replacing the Cover

6. Remove the test oscilloscope probe from TP 24.
7. If the supply voltages will be checked, skip to *Examining/Adjusting the Regulators.*
8. If the supply voltages will not be checked, switch **OFF** the 7250 power.
9. Replace the cover for the M7900A Low Voltage Power Supply module and replace the securing screws.
10. If the Very High Voltage power supply will not be checked, replaced the 7250 top panel cover and its securing screws.
11. Switch **ON** the 7250 power.

Examining/Adjusting the Regulators

DO NOT perform this step unless the M7900 Low Voltage Power Supply module has been replaced or a power supply problem is suspected. **DO NOT** perform this step as part of a normal functional check or performance check procedure.

Description

In this step, the low voltage regulators are examined and, if necessary, adjusted.

Measurement Limits

The measured voltages should be within the range given in Table 4-3 for proper operation.

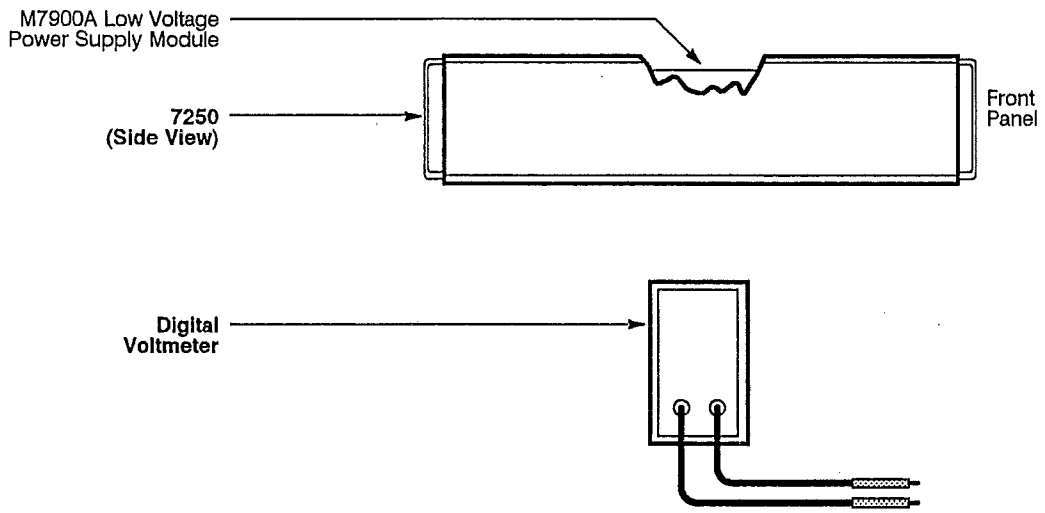
DO NOT attempt to optimize the voltages within their given range with the corresponding adjustments. Any change in these voltages may affect the accuracy and function of other circuits.

Accessing the Low Voltage Power Supply Module

1. Switch OFF the 7250 power.
2. Remove the 7250 top center panel and the cover to the M7900A Low Voltage Power Supply module, following the instructions given under *Accessing Top Panel Modules* and *Replacing the M7900A Low Voltage Power-Supply Module* in *Section 3, Maintenance*.

Use Figure 4-1 to locate the test points and adjustments for this step.

Setup Conditions



7250 settings:
Press **3 ENTER** on the **KEYBOARD**.

Test equipment settings:
Digital Voltmeter
Mode ..... DC Voltage

Determining Whether Adjustment is Necessary

3. Switch **ON** the 7250 power.
4. **EXAMINE** the digital voltmeter reading at each test point for a voltage within the range listed in Table 4-4 (TP 14 is the ground reference).

If the readings are all within their range, skip over the following adjustment instruction.

If any reading is not within its range, perform the following adjustment instructions.

Table 4-4
Low Voltage Regulator Voltage Ranges

Test Point	Power Supply (V)	Minimum Value (V)	Maximum Value (V)	Adjustment
TP 13	−12	−11.94	−12.06	R32
TP 10	+12	+11.94	+12.06	R28
TP 7	−28	−27.86	−28.14	R24
TP 3	+28	+27.86	+28.14	R20
TP 16	+5.20	+5.19	+5.21	R11
TP 18	−5.35	−5.28	−5.38	Not Adjustable
TP 20	+70	+69.65	+70.35	R95
TP 22	−70	−69.65	−70.35	R117

Adjusting the Low Voltage Regulators

DO NOT make any of the adjustments listed in Table 4-4 unless the digital voltmeter reading for the corresponding test point is out of range. **DO NOT** attempt to optimize the adjustments within the given range.

5. **ADJUST** the corresponding regulator adjustment for any digital voltmeter reading outside its range to a value within the range (see Table 4-4).

Removing the Setup

6. Remove the meter leads.
7. Switch OFF the 7150 power.
8. Replace the cover on the M7900A Low Voltage Power Supply module and replace the securing screws and lockwashers.
9. If the Very High Voltage power supply will not be checked, replace the 7250 top panel cover and its securing screws.
10. Switch ON the 7250 power.

Part 2—High Voltage Power Supply

No specifications are checked in this part. These steps examine the high voltage power supply for proper operation and provide adjustment instructions for correcting supply levels that are outside the given measurement limits. The high voltage power supply provides operating potentials to the CRT system.

NOTE

If any adjustments are made in this portion of the procedure, additional steps must be performed to check for circuit interaction:

- Repeat all steps in this part of the procedure after two hours of instrument operation. The CRT system may take up to two hours to stabilize after operating parameters are adjusted.
- Perform the procedure steps in *Part 9—Digitizer* to assure proper digitizer function.

Examining the Cathode, Grid, Focal, MCP, and Camera Voltages

DO NOT perform this step unless the M7911 High Voltage Power Supply module has been replaced or a problem is suspected. **DO NOT** perform this step as part of a normal functional check or performance check procedure.

Description

This step examines voltages at test points on the M7911 High Voltage Power Supply module for correct operating levels.

CAUTION

Damage to the 7250 may occur if waveform acquisition is made with these voltages not properly set within the given ranges.

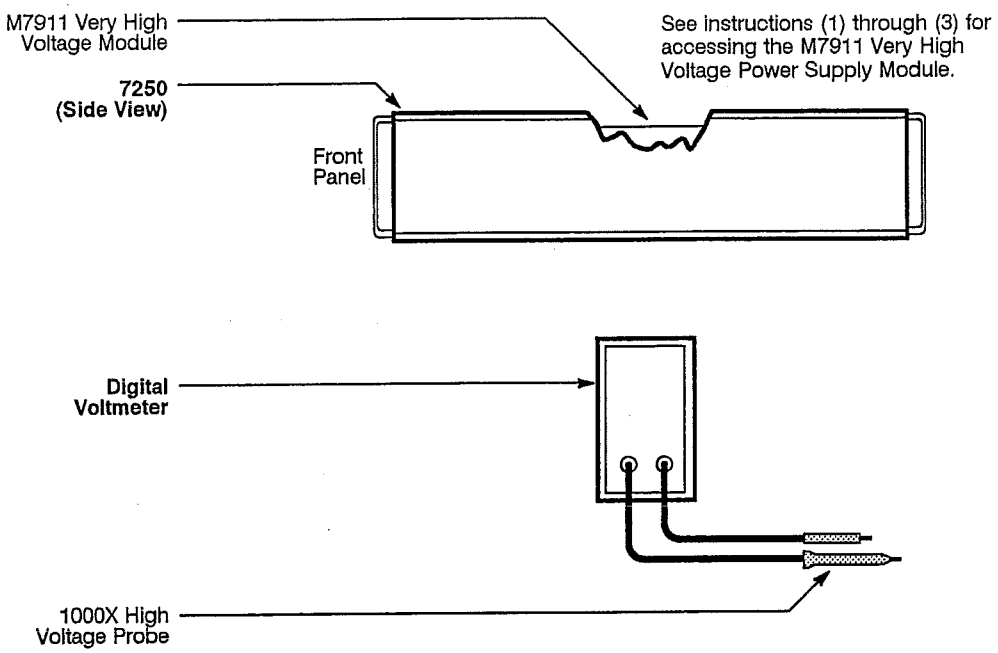
Measurement Limits

The measured voltages should be within the range given in Table 4-4 for proper operation.

WARNING

ELECTRIC SHOCK HAZARD: To avoid personal injury or death, use extreme care when operating the 7250 with covers removed. Dangerous voltages are present due to the line voltage and high voltages in the High Voltage Power Supply and many other modules. Dangerous charges are present in the instrument even when the power is OFF.

Setup Conditions



7250 settings:
Press **3 ENTER** on the **KEYBOARD**.

Test Equipment settings:
Digital Voltmeter
Mode ..... DC Voltage
Range ..... 20 V
Probe ..... 1000 X High Voltage

Accessing the Test Points

1. Switch **OFF** the 7250 power.
2. Remove the the 7250 top center panel following the instructions given under *Accessing Top Panel Modules* in *Section Three, Maintenance*.

These instructions reset the secondary parameters to values preset at the factory to match the CRT parameters.

3. Switch **ON** the 7250 power.

Resetting Factory Values

4. Press 3 ENTER on the KEYBOARD.

Examining the Very High Voltages

5. Connect the ground lead of the digital voltmeter to a reliable ground point.

6. **EXAMINE** the digital voltmeter for a reading within the limits given in Table 4-5 for each test point.

If high current is drawn by the probe when connected to the test point, the supply will shut down. When this occurs, switch the power to OFF, connect the probe, then switch the power to ON.

Table 4-5
Very High Voltage Values

Supply	Test Point	Voltage Range (V)
Cathode	K1-2	–1960 to –2040
Grid	W1	–2100 to –2300
Focal	FOC1	–1140 to –1240
MCP	GMC1	500 to 900
Camera Supply	CAM1-2	955 to 1005

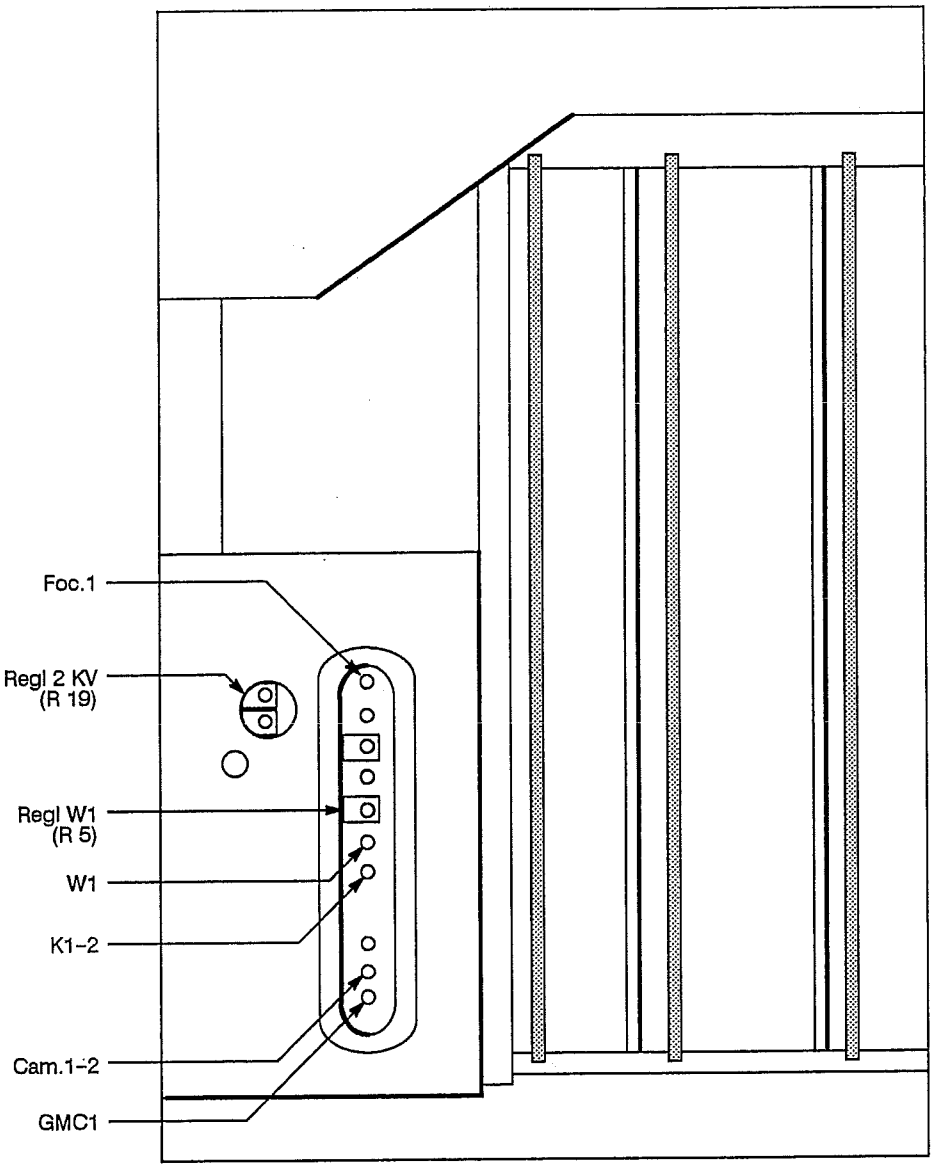
Remember: When using a 1000X high voltage probe, the digital voltmeter measurements are in kilovolts, not volts as displayed.

See Figure 4-2 for the location of the test points listed in Table 4-5.

NOTE

The Focal voltage and MCP voltage are programmable and can be set only from the Secondary Menu.

DO NOT change these voltages from the front panel at this time.



DO NOT change the setting of any adjustments unless instructed to do so in the procedure.

Figure 4-2. Top view of the M7911 High Voltage Power Supply module showing test point locations.

Adjusting the 2 kV Regulator

DO NOT make the following adjustment unless the digital voltmeter reading for the Cathode Voltage test point is out of range. **DO NOT** attempt to optimize the adjustment if the cathode voltage is within range.

7. **ADJUST** 2 kV Regulator *(Regl 2 kV)* adjustment R19 for a cathode voltage within the limits given in Table 4-5.

Examining/Adjusting the Grid Voltage

DO NOT perform this step unless the M7911 High Voltage Power Supply module has been replaced or a problem is suspected. **DO NOT** perform this step as part of a normal functional check or performance check procedure.

Description

This step examines the CRT grid voltage and, if necessary, adjusts it to match the CRT characteristics.

The CRT grid voltage is measured only after the 7250 has warmed up at least twenty minutes.

Measurement Limits

The CRT grid voltage should be ten volts more negative than the CRT cutoff voltage for proper operation.

The CRT characteristics, including cutoff voltage, are given on the CRT identification sheet supplied with your instrument (see Figure 4-3).

Safety Precautions

1. Switch OFF the 7250 power
2. Place the battery powered voltmeter on a non-conductive surface (dielectric rated to withstand 3000 V).

The meter and leads will be at a potential of more than –2 kV.

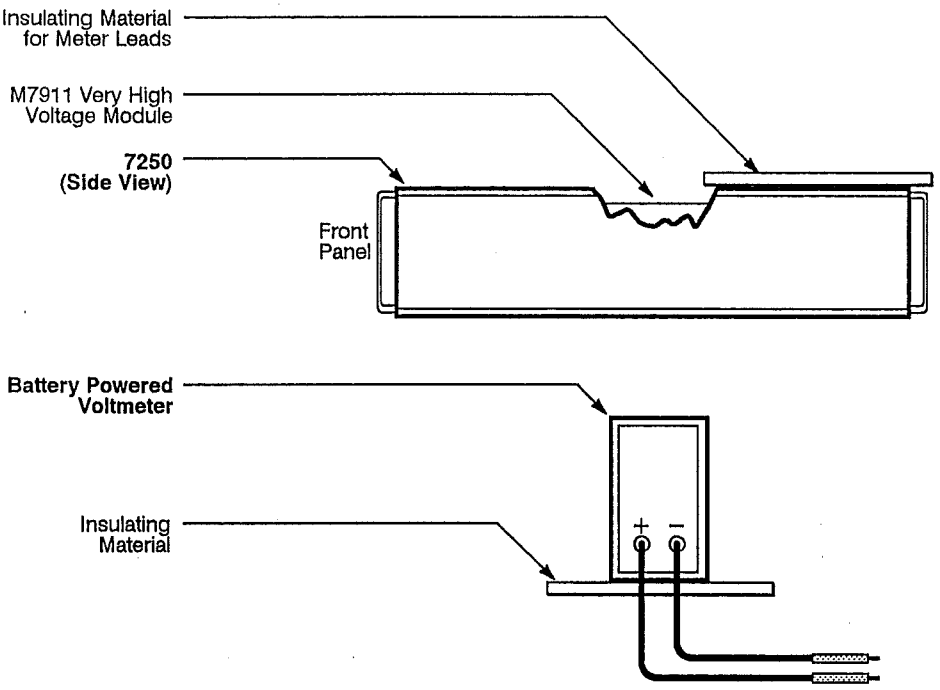
WARNING

ELECTRIC SHOCK HAZARD: To avoid personal injury or death, use extreme care when operating the 7250 with covers removed. Voltages up to 6 kV are present in the Very High Voltage Power Supply and many other modules. Dangerous charges are present in the instrument even when the power is off.

Setup Conditions

WARNING

Read the instructions under "Safety Precautions" before beginning this setup.



7250 settings:

Press **3 ENTER** on the **KEYBOARD/**

Test Equipment settings:

Battery Powered Voltmeter

Mode ..... DC Voltage

Range ..... 320 V

Determining Whether Adjustment is Necessary

WARNING

ELECTRIC SHOCK HAZARD: To avoid personal injury, **DO NOT** touch or connect the meter while the 7250 power is on. Place the meter and its leads on a non-conductive surface before operating.

3. Read the CRT "Cut-off" voltage from the CRT identification sheet (see Fig. 4-3).

NOTE

Be sure the CRT serial number on the CRT identification Sheet matches the serial number on the M7715 Scan Converter Rack module. The instrument serial number is irrelevant in this case.

TIROIR TUBE M7715 N.198

FICHES REGLAGES SECONDAIRES TIROIR TUBES

Realise le : 11-12-87
par : QUOIREZ D.

Tube N. 397 Cut-off : 185V
Sensibilite Verticale : SV1 = 5,17V SV2 = 5,31V
* Vcm : +1,94V
* VcH : +8,10V
* CADH Volts min : +6,95V max : +5,33V
* CADV Volts min : +2,62V max : -1,61V

Bdt	FOC			GMC		ALL		CADRAGE	
en nS	HEX	DEC	VOLTS	HEX	DEC	HEX	DEC	HEX	DEC
0,5	0622	1570	-1214	0096	150	01F0	496	0100	256
1	0622	1570	-1214	0078	120	01F0	496	0100	256
2	0640	1600	-1215	0050	80	01F0	496	0100	256
5	062C	1580	-1215	0096	150	01F0	496	0100	256
10	062C	1580	-1215	006E	110	01F0	496	0100	256
20	062C	1580	-1215	0050	80	01F0	496	0100	256
50	05F0	1520	-1312	002D	45	01C2	450	012C	300
100	05DD	1501	-1211	002D	45	017C	380	0300	768
200	028A	650	-1163	002D	45	00F0	240	0300	768
500	026C	620	-1161	002D	45	00AA	170	0300	768
1000	0258	600	-1160	002D	45	0096	150	0300	768
2000	0244	580	-1159	002D	45	0087	135	0300	768
5000	0244	580	-1159	002D	45	007D	125	0300	768
10000	0244	580	-1159	002D	45	0073	115	0300	768
MIRE	0280	640	-1168	002D	45	0078	120	0100	256

* Suivant specification IN2

Figure 4-3. CRT identification sheet.

See Figure 4-3 for location of test points.

4. Connect the red (positive) meter lead to Grid test point W1.

5. Connect the black (negative) meter lead to Cathode test point K1.

6. Place a layer of insulating material rated for 3 kV between the meter leads and the 7250 chassis.

WARNING **ELECTRIC SHOCK HAZARD: DO NOT** touch the Battery Powered Voltmeter or its leads while the 7250 power is **ON.**

7. Switch ON the 7250 power.

8. Wait for the 180-second timer in the 7250 to complete its countdown.

9. Wait an additional seven minutes for the 7250 to warm up (ten minutes total warm-up time) unless it was operating for longer than ten minutes prior to the start of this step.

10. **EXAMINE** the grid-to-cathode voltage reading on the battery powered voltmeter. The voltage should be 9 to 11 volts more negative than the cutoff voltage. The cutoff voltage value is taken from the CRT identification sheet (see Figure 4-3).

Example:

Cutoff voltage (from CRT identification sheet): −137 V

Allowable grid-to-cathode voltage range:

Minimum = −137-9 = −146 V

Maximum = −137-11 = −148 V

*If the reading is within the range, **DO NOT** perform the adjustment in instruction 11; proceed to instruction 12.*

If the reading is not within the range above, the following adjustment is necessary.

Adjusting the Grid Voltage

WARNING

ELECTRIC SHOCK HAZARD: Use only a non-metallic screwdriver to adjust R5.

11. **ADJUST** Regl W1 adjustment R5 for a grid-to-cathode voltage within the calculated range. See Figure 4-2 for the location of adjustment R5.

Removing the Setup

12. Switch OFF the 7250 power.
13. Disconnect the meter leads from the 7250.
14. Switch ON the 7250 power.

Examining/Adjusting the MCP Voltage

DO NOT perform this step unless the M7911 High Voltage Power Supply or M7640 MCP Range Card module has been replaced, or a problem is suspected. **DO NOT** perform this step as part of a normal functional check or performance check procedure.

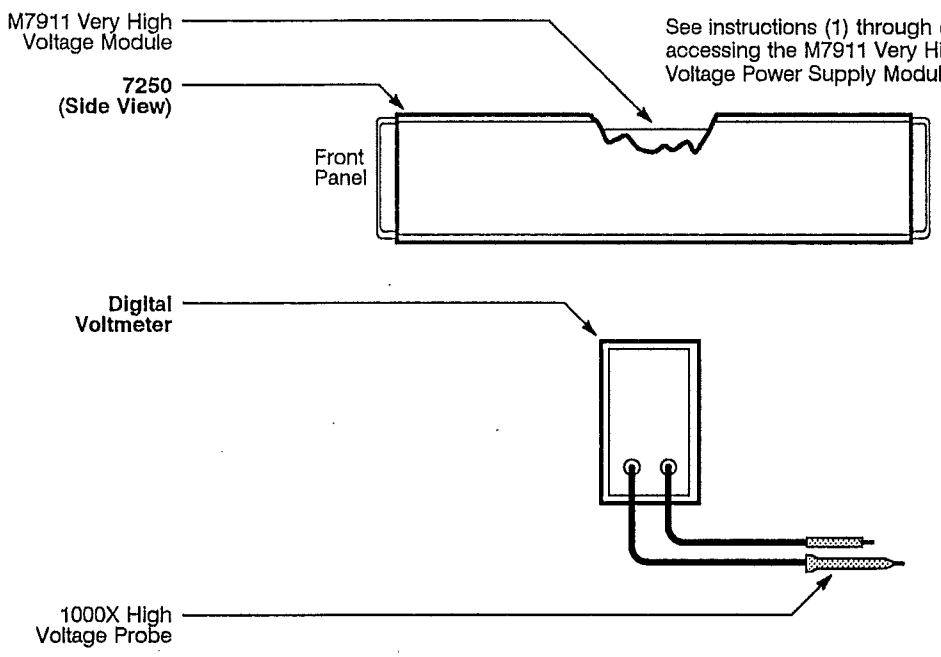
Description

This step verifies that the MCP voltage range correctly matches the numeric entry range available in the 7250 **SECONDARY MENU**. Minimum and maximum numeric values are entered in the menu and the resulting MCP voltage is measured with a digital voltmeter. If necessary, the minimum and maximum voltages are adjusted.

Measurement Limits

The MCP voltage range should be 500 V ±5 V to 900 V ±9 V.

Setup Conditions



7250 settings:

Press 3 **ENTER** on the **KEYBOARD**.

Test Equipment settings:

Digital Voltmeter

Mode ..... DC Voltage

Range ..... 10 V

Accessing the Test Point

1. Switch OFF the 7250 power.
2. Remove the 7250 top center panel following the instructions given under *Accessing Top Panel Modules* in *Section Three, Maintenance*.
3. Connect the black (negative) lead of the digital voltmeter to a reliable ground point.

WARNING **ELECTRIC SHOCK HAZARD:** The GMC1 test point can reach 1 kV when the7250 power is **ON**.

---

4. Connect the 1000X high voltage digital voltmeter probe to the GMC1 test point on the M7911 Very High Voltage Power Supply module (see Fig. 4-4).
5. Switch **ON** the 7250 power and await completion of the 180-second countdown.

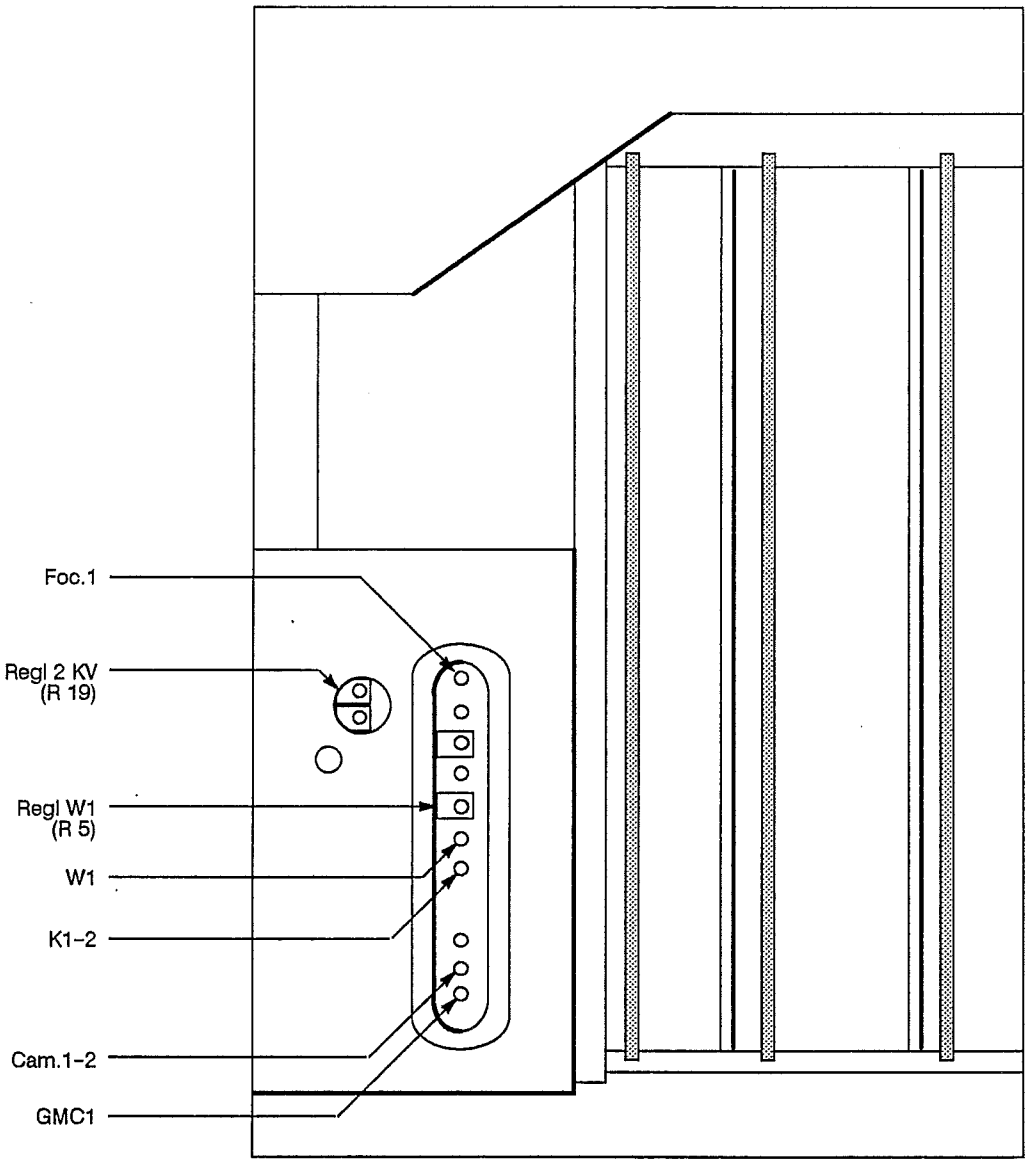


Figure 4-4. Top view of the M7911 Very High Voltage Power Supply module showing the test points.

Determining Whether Adjustment is Necessary

6. Press **2 ENTER** on the **KEYBOARD** to unlock the secondary settings.
7. Press the **MENU** key to access the **SECONDARY MENU**.
8. Select **MCP VOLTAGE** from the **SECONDARY MENU**.

9. Read and note the displayed **MCP VOLTAGE** value for use in step 15.
10. Set the **MCP VOLTAGE** value to **0** in the **SECONDARY MENU**.
11. **EXAMINE** the digital voltmeter for a reading of 500 V ±5 V.
12. Set the **MCP VOLTAGE** value to **255** in the **SECONDARY MENU**.
13. **EXAMINE** the digital voltmeter for a reading of 900 V ±9 V.

DO NOT perform the following adjustment instructions if the voltmeter readings are within the given limits.

If no adjustment is necessary, you are finished with this step.

Adjusting the MCP Voltage

WARNING

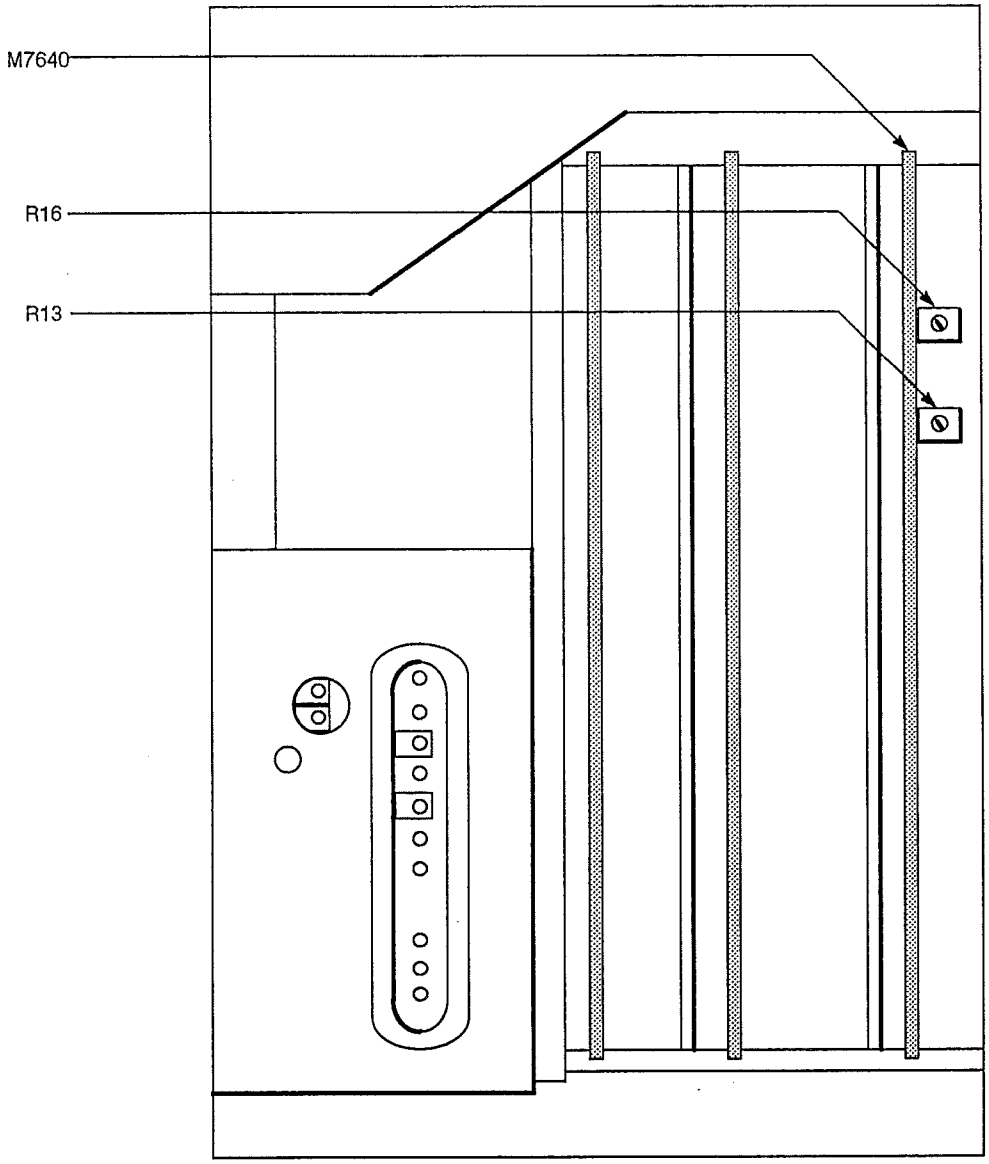
ELECTRIC SHOCK HAZARD: Use only a nonmetallic screwdriver to adjust R16 and R13.

14. **ADJUST** Min adjustment R16 and Max adjustment R13 on the M7640 Calibration Control Card module (see Fig. 4-5) for a voltmeter reading of 500 V ±5 V with the **MCP VOLTAGE** value set to **0** (in the **SECONDARY MENU**) and 900 V ±9 V with the **MCP VOLTAGE** set to **255**.

These adjustments are interactive and must be adjusted until both conditions are met.

Resetting the MCP Voltage

15. Enter (in the **SECONDARY MENU**) the **MCP VOLTAGE** value noted in instruction step 9.
16. Press **1 ENTER** on the **KEYBOARD** to lock the **SECONDARY MENU** settings.
17. Switch **OFF** the 7250 power.



DO NOT change the setting of any adjustment unless instructed to do so in the procedure.

Figure 4-5. M7640 Calibration Control module adjustment locations

18. Disconnect the digital voltmeter leads from the 7250.
19. Replace the 7250 top panel cover and its securing screws.
20. Switch ON the 7250 power.

Part 3—Static Calibration

The steps in this part use an internal test routine to check for positioning error and distortion in the 7250 CRT system. If errors are detected for which the system cannot compensate, instructions are provided for adjusting vertical and horizontal gain and offset.

Checking Static Calibration

Description

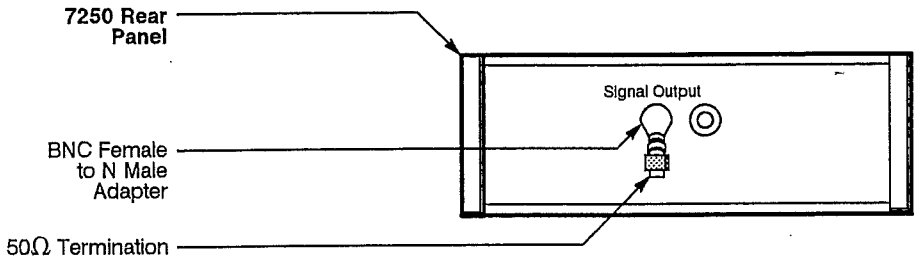
In this step, the static calibration (static defaults elaboration) is checked.

Refer to the 7250 Operators manual, *Section Four*, *Acquisition Calibration*, for details on static calibration.

Specification

The static calibration routine must complete successfully with the number of static correction terms greater than 91.

Setup Conditions



7250 settings:

Press **3 ENTER** on the **KEYBOARD**, then change the following setting:

TIME BASE ..... 10 * 10 MATRIX

Invoking the Static Calibration Routine

1. Press the **GRATICULE** key to display a grid.
2. Press the **SINGLE SHOT** key to acquire and display a 10 X 10 test pattern on the 7250.

*The **HELP** +/- menu contains additional commands to those executed by the 7250 front panel control keys. The following instructions use the static defaults elaboration, found in the **HELP** +/- menu, for static calibration.*

3. Press the **ENTER** key on the **KEYBOARD** to display the **HELP** +/- menu.
4. Press **5 ENTER** on the 7250 **KEYBOARD** to select and initiate the static defaults elaboration routine.

The word "BUSY" will appear in the lower left corner of the display for a short time. Then either a number greater than 91 or an "ERROR" readout will appear in the same location (see Fig. 4-6).

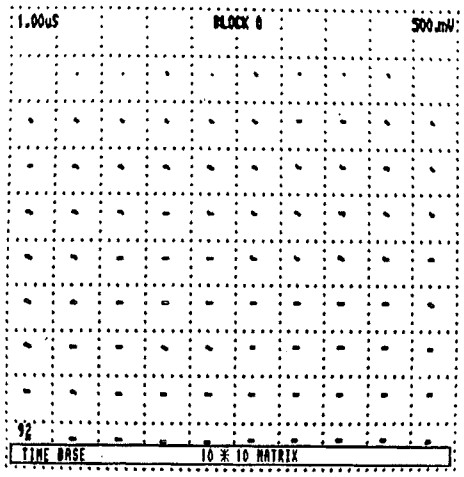


Figure 4-6. Display with static correction terms.

Determining Whether Adjustment is Necessary

5. **EXAMINE** the static corrections readout for a value between 92 and 100.

If there are 92 or more correction terms, go on to Part 4—Time Base.

If the number of correction terms is less than 92, an "Error" readout will appear in the display lower left corner. This indicates that beam current, MCP voltage, horizontal and vertical gain, and offset may require adjustment.

For numbers less than 92, the following adjustment procedure is necessary.

Adjusting Beam Current

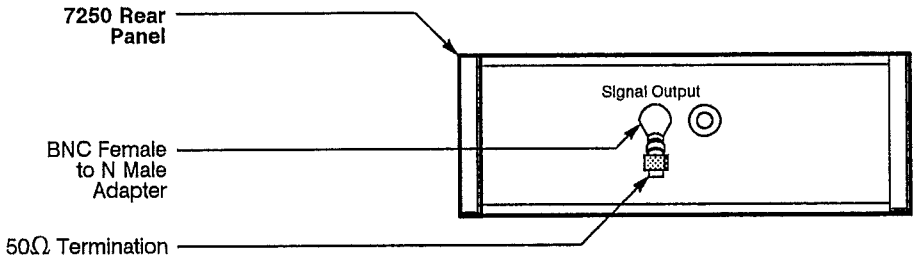
DO NOT perform this step unless the 7250 failed the previous step, *Checking Static Calibration*.

Description

This step adjusts the beam current of the oscilloscope tube in the scan converter module. Optimum beam current will assure a high number of static correction terms while preventing early failure of the scan converter.

Specification

The static calibration routine must complete successfully with the number of static correction terms greater than 91.



7250 settings:

Press **3 ENTER** on the **KEYBOARD**, then change the following settings:

TIME BASE ..... 10 * 10 MATRIX

Finding the Beam Current Value

1. Press the **MENU** key to display the **SECONDARY MENU**.
2. Note the present **BEAM CURRENT** value for use in instruction 7.
3. Press **2 ENTER** on the 7250 **KEYBOARD** to unlock the **SECONDARY MENU** settings.

Increasing the Beam Current

4. Adjust the **BEAM CURRENT** by increasing its value by 2 units, using the **MENU SETTING** arrow keys.
5. Press the **SINGLE SHOT** key to acquire and display a 10 x 10 test pattern on the 7250.
6. Press **5 ENTER** on the **KEYBOARD** to initiate the static defaults elaboration routine.

The word "BUSY" will appear in the lower left corner of the display for a short time. Then either a number greater than 91 or an "ERROR" readout will appear in the same location (see Fig. 4-6).

7. If the word "ERROR" appears, repeat instructions 4 through 7, *but do not increase the **BEAM CURRENT** value more than 20 units above the value noted in instruction 2.*

*When a 20-unit increase in the **BEAM CURRENT** value does not increase the number of static correction terms to more than 91, MCP voltage, horizontal and vertical gain; and offset may require adjustment. Reset the **BEAM CURRENT** to the value noted in instruction 2, press **1 ENTER** on the **KEYBOARD** to lock the **SECONDARY MENU** settings, then go to the next step, Adjusting Horizontal & Vertical Gain.*

8. If the number of static correction terms appears, decrement the **BEAM CURRENT** value by 1, using the **MENU SETTING** arrow keys, and repeat instructions 4 through 6.
9. If the word "ERROR" reappears, increase the **BEAM CURRENT** value by 1 unit.
10. Press **1 ENTER** on the **KEYBOARD** to lock the **SECONDARY MENU** settings.

CAUTION

The following instruction will replace calibrated settings with those settings now in RAM. Be sure that all changes are correct before proceeding. Incorrect settings can damage the scan converter.

---

11. Press **1964 ENTER** on the **KEYBOARD** to transfer the parameters from RAM to EEPROM.

Adjusting Horizontal and Vertical Gain and Offset

DO NOT perform this step unless the 7250 failed the previous step, *Adjusting Beam Current*.

Description

This step uses a 10 × 10 matrix to examine and, if necessary, adjust the horizontal and vertical gain and offset.

Measurement Limits

The waveform-point array in two magnified test squares of a 10 X 10 matrix are alternately centered for the best possible positioning.

Setup Conditions

This step uses the same Setup Conditions used for the preceding step, *Checking Static Calibration*.

Accessing the Adjustments

1. Switch OFF the 7250 power.
2. To access the M7600 Beam Position Card, remove the 7250 top panel following the instructions under *Accessing Top Panel Modules* in *Section Three, Maintenance*.
3. Disconnect the cable connector from J1 on the M7640 MCP Range Card and connect an MT90074 Extension Cable between the board and the cable (see Fig. 4-7).
4. Disconnect the cable connector from J1 on the M7600 Beam Position Card.
5. Remove the M7600 Beam Position Card from the 7250 following the instructions under *Replacing the M7600, M76450, and M7655 Cards* in *Section Three, Maintenance*.
6. Install the MT8700 Extender Board in place of the M7600 Beam Position Card in the 7250.
7. Install the M7600 Beam Position Card on the MT8700 Extender Board.
8. Connect J1 of the M7600 Beam Position Card to the 7250 with an MT90078 Extension Cable.

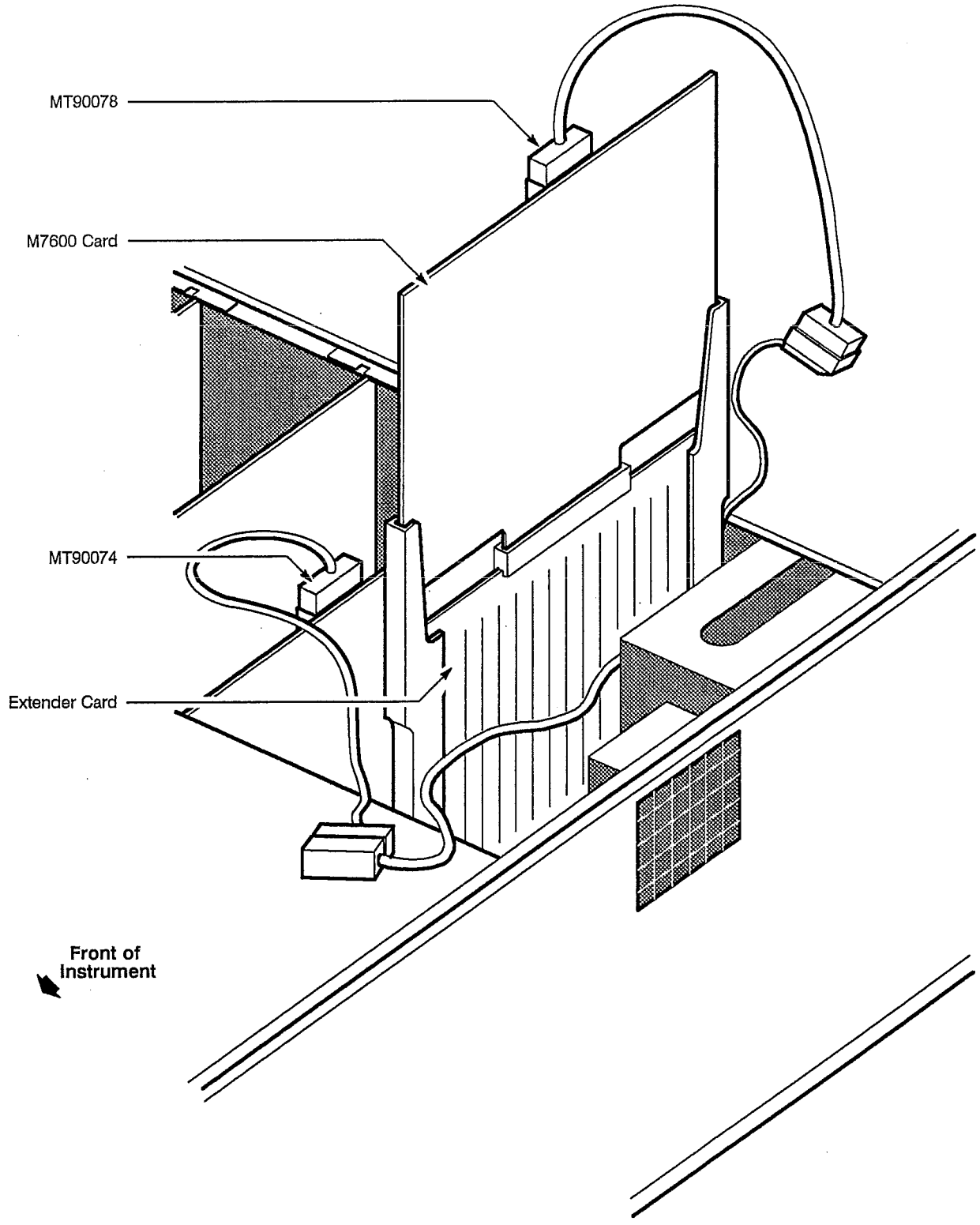


Figure 4-7. Connection of the M7600 Beam Position Card and M7640 MCP Range Card for the Static Calibration adjustment.

Displaying the Adjustment Matrix

9. Switch **ON** the power to the 7250 and await completion of the 180-second countdown.

10. Press **1 2 3** on the **KEYBOARD**, then press the **MENU** key to display **RESERVED MENU 1** (see Fig. 4-8).

11. Using the **MENU** arrow keys, select line **R29** and set its value to **1**.

12. Press the **MENU** key to display the **MAIN MENU**.

13. Using the **MENU** arrow keys, select **SWEEP DELAY** and set its value to **1050.00 ns** or greater.

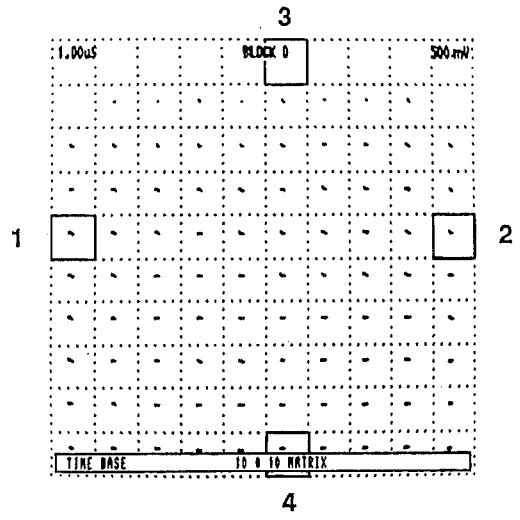


Figure 4-8. The 10 × 10 matrix with squares 1, 2, 3, and 4 identified.

*The following two instructions display the 10 * 10 matrix (see Fig.4-8).*

14. Select **TIME BASE** and set it to **10 * 10 MATRIX**.

15. Press the **CONTINUOUS** key.

The following two instructions define the magnification window.

16. For more accurate visual resolution, press the **GRATICULE** key to display the 10 X 10 grid-type graticule.

17. Press the **ORIGIN** key and use the **GRAPHICS FUNCTIONS** arrow keys to position the horizontal and vertical cursors at the left and bottom edges of square 1 (see Fig. 4-8 for the location of square 1).

The following instructions magnify square 1 by a factor of 10 on both axes.

18. Press **1 0** on the **KEYBOARD**, then press the **MAG X** key to magnify the horizontal scale by a factor of 10.

19. Press **1 0** on the **KEYBOARD**, then press the **MAG Y** key to magnify the vertical scale by a factor of 10.

20. Enable the magnifier function by pressing the **MAG ON/OFF** key.

The magnified square will now fill the display (see Fig. 4-9).

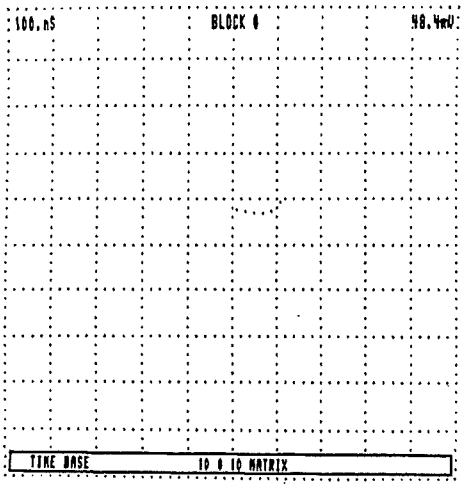


Figure 4-9. Display with square 1 magnified, showing waveform-point array about 1% low.

Adjusting Horizontal Gain and Offset

21. **ADJUST** H Offset adjustment R1 on the M7600 Beam Position Card to position the waveform-point array near the horizontal screen center (see Fig. 4-10 for adjustment locations).

22. Disable the magnifier function by pressing the **MAG ON/OFF** key.

23. Magnify square 2 (location shown in Fig. 4-8) repeating steps 17. through 20.

24. **ADJUST** H Offset adjustment R1 and H Gain adjustment R44 on the M7600 Beam Position Card to position the waveform-point array near the horizontal screen center. (See Fig. 4-10 for adjustment locations.)

25. **ADJUST** R1 and R44 while alternately displaying square 1 and square 2 to attain the best possible centering.

Adjusting Vertical Gain and Offset

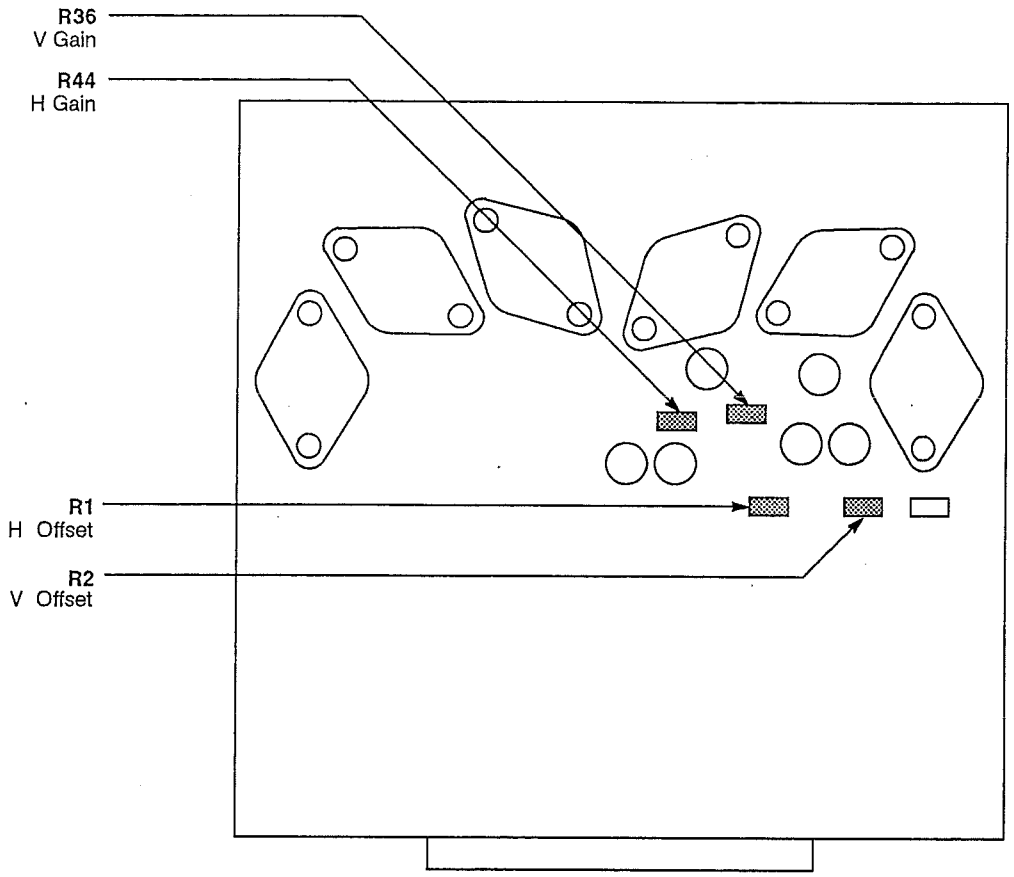
26. Repeat steps 17. through 20. to magnify square 3.
27. **ADJUST** V Offset adjustment R2 and V Gain adjustment R36 to center the waveform point-spread near the vertical center of the screen.
28. Magnify square 4 by repeating steps 17. through 20.
29. **ADJUST** V Offset adjustment R2 and V Gain adjustment R36 to center the waveform point-spread near the vertical center of the screen.
30. **ADJUST** R2 and R36 while alternately displaying square 3 and square 4 to attain the best possible centering.

Rechecking Static Calibration

31. Verify correct horizontal and vertical adjustment by repeating the *Checking Static Calibration* step at the beginning of *Part 3*.

Removing the Setup

32. Switch **OFF** the 7250 power.
33. Remove the Extension Cables and Extender Board.
34. Replace the M7600 Beam Position Card using the instructions under *Replacing the M7600, M7640, and M7655 Modules* in *Section Three, Maintenance*.
35. Switch **ON** the 7250 power.



DO NOT change the setting of any adjustment unless instructed to do so in the procedure.

Figure 4-10. M7600 Beam Position Card adjustment locations.

Part 4—Time Base

These steps check the horizontal accuracy and linearity of the 7250. Linearity is checked after an internal correction routine is used to identify and correct sweep nonlinearity. Adjustment instructions are provided, if necessary, for correcting sweep accuracy.

Checking/Adjusting Sweep Accuracy and Linearity

DO NOT perform this procedure step without first performing *Part 3—Static Calibration*.

Description

This step checks uncorrected accuracy for each **TIME BASE** setting by measuring sweep duration over eight divisions. The dynamic calibration routine is then invoked and the corrected waveform is checked for linearity over eight divisions.

Perform this procedure after replacing any of the following modules:

M7311 Main Sweep Unit
M7315 Fast Sweep Unit
M7715 Scan Converter Rack

Each of the three units is checked for **TIME BASE** settings as follows:

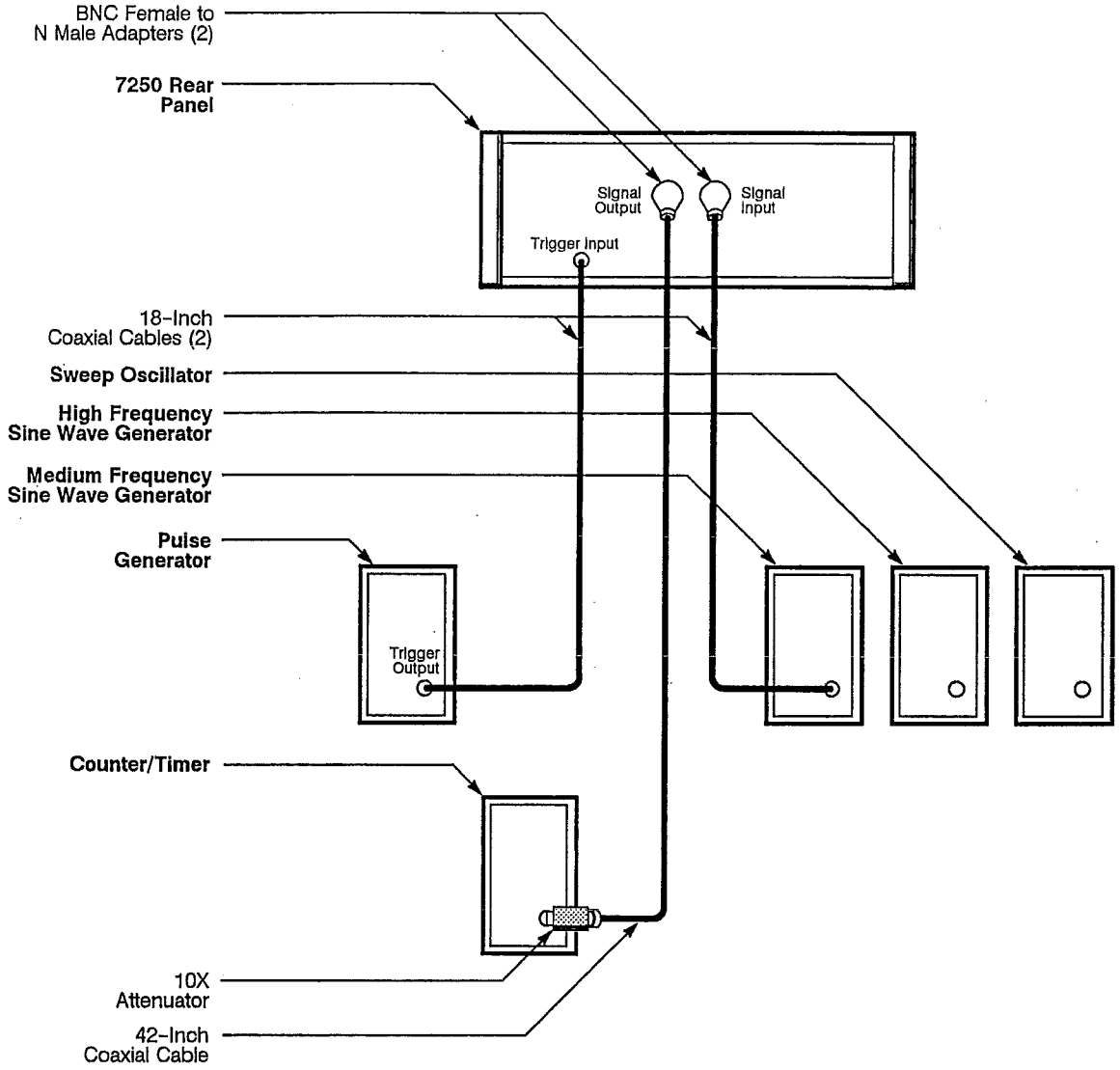
M7311 Main Sweep Unit: **500 ps/DIV** to **1 µs/DIV**
M7315 Fast Sweep Unit: **50 ps/DIV** to **200 ps/DIV**
M7715 Scan Converter Rack: All **TIME BASE** settings

Specifications

Before dynamic calibration, the sweep accuracy must be within ±2% (±0.16 division) over the center 8 divisions of the display.

After dynamic calibration, the sweep linearity over the center 8 divisions must be within ±1.5% (±0.15 division) of full scale.

Setup Conditions



NOTE

For sine wave frequency settings below 1 GHz, set the frequency to within ±0.1% of the specified frequency using the counter/timer readout. For frequency settings at or above 1 GHz, set the frequency using the sine wave generator readout and be certain the generator's frequency accuracy is within ±0.25%.

Setup Conditions (cont.)

7250 settings:

Press 3 ENTER on the KEYBOARD, then change the following settings:

TRIGGER TYPE	NORMAL
TIME BASE	1 µs/DIV
DATA PROCESSING	SMOOTHING WITHOUT CALIBRATION
CONSEC. INTERPOL. POINTS	5 POINTS
SMOOTHING NB OF POINTS	5 POINTS

Test Equipment settings:

Pulse Generator	
Period	1 ms
Duration	1 µs
Output Level, High	2.5 V
Output Level, Low	–2.5 V
Counter/Timer	
Function	Frequency
Sine Wave Generator, Medium Frequency	
Frequency	1 MHz
Amplitude	1 V p-p
Sine Wave Generator, High Frequency	
Frequency	400 MHz
Amplitude	1 V p-p
Sweep Oscillator	
Frequency	10 GHz
Amplitude	1 V p-p

Checking Sweep Accuracy

1. Make a single-shot acquisition of the medium frequency sine wave generator signal.
2. Press the PROCESS key.
3. **CHECK** that eight cycles of waveform occupy eight horizontal divisions, ±0.16 division, of the display.

Checking Sweep Linearity

4. Select and execute the **dynamic defaults elaboration : periods method** in the HELP +/- menu by pressing 7 ENTER on the KEYBOARD.

After a short delay, the time base duration reading will appear in the lower left corner of the display (see Fig. 4-11).

5. **CHECK** the duration reading for a value of 9.8 to 10.2 µs.

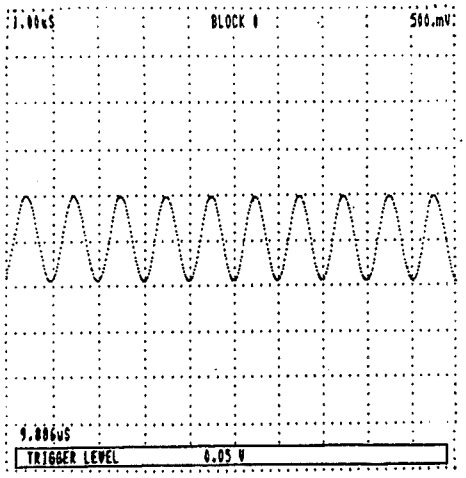


Figure 4-11. Signal with time base duration displayed.

6. In the **MAIN MENU**, set **DATA PROCESSING** to **SMOOTHING WITH CALIBRATION.**
7. Make a single-shot acquisition of the signal.
8. Press the **PROCESS** key.
9. **CHECK** that eight cycles of the displayed waveform in the center eight divisions occupies 7.84 to 8.16 divisions.

Checking Accuracy and Linearity at 500 ns/DIV

10. Set the 7250 **TIME BASE** to **500 ns/DIV.**
11. Set **DATA PROCESSING** on the 7250 to **SMOOTHING WITHOUT CALIBRATION.**
12. Set the sine wave generator frequency control for 4 MHz (with 16 cycles displayed over the center eight divisions of the display).
13. **CHECK** accuracy and linearity at **500 ns/DIV** by repeating instructions 1. through 8. The sixteen cycles in the center eight divisions should occupy 7.84 to 8.16 divisions.

Checking the Other TIME BASE Settings

14. Repeat this sequence (instructions 10. through 13.) for each **TIME BASE** setting up to a sine wave generator frequency setting of 10 GHz and a **TIME BASE** setting of **200 ps/DIV**. (See Table 4-6 for signal generator frequency and 7250 **TIME BASE** settings.)

Table 4-6
Sweep Accuracy Calibration Frequencies

TIME BASE Setting (time/div)	Number of Cycles Over the Center Eight Divisions	"6 ENTER" Dynamic Defaults Elaboration (Half Periods) Sine Wave Generator Frequency	"7 ENTER" Dynamic Defaults Elaboration (Periods) Sine Wave Generator Frequency	Time Base Duration Reading
50 ps	4	10 GHz	n/a	490.0 to 510.0 ps
100 ps	8	10 GHz	n/a	980.0 ps to 1.020 ns
200 ps	16	n/a	10 GHz	1.960 to 2.040 ns
500 ps	16	n/a	4 GHz	4.900 to 5.100 ns
1 ns	16	n/a	2 GHz	9.800 to 10.20 ns
2 ns	16	n/a	1 GHz	19.60 to 20.40 ns
5 ns	16	n/a	400 MHz	49.00 to 51.00 ns
10 ns	16	n/a	200 MHz	98.00 to 102.0 ns
20 ns	16	n/a	100 MHz	196.0 to 204.0 ns
50 ns	16	n/a	40 MHz	490.0 to 510.0 ns
100 ns	16	n/a	20 MHz	980.0 ns to 1.020 μs
200 ns	16	n/a	10 MHz	1.960 to 2.040 μs
500 ns	16	n/a	4 MHz	4.900 to 5.100 μs
1 μs	8	n/a	1 MHz	9.800 to 10.20 μs

15. Repeat the procedure with a sine wave generator frequency setting of 10 GHz and **TIME BASE** settings of **100 ps/DIV** and **50 ps/DIV**, except this time, in instruction 4., select the **dynamic defaults elaboration : half periods method** by pressing **6 ENTER** on the **KEYBOARD**.

16. If the duration readings are all within the acceptable limits, no adjustment is necessary and you may proceed to the next step.

    If before dynamic calibration the accuracy for any **TIME BASE** setting is not within the specified limits, continue with the following instructions.

Determining Which Module to Adjust

The **TIME BASE** setting for which the duration reading is not within tolerance will determine which module requires adjustment:

If the out-of-tolerance **TIME BASE** setting is less than 200 ps/DIV, the adjustment is located on the M7311 Main Sweep module.

For all other **TIME BASE** settings (**50 ps/DIV** to **200 ps/DIV**) the adjustment is located on the M7315 Fast Sweep module.

Preparing for Adjustment

These preparation instructions are for the M7311 and M7315 modules only. There are no sweep adjustments on the M7715 module.

17. Switch **OFF** the 7250 power.

18. Remove the rear panel following the instructions given under *Accessing Rear Panel Modules* in *Section Three, Maintenance.*

19. Remove the M7311 Main Sweep module or M7315 Fast Sweep module (whichever will be adjusted) and install an MT8650 Extender Board in its place.

20. Remove the circuit board from the module by following the instructions given under *Accessing Module Circuit Boards* in *Section Three, Maintenance.*

21. Place the circuit board into the Adjustment Shield (part of the 7250 Service Kit) rather than its own shield.

22. Install the circuit board on the M8650 Extender Board and use a W170085 Extension Cable to connect the module to the 7250.

Adjusting Sweep Accuracy

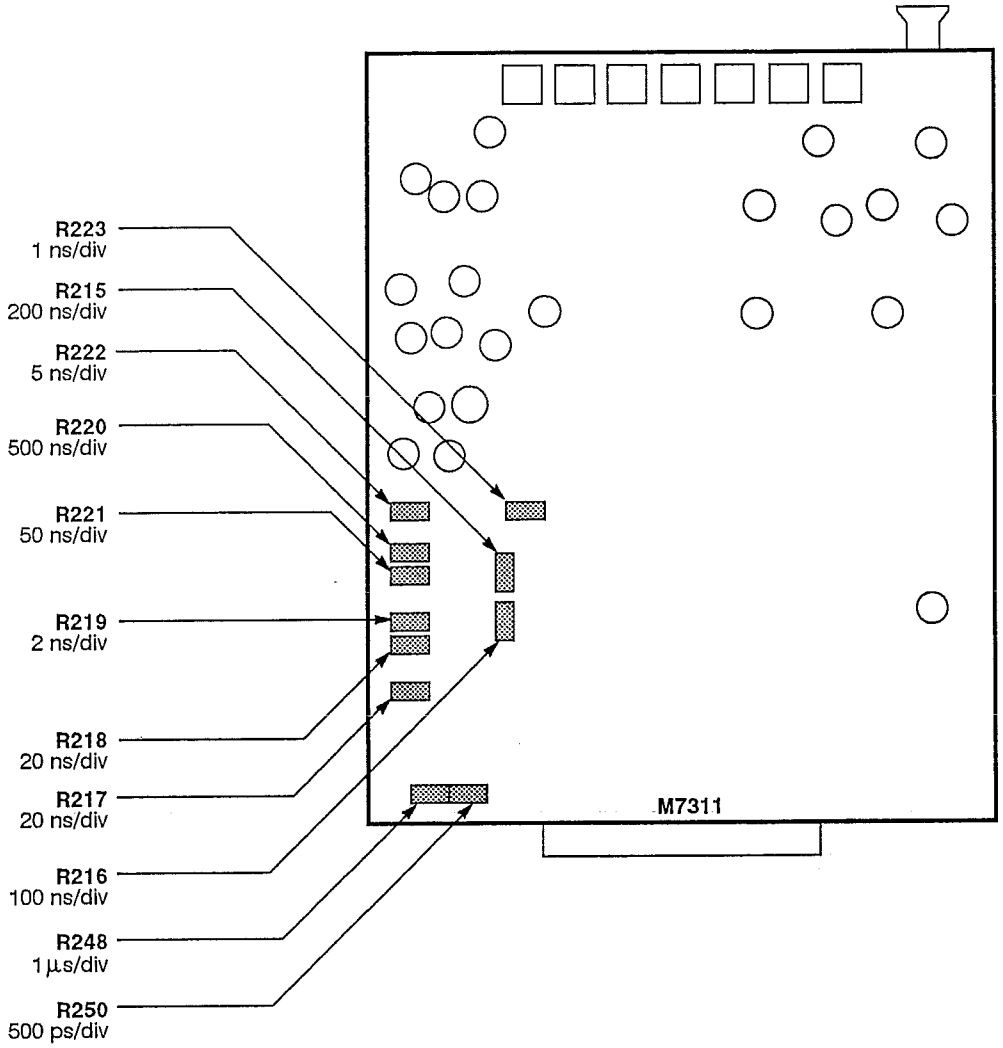
23. Switch **ON** the 7250 power.
24. Allow the 180-second timer to complete its countdown and at least ten minutes of total warm-up time before proceeding.
25. **ADJUST** the corresponding adjustment on M7311 or M7315 for whichever **TIME BASE** setting is out of tolerance. Repeat instruction 14 or 15 after each adjustment to determine whether additional adjustment is necessary.
26. If several **TIME BASE** settings on the M7311 module require adjustment, make the lowest sweep speed adjustment first (if required).
27. If the **500 ps/DIV TIME BASE** setting is adjusted, recheck the accuracy of all **TIME BASE** settings from **1 µs/DIV** to **500 ps/DIV** and adjust if necessary.

Adjustment locations for the M7311 Main Sweep module are shown in Figure 4-12.

Adjustment locations for the M7315 Fast Sweeping Unit module are shown in Figure 4-13. Remove the threaded caps from the adjustable capacitors to access the adjustment. Use only a non-metallic adjustment tool.

When Adjustment Does Not Correct Sweep Inaccuracy

28. If adjustment does not correct sweep inaccuracy and you are certain the M7311 and M7315 modules are good, the M7715 Scan Converter Rack module may be at fault. If this is the case, replace the M7715 module following the instructions under *Replacing the M7715 Scan Converter Rack Assembly* in *Section Three, Maintenance*.
29. Repeat all instructions in this step, beginning with the *Setup Conditions*, to recheck and, if necessary, adjust sweep accuracy.



DO NOT change any adjustment settings unless instructed to do so in the procedure.

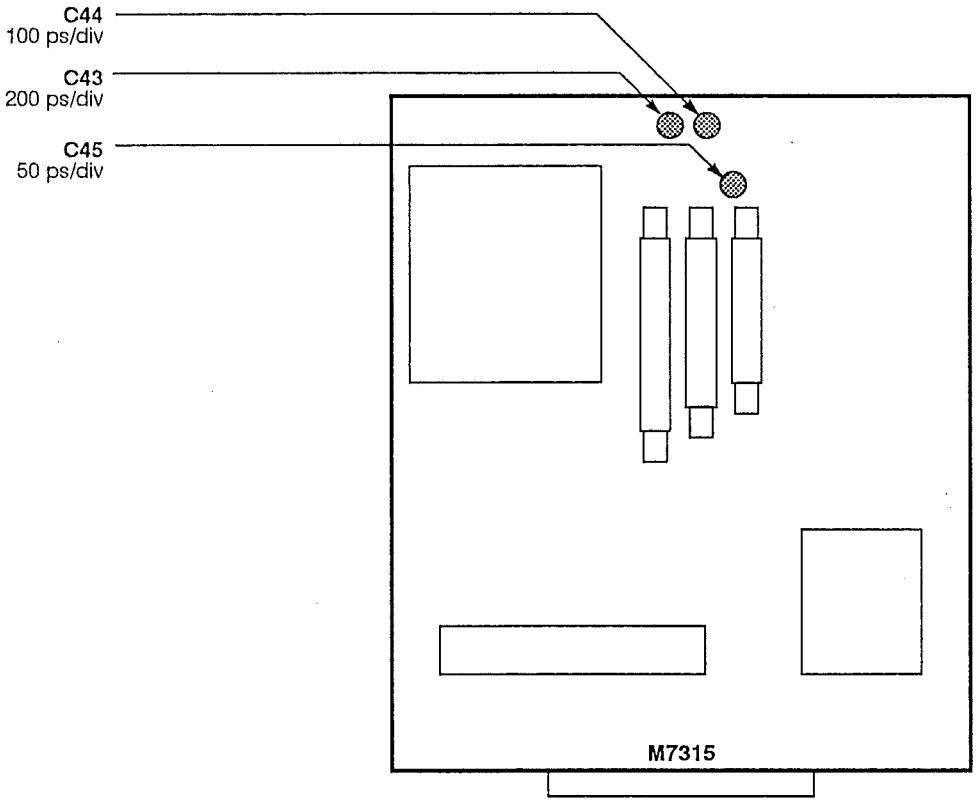
Figure 4-12. Adjustment locations on the M7311 Sweep module.

Removing the Setup

30. Switch OFF the 7250 power.
31. Replace any threaded caps removed from adjustable capacitors on the M7315 Fast Sweep module.
32. Remove the Extension Cable(s) from the circuit board.

33. Remove the M7311 or M7315 circuit board from the Adjustment Shield and M8650 Extender Board and reassemble the module by using the circuit board removal instructions in reverse order.

34. Replace the module in its proper location and reconnect all cables.



DO NOT change the setting of any adjustment unless instructed to do so in the procedure.

Figure 4-13. Adjustment locations on the M7315 Fast Sweep module.

35. Switch **ON** the 7250 power.

36. Wait at least ten minutes for warmup before continuing with the next part of the procedure.

Part 5—Vertical

This part checks vertical sensitivity accuracy by measurement and compares the measured value against the displayed value. The displayed value is adjusted, if necessary, to match the measured value.

Checking Vertical Sensitivity

Description

Vertical sensitivity is checked at two **TIME BASE** settings using a DC voltage source and voltmeter.

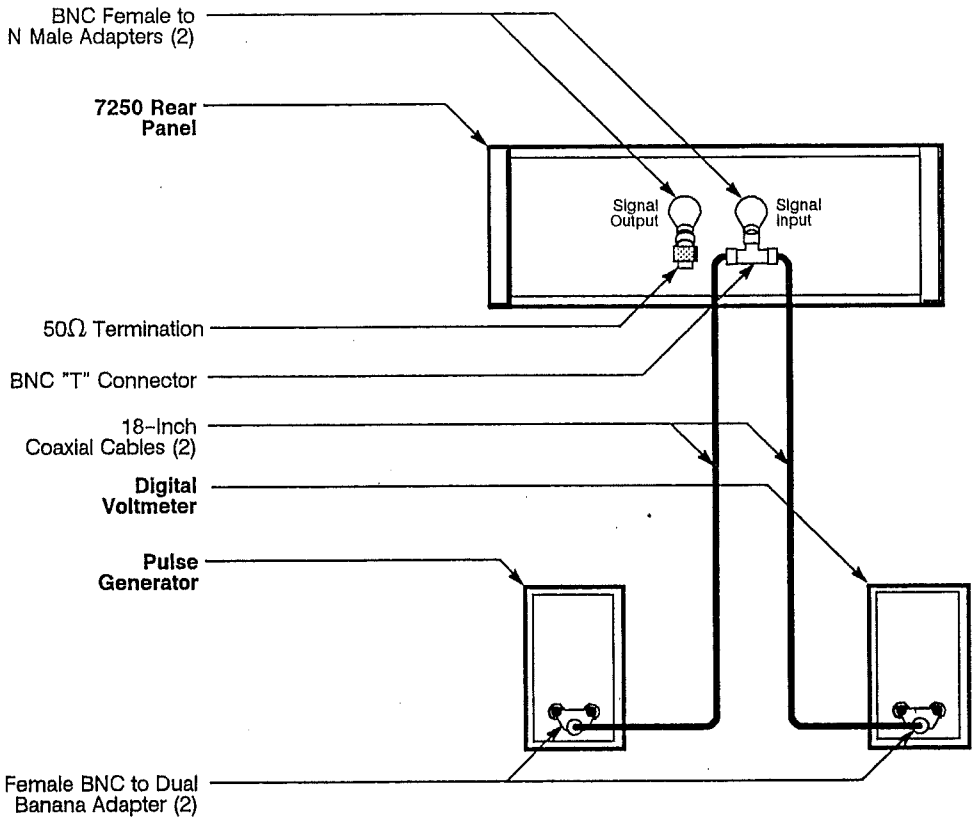
Electrical zero reference values are acquired with DC input voltages of +2 V and −2 V. The change in electrical zero reference values in these two conditions is used to calculate the vertical sensitivity.

Specifications

Measured vertical sensitivity is 0.5 V/division ±15%.

Measured vertical sensitivity is within ±1% of displayed vertical sensitivity.

Setup Conditions



7250 settings:

Press 3 ENTER on the KEYBOARD, then change the following setting:

ACQUISITION MODE ..... **ELECTRICAL ZERO VALUE**

Test Equipment settings:

Digital Voltmeter

Mode ..... DC Voltage

Range ..... 2 V

Low Voltage Power Supply

DC Voltage 2

NOTE

In each instruction where directed to set the low voltage power supply to 2 V, begin by setting it just under 2 V so the digital voltmeter does not over-range.

Checking Sensitivity at 500 ns/DIV

1. Press **1 0 0** on the **KEYBOARD**, then press the **ACQUIRE** key.
2. After the word "Busy" disappears from the lower left corner of the screen, record the electrical zero value displayed in the lower center of the screen (designated N1 in the following calculations) and the digital voltmeter reading (designated V1).
3. Reconnect the low voltage power supply, set for −2 V.
4. Press **1 0 0** on the **KEYBOARD**, then press the **ACQUIRE** key.
5. After the word "Busy" disappears from the lower left corner of the screen, record the electrical zero value displayed in the lower center of the screen (designated as N2) and the digital voltmeter reading (designated V2).
6. Compute the first vertical sensitivity value with the following equation:

   VS1 = 2048(V2-V1)/(N2-N1)

   Example:
   N1 = 180 V
   V1 = 1.986 V
   N2 = 1851 V
   V2 = −1.983 V
   VS1 = 2048 (−1.983 − 1.986)/(1851−180)
   = 2048 (−3.969)/1671
   = −4.864 V
7. **CHECK** that VS1 is between 4.25 and 5.75 V, and is equal to 10 times the mV/DIV value displayed in the upper right corner of the screen, ±1%.

Checking Sensitivity at 500 ps/DIV

8. Reconnect the low voltage power supply, set for +2 volts.
9. Set the 7250 **TIME BASE** to **500 ps/DIV**.
10. Press **1 0 0** on the **KEYBOARD**, then press the **ACQUIRE** key.
11. After the word "Busy" disappears from the lower left corner of the screen, record the electrical zero value displayed in the lower center of the screen (designated N3) and the digital voltmeter reading (designated V3).
12. Reconnect the low voltage power supply, set for a digital voltmeter reading of −2 volts.
13. Press **1 0 0** on the **KEYBOARD**, then press the **ACQUIRE** key.
14. After the word "Busy" disappears from the lower left corner of the screen, record the electrical zero value displayed in the lower center of the screen (designated N4) and the digital voltmeter reading (designated V4).

15. Compute the second vertical sensitivity value with the equation:

    VS2 =2048(V4-V3/(N4-N3).

16. **CHECK** that VS2 is between 4.25 and 5.75 V, and is equal to 10 times the mV/DIV value displayed in the upper right corner of the screen, ±1%.

Adjusting Vertical Sensitivity

DO NOT perform this step unless either or both checks failed in the preceding step, *Checking Vertical Sensitivity*.

The following instructions provide correction if the displayed mV/DIV value is not within 1% of the computed vertical sensitivity value.

The M7715 CRT Rack module must be replaced if the computed vertical sensitivity value is not within 15% of 500 mV/division.

Description

If the sensitivity measured in the previous step, *Checking Vertical Sensitivity*, is not within the specified limits at the two **TIME BASE** settings, new values are entered into lines **R28** and **R29** of **RESERVED MENU 1**. These secondary parameters are then transferred from RAM to EEPROM.

Storing the Vertical Sensitivity Values

*These instructions transfer all menu settings from EEPROM to RAM and lock the **SECONDARY MENU** settings to prevent accidental alteration.*

1. Press **3 ENTER** on the **KEYBOARD**.
2. Press **1 ENTER**.

*The following instructions display **RESERVED MENU 1** and store new vertical sensitivity settings.*

3. Press **1 2 3** on the **KEYBOARD**, then press the **MENU** key.
4. Select line **R28** and store the value computed for VS1, using the **MENU SETTING** arrow keys.
5. Select line **R29** and store the value computed for VS2, using the **MENU SETTING** arrow keys.

CAUTION

The following instruction will replace calibrated settings with those settings now in RAM. Be sure that all changes are correct before proceeding. Incorrect settings can damage the scan converter.

Transferring Parameters to EEPROM

6. Press **1 9 6 4 ENTER** on the **KEYBOARD** to transfer the parameters from RAM to EEPROM.

Verifying Storage of the Parameters

These instructions demonstrate that the new settings were stored successfully. Incorrect values are written into ***RESERVED MENU 1****, then the stored menu values are recalled from EEPROM and should overwrite the incorrect entries.*

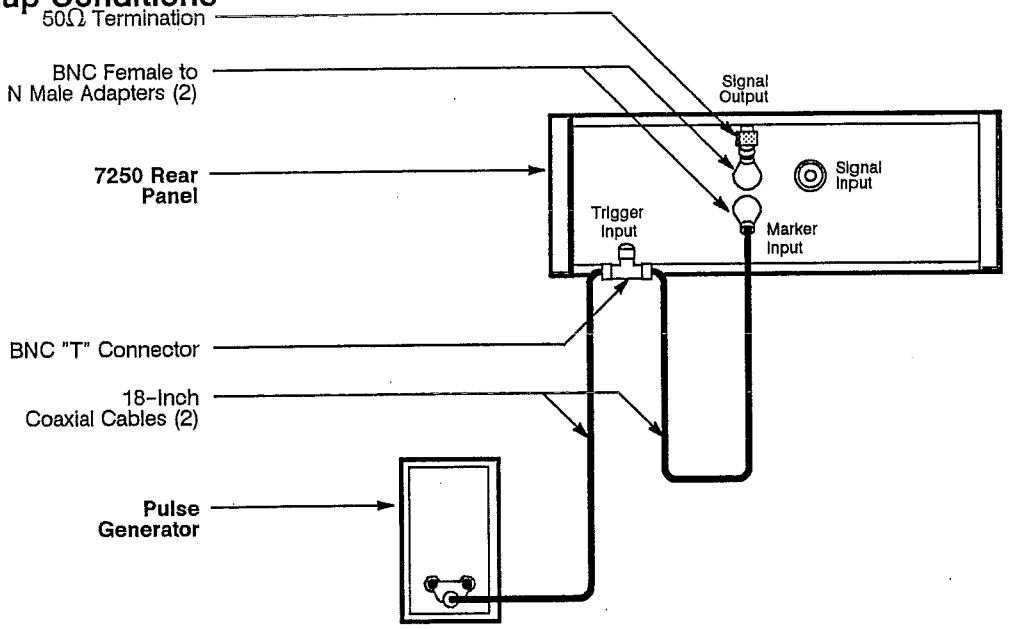
7. Press **1 2 3 MENU** on the KEYBOARD.
8. Change the values of lines **R28** and **R29** by one increment.
9. Press **3 ENTER** on the **KEYBOARD**.
10. Press **1 2 3 MENU** on the **KEYBOARD**.
11. **CHECK** that the values in lines **R28** and **R29** are restored to the values entered in *Storing the Vertical Sensitivity Values*.

Checking Marker Input

Description

This step checks the **MARKER INPUT** feature of the 7250 by displaying a marker signal.

Setup Conditions



7250 settings:

Press **3 ENTER** on the **KEYBOARD.**

Test Equipment settings:

Pulse Generator

Period	100 ns
Duration	10 ns
High Output Level	+2.5 V
Low Output Level	+2.5 V

Checking the Marker Input

1. **CHECK** the 7250 display for the marker signal. Amplitude of the displayed pulses will be about one-eight of the marker signal amplitude.

Part 6—Triggering

The steps in this part check trigger jitter and stability on the leading edge of a repetitive pulse.

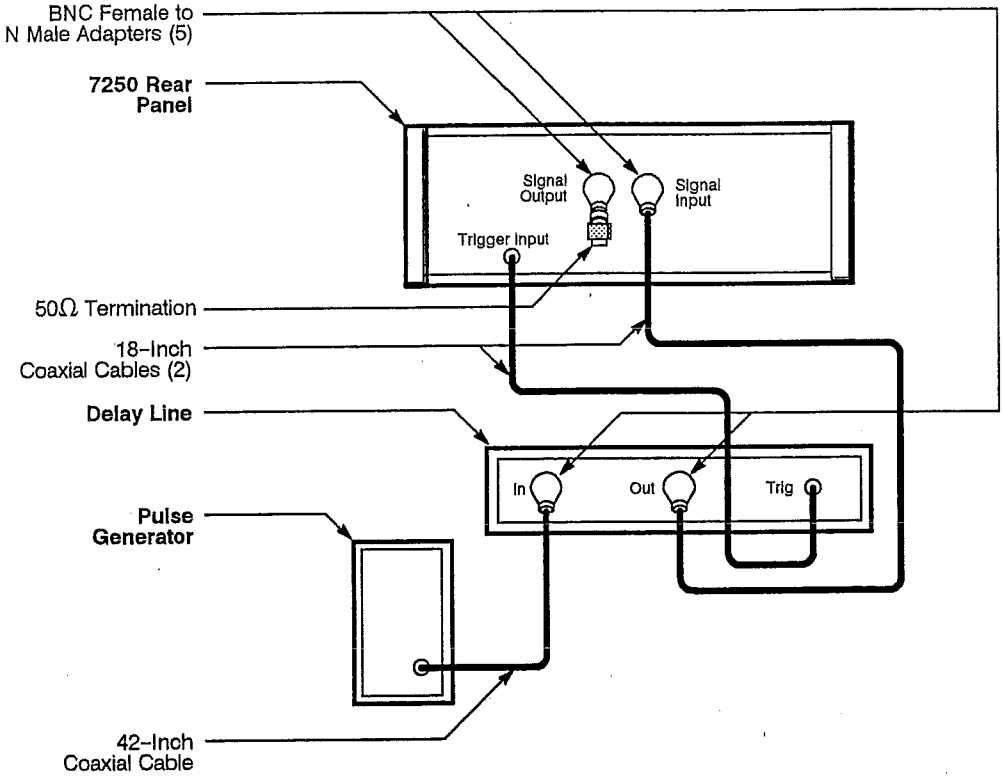
Checking Trigger Jitter

Description This step checks trigger jitter with a 1 ns risetime pulse.

Specifications For a triggering signal with 1 ns risetime, jitter is no more than 100 ps peak to peak in 95% of the tests.

Delay Line Before performing this step, determine the delay time. If the delay time is not known, use *Checking the Time Delay of a Delay Line* in *Part 10—Delay Lines*.

Setup Conditions



7250 Settings

Press **3 ENTER** on the **KEYBOARD**, then change the following settings:

TRIGGER LEVEL ..... **0.25 V**
SWEEP DELAY ..... Dependent on delay time of the delay line
TIME BASE ..... **50 ps/DIV**

Test Equipment settings

Pulse Generator

Period ..... 1 ms
Duration ..... 15 ns
Output Level Low ..... –2.5 V
Output Level High ..... +2.5 V

Defining the Measurement Window

These instructions position the waveform in the center of the display and define the portion magnified for measurement.

1. Press the **CONTINUOUS** key to begin acquisitions.
2. Set the **SWEEP DELAY** to position the 50% level of the pulse rising edge near the horizontal center of the screen.

3. Press the **GRAPHICS FUNCTIONS ORIGIN** key.
4. Position the horizontal origin cursor (vertical bar) to the extreme left side of the screen.
5. Position the vertical origin cursor (horizontal bar) 4.5 divisions above the bottom of the screen.
6. Press the **MAG ON/OFF** key to enable magnification (MAG ON).
7. Press **1 6** on the **KEYBOARD**, then press the **MAG Y** key.
8. Press **1** on the **KEYBOARD** then press the **MAG X** key.
9. Press the **ACQUISITION STOP** key.
10. Set the **ACQUISITION MODE** to **ENVELOPE** in the **MAIN MENU**.
11. Press **1 0 0** on the **KEYBOARD**, then press the **ACQUIRE** key.

Checking Jitter for Fast Trigger

12. Wait for the "Busy" indication to disappear from the display.

Two traces will be displayed from the bottom left to the top right of the screen. Ignore the few spurious dots scattered over the screen (see Fig. 4-[7133-426]).

13. **CHECK** that the time difference between the two traces is 100 ps or less (two horizontal divisions).

Take into account the thickness of the trace and make the measurement from the center of one trace to the center of the other. The CURSORS can be used when making this measurement.

14. **CHECK** that, by repeating instructions 10. through 12. an additional 19 times, the time difference between the two traces is no more than 100 ps in at least 19 of the 20 tests (95% success rate)

Checking Jitter for Normal Trigger

15. Set the **TRIGGER TYPE** to **NORMAL**.
16. **CHECK** jitter for **NORMAL** by repeating instructions 10. through 13.

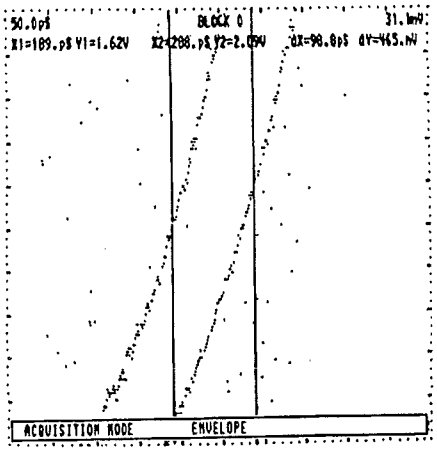


Figure 4-14. Trigger jitter is measured with CURSORS.

Checking Trigger Stability

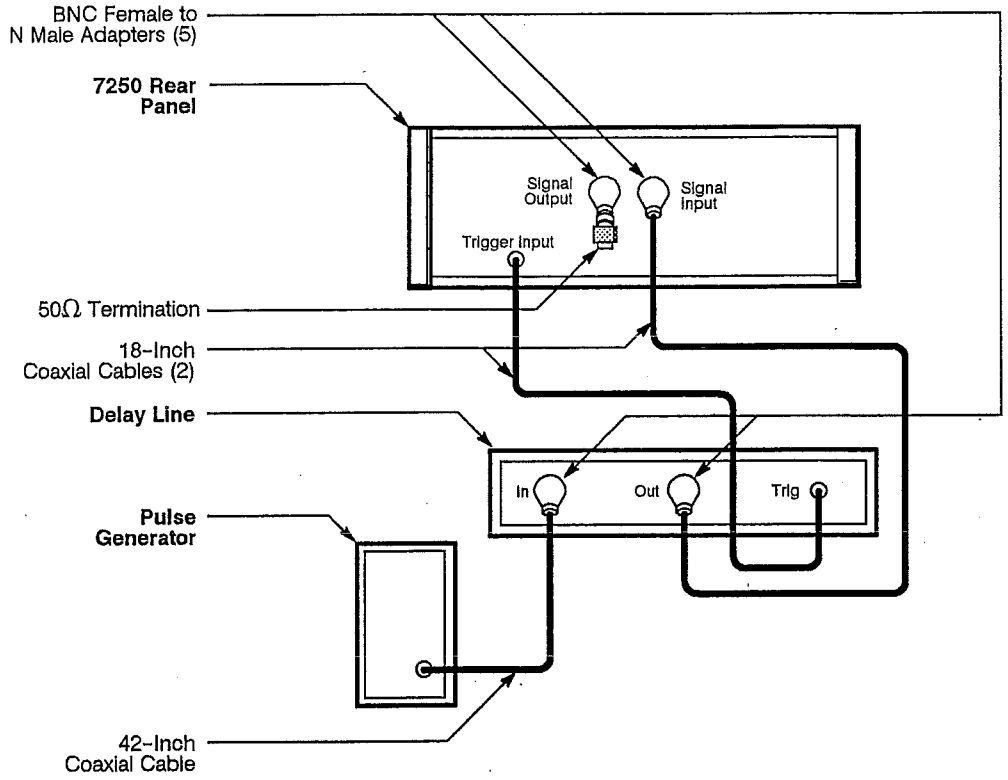
Description

This step checks triggering stability using a pulse with 10 MHz repetition rate. Envelope acquisition mode is used and the time difference between envelope edges is measured.

Specifications

The trigger must be stable within 250 ps or less.

Setup Conditions



7250 settings:

Press **3 ENTER** on the **KEYBOARD**, then change the following settings:

TRIGGER TYPE ..... **NORMAL**
SWEEP DELAY ..... Dependent on delay time of the delay line
TIME BASE ..... **200 ps/DIV**

Pulse generator settings:

Period ..... 100 ns
Duration ..... 50 ns
Output Level Low ..... –2.5 V
Output Level High ..... +2.5 V

Setting Display Magnification

These instructions position the waveform, define the measurement window, and set the magnification factors.

1. Press the **CONTINUOUS** key to begin acquisitions.
2. Set **SWEEP DELAY** to position the rising edge of the pulse near the horizontal center of the display.

3. Press the **GRAPHICS FUNCTIONS ORIGIN** key and move the horizontal origin cursor (vertical bar) to the extreme left side of the display graticule.
4. Move the vertical origin cursor (horizontal bar) 4.5 divisions above the bottom of the display graticule.
5. Press the **MAG ON/OFF** key to enable magnification (MAG ON).
6. Press **1 6** on the **KEYBOARD**, then press **MAG Y**.
7. Press **1** on the **KEYBOARD**, then press **MAG X**.
8. Press the **ACQUISITION STOP** key.

Checking Stability for Normal Triggering

These instructions check trigger stability over 100 acquisitions by measuring the time difference between the envelope boundaries

9. Set the **ACQUISITION MODE** to **ENVELOPE** in the **MAIN MENU**.
10. Press **1 0 0** on the **KEYBOARD**, then press **ACQUIRE**.

Two traces will be displayed from the bottom left to the upper right of the display graticule. Ignore the few spurious dots scattered over the display. See Figure 4-14.

11. **CHECK** that the time difference between the two traces is 250 ps or less (1.25 horizontal divisions or less).

Take into account the thickness of the trace and make the measurement from the center of one trace to the center of the other.

12. Set the **TRIGGER LEVEL** to **0.25 V**.
13. Set the duration control on the pulse generator to 10 ns.
14. **CHECK** stability for a 10 ns pulse by repeating instructions 9. through 11.

Checking Stability for Fast Triggering

15. Set the **TRIGGER TYPE** to **FAST**.
16. Set the Duration control on the pulse generator to 20 ns.
17. **CHECK** stability for **FAST** triggering at 20 ns by repeating instructions 9. through 11.
18. Set the Duration control on the pulse generator to 2 ns.
19. **CHECK** stability for **FAST** triggering at 2 ns by repeating instructions 9. through 11.

Part 7—Sweep Delay

The steps in this part check and, if necessary, adjust the minumum sweep delay for the four fastest **TIME BASE** settings. Minimum sweep delay for the slower **TIME BASE** settings is not specified; however, instructions are included for adjusting the delay for these settings when the faster settings are adjusted.

Checking Minimum Delay Before Start of Sweep

Description

This step checks the minimum time delay from the triggering event to the start of the sweep.

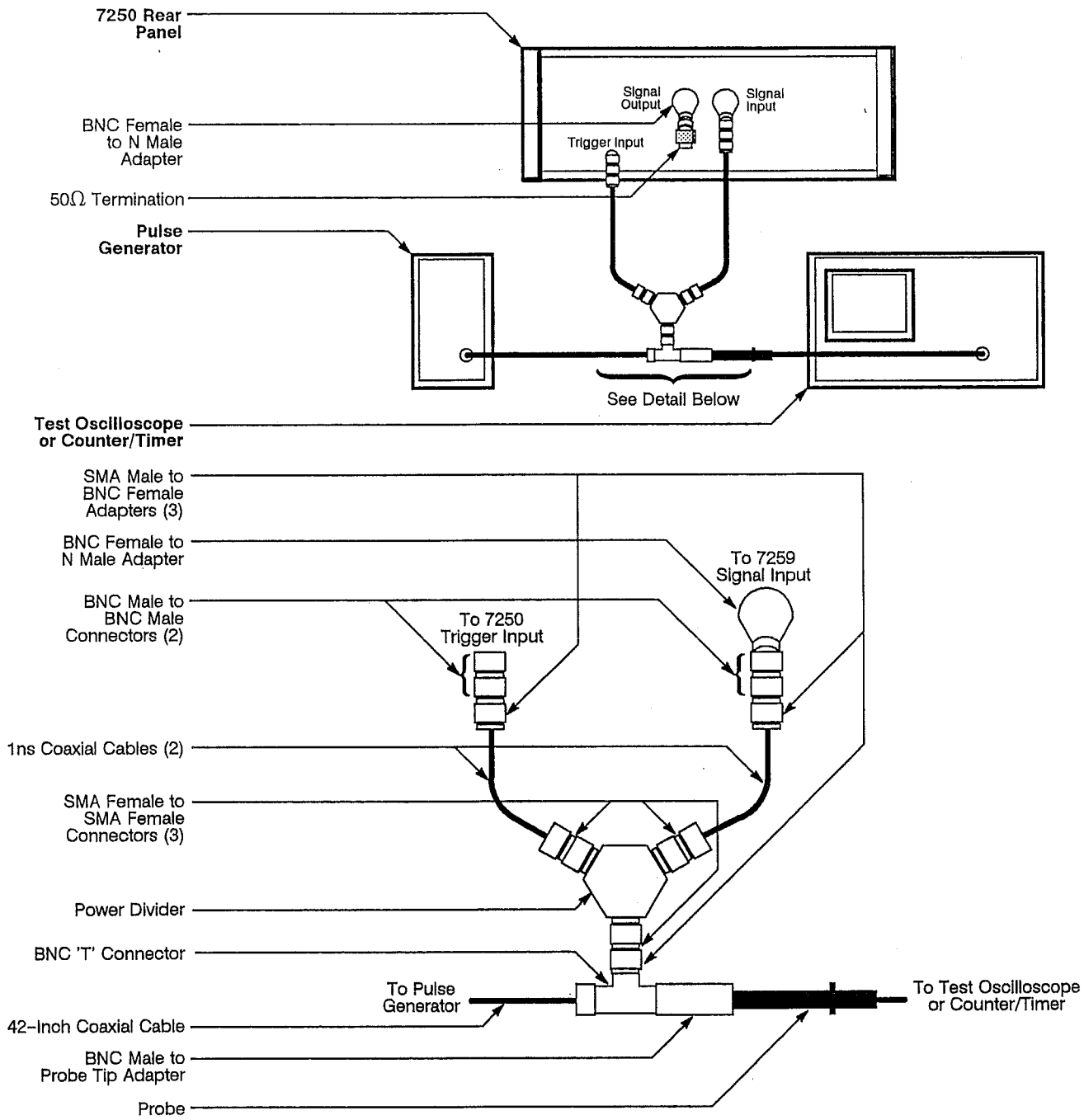
Specifications

The minimum delay for the four fastest **TIME BASE** settings, **50 ps/DIV** through **500 ps/DIV**, must be 50 ns ±2 ns. Between these ranges, the minimum delay can not differ more than the limits specified in Table 4-7.

TABLE 4-7
Sweep Delay Specifications

TIME BASE Settings	**Maximum Variation Between Settings**
50 ps/DIV to **100 ps/DIV**	250 ps
100 ps/DIV to **200 ps/DIV**	250 ps
200 ps/DIV to **500 ps/DIV**	500 ps

Setup Conditions



Setup Conditions (cont)

7250 settings:

Press 3 ENTER on the KEYBOARD, then change the following settings:

TRIGGER LEVEL	1.25 V
TRIGGER TYPE	NORMAL
SWEEP DELAY	50 ns
TIME BASE	500 ps/DIV

Test equipment settings:

Pulse Generator

Period	1 ms
Duration	50 ns
Output Level High	+2.5 V
Output Level Low	−2.5 V

Counter/Timer or Test Oscilloscope

Function	Width
Trigger Level	0 V
Coupling	DC
Slope	+

Checking Delay at 50 ns/DIV

1. Press the CONTINUOUS key to begin acquisitions.
2. Use the pulse generator duration (pulse width) control to position the 50% point of the falling edge of the pulse on the left edge of the display graticule (see Fig. 4-15).

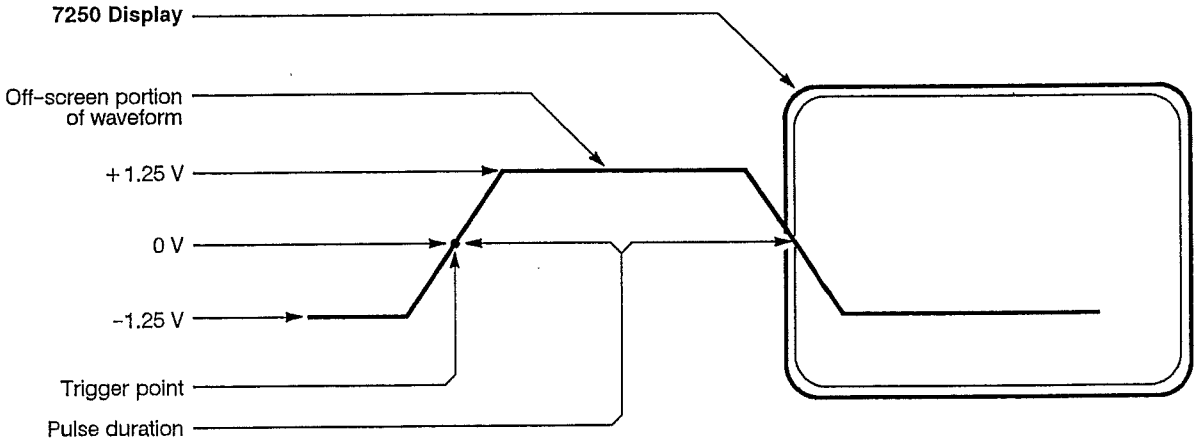


Figure 4-15. Waveform positioned at 50% of falling edge.

3. **CHECK** that the value of the delay (pulse width measured by the counter/timer or test oscilloscope) is 50 ns ±2 ns.

NOTE

If the pulse generator duration control is not sufficiently adjustable to position the falling edge as instructed, set the edge so that the 50% level is on screen and measure the time from the left edge of the screen to the 50% level. Then subtract this value from the counter timer reading.

Checking Delay at 100 ps/DIV

4. Set the **TIME BASE** to **100 ps/DIV**.
5. **CHECK** the delay at **100 ps/DIV** by repeating instructions 2. and 3.

Checking Difference Between Settings

6. **CHECK** that the difference between the delay measurements made at **50 ps/DIV** and **100 ps/DIV** is less than 250 ps.

Checking the Remaining Settings

7. **CHECK** the delay value and the delay difference between **TIME BASE** settings for the remaining settings in Table 4-7 by repeating instructions 2. through 6.

*If the delay measurements are not within tolerance or the difference in delay between **TIME BASE** settings is greater than specified, perform the following step,* Adjusting Minimum Sweep Delay for the Fast Time Base Settings.

If the measurements and differences between settings are all within specification, the following adjustment step is not necessary.

Adjusting Minimum Sweep Delay for the Fast Time Base Settings

DO NOT perform this step unless the delay measurements taken in the preceding step, *Checking Minimum Delay Before Start of Sweep*, are out of the specified range or if the difference in delay between ranges is greater than the specified limits. If neither of these situations apply, skip this step; no adjustment is necessary.

Description

This step adjusts minimum delay for the fast **TIME BASE** settings (**50, 100, 200,** and **500 ps/DIV**) by entering measured values into **RESERVED MENU 3.**

Setup Conditions

The setup conditions for this step are the same as used in the previous step, *Checking Minimum Delay Before Start of Sweep*.

Adjusting Minimum Sweep Delay

These instructions display ***RESERVED MENU 1*** *and temporarily change the contents.*

1. Press **1 2 5 MENU** on the **KEYBOARD**.
2. Set lines **R49**, **R50**, **R51**, and **R52** to zero.
3. Repeat the measurements made in the previous step, *Checking Minimum Delay Before Start of Sweep*, and record the values on Table 4-8.

Now the stored menu settings are transferred from EEPROM to RAM where the contents of ***RESERVED MENU 1*** *can be changed to measured values.*

4. Press **3 ENTER** on the **KEYBOARD**.
5. Press **1 ENTER** on the **KEYBOARD** to guard the secondary CRT settings against accidental change.
6. Press **1 2 5 MENU**.
7. **ADJUST** the minimum sweep delay for the **TIME BASE** settings in Table 4-8 by entering the values measured in instruction 3.

TABLE 4-8
Setting Minimum Sweep Delay in RESERVED MENU 3 for the Fast Sweep TIME BASE

TIME BASE Setting (Time/DIV)	Line of RESERVED MENU 3	Original Value	Measured Value
50 ps	R49		
100 ps	R50		
200 ps	R51		
500 ps	R52		

CAUTION

The following instruction will replace calibrated settings with those settings now in RAM. Be sure that all changes are correct before proceeding. Incorrect settings can damage the scan converter.

Transferring Settings Back into EEPROM

8. Press **1 9 6 4 ENTER** on the **KEYBOARD**.

These instructions demonstrate that the new settings were stored successfully. Incorrect values are written into ***RESERVED MENU 3****, then the stored menu values are recalled from EEPROM and should overwrite the incorrect entries.*

Verifying Storage of the Settings

9. Press **1 2 5 MENU** on the **KEYBOARD**.
10. Change the values of lines **R49** through **R52** by one increment.
11. Press **3 ENTER** on the **KEYBOARD** to transfer the settings from EEPROM to RAM.
12. Press **1 2 5 MENU** to display the stored version of **RESERVED MENU 3**.
13. **CHECK** that the values in lines **R49** through **R52** are restored to the values entered in *Adjusting Minimum Sweep Delay* earlier in this step.

Recording the Calibration Data

A hardcopy record of the calibration data can be made in three ways:

- Make a video hardcopy while **RESERVED MENU 3** is displayed.
- Write the menu values onto a data log sheet.
- For instruments with serial number FR1146 and above, connect a plotter and press **1 9 6 7 ENTER** on the **KEYBOARD** to plot a copy of **RESERVED MENU 3**. (See the Operators manual for plotter compatibility information.)

Adjusting Delay (with Measured Values) for the Slow Time Base Settings

DO NOT perform this step unless the preceding step, *Adjusting Minimum Delay for the Fast Time Base Settings*, has been performed.

Description

This step adjusts minimum delay by entering values measured for the slow **TIME BASE** settings (**1 ns/DIV** to **1 µs/DIV**) into **RESERVED MENU 3.**

Setup Conditions

The setup conditions for this step are the same as used in a previous step, *Checking Minimum Delay Before Start of Sweep*.

Adjusting Minimum Sweep Delay

These instructions display **RESERVED MENU 3**, *set the delay values for the slow* **TIME BASE** *settings to zero, then enter measured values.*

1. Press **1 2 5 MENU** on the **KEYBOARD** to display **RESERVED MENU 3**, and record the values for lines R53 through R62 on Table 4-9.
2. Set lines **R53** through **R62** to zero.
3. Measure and record on Table 4-9 the minimum time delay for each **TIME BASE** setting from **1 ns/DIV** through **1 µs/DIV** by performing steps 1 and 2 under *Checking Minimum Delay Before Start of Sweep*.
4. Press **3 ENTER** on the **KEYBOARD** to transfer the menu settings from EEPROM to RAM where they can be changed.
5. Press **1 ENTER** to lock the settings for the CRT parameters to prevent accidental change.
6. Press **1 2 5 MENU** to display the stored version of **RESERVED MENU 3**.
7. **ADJUST** the minimum delay for each setting in Table 4-9 by entering the measured values in lines **R53** through **R62** in **RESERVED MENU 3**.
8. **ADJUST** the value for line **R63** in **RESERVED MENU 3** by setting it to the same value entered for line **R49**.

CAUTION

The following instruction will replace calibrated settings with those settings now in RAM. Be sure that all changes are correct before proceeding. Incorrect settings can damage the scan converter.

Transferring Settings Back into EEPROM

9. Press **1 9 6 4 ENTER** on the **KEYBOARD**.

TABLE 4-9
Adjusting Minimum Sweep Delay in RESERVED MENU 3 for the Slow TIME BASE Settings

TIME BASE Setting (Time/DIV)	Line of RESERVED MENU 3	Original Value	Measured Value
1 ns	R53		
2 ns	R54		
5 ns	R55		
10 ns	R56		
20 ns	R57		
50 ns	R58		
100 ns	R59		
200 ns	R60		
500 ns	R61		
1 µs	R62		

Verifying Storage of the Settings

These instructions demonstrate that the new settings were stored successfully. Incorrect values are written into ***RESERVED MENU 3****, then the stored menu values are recalled from EEPROM and should overwrite the incorrect values.*

10. Press **1 2 5 MENU** on the **KEYBOARD** to display **RESERVED MENU 3.**
11. Change the values in lines **R53** through **R62** by one increment.
12. Press **3 ENTER** on the **KEYBOARD** to transfer the settings from EEPROM to RAM.
13. Press **1 2 5 MENU** to display the stored version of **RESERVED MENU 3.**
14. **CHECK** that the values in lines **R53** through **R62** are restored to the values entered earlier in this step in *Adjusting Minimum Sweep Delay*.

Part 8—Bandwidth

The steps in this section check the bandwidth in two input signal configurations, one with and one without the Option 01 Delay Line.

Checking Bandwidth without the Option 01 Delay Line

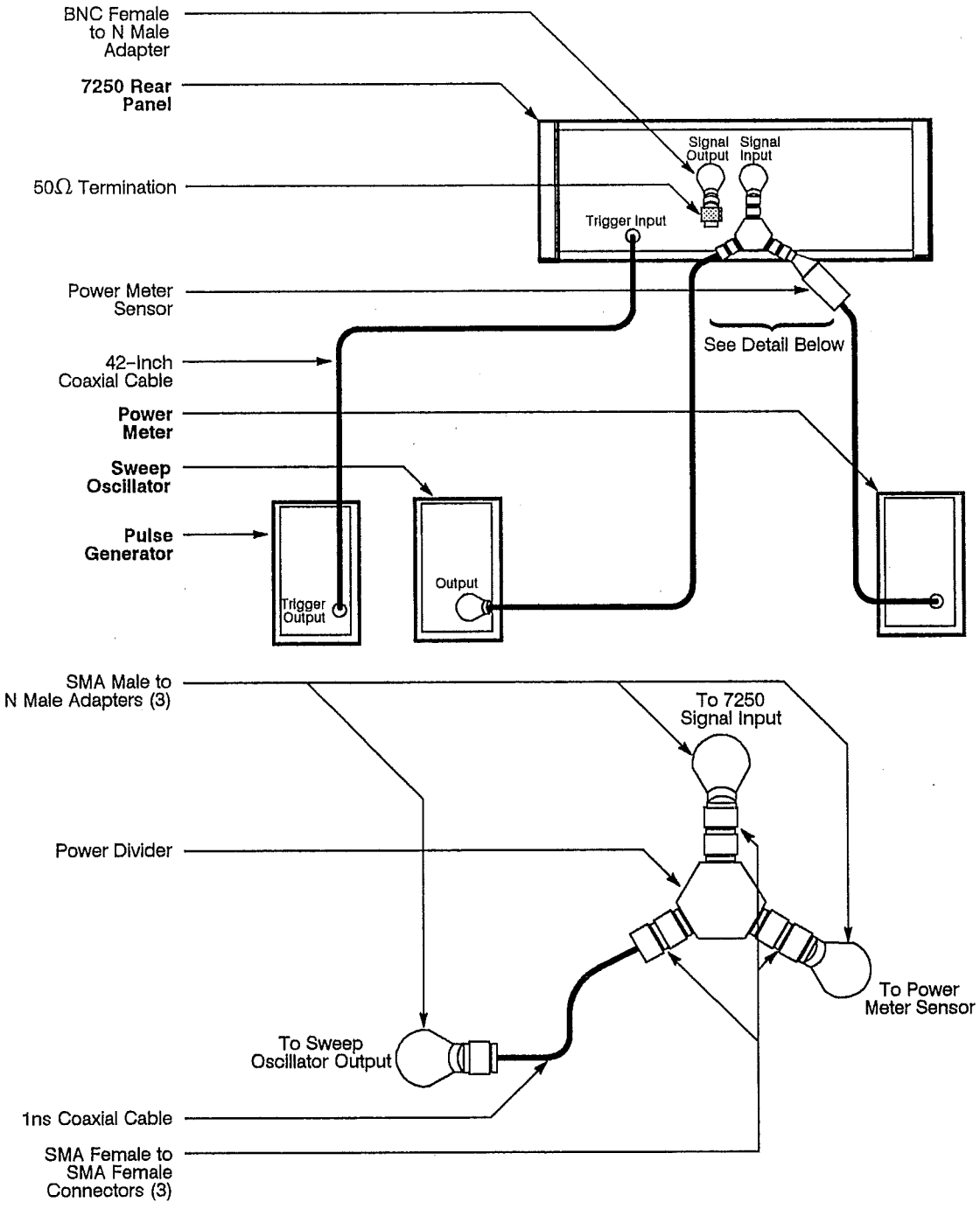
Description

This step checks that the bandwidth is at least 6 GHz. A reference frequency of 50 MHz is set to a displayed amplitude of 5 divisions at a **TIME BASE** setting of **100 ns/DIV**. The frequency is increased to 6 GHz and the displayed amplitude is examined for at least 3.5 divisions peak-peak.

Specifications

With a 50 MHz reference signal of 5 divisions peak-to-peak, the displayed amplitude must be at least 3.5 divisions peak-to-peak for input signals with up to 6 GHz frequency.

Setup Conditions



Setup Condition (cont)

7250 settings

Press 3 ENTER on the KEYBOARD, then change the following settings:

TRIGGER LEVEL	**2.5 V**
TRIGGER TYPE	**NORMAL**
SWEEP DELAY	**200 ns**
TIME BASE	**100 ns/DIV**
DATA PROCESSING	**SMOOTHING WITHOUT CALIBRATION**

Test Equipment settings

Pulse Generator	
Period	1 ms
Duration	1 µs
Output Level High	+2.5 V
Output Level Low	-2.5 V
Sweep oscillator	
Frequency	50 MHz
Amplitude	+12 dBm or 2.5 Vp-p
Power Meter	
Mode	dBm
Cal Adjust	According to Sensor calibration data

Setting the Reference

1. Press the **GRAPHICS FUNCTIONS ORIGIN** key.
2. Position the horizontal reference cursor (vertical bar) to the left side of the display perimeter and the vertical reference cursor (horizontal bar) 2.5 divisions above the bottom of the display perimeter.
3. Press the **MAG ON/OFF** key to enable magnification.
4. Press 1 on the **KEYBOARD**, then press **MAG X**.
5. Press 2 on the **KEYBOARD**, then press **MAG Y**.
6. Press the **CONTINUOUS** key to begin acquisitions.
7. Set the sine wave generator amplitude control to obtain a peak-to-peak amplitude of exactly 5 divisions on the 7250 display.
8. Set the power meter to dB reference mode.
9. Press the **GRATICULE** key to select the 10 X 10 grid for better visual resolution.

*An alternate method is to press the **PROCESS** key then the **MEASURE** key to read the peak-to-peak amplitude. (2 **CURSORS** mode must be enabled for this measurement.)*

Checking Bandwidth

10. Set the sine wave generator frequency control for 1 GHz.
11. Set the power meter cal factor control according to the sensor calibration chart.
12. Set the sine wave generator amplitude control for a power meter reading of 0 dB.
13. **CHECK** that the display amplitude is at least 3.5 divisions.
14. **CHECK** displayed amplitude at 3 GHz, 5 GHz, and 6 GHz by changing the sine wave frequency in instruction 10. and repeating instructions 11. through 13.

Checking Bandwidth with the Option 01 Delay Line

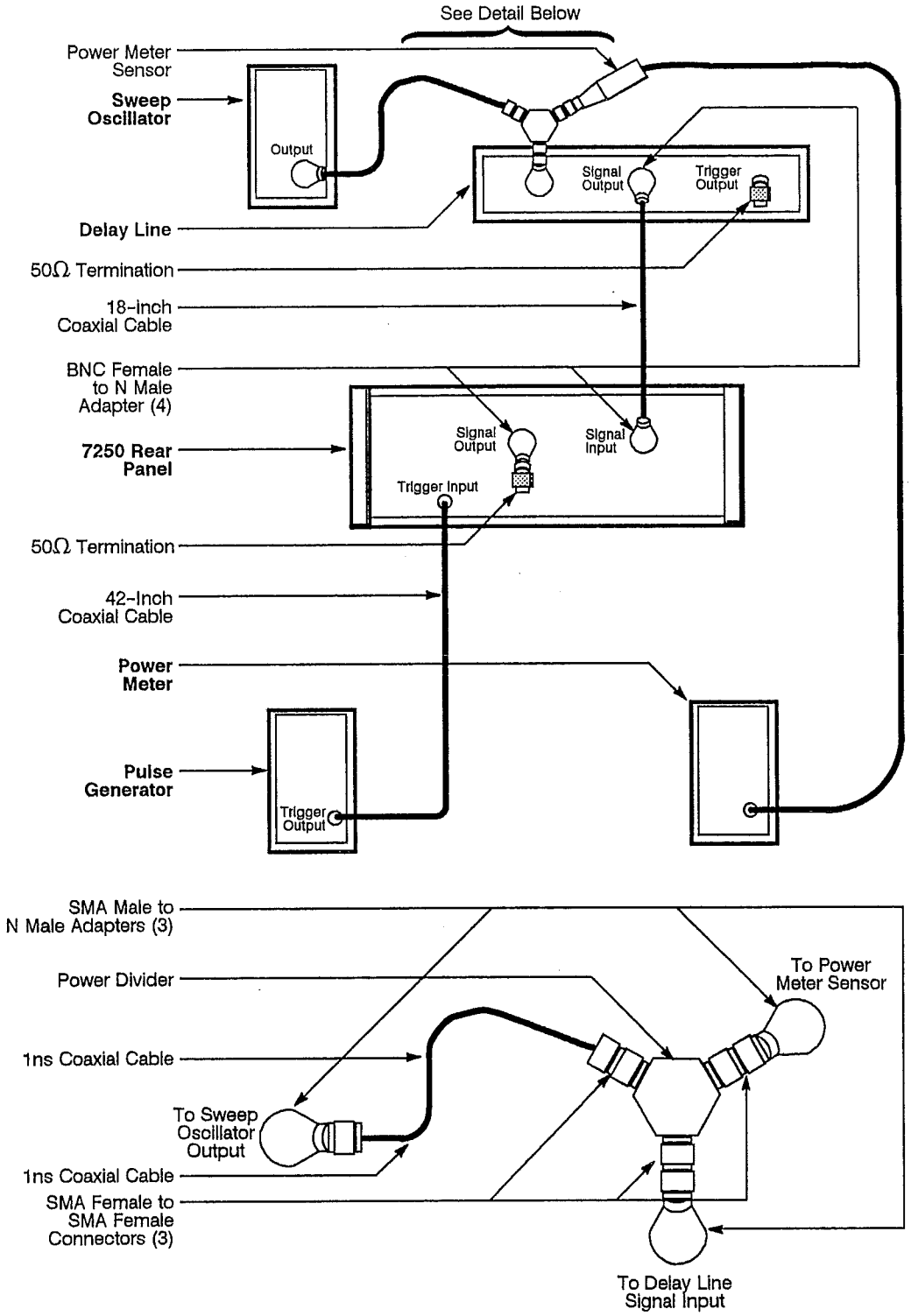
Description

This step checks bandwidth with the Option 01 Delay Line installed between the signal generator and the 7250. This configuration reduces bandwidth.

Specifications

With a 50 MHz reference signal of 5 divisions peak-to-peak, the displayed amplitude must not be less than 3.5 divisions peak-to-peak for input signals with up to 4.5 GHz frequency.

Setup Conditions



Setup Conditions (cont)

7250 settings

Press 3 ENTER on the KEYBOARD, then change the following settings:

TRIGGER LEVEL	2.5 V
TRIGGER TYPE	NORMAL
SWEEP DELAY	200 ns
TIME BASE	100 ns/DIV
DATA PROCESSING	SMOOTHING WITHOUT CALIBRATION

Test Equipment settings

Pulse Generator	
Period	1 ms
Duration	1 μs
Output Level High	+2.5 V
Output Level Low	-2.5 V
Sweep oscillator	
Frequency	50 MHz
Amplitude	+12 dBm or 2.5 Vp-p
Power Meter	
Mode	dBm
Cal Adjust	According to Sensor calibration data

Checking Bandwidth

1. Press 4 on the KEYBOARD, then press the MAG Y key (with MAG ON).
2. **CHECK** bandwidth by repeating the instructions under *Checking Bandwidth without the Option 01 Delay Line*, except that the displayed waveform amplitude must be at least 3.5 divisions peak-to-peak at 4.5 GHz, which is the maximum frequency tested with the delay line.

Part 9 – Digitizer

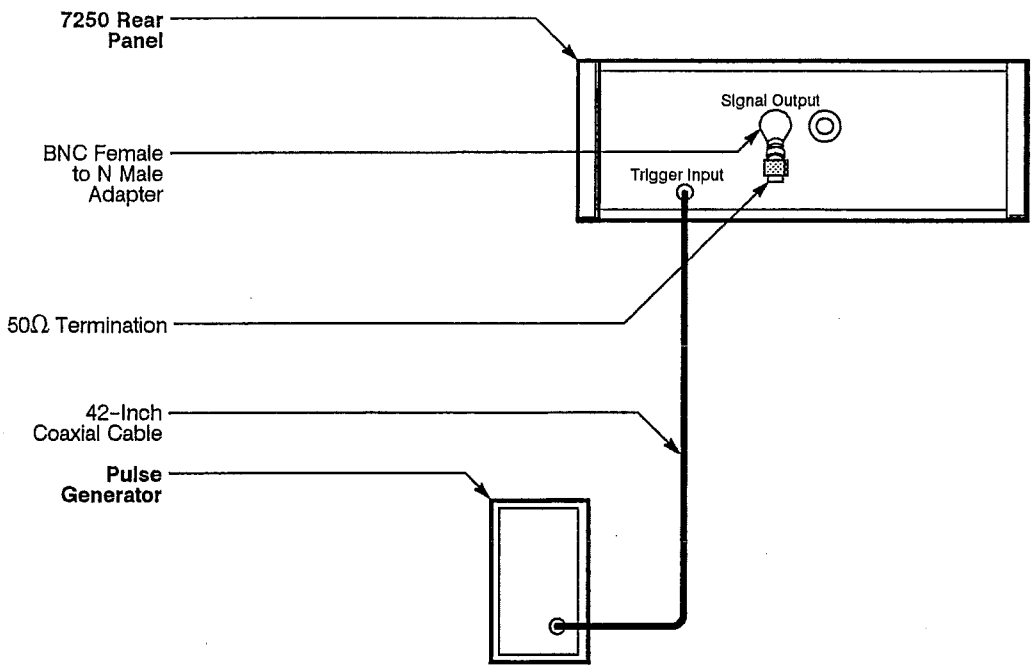
The steps in this part examine the digitized image for noise, missing points, parasitic points, and trace thickness.

Examining Digitizing Noise

Description This step examines digitizing noise at each **TIME BASE** setting with no input signal applied.

Measurement Limits Noise on the baseline should not exceed 20 points peak to peak.

Setup Conditions



7250 settings:

Press **3 ENTER** on the **KEYBOARD**, then change the following settings:

TRIGGER LEVEL ..... **2.5 V**
TRIGGER TYPE ..... **NORMAL**
TIME BASE ..... **1 µs/DIV**
DATA PROCESSING ..... **SMOOTHING WITHOUT CALIBRATION**

Test Equipment settings:

Pulse Generator

Period ..... 1 ms
Duration ..... 1 µs
Output Level High ..... +2.5 V
Output Level Low ..... –2.5 V

Setting Display Magnification

These instructions define the magnification window and set vertical magnification to 10.

1. Press the **DISPLAY MODE GRAPHICS** key.
2. Press the **GRAPHICS FUNCTIONS ORIGIN** key.

3. Position the horizontal origin cursor 0.5 division below the center of the display and position the vertical origin cursor at the left graticule edge, using the **CURSOR POS/ORIGIN POS** arrow keys.
4. Press the **MAG ON/OFF** key to turn magnification on.
5. Press **1** on the **KEYBOARD**, then press the **MAG X** key.
6. Press **1 0** on the **KEYBOARD**, then press the **MAG Y** key.

Examining Noise

7. Press **SINGLE SHOT** to acquire a waveform.
8. **EXAMINE** the baseline display for less than 20 points (1 division) peak to peak of noise.
9. **EXAMINE** the baseline for 20 points or less peak to peak of noise in 95% of the tests by repeating instructions 7. and 8. another 19 times. The test must be successful in at least 19 of the 20 attempts.
10. Change the **TIME BASE** to the next faster setting.
11. **EXAMINE** baseline noise for each **TIME BASE** setting by repeating instructions 7. through 10.
12. Press the **MAG ON/OFF** key to turn the magnification off.

Examining Waveform Digitization

Description

This step examines digitizing quality with a sine-wave signal applied to the 7250 **SIGNAL INPUT**.

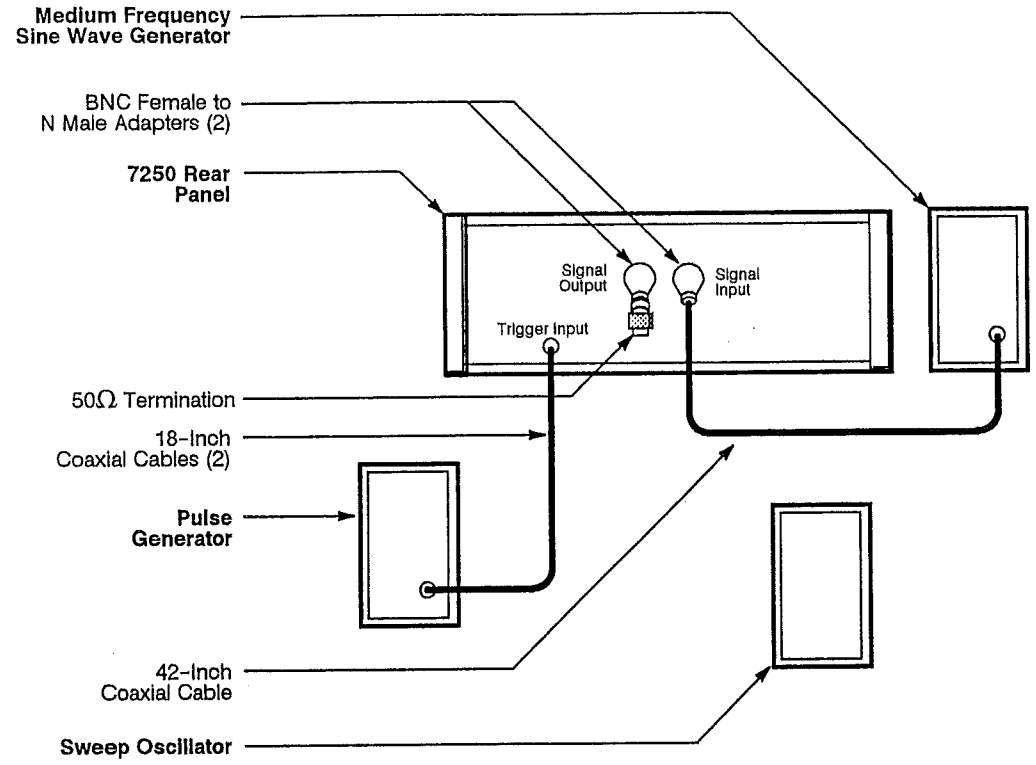
Measurement Limits

Trace thickness should be no more than six points at the zero crossing of the display.

There should be no more than five missing points.

There should be no more than five parasitic points.

Setup Conditions



7250 settings:

Press 3 ENTER on the KEYBOARD, then change the following settings:

TRIGGER LEVEL	2.5 V
TRIGGER TYPE	NORMAL
TIME BASE	1 µs/DIV
ACQUISITION MODE	ACQUIRE PERMANENT DEFECTS
DATA PROCESSING	SMOOTHING WITHOUT CALIBRATION

Test Equipment settings:

Pulse Generator

Period	1 ms
Duration	1 µs
Output Level High	+2.5 V
Output Level Low	-2.5 V

Sine Wave Generator

Frequency	250 kHz
Amplitude	4 V p-p

Locating the Permanent Defects

These instructions acquire a map of permanent defects in the CRT system. By knowing where these defects are located, they will not be mistaken for digitizer problems.

1. Press **ACQUIRE** to display the permanent defects map.
2. Note the location of all points in this display for future reference.

Examining the Display for Missing Points

3. Press **SINGLE SHOT** to acquire a waveform.
4. **EXAMINE** the waveform for missing points. There should be one dot for each X value across the display, with no more than five X values missing. (CURSOR 1 can be used to check for missing points. The Y1 readout will display ****** when positioned over a missing point.)

Examining the Display for Parasitic Points

5. **EXAMINE** the display for parasitic points. A parasitic point is one which lies more than 12 points (0.24 division) from the waveform and is not a permanent defect.
6. Count the parasitic points on the display.

Determining the Average Number of Parasitic Points

7. Repeat instructions 3. through 6. another nine times (ten times total).
8. Average the number of parasitic points found per acquisition. The average number of parasitic points per acquisition should not exceed five.

Setting Display Magnification

These instructions define the measurement window and set vertical magnification to 10.

9. Press the **GRAPHICS FUNCTIONS ORIGIN** key.
10. Position the horizontal origin cursor to 0.5 division below the center of the display and the vertical origin cursor to the left edge of the display graticule.
11. Press the **MAG ON/OFF** key to enable magnification.
12. Press **1** on the **KEYBOARD** then press **MAG X**.
13. Press **1 0** on the **KEYBOARD**, then press **MAG Y**.

Examining the Width of the Displayed Waveform

14. **EXAMINE** the waveform at the zero crossing (horizontal center) of the display. The thickness of the trace, measured perpendicularly, should be no more than six points (0.3 division).

15. **EXAMINE** the trace thickness for each **TIME BASE** setting. At each setting, set the sine wave generator frequency control to provide 2.5 sine-wave cycles in the display area. Above 1 GHz, 2.8 V peak to peak of signal amplitude may be used if the generator output is limited at high frequency.

Part 10—Delay Lines

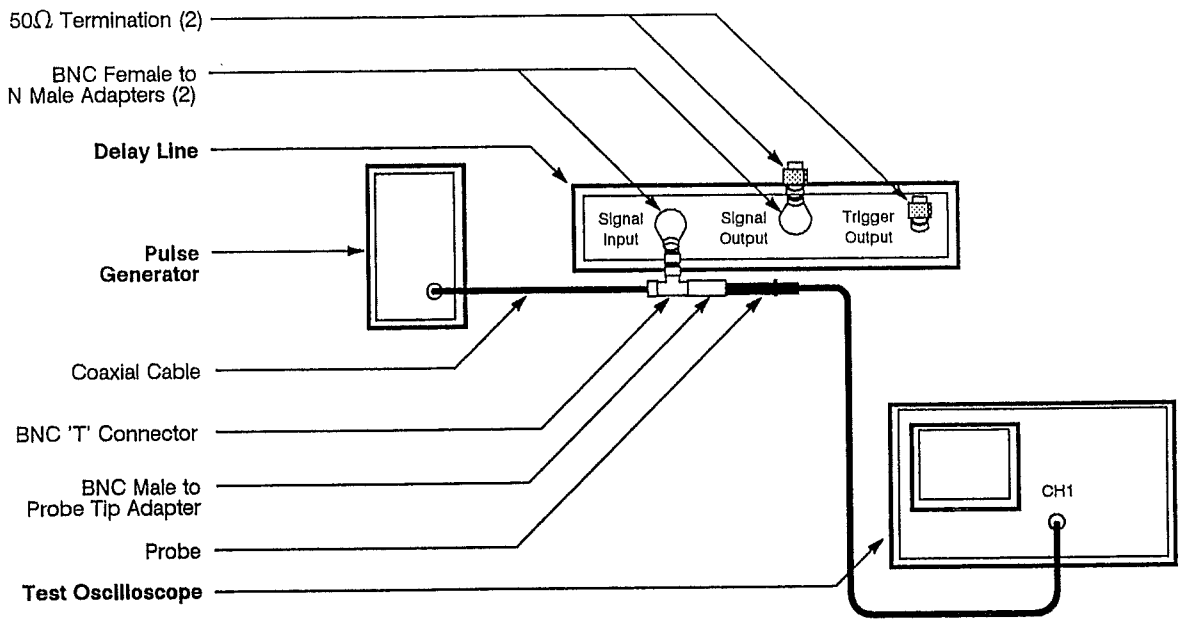
The steps in this part check the attenuation and time delay of a delay line.

Checking Attenuation of a Delay Line

Description This step uses a pulse generator and an oscilloscope to check the the attenuation of the delay line.

Specifications With reference to the signal amplitude at the Option 01 Delay Line Signal Input connector, the signal amplitude is attenuated 4.5 dB ±0.5 dB at the Signal Output connector and 20 dB ±1 dB at the Trigger Output connector. For other delay lines, check the product specifications

Setup Conditions



Test equipment settings:

- Pulse Generator
  - Period ..... 1 ms
  - Duration ..... 0.5 ms
  - High Output Level ..... +2.5 V
  - Low Output Level ..... -2.5 V
- Test Oscilloscope
  - Time/Div ..... 0.5 ms
  - Volts/Div 1
  - Coupling ..... DC

Checking Signal Attenuation

1. Set the pulse generator amplitude control for exactly 5 divisions peak-to-peak, as measured on the test oscilloscope.
2. Move the test oscilloscope probe and probe tip adapter to the Delay Line Signal Output connector. **DO NOT** remove the 50 Ω Termination.
3. **CHECK** that the peak-to-peak signal amplitude displayed on the test oscilloscope is between 2.8 V and 3.1 V for the Option 01 delay line.

Checking Trigger Attenuation

4. Move the probe and probe tip adapter to the Delay Line Trigger Output connector. **DO NOT** remove the 50 Ω Termination.
5. Set the test oscilloscope volts/division to 0.1 V.
6. **CHECK** that the peak-to-peak signal amplitude displayed on the test oscilloscope is between 0.45 V and 0.56 V for the Option 01 delay line.

Checking the Time Delay of a Delay Line

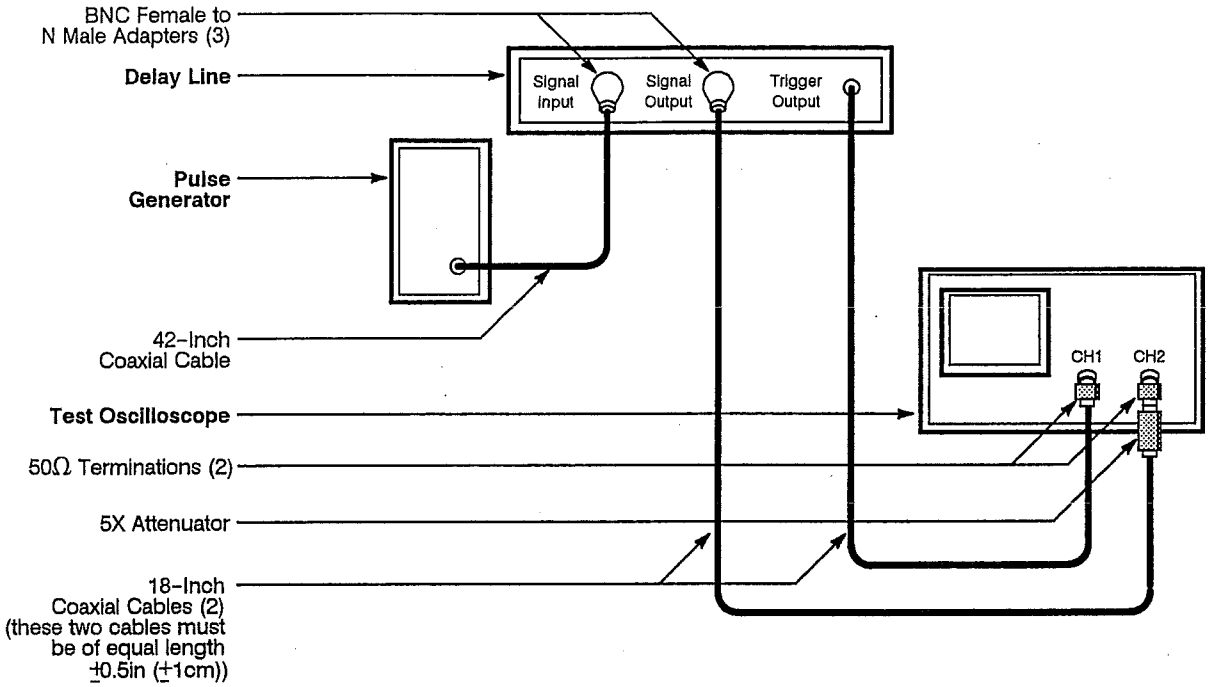
Description

This step uses a pulse generator and test oscilloscope to measure the time delay between the Trigger Output and Signal Output connectors on a delay line

Specifications

The time delay between the Trigger Output and Signal Output is 55 ns ±2 ns for the Option 01 Delay Line. For other delay lines, check the product specification.

Setup Conditions



Test Equipment settings:

- Pulse Generator
  - Period ..... 1 ms
  - Duration ..... 1 µs
  - Output Level High ..... 2.5 V
  - Output Level Low ..... -2.5 V
- Test Oscilloscope
  - Volts/Div ..... 100 mV
  - Coupling ..... DC
  - Trigger Source ..... Channel 1
  - Trigger Slope ..... +
  - Trigger Level 0

Checking Delay

1. **CHECK** that the time between the 0 V level crossing of the Trigger Output pulse and the Signal Output pulse is 55 ns ±2 ns for the Option 01 delay line.

Section Five
Instrument Options

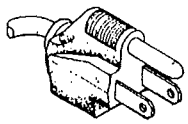
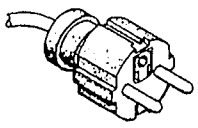
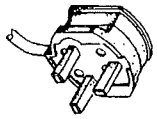
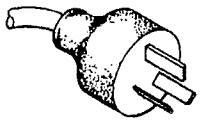
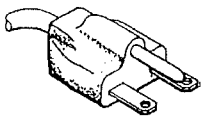
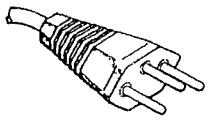
Your instrument may be equipped with one or more instrument options. A brief description of each available option is given in the following discussion. Option information is incorporated into the appropriate sections of the manual. For further information on instrument options, see your Tektronix Products catalog or contact your Tektronix Field Office.

Option A1-A5: See Table 5-1.

Option 01: External Delay Line
Provides 55 ns delay with 75 ps risetime.

Option 2D: Extended Memory
Adds waveform memory blocks 15 through 30.

Table 5-1
Option A1-A5

Plug Configuration	Usage (Max Rating)	Reference Standards & Certification	Option #
	North American 125 V/6 A	[1]ANSI C73.11 [2]NEMA 5-15-P [3]IEC 83 [10]UL [11]CSA	Standard
	European 220 V/6 A	[4]CEE (7),II, IV, VII [3]IEC 83 [8]VDE [9]SEMKO	A1
	United Kingdom 240 V/6 A	[5]BSI 1363 [3]IEC 83	A2
	Australian 240 V/6 A	[6]AS C112 [12]ETSA	A3
	North American 250 V/10 A	[1]ANSI C73.20 [2]NEMA 6-15-P [3]IEC 83 [10]UL [11]CSA	A4
	Switzerland 240 V/6 A	[7]SEV	A5

[1]*ANSI—American National Standards Institute*
[2]*NEMA—National Electrical Manufacturer's Association*
[3]*IEC—International Electrotechnical Commission*
[4]*CEE—International Commission on Rules for the Approval of Electrical Equipment*
[5]*BSI—British Standards Institute*
[6]*AS—Standards Association of Australia*
[7]*SEV—Schweizevischer Elektrotechischer Verein*
[8]*VDE—Verband Deutscher Elektrotechniker*
[9]*SEMKO—Swedish Institute for Testing and Approval of Electrical Equipment*
[10]*UL—Underwriters Laboratories*
[11]*CSA—Canadian Standards Association*
[12]*ETSA—Electricity Trust of South Australia*

Section Six
Replaceable Parts

This section contains a list of the components that are replaceable for the 7250. As described below, use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you order has been replaced with a different or improved part, your local Tektronix Field Office or representative will contact you concerning any change in the part number.

Change information, if any, is located at the rear of this manual.

Module Replacement

The 7250 is serviced by module replacement so there are three options you should consider:

- **Module Exchange.** In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEKWIDE, extension BV 5799.
- **Module Repair.** You may ship your module to us for repair, after which we will return it to you.
- **New Modules.** You may purchase new replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

The tabular information in the Replaceable Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find the all the information you need for ordering replacement parts.

Item Names

In the Replaceable Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, U.S. Federal Cataloging Handbook H6-1 can be used where possible.

Indentation System

This parts list is indented to show the relationship between items. The following example is of the indentation system used in the Description column:

1 2 3 4 5 *Name & Description*

Assembly and/or Component
Attaching parts for Assembly and/or Component
(END ATTACHING PARTS)
Detail Part of Assembly and/or Component
Attaching parts for detail part
(END ATTACHING PARTS)
Parts of Detail Part
Attaching parts for Parts of Detail Part
(END ATTACHING PARTS)

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
16428	COOPER BELDEN ELECTRONIC WIRE AND CA SUB OF COOPER INDUSTRIES INC	NW N ST	RICHMOND IN 47374
70903	COOPER BELDEN ELECTRONICS WIRE AND C SUB OF COOPER INDUSTRIES INC	2000 S BATAVIA AVE	GENEVA IL 60134-3325
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97707-0001
S3109	FELLER	ASA ADOLF AG STOTZWEID CH8810	HORGEN SWITZERLAND
TK1373	PATELEC-CEM (ITALY)	10156 TORINO	VAICENTALLO 62/45S ITALY
TK6020	DAINICHI-NIPPON CABLES	NEW KOKUSAI BLDG 4-1 MARUNOUCHI 3-CHOME CHIYODA-KU	TOKYO 100 JAPAN

Reference Part No.	Tektronix Part No.	Name & Description	Mfr. Code	Mfr. Part No.
ACCESSORY, STANDARD	070-6401-00	MANUAL,TECH:OPERATORS,7250	80009	070-6401-00
ACCESSORY, STANDARD	161-0066-00	CABLE ASSY,PWR,:3,18AWG,115V,98.0 L	16428	CH8481, FH8481
ACCESSORY, STANDARD	161-0066-09	CABLE ASSY,PWR,:3,0.75MM SQ,220V,99.0 L (OPTION A1 ONLY)	S3109	86511000
ACCESSORY, STANDARD	161-0066-10	CABLE ASSY,PWR,:3,0.75MM SQ,240V,96.0 L (OPTION A2 ONLY)	TK1373	24230
ACCESSORY, STANDARD	161-0066-11	CABLE ASSY,PWR,:3,0.75MM,240V,96.0 L (OPTION A3 ONLY)	S3109	ORDER BY DESCR
ACCESSORY, STANDARD	161-0066-12	CABLE ASSY,PWR,:3,18 AWG,250V,99.0 L (OPTION A4 ONLY)	70903	CH-77893
ACCESSORY, STANDARD	161-0154-00	CABLE ASSY,PWR,:3,0.75MM SQ,240V,6A,2.5M L (OPTION A5 ONLY)	S3109	86515000
ACCESSORY,OPTIONAL	012-0911-00	CABLE,INTCON:144.0 L, RS 232	TK6020	ESF-85249
ACCESSORY,OPTIONAL	012-0991-00	CABLE,GPIB:LOW EMI,2 METER	00779	553577-3
ACCESSORY,OPTIONAL	070-7133-00	MANUAL,TECH:SERVICE,7250	80009	070-7133-00
ACCESSORY,STANDARD	159-0019-00	FUSE,CARTRIDGE:3AG,1A,250V,SLOW BLOW	71400	MDL 1
ACCESSORY,STANDARD	159-0023-00	FUSE,CARTRIDGE:3AG,2A,250V,SLOW BLOW	71400	MDX2
ACCESSORY,STANDARD	159-0032-00	FUSE,CARTRIDGE:3AG,0.5A,250V,SLOW BLOW	71400	MDL 1/2
ACCESSORY,STANDARD	159-0198-00	FUSE,CARTRIDGE:3AG,3.2A,250V,SLOW BLOW	75915	31303.2
E885267	118-7209-00	PLUG-IN,BLANK:	80009	118-7209-00
E905011	118-7193-00	HANDLE,FRONT:RIGHT,W/EAR	80009	118-7193-00
E905012	118-7194-00	HANDLE,FRONT:LEFT,W/EAR	80009	118-7194-00
E905013 (NEED 2 EACH)	118-7192-00	HANDLE,REAR:	80009	118-7192-00
E905029	118-7216-00	SCREW,CAP:	80009	118-7216-00
E905052	118-7201-00	GUIDE:	80009	118-7201-00
E905273	118-7202-00	FAN GRILLE:	80009	118-7202-00
E909031	118-7217-00	SLIDE:STOP,7250	80009	118-7217-00
J391017	118-7210-00	CABLE:IVG A INTFC,7250	80009	118-7210-00
J891015	118-7211-00	CABLE:A INTFC,7250	80009	118-7211-00
J891168	118-7213-00	CABLE:RS-232,INTERNAL	80009	118-7213-00
J891305	118-7222-00	CABLE,RF:	80009	118-7222-00
J891307	118-7221-00	CABLE,RF: (FROM M7315J1 TO M7611J2)	80009	118-7221-00
J891309	118-7220-00	CABLE,RF: (FROM M7715J2 TO M7311J6)	80009	118-7220-00
J891311	118-7219-00	CABLE,RF: (FROM M7311J5 TO M7611J1)	80009	118-7219-00
J891313	118-7218-00	CABLE,RF: (FROM M7510J3 TO M7300J4)	80009	118-7218-00
J905222	118-7198-00	FR PNL ASSY:	80009	118-7198-00
J905314	118-7195-00	DIGITAL/ANALOG:BOTTOM,RIGHT,7250	80009	118-7195-00
J905325	118-7200-00	EXTENSION:	80009	118-7200-00
J905439	118-7197-00	CIRCUIT BD ASSY:MOTHER	80009	118-7197-00
J905752	118-7199-00	CONTROL UNIT:	80009	118-7199-00
J963174	118-7214-00	CABLE:26 COND,7250 (FROM J1 TO J1)	80009	118-7214-00
M7002	118-6299-00	MODULE:I/O PROCESSOR UNIT,M7002	80009	118-6299-00
M7003	118-6300-00	MODULE:CONTROL PROCESSOR UNIT,M7003	80009	118-6300-00
M7115	118-6306-00	MODULE:DISPLAY RACK,M7115	80009	118-6306-00
M7200	118-6301-00	MODULE:NON-VOLATILE MEMORY UNIT	80009	118-6301-00
M7300	118-6302-00	MODULE:CAMERA SCAN UNIT	80009	118-6302-00
M7310	118-6303-00	MODULE:MAIN SWEEP UNIT	80009	118-6303-00
M7315	118-6292-00	MODULE:FAST SWEEP UNIT	80009	118-6292-00
M7405	118-6298-00	MODULE:MAINFRAME CHASSIS ONLY,M7405	80009	118-6298-00
M7510	118-6295-00	MODULE:DATA ACQUISITION UNIT,M7510	80009	118-6295-00
M7580	118-6294-00	MODULE:GRAPHICAL DISPLAY INTFC UNIT	80009	118-6294-00
M7588	118-6293-00	MODULE:GPIB I/O UNIT	80009	118-6293-00

Reference Part No.	Tektronix Part No.	Name & Description	Mfr. Code	Mfr. Part No.
M7600	118-6297-00	MODULE:BEAM POSITION UNIT	80009	118-6297-00
M7611	118-6296-00	MODULE:DELAY TRIGGERING UNIT,M7611	80009	118-6296-00
M7640	118-6304-00	MODULE:MCP RANGE UNIT	80009	118-6304-00
M7655	118-6305-00	MODULE:200MHZ GENERATOR UNIT	80009	118-6305-00
M7704 OPTIONAL ACCESSORY	118-6445-00	DELAY LINE:EXTERNAL	80009	118-6445-00
M7715	118-6307-00	MODULE:SCAN CONVERTER UNIT	80009	118-6307-00
M7900	118-6308-00	MODULE:LOW VOLTAGE POWER SUPPLY,M7900	80009	118-6308-00
M7911	118-6309-00	MODULE:HIGH VOLTAGE SUPPLY	80009	118-6309-00
S120252	118-7203-00	SWITCH:ON/OFF,7250	80009	118-7203-00
S189016	118-7206-00	CAP,FUSE HLDR:	80009	118-7206-00
S189017	118-7207-00	FUSE HOLDER:	80009	118-7207-00
S600153	118-7208-00	TIMER:ELAPSED TIME INDICATOR (REAR PANEL TIMING COUNTER)	80009	118-7208-00
SCREWS:	118-7205-00	SCREWS:	80009	118-7205-00
VS01721 OPTIONAL ACCESSORY	118-7225-00	FIELD KIT:EXTENDER CABLES & CARDS	80009	118-7225-00
VS01722 OPTIONAL ACCESSORY	118-7224-00	FIELD KIT:FIELD MAINTENANCE TOOLS	80009	118-7224-00
W963168	118-7215-00	CABLE:EQUIP,7250	80009	118-7215-00
W963172	118-7212-00	CABLE:EQUIP,7250	80009	118-7212-00
W963289	118-7223-00	CABLE ASSY,RF:	80009	118-7223-00
X900571	118-7204-00	RES,VAR,NONWW:BRIGHTNESS,7250	80009	118-7204-00