TEK

Operators Manual

Part No. 070-6401-01
Product Group 42

THE 7250

TRANSIENT DIGITIZING OSCILLOSCOPE

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

Tektronix®
COMMITTED TO EXCELLENCE

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
FR10000	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 ot 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 connectcion, 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

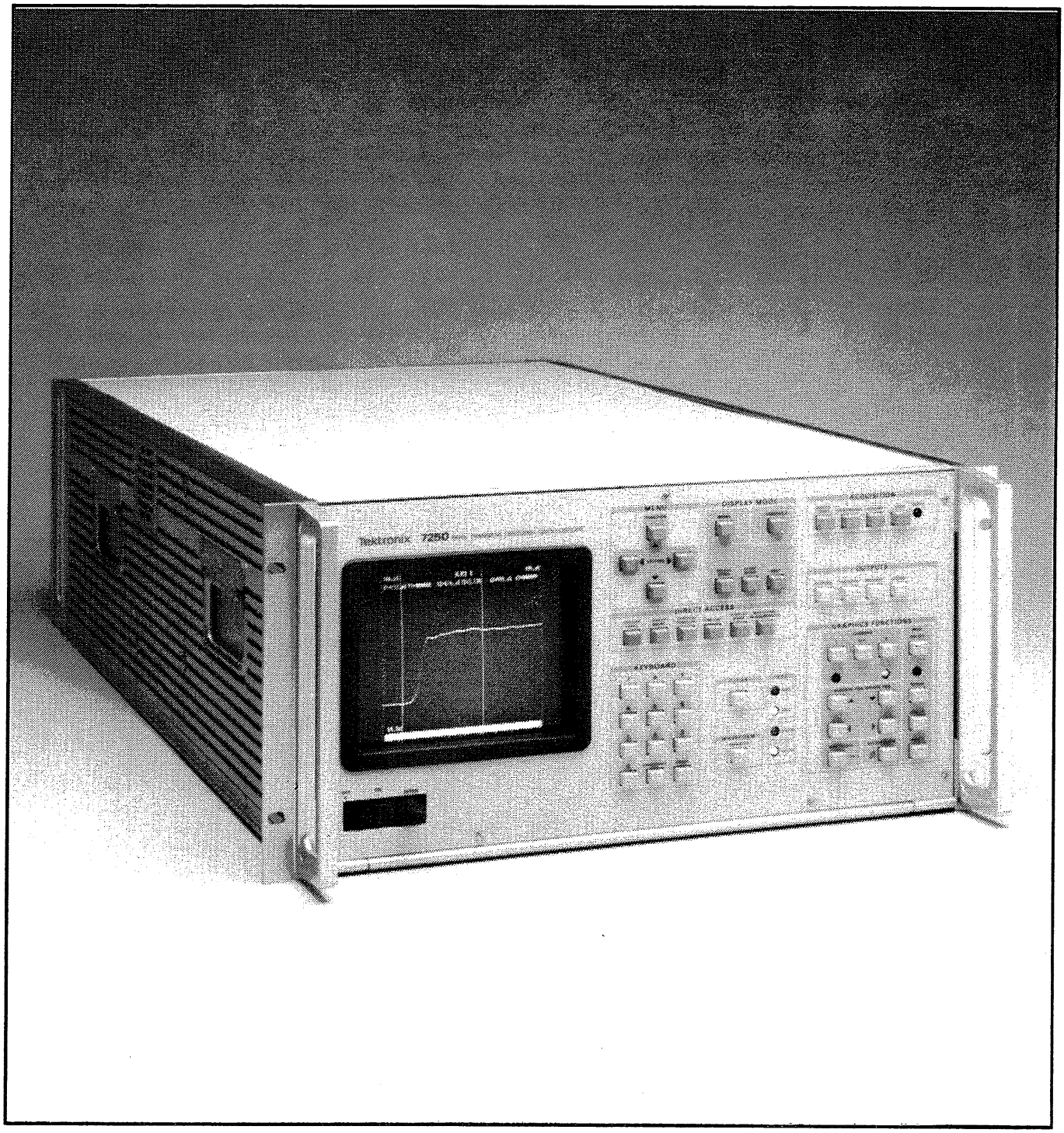
To avoid explosion, do not operate the instrument in an atmosphere of explosive gasses.

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.



7250 Transient Digitizing Oscilloscope.

Section 1
General Information

This section of the manual describes the 7250 Transient Digitizing Oscilloscope and gives the electrical, environmental, and mechanical specifications. Operating characteristics of the instrument, general instructions for installation, and information regarding options, accessories, and packaging for shipment are also provided.

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Description

The Tektronix 7250 Transient Digitizing Oscilloscope is designed specifically to acquire fast single-shot or repetitive signals and display them digitally. It uses a scan converter system to capture very high frequency, fast rise time pulses. The instrument provides a DC to 6 GHz (-3 dB) bandwidth and 50 ps rise time. Transient digitizing lets the user digitize single-shot events, or non-repetitive waveforms and view them. Waveforms are processed for display on a built-in CRT monitor.

Other features include:

- Storage capacity for 15 (or optional 31) waveform acquisitions and four front panel setups. A stored waveform can be displayed on the CRT or programmed for data processing.
- Menu driven operation and on-screen cursors are used for ease of operation. All instrument settings and parameters for waveform acquisition, processing, and measurement, as well as selections for data output, display mode, and GPIB address are contained in two menu levels.
- GPIB programmability: All front panel functions (except Power-On/Off, and CRT Intensity) are remotely controllable. Waveform data can be sent or received over the GPIB.
- Split screen operation permits a comparison of a stored waveform with a newly acquired waveform, or allows the display of two waveform acquisitions. An image magnifier, 2 internal graticules, and accumulate function permit enhancement to displays.
- RS 232 interface permits the output of displayed curve data to a plotter. Output to a video monitor or a local screen hard copy is also available.

Instrument Options

Option 2D: This option extends memory from 64 to 128 K-bytes. The 64 K-byte memory allows storage of up to 15 waveforms. Option 2D allows the 7250 to store up to 31 total waveforms.

Option 01: This option is an external delay line which provides a trigger pickoff signal and the delay necessary to view the triggering event. Option 01 limits bandwidth to 4.5 GHz.

Installation

This information describes:

- How to inspect a new instrument
- How to determine the appropriate line voltage setting and power cord
- Appropriate operating temperature
- Rackmounting the 7250

Initial Inspection

This instrument was thoroughly inspected for mechanical and electrical defects before shipment. It should be free of mars or scratches and meet or exceed all electrical specifications. Inspect the instrument for physical damage incurred in transit and test the electrical performance by following the Incoming Inspection Procedure in Section Two of this manual. If a discrepancy is found, contact your nearest Tektronix Field Office or representative for instructions.

Power Source Information

The 7250 can be operated from either a 115 VAC or 220 VAC nominal supply source at a line frequency of 48–62 Hz. The acceptable range for each nominal voltage is 95–126 VAC for the 115 VAC supply and 198–250 VAC for the 220 VAC supply.

Overcurrent protection is provided within the instrument by a fuse in the ungrounded conductor. For continued fire-hazard protection, replace only with a fuse which is identical in type, voltage rating and current rating.

Before operating the 7250, be sure that your instrument is properly configured for the voltage supply in your area and is equipped with a suitable plug (two-pole, three terminal, grounding type). Check the label on the 7250 rear panel to see if it conforms with the operating voltage supply in your area.

WARNING

Dangerous voltages exist in the 7250, even when the power is off. To avoid personal injury, refer line voltage setting changes to a qualified service technician.

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

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

Power Cord Information

The 7250 comes with a detachable power cord. The color coding of the power cord conductors appears in Table 1-1. Should you require a power cord plug other than the one supplied, refer to Table 1-2, Power Cord and Plug Identification.

TABLE 1-1
Power Cord Color Conductor Identification

Conductor	Color	Alternate
Ungrounded (line)	Brown	Black
Grounded (neutral)	Light Blue	White
Grounded (protective ground)	Green/Yellow	Green/Yellow

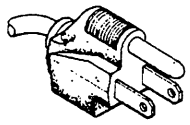
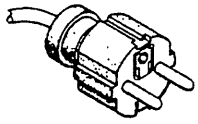
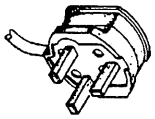
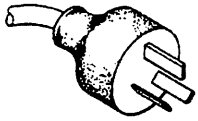
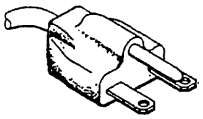
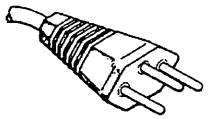
WARNING

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

This instrument is safety Class 1 equipment. All accessible conductive parts, which could become live in the event of an electrical fault (including buttons and controls which appear to be insulating), are directly connected to the ground contact of the power plug. For protection from an electric shock, connect the power plug to a receptacle with a grounding contact. This is to be done before connections are made to the input or output terminals of the instrument.

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

TABLE 1-2
Power-Cord and Plug Identification

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

Operating Temperature

The 7250 can be operated where the ambient air temperature is 0° to 40° C and can be stored in ambient temperatures from −10° to +70° C. After storage at temperatures outside the operating limits, allow the chassis temperature to reach the safe operating limits before applying power.

The 7250 is cooled by air circulation, drawing cooling air through vents on the sides and out the rear of the instrument. When installing the 7250, allow at least two inches clearance on the sides, top, and bottom of the instrument, and six inches at the rear.

Rackmounting Information

The best rackmounting configuration for the 7250 is to firmly fasten it to a stationary equipment rack. The 7250 will fit a 19 inch rack. To rackmount the 7250, install angle brackets on each side of the rack, both above and below the 7250. These four brackets should be 2 inches by 36 inches in length. Fasten the 7250 securely to the rack. It is not recommended that the 7250 be mounted with slide-out tracks.

To remove the 7250 from the rack, unfasten the 7250 from the rack, then slide it from the rack, with one person on each side of the instrument.

WARNING

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

Repacking For Shipment

The 7250 comes packaged in a crate that protects the unit from damage in transit. It is recommended that upon unpackaging the instrument, all packing materials be saved for later use.

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 allow for at least two 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. It is recommended to secure the crate with packing bands.

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

- Owner of the instrument (with address)
- Name of person at your firm to contact
- Instrument serial number
- Description of the service required

WARNING

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

Specifications and Operating Characteristics

This section specifies the electrical, environmental, and mechanical performance requirements of the 7250. Also included are functional descriptions of features that do not have specified performance requirements.

Specifications

The following electrical and environmental specifications are valid when the 7250 is operated at ambient temperatures from 0°C to 40°C and after an initial warmup period of 20 minutes. The 7250 must also have been calibrated within an ambient temperature range of 20°C to 30°C. All functions will operate immediately after the 7250 power is switched on and after the selftests are successfully completed.

TABLE 1–3
Electrical Specifications

Parameter	Specification
Vertical Sensitivity	
Measured	0.5 V/division ±15%
Displayed	Measured vertical sensitivity is within ±1% of displayed vertical sensitivity.
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.
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.

TABLE 1–3 (cont.)
Electrical Specifications

Parameter	Specification
Trigger Jitter	For a triggering signal with 1–ns risetime, jitter is no more than 100 ps peak to peak.
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 is 50 ns ±2 ns.
Difference in delay between settings	≤250 ps from 50 ps/div to 100 ps/div ≤250 ps from 100 ps/div to 200 ps/div, ≤500 ps from 200 ps/div to 500 ps/div,
Static Calibration (positioning error)	After running the static defaults elaboration, the number of static correction terms is 92 or greater.
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

TABLE 1-4
Mechanical Specification

Parameter	Specification
Weight	132 lbs. (60kg).
Shipping	242 lbs. (110kg).
Height	8.74 inches (22.2cm).
Width	19 inches (48.3cm).
Depth	36 inches (91.5cm).

TABLE 1-5
Environmental Specification

Parameter	Specification
Temperature	
Non-Operating*	-10°C to +70°C.
Operating	0°C to 40°C.
Altitude	
Non-Operating*	40,000 ft (12km).
Operating	10,000 ft (3km).
Humidity	
Operating	90% at 40°C.

* Non-operating means the power switch is off or the power cord is disconnected.

Operating Characteristics

The operating characteristics listed in Table 1–6 are functional descriptions of those features of the 7250 that have no specified performance requirements.

TABLE 1–6
Operating Characteristics

Category	Description
Vertical System	**Rise Time:** Calculated to be less than 50 ps. **Input Impedance:** Typically 50 ±2 Ω and must be externally terminated. **VSWR:** Typically less than 1.5 from DC to 2 GHz and less than 2.5 from 2 GHz to 7 GHz. **Insertion Loss:** Typically less than 2 dB from DC to 5 GHz. **Absolute Maximum Input Voltage:** Typically 2 kV for less than 1 μs. **Position Range:** 0 to 100% of full scale in 1% increments.
Horizontal System	**Range:** From 50 ps/div to 1 μs/div in a 1–2–5 sequence of 14 settings. The range of settings is limited by the delay setting as follows: **Delay Setting** — **Maximum Time/Division** 50 ns to 100 ns — 500 ps 100 ns to 150 ns — 50 ns 150 ns to 250 ns — 100 ns 250 ns to 550 ns — 200 ns 550 ns to 1050 ns — 500 ns 1050 ns to 1 μs — 1 μs **Horizontal Position:** Not adjustable. **Sweep Delay:** Available in five ranges as follows: **Delay Range** — **Delay Adjustment** — **Resolution (per step)** 1 — 50 ns to 100 ns — 50 ps 2 — 100 ns to 150 ns — 100 ps 3 — 150 ns to 550 ns — 500 ps 4 — 550 ns to 1050 ns — 1 ns 5 — 1050 ns to 5000 ns (or more) — 5 ns **Minimum Sweep Delay:** Typically 50 ns ±2 ns, plus the Time/Div setting.

TABLE 1-6 (cont.)
Operating Characteristics

Category	Description
Marker System	**Sensitivity:** Typically 5 V/div ±20%.
	Range: Approximately 25% of full screen.
	Bandwidth (to -4 dB): Typically DC to 3 GHz.
External Horizontal Input	**Sensitivity:** Typically 24 V, full screen.
	Bandwidth (to -3 dB): Typically DC to 3 GHz.
Triggering System	**Input Impedance:** Typically 50 Ω ± 5%.
	Source: External only.
	Polarity: Can be set for positive or negative.
	Coupling: Direct.
	Level: Adjustable from 50 mV to 10 V with approximately 10% accuracy. The resolution of the level setting is 10 mV for settings between 50 mV and 1 V, and 100 mV for settings between 1 V and 10 V.
	Normal Trigger Pulse Duration: Typically greater than 10 ns.
	Fast Trigger Pulse Duration: Typically between 400 ps and 20 ns.
	Fast Trigger Pulse Repetition Rate: Typically 10 MHz maximum.
	Threshold Accuracy: Typically ±10%.
	Absolute Maximum Input Voltage: Typically 500 V for less than 1 μs.
Input Power	**Line Voltage Range:** 90 to 126 VAC, or 198 to 250 VAC.
	Line Frequency Range: 48 to 62 Hz.
	Power Consumption: Approximately 200 W.

TABLE 1-6 (cont.)
Operating Characteristics

Category	Description
Digitizer	**Resolution:** Digitizer resolution is 11 bits vertical and 9 bits horizontal (2048 vertical points and 512 horizontal points). **Memory:** The 7250 standard memory configuration is 64 K-bytes divided into 16 blocks of 4 K-bytes each. One 4 K-byte block is reserved for internal constants. The remaining blocks are reserved for waveform acquisition storage and have the address range 0 to 14. If Option 2D is used, it has a total of 128 K-bytes of memory and can store an additional 16 waveform acquisitions (address range is 0 to 30). The one 4 K-byte block that is reserved for internal constants and permanent faults data can store 4 setups and has the address range 0 to 3. **NOTE** *The memory cards in the 7250 are equipped with battery backup (five year duration) so waveforms and setups stored in the 7250 memory are not lost when the instrument is turned off.*
Display	**Integrated Video Monitor:** Seven-inch diagonal, monochrome; display dimensions: 10 x 10 cm ±2%. **Graphics Mode:** Resolution is 512 pixels in the horizontal axis and 256 pixels in the vertical axis. Waveform display is in two formats: • Full Screen: 512 x 256 points • Half Screen: 512 x 128 points **Graticule:** two internal types: • Graduated axes on the perimeter of the display screen • 10 x 10 grid pattern **Alphanumeric Mode:** Resolution is 23 lines of 64 characters; displays Main, Secondary, and Help menus. **Readout:** Automatic on-screen display.

TABLE 1-6 (cont)
Operating Characteristics

Category	Description
Waveform Processing	**Target Defect Correction:** Corrects for defects in the reading tube image target. **Filtering:** Redundant Y values are suppressed and missing Y values are created. **NOTE** *Missing Y values at beginning and end of the sweep are not interpolated; an interpolated image contains less than 512 points.* **Smoothing:** Mathematical smoothing operation based on averaging over adjacent points. The number of points is selectable in odd integers from 1 to 15.
Measurement Aids	**Cursors:** Two vertical cursors with CRT readout of X and Y coordinates of cursor and waveform intersection point, plus delta time and delta voltage between cursors. **Magnifier:** Up to X16 magnification in horizontal and/or vertical axis. A horizontal and a vertical cursor set a display window defining magnification area. **Accumulate:** This function allows for consecutive waveform acquisitions to be superimposed for comparison. **Measurements:** The following programmed waveform measurement routines are performed automatically upon command: • Minimum Value • Maximum Value • Rise Time • Fall Time • Pulse Width • Delay/Beginning of Acquisition • Mid Value • Peak-to-Peak

TABLE 1-6 (cont)
Operating Characteristics

Category	Description
Acquisition Modes	**Single Shot:** One waveform is acquired and displayed. **Continuous:** Acquisitions consecutively acquired and displayed at a frequency of approximately 1 Hz. **Burst:** Up to 15 (or 31 for Option 2D) acquisitions stored in successive memory blocks; acquisition frequency is approximately 8 Hz. **Averaging:** Waveforms are acquired (range 1 to 255), the resultant waveform is displayed. **Envelope:** Waveforms are acquired (range 1 to 255), envelope is updated with each acquisition and resultant waveform is displayed. **Permanent Defects:** Waveforms are acquired with no sweep and averaged (range 1 to 255), a table of waveform faults is updated in memory for subtraction from any stored curve. **Electrical Zero Value:** Allows acquisition of an electrical baseline, acquires waveforms (range 1 to 255); at each acquisition, an average curve is updated. After the last acquisition, an electrical zero value is calculated, stored, and can be used with the cursors.
Input/Output Connectors	**External Connections:** All connections to the 7250 are made at the rear panel. **Power Source:** For 115 VAC or 220 VAC line source. **External Sweep Input:** Type N connector that allows external application of a sweep signal. **Trigger Input:** BNC connector for application of trigger signal that initiates acquisition. **Signal Input:** Type N connector for application of signal to acquisition circuits. **Signal Output:** Type N connector to output the acquisition signal. **Marker Input:** Type N connector for application of markers used principally for time measurements in conjunction with external sweep inputs. **Video Monitor** **Sync Input:** BNC connector to convey sync signal from external device to synchronize the CCIR Output signal. **CCIR Output:** For local screen hard copy compatible with 625 line 50 Hz frame rate.

TABLE 1-6 (cont)
Operating Characteristics

Category	Description
Input/Output Connectors (cont)	**Control Video:** BNC connector that conveys vertical-scan, 625-line, 50-Hz signal that represents the acquired display. Requires 625-line, 50-Hz, composite video monitor; non-interlaced, vertical raster rotated 90 degrees counter-clockwise, scanned bottom to top. **IEEE-488:** Two-24 pin connectors wired in parallel for GPIB interface operations. **RS 232:** 24-pin connector used only for output to TEK 4662 or HP 7475A Plotter. **IEC:** Not used.

GPIB Interface

The 7250 is equipped with an interface that conforms to a subset of the provisions of IEEE-488, and to a portion of the Tektronix Codes and Formats. GPIB functions performed by the 7250 are shown in Table 1-7.

TABLE 1-7
7250 GPIB Interface Specifications

Code	Function	Capability
SH1	Source handshake	Full
AH1	Acceptor handshake	Full
T5	Talker	Full*
L3	Listener	Full*
SR1	Service Request	Full
RL1	Service Request	Full**
PPO	Parallel Poll	None
DC1	Device Clear	Full
DT1	Device Trigger	Full
CO	Controller	None

*** No secondary addressing**
**** Front panel indicator lights do not correctly indicate the internal remote and local states of the instrument.**

Data is in binary format, commands are in ASCII format.

Accessories

Standard Accessories include:

- Operators manual, Tektronix Part No. 070-6401-00.
- Service Reference manual, Tektronix Part No. 070-7133-00
- Power Cord, North American Version, Tektronix Part No. 161-0066-00.

Section 2
Operating Information

This section of the manual describes all 7250 front panel operation.

The description begins with the theory of operation. Using a block diagram, the discussion includes the 7250's scan converter technology, digitization principle, and data structure/storage.

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Operation of the 7250 falls generally into three categories:

- Setting up the instrument
- Data acquisition, including waveform acquisition and storage
- Data processing and output, including waveform measurements

Each type of instrument operation includes a discussion of the front panel controls related to it. The front panel controls are divided into two sections:

1. The video monitor, including screen organization
2. The control keys, which are divided into four groups:
   - The Programming keys
   - Data Acquisition and Outputs keys
   - Graphics Functions keys
   - The Numeric Keyboard

7250 Theory of Operation

The Tektronix 7250 Transient Digitizing Oscilloscope is designed to acquire fast single-shot or repetitive signals and display them digitally. It can capture and store very high frequency, fast rise time pulses. It is the 7250's scan converter technology which allows for scope acquisitions at very high frequencies and fast rise times.

The scan converter system consists of two cathode-ray tubes: a writing tube and a reading tube (see Fig. 2-1). The writing tube receives and displays the incoming signal to be analyzed. The writing tube is coupled via fiber-optics to the reading tube, which stores the image on its image target.

The reading tube beam moves over the image target, successively sweeping the target from bottom to top in 512 sweeps, from left to right. When the beam reaches the upper right corner of the target, it starts over again at the lower left corner.

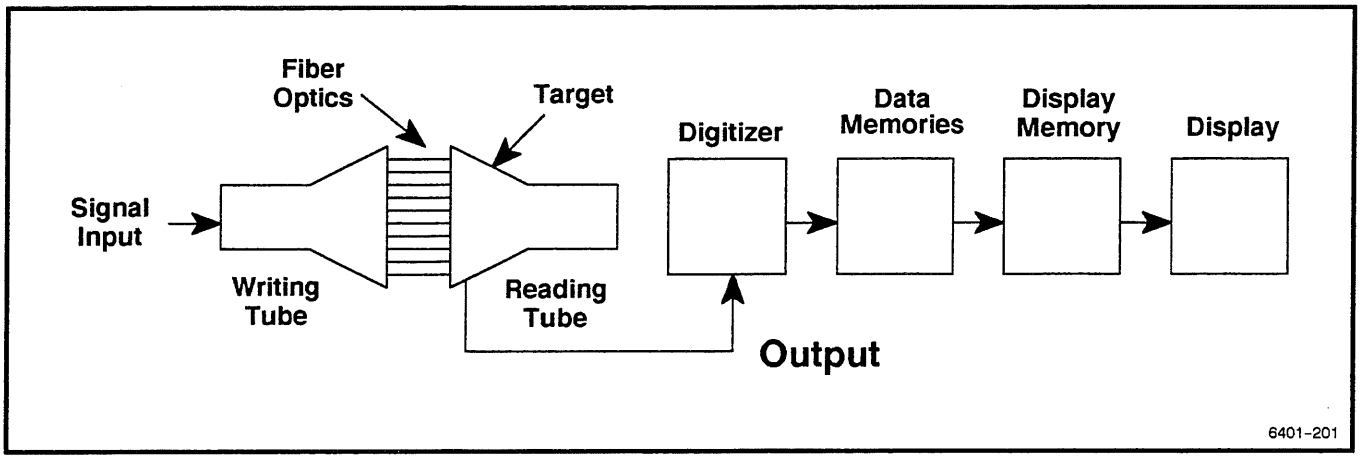

Figure 2-1. 7250 block diagram (simplified).

Once the image is digitized, the digital values of the signal image pixels are stored in the data memory via a direct memory access (DMA) channel. From the data memory, the data is available to the GPIB, to a plotter via RS 232 bus, to the video monitor, and to an external monitor via the CCIR Output connector.

Refer to Appendix A—Data Structure for a further elaboration of the 7250's digitization principle, and discussion of the 7250's acquisition data format, and acquisition data processing.

The 7250 Front Panel

The 7250 front panel consists of a keyboard and a video monitor that form the dialogue components in the local mode (see Fig. 2–2). The user, with the front panel, can program the various settings and start performance of the various commands through the keyboard. The video monitor is used to view the display of the digitized waveforms.

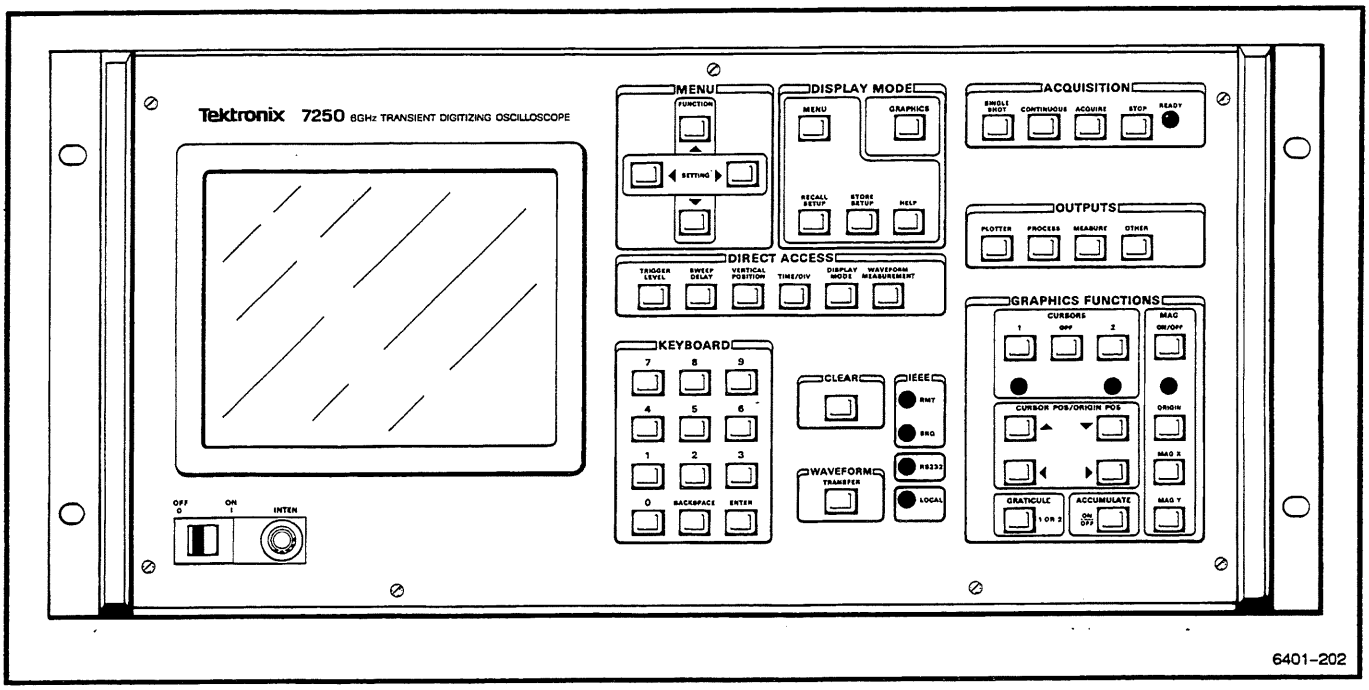

Figure 2–2. The 7250 front panel.

The Display Section

The display section consists of the following (see Fig. 2–3):

- **Video Monitor**—Displays a waveform or a menu, depending on the front panel or GPIB commands.
- **Intensity Control**—Regulates the display intensity.
- **Power Switch**—Controls the input power to the oscilloscope (marked by the labels zero and one for off and on).

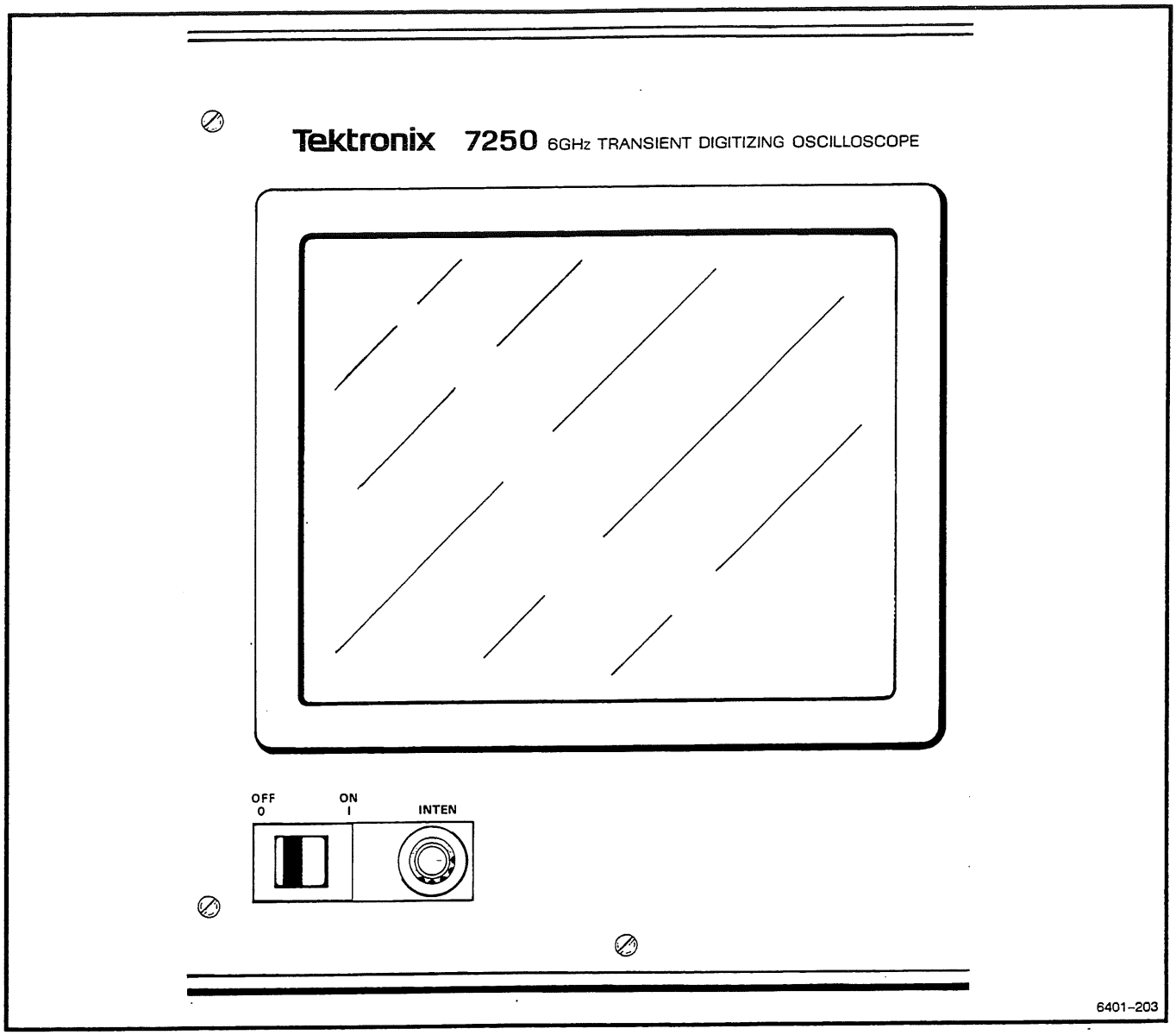

Figure 2–3. Display Section.

Screen Organization

The video monitor produces displays in two modes:

- **Graphics Mode**—displays digitized waveforms.
- **Alphanumeric Mode**—displays menus in two levels for instrument settings.

The Graphics Mode

In the graphics mode, the resolution is 512 pixels in the horizontal and 256 pixels in the vertical. Waveform display is in two formats:

- Full Screen: 512 x 256 points (see Fig. 2-4)
- Half Screen: 512 x 128 points (see Fig. 2-5)

The Half Screen display can be on the upper half, or lower half screen. Two waveforms can be displayed simultaneously with one on the upper half screen and the other on the lower half screen.

The Full Screen or Half Screen display is selected using the Display Mode setting on the Main Menu or the Display Mode key in the Direct Access control key section. (Refer to the Setting the Instrument section on page 2-20).

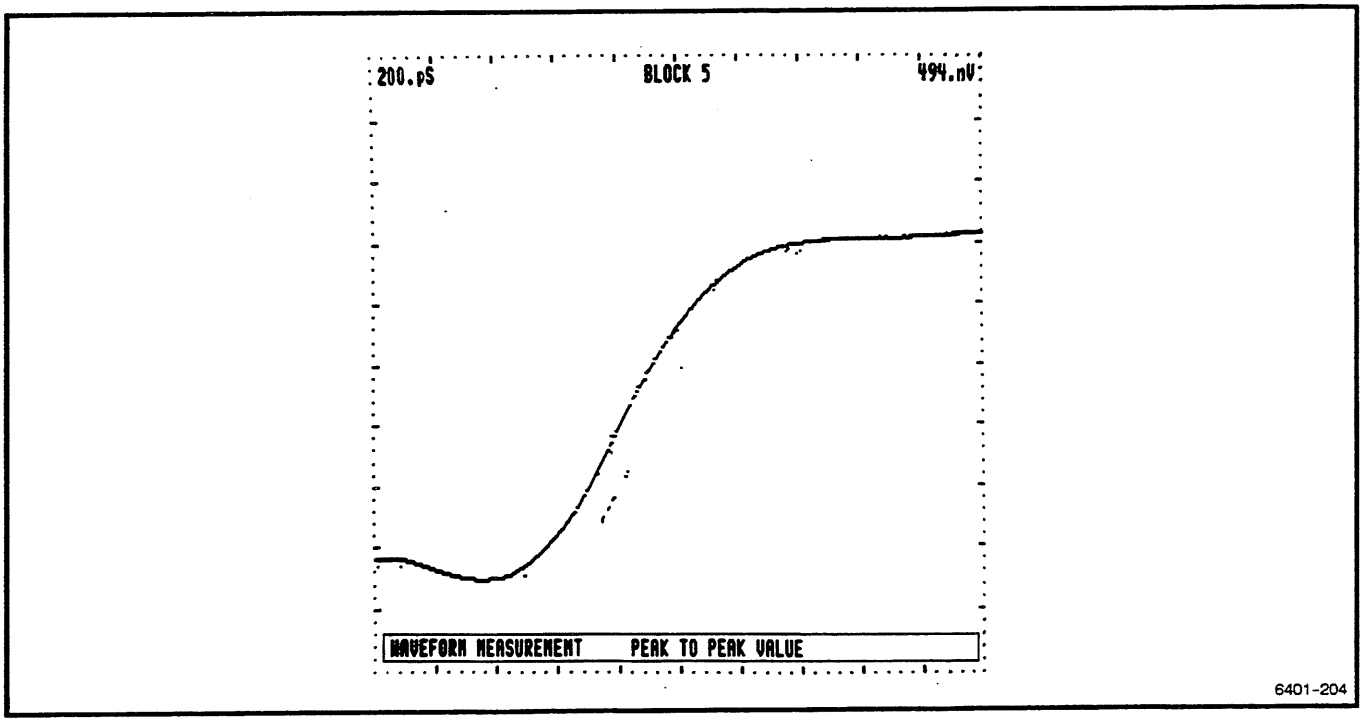

Figure 2-4. Full Screen graphic representation.

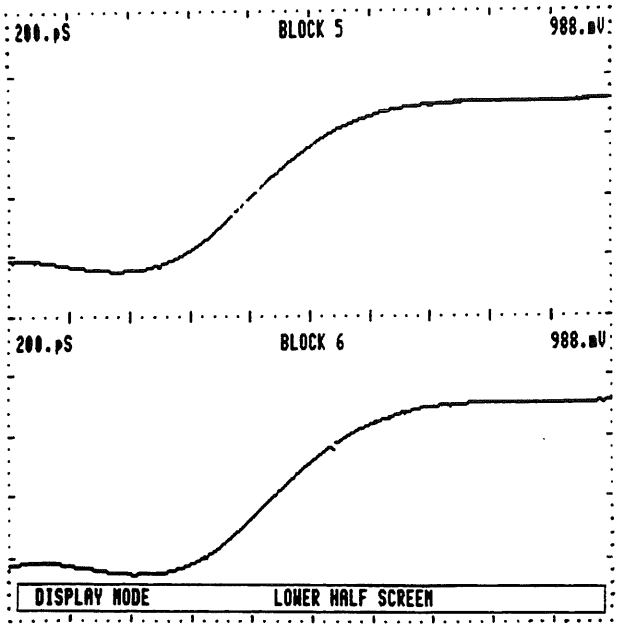

Figure 2–5. Half Screen graphic representation.

Independent of Full Screen or Half Screen choices, two types of graticule display are available on the screen:

- Graduated axes on the edge of the display screen (see Fig. 2–6)
- A 10 x 10 grid pattern (see Fig. 2–7)

Pushing the Graticule 1 or 2 control key in the Graphics Functions section of the keyboard will alternate display of the two graticule patterns.

The Alphanumeric (Menu) Mode

The screen organization of this mode consists in the display of two levels:

- The Main Menu and Secondary Menu at the first level
- A Help Menu at the second level

When the 7250 is in the Menu Mode, pressing the Menu control key will alternate between the Main Menu and the Secondary Menu (see Figs. 2–8 and 2–9). Pressing the Help control key will display a Help menu for the line item selected in the Main or the Secondary menu (refer to the Setting the Instrument section on page 2–20).

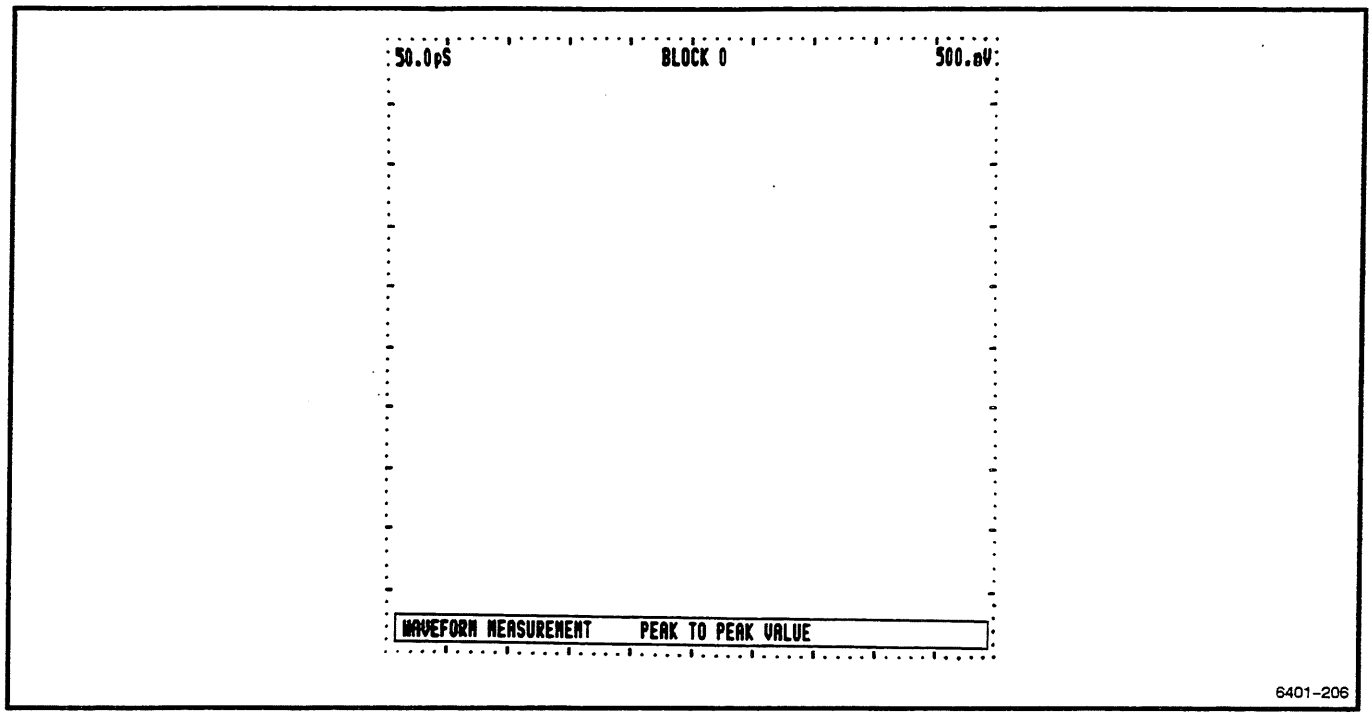

Figure 2–6. Graticule with graduated lines.

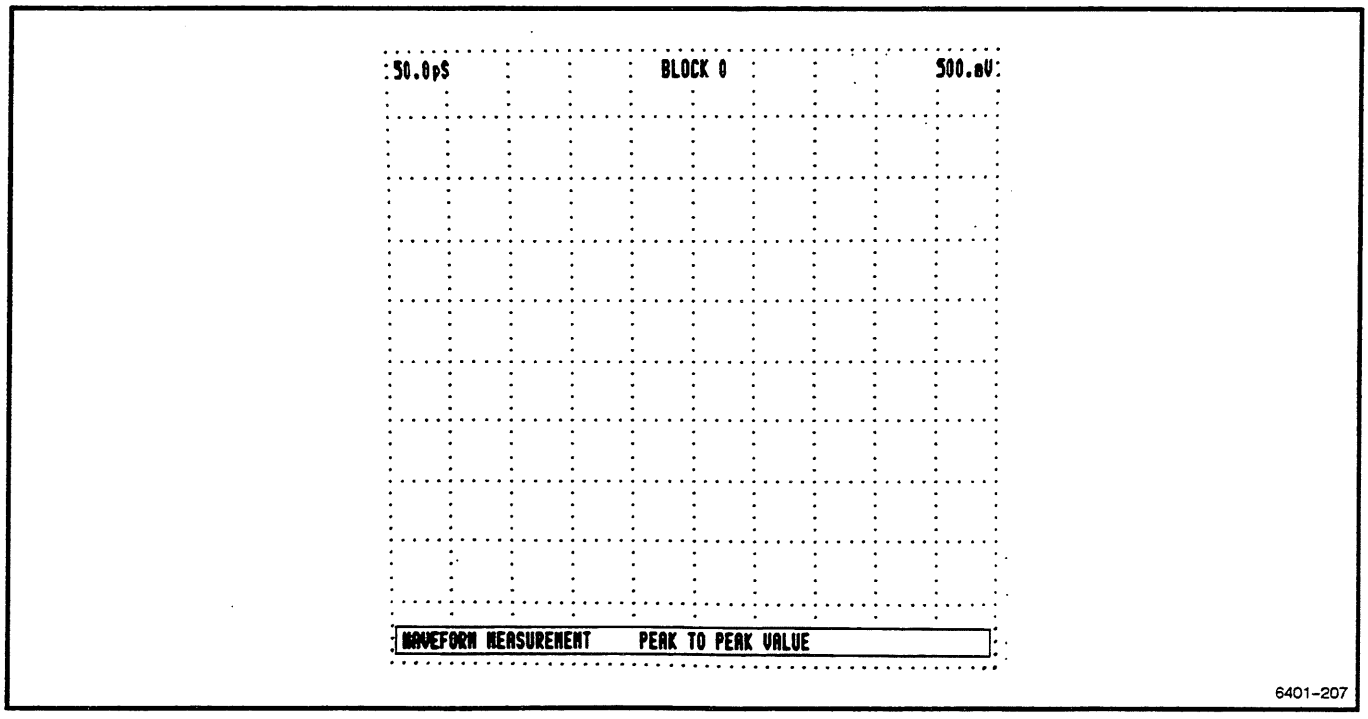

Figure 2–7. Graticule with 10 x 10 grid.

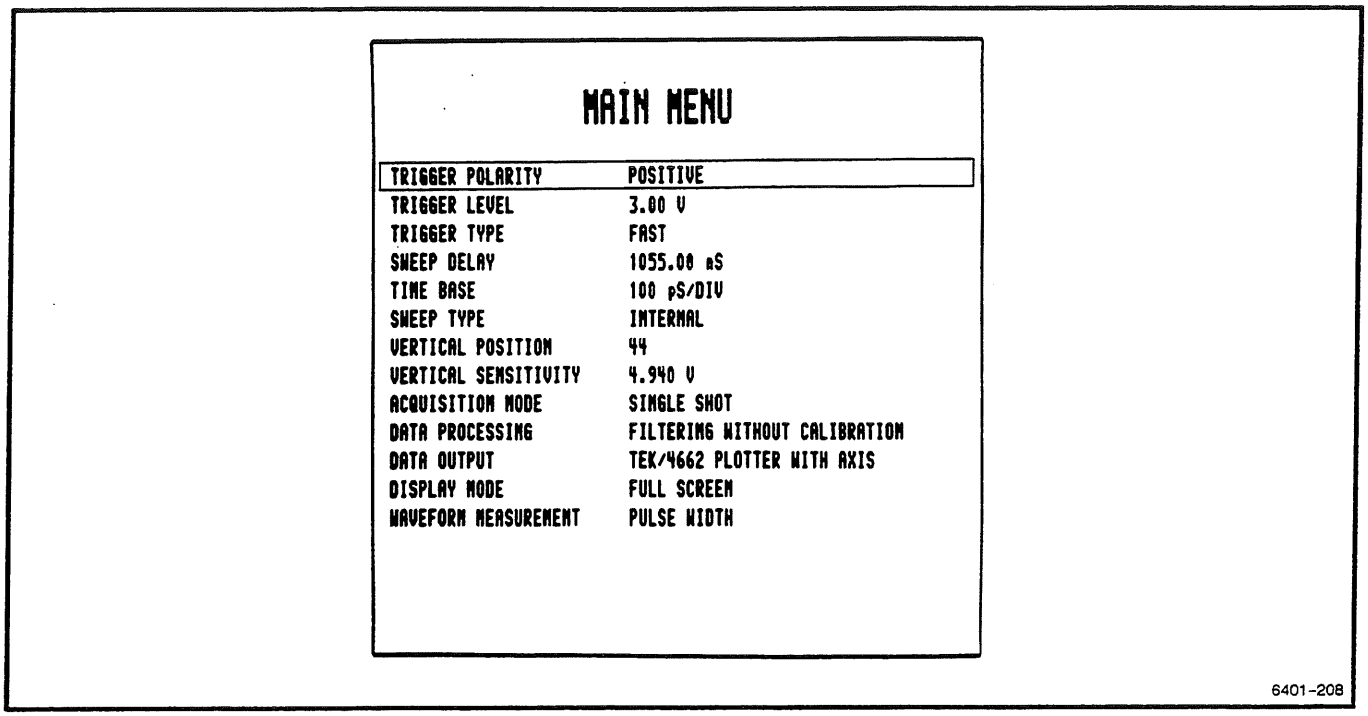

Figure 2–8. Main Menu display.

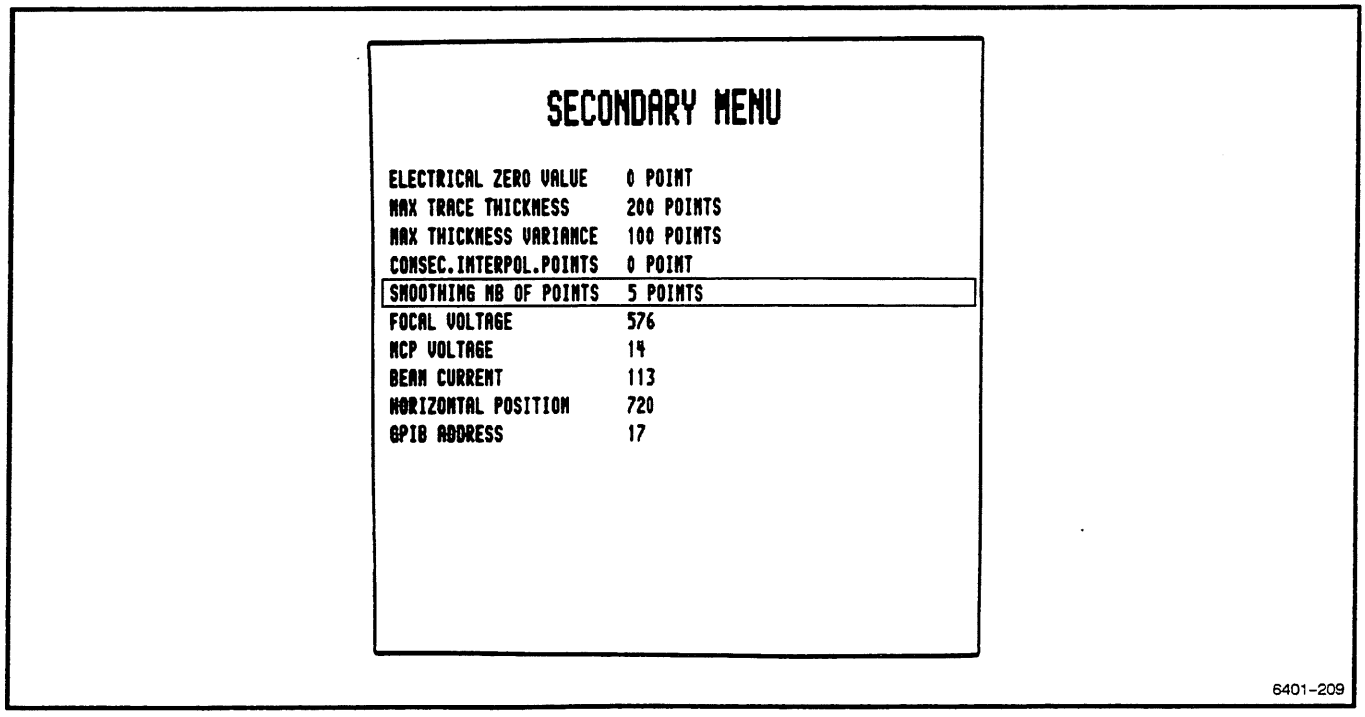

Figure 2–9. Secondary Menu display.

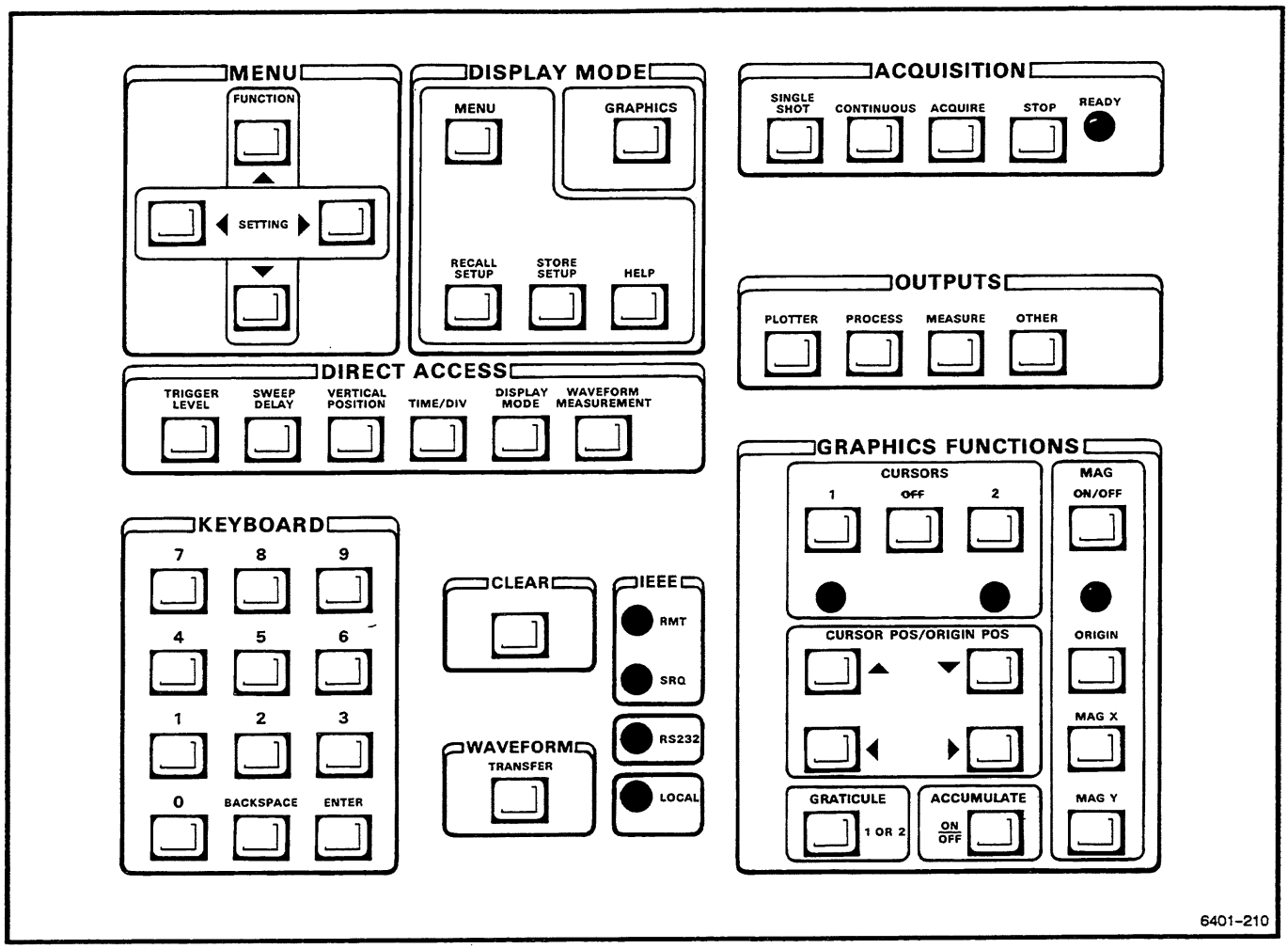

Figure 2–10. 7250 control key organization.

Control Key Section

The front panel control keys are organized into four basic groups:

1. Programming keys (Menu, Display Mode, and Direct Access keys)
2. Acquisition keys and Outputs keys
3. Graphics Functions keys
4. Numeric keyboard (grouped with the Clear key and Waveform Transfer key)

Table 2-1 briefly defines each key function. Generally, each type of 7250 operation includes a discussion of the control keys related to it:

- Setting the instrument: Programming keys
- Data Acquisition: Acquisition keys, Clear key and Waveform Transfer key, numeric keyboard
- Data Processing and Outputs: Outputs keys, Graphics Functions keys.

Indicator Lights

The four indicator lights on the front panel function as follows:

- **IEEE:** These two lights are used to indicate operating status when using the GPIB.

  The **RMT** lamp is lighted when the GPIB controller has switched the 7250 to remote operation.

  The **SRQ** lamp is lighted when SRQ line is asserted.

- **RS 232:** This light indicates when the RS 232 bus is in operation; it corresponds to a 'busy' signal.
- **LOCAL:** This indicator is lighted whenever the 7250 is operated from the front panel.

NOTE

The indicator lights do not always correctly indicate the internal remote and local states of the instrument.

TABLE 2-1
Front Panel Key Definitions

Control Keys	Description
	1. PROGRAMMING KEYS
Menu Section	
Up Arrow ▲ Down Arrow ▼	Selects line item (function) on menu or graphics display.
Right Arrow ◀ Left Arrow ▶	Changes parameter value (setting) of line item: Right key – increases value, Left key – decreases value.
Display Mode Section	
Menu key	Displays current Main or Secondary menu settings.
Graphics key	Displays current waveform acquisition.
Help key	Displays range of values for the selected setting of the current function.
Store Setup key	Stores current menu settings in a memory block (non-volatile), address range 0-3.
Recall Setup key	Redisplays set stored in a memory block (non-volatile), address range 0-3.
Direct Access Section	
Trigger Level key	Direct access to Trigger Level function.
Sweep Delay key	Direct access to Sweep Delay function.
Vertical Position key	Direct access to Vertical Position function.
Time/Div key	Direct access to Time/ Div function.
Display Mode key	Direct access to Display Mode function.
Waveform Measurement key	Direct access to Waveform Measurement function.
	2. ACQUISITION AND OUTPUTS KEYS
Acquisition Section	
Single Shot key	Programs 7250 for single waveform acquisition mode, and arms the instrument for acquisition.
Continuous key	Programs 7250 for continuous acquisition mode and arms the instrument for acquisition.
Acquire key	Initiates waveform acquisition according to Acquisition Mode setting on Main Menu.
Stop key	Terminates the continuous acquisition mode when in progress.

TABLE 2-1 (cont)
Front Panel Key Definitions

Control Keys	Description
2. ACQUISITION AND OUTPUTS KEYS (cont)	
Outputs Section	
Plotter key	Sends stored waveform from memory block to plotter.
Process key	Recalls stored waveform and executes specified Data Processing (as set on Main Menu) before display.
Measure key	Executes specified Waveform Measurement (as set on Main Menu).
Other key	Reserved for future output devices.
3. GRAPHICS FUNCTIONS KEYS	
1 key	Activates Cursor 1 on displayed waveform and switches control of left and right cursor controls to Cursor 1.
2 key	Activates Cursor 1 and 2 on displayed waveform and switches control of left and right cursor controls to Cursor 2.
Off key	Deactivates and removes Cursors from display.
Mag On/Off key	Turns magnifier on.
Origin key	Displays origin reference lines of magnified waveform display.
Mag X key	Changes magnification of X-axis component of waveform display.
Mag Y key	Changes magnification of Y-axis component of waveform display.
Up Arrow key Down Arrow key Left Arrow key Right Arrow key	These 4 keys perform a dual function: When Cursor 1 or Cursor 2 is on, they move the cursor position. When Origin is on, they position the horizontal and vertical origin lines.
Accumulate Key	Causes consecutive acquisitions to be superimposed cumulatively and displayed on screen for comparison.
Graticule key	Switches graphic display between perimeter-marked graticule and 10 x 10 grid pattern.

TABLE 2-1 (cont)
Front Panel Key Definitions

Control Keys	Description
	4. NUMERIC KEYBOARD SECTION
Numeric entry keys, 0–9	Place number(s) on lower right corner of display.
Backspace key	Clears last digit placed on the display. Typical uses of the numeric keys are: • Specifying the number of sweeps for acquisition modes. • Specifying the magnification factor for the Magnifier function. • Specifying address number when placing waveforms or setups into memory blocks. • Specifying address number when stored waveforms are to be processed, plotted, or measured. (Refer to the Numeric Keyboard Section on page 2–46 for a list of functions requiring use of numeric keys.)
Enter key	Displays a special Help Menu which lists functions executed with the Numeric Keyboard. (Push Enter to display the Help Menu. Again pushing Enter switches the display to the Main or Secondary Menu.) The Enter key also executes additional instrument commands: a command code number is placed on the screen, then the Enter key is pushed. Example command execution: Placing the number, 1956 on the display with the numeric keys, then pressing the Enter key will eliminate the three minute delay after the selftests if the power is recycled on a warmed-up instrument. (See the Numeric Keyboard Section, page 2–46, for a list of commands executed with the keyboard.)
Clear key	Clears instrument to completed selftests power-up state.
Waveform Transfer key	When address is entered with keyboard, stores displayed waveform in location addressed.

Selftests

At power on, the 7250 runs a set of selftests on the digital part of the system.

First, a program verifies that sufficient memory is working to continue the selftests (and the storage of results). This program also tests for the presence of the video processor, without which display of results would be impossible on the local screen. If a defect is detected at this level, the tests are interrupted and the defect is indicated by the front panel indicator lights as follows:

- For a RAM defect: the RMT, SRQ, RS 232, and LOCAL indicator lights are on.
- For a Video Processor defect: the CURSOR 1, CURSOR 2, MAG ON/OFF, and READY indicator lights are on.

If neither of these failures occur, the tests proceed and the message SELFTESTS V 4.3 appears on the screen. The display will then switch to the Main Menu. A 180 second timer will count down and be displayed in the lower right corner of the screen. The timer allows the scan converter system to warm up. During this time new waveform acquisitions cannot be performed. Processing and manipulation of stored waveforms and menus, however, can be performed.

At this point, tests are executed simultaneously on the Input/Output part and the Acquisition part of the system. Each is equipped with a processor. When all the tests are finished, two possible cases exist:

1. No defect has been detected. The 7250 then passes automatically to the operation program and displays the Main Menu.
2. At least one defect has been detected. The results for the selftests are displayed in the form of a table indicating the state (good or bad) of each module. For example, the table may display information such as:

SELFTESTS

Tests	I/O	Acq
Processor Card	Bad	Good
IEEE Card	Bad	
NVRAM1		Good
NVRAM2		Good

An absence of indication signifies that no test was executed, for example: no NVRAM test in the Input/Output part.

NOTE

The NVRAM2 card in the acquisition section is an option, so the test is executed only if the presence of the card is detected. The absence of the card is not considered a defect.

Depending on the importance of the defect, the user will or will not be able to continue the operating program. In the case of a non-disabling defect, pushing the Menu key will display the Main Menu.

Incoming Inspection Procedure

Following a satisfactory initial inspection, as described in the Installation information in Section 1, the 7250 should be tested for operation using the following Test Equipment and Preliminary Setup. After studying the 7250 Operation section for familiarization with front panel controls, all functions should be tested using the procedures in the Demonstrations later in this section. The purpose of this test procedure is to determine if the instrument is operating properly and whether a complete performance check should be performed by a qualified techician.

Test Equipment

The following equipment is required to perform the instrument familiarization and test procedure:

- **Pulse Generator** – capable of generating a test signal with the following characteristics:

  Rise time . . . . . 100 ps or less into 50 Ω
  Amplitude . . . . . 5 V into 50 Ω
  Trigger Output . . . . 5 V into 50 Ω
  Repetition Rate . . . . at least 1 kHz

- Various attenuators and adaptors to connect the test equipment (see the Preliminary Setup).
- **Plotter** – (Optional) for testing RS 232 plotter output.
- **Controller** – (Optional) for testing GPIB operation.

Preliminary Setup

1. Check the voltage setting of the 7250. This is done by checking the label on the 7250 rear panel.

   WARNING

   Dangerous voltages exist within the 7250, even when the power switch is not on. To avoid personal injury, refer line voltage setting changes to a qualified service technician.

2. If the line voltage setting tag is in agreement with the local main power source, connect the 7250 with the operating power.
3. Connect the pulse generator to the power source.

4. From the pulse generator trigger output, connect a BNC cable to the 7250 Trigger Input connector on the 7250 rear panel (see The 7250 Rear Panel, later in this section).

5. From the pulse generator signal output, connect a cable to the 7250 rear-panel Signal Input connector.

6. Terminate the 7250 rear-panel Signal Output connector with a 50 Ω termination.

7. Turn on the pulse generator and allow a few minutes for it to stabilize.

8. Turn on the 7250. The Cursor 1, Cursor 2, Mag On/Off, and Local indicator lights should illuminate immediately and a short tone should sound; then only the Local indicator should remain on. Selftests are executed and upon their completion "SELFTESTS V4.3" will appear on the screen. After a few seconds the Main Menu should be displayed. Note that in the lower right corner, numerals are displayed that count down from 180 to 0. This is the power-up time delay used by the 7250 for and stabilization of the scan converter system.

NOTE

In some cases, the power must be recycled (turned off, then on). In such cases, it may be desirable to bypass the 180 second time delay. To do so, enter 1956 on the Numeric Keyboard, then press Enter. The 180 second count down will be removed from the display and normal operations can begin immediately.

This procedure should not be used to bypass initial warm-up.

7250 Operation

Use of the 7250 falls into three classes of operation:

- Setting the Instrument
- Data Acquisition
- Data Processing and Output

Setting the Instrument. This stage consists of selecting function settings in the Main (and Secondary) Menu. The functions include not only waveform parameter values, but also selections for:

- Acquisition Mode
- Data Processing
- Data Output
- Display Mode
- Waveform Measurement

These latter functions require other front panel control keys to execute. For example, the type of waveform measurement selected is executed by pushing the Measure key.

Data Acquisition. After the function settings are selected, one or more waveform acquisitions can be made using one of the Acquisition keys. In most cases, a waveform acquisition is displayed on the video monitor.

Data Processing and Output. Waveform acquisitions can be stored in memory blocks. A stored waveform can be displayed after it is processed (e.g., filtering or smoothing). If the result of the processing is satisfactory, waveform measurements (e.g., risetime, peak-to-peak, etc.) can be performed. Output of the waveform data to a peripheral, such as a plotter, is also available.

Each class of operation will now be described along with the front panel keys which control the functions.

Setting the Instrument

All of the setting parameters of the 7250 are stored internally in a table. This table is represented on the 7250 display by the Main and Secondary Menus. (See Table 2-2 for a listing of all 7250 settings.)

The Programming Keys

This section of control keys on the 7250 front panel includes all the functions necessary to set up the instrument (see Fig. 2-11).

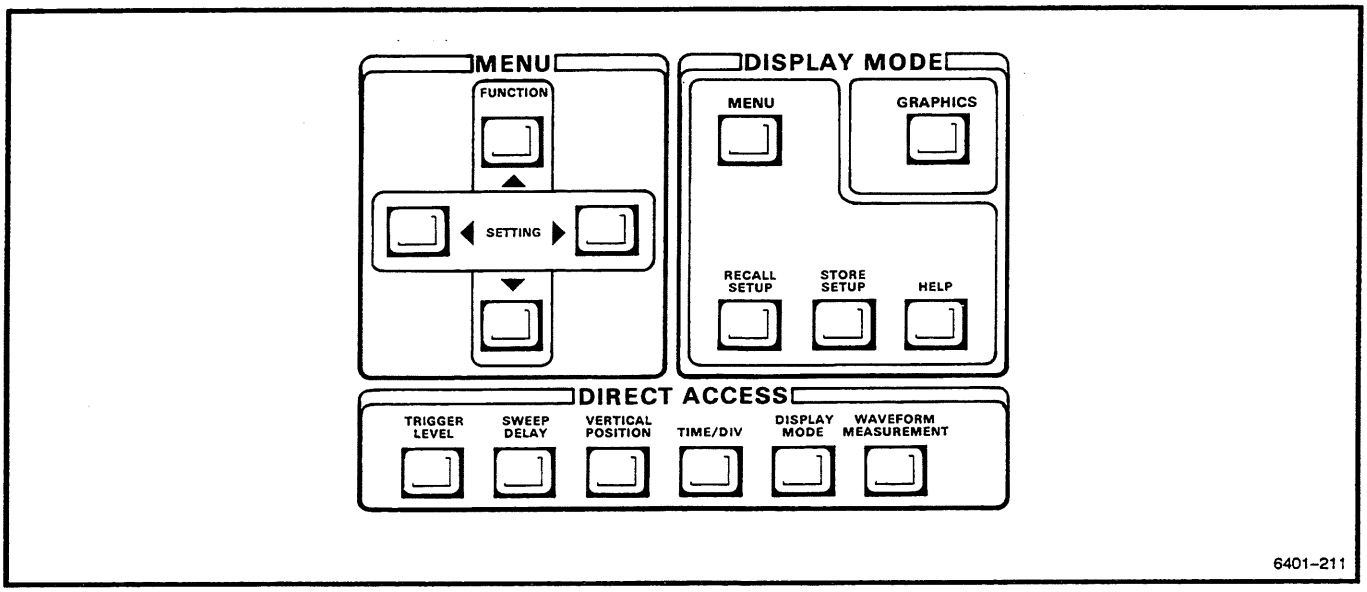

Figure 2-11. The Programming control keys.

Display Mode keys

These keys control the three types of display used on the 7250:

1. **Display in the "Menu" mode:** Presents all the current functions and settings of the menu.

2. **Display in the "Help" mode:** Pressing the Help key displays all the values authorized for the function selected in the menu, either in the form of a list of values, or in the form of one or several ranges with indication of the minimum values, the maximum values and the incremental steps for the range. The current selected setting is displayed on the last line in reverse video. If a continuous waveform acquisition is in operation, pressing the Help key will momentarily flash the menu on-screen between acquisitions.

3. **Display in the "Graphics" mode:** All waveform images are displayed in this mode. The current selected setting from the menu is displayed on the last line in reverse video. Pressing the Graphics key switches the display from a menu to the Graphics mode with a waveform display. No waveform acquisition is performed when the switch is made. If an acquisition has

already been made, the waveform (stored at Address 0) will be displayed when the Graphics key is pressed.

It is possible to modify the value of a setting, regardless of the display mode.

Pressing the Menu key has a different effect, depending on whether the instrument is already in the Menu mode or not:

- If the display is in the menu mode, it passes to the other menu (shifting between the Main Menu and Secondary Menu).
- If the display is in the Graphics or Help mode, it returns to the menu mode with display of the menu containing the current setting.
- If a continuous acquisition is operating (see Data Acquisition section), pressing the Menu key will momentarily flash the Main Menu on-screen between acquisitions,then return to the graphics display. (To return to a menu display in this case, press Stop, then Menu.)

Modification of the Current Set Settings

The four Arrow keys in the Menu section (see Figure 2-11) control selecting line items (settings) from the menus and setting the parameter values for each.

The Arrow Keys

The Up Arrow key is used to pass to the previous setting. The Down Arrow key is used to pass to the following setting. The reverse video highlight moves to point out the newly selected setting.

To modify the value of a setting, the video inversion should be positioned on the line containing the desired setting using the Up Arrow key or Down Arrow key (or one of the Direct Access keys).

The Left Arrow and Right Arrow keys modify the value of the setting pointed out by the video inversion:

- For digital values, the Left Arrow key is used to select a lower value, while the Right Arrow key is used to select a higher value.
- For non-digital values, these two keys are used to explore a list of parameters proper to the selected setting.

If the display is in Graphics mode, use of the Up and Down Arrow keys changes the menu item listed at the bottom of the screen in video inversion, while use of the Right and Left Arrow keys will change the parameter value of the setting in video inversion.

Direct Access Keys

The Direct Access keys are for convenience. They are used to quickly select one of six most often used settings:

- Trigger Level
- Display Mode
- Measurement
- Sweep Delay
- Vertical Position
- Time/Div
- Waveform

Pressing one of these keys (see Fig. 2–11) highlights that setting on the menu, or displays that setting on the video inversion line at the bottom of the screen when in Graphics mode. Pressing one of these keys when in the Help mode displays the range of values or choices associated with that setting.

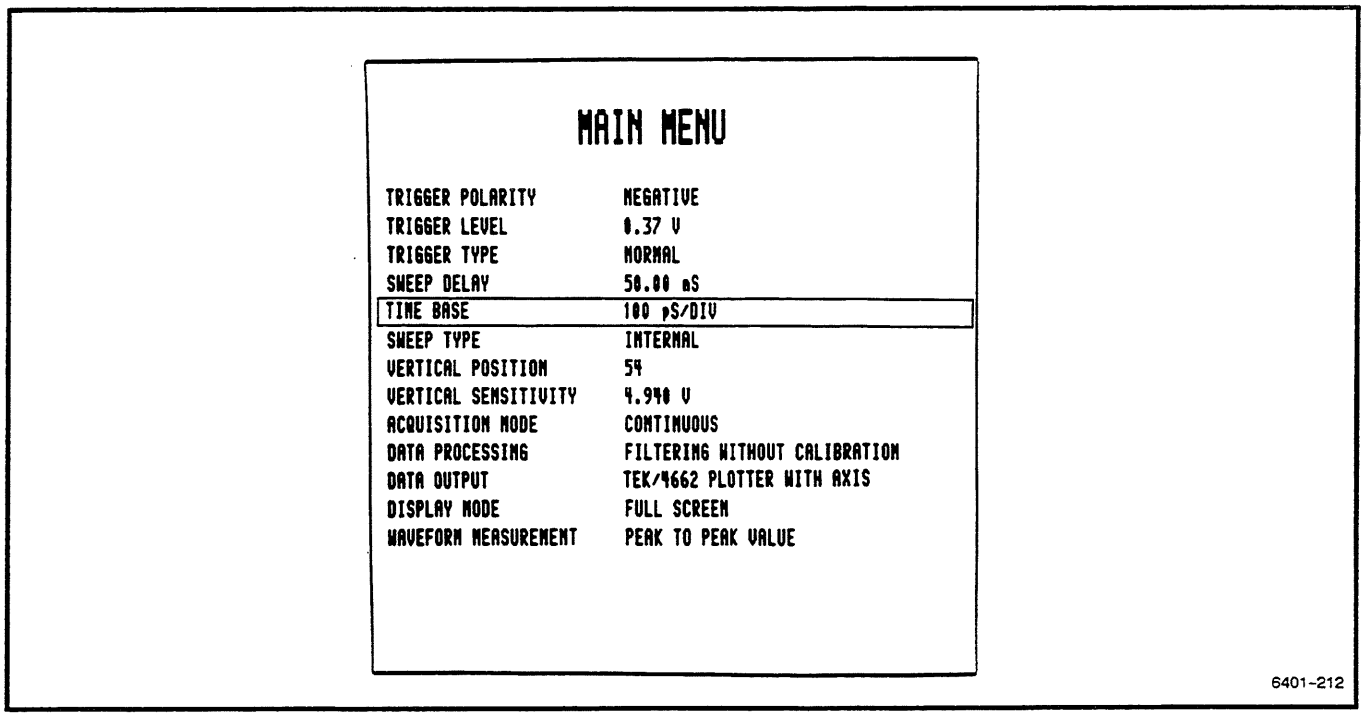

Figure 2–12. Main Menu display.

Example:

Pushing the Menu key results in the following display:

The reverse video points out the Time/Base setting. The displayed value is 100 ps/div.

The Up Arrow key moves the reverse video to Sweep Delay.

The Down Arrow key moves the reverse video to Sweep Type.

The Left Arrow key moves the reverse video to display the value 50 ps/div in place of the value 100 ps/div.

The Right Arrow key moves the cursor to display the value 200 ps/div in place of the value 100 ps/div.

Neither the Right or Left Arrow keys affect the position of the reverse video.

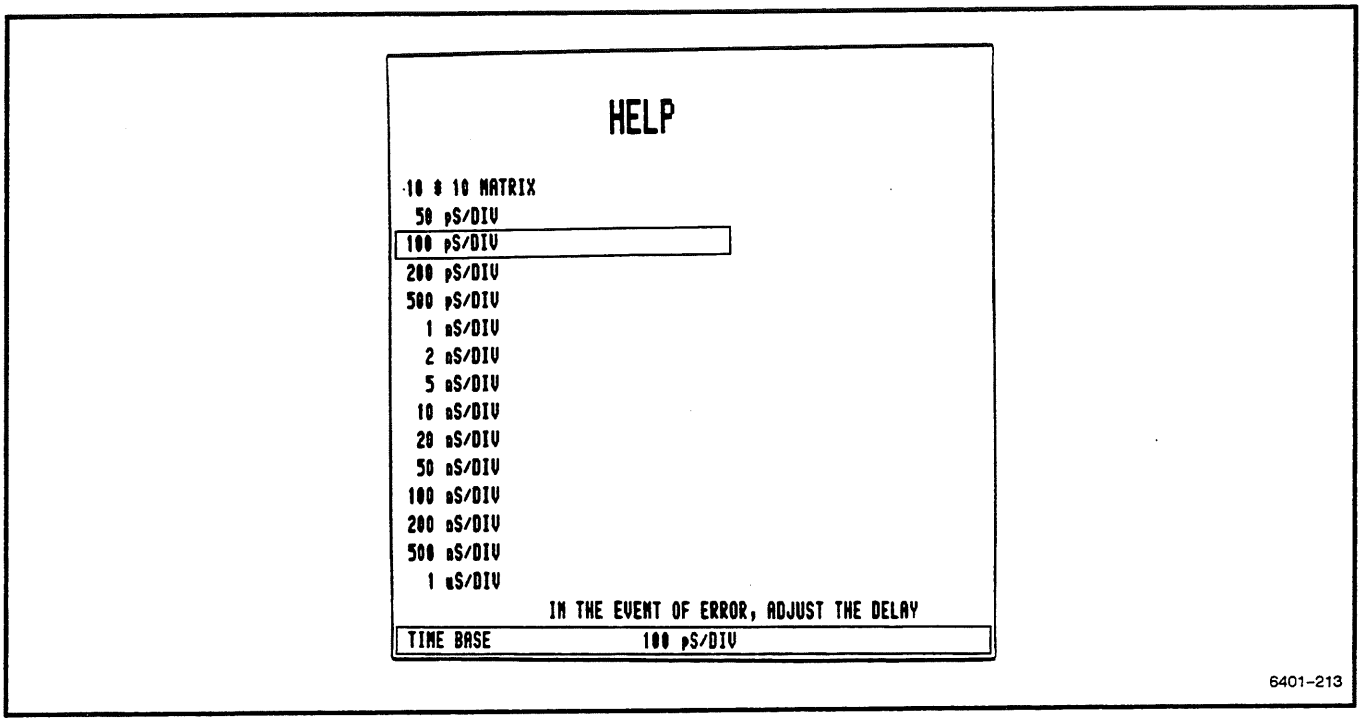

Figure 2-13. Help Menu display.

Now pressing the Help key displays the Help menu shown in Figure 2-13.

The last line, shown in reverse video, is the exact copy of the Time/Base line in the Main Menu and retains the current value of 100 ps/div.

To modify the Time/Base in this display mode:

- The Up and Left Arrow keys operate the same, and revert to the previous value.
- The Down and Right Arrow keys operate the same, and advance to the next value.

Storing the Current Setup

Operations for storing and recalling setups are done with the Store Setup and Recall Setup key.

The Store Setup Key

When all setting values have been selected, the user can transfer the current set (set 0) to one of the three non-volatile sets. (The address is 1 to 3). To store a setup: press the storage address number, then press Store Setup. Since Address 0 is where current settings are stored, specifying Address 0 causes no change.

NOTE

The setup storage is distinguished from the digitized waveform storage which uses the Waveform Transfer key.

Block 0 also has non-volatile memory so recycling the power will not reinitialize the settings in Block 0.

The Recall Setup Key

Conversely, the current set can be initialized with the contents of one of the sets in non-volatile memory. To recall a setup, press the number of the location, then press Recall Setup.

For a more complete familiarization, it is recommended that you use the Menu Functions and Setup and Waveform Storage and Recall exercises in the Demonstrations section.

TABLE 2-2
The 7250 Settings

Setting	Value Range or Sub-Functions
	MAIN MENU
Trigger Polarity	Positive Negative
Trigger Level	50 mV to 1 V in 10 mV steps 1 V to 10 V in 100 mV steps
Sweep Delay	0 to 50 ns in 50 ps steps 50 to 100 ns in 100 ps steps 100 to 500 ns in 500 ps steps 500 to 1000 ns in 1 ns steps 1000 to 5000 ns in 5 ns steps Internal delay: 50 ns For sweep speeds greater than 1 ns/div, add the equivalent of one division. The displayed delay value takes into account the internal delay of the 7250 and the correct delay for the programmed sweep speed. **NOTE** *The Time Base is limited by the Sweep Delay setting: If Time Base and Sweep Delay are incompatible, an ERROR message is displayed.*
Time/Base	50 ps/div 100 ps/div 200 ps/div 500 ps/div 1 ns/div 2 ns/div 5 ns/div 10 ns/div 20 ns/div 50 ns/div 100 ns/div 200 ns/div 500 ns/div 1 μs/div **NOTE** *Minimum internal delay is a function of sweep speed (50 ns + 1 time/division). If Sweep Delay and Time Base settings are incompatible, an ERROR message is displayed.*

TABLE 2-2 (cont)
The 7250 Setting

Setting	Value Range or Sub-Functions
	MAIN MENU (cont)
Sweep Type	Internal External
Vertical Position	0 to 100% in 1% steps
Vertical Sensitivity	Specified for each CRT and expressed in Volts, typically about 5 V full-screen.
Acquisition Mode	Single Continuous Averaging Envelope Burst Permanent Defects Electrical Zero
Data Processing	No Processing. Filtering without Calibration (suppression of permanent faults, filtering and interpolation). Filtering with Calibration (suppression of permanent faults, corrections, filtering and interpolation. Smoothing without Calibration (suppression of permanent faults, filtering, interpolation and smoothing). Smoothing with Calibration (suppression of permanent faults, corrections, filtering, interpolation and smoothing).
Data Outputs	Tek 4662 Plotter with axes Tek 4662 Plotter without axes HP 7475A Plotter with axes HP 7475A Plotter without axes
Display Mode	Full screen Upper half-screen Lower half-screen

TABLE 2-2 (cont)
The 7250 Setting

Setting	Value Range or Sub-Functions
	MAIN MENU (cont)
Waveform Measurement	Minimum value Maximum value Peak to peak value Mid value Rise time Fall time Pulse width Delay with respect to the beginning of the acquisition window
	SECONDARY MENU
Electrical Zero Value	0 to 2047 points
Maximum Trace Thickness	0 to 2047 points
Maximum Trace Thickness Variation	0 to 2047 points
Consec. Interpol. Points (Maximum number of consecutive interpolated points)	0 to 511
Number of Points for the Smoothing Function	1, 3, 5, 7, 9, 11, 13, or 15 points
Focal Voltage*	0 to 4095 in 1 steps
GMC Voltage*	0 to 255 in 1 steps
Beam Current*	0 to 511 in 1 steps
Horizontal Position*	0 to 4095 in 1 steps
GPIB Address	0 to 30 in 1 steps. Factory specified address = 17.

***These 4 settings are set at the factory and locked. To designate different values, unlock settings by pressing 2, then Enter. Re-lock by pressing 1, then Enter.**

CAUTION

Extended use of non-factory values for Focal Voltage, GMC Voltage, Beam Current, and Horizontal Position may cause damage to the 7250.

7250 Menus

The following figures show the Main and Secondary Menu displays and the Help Menu for each line item.

Note that the settings on these menus may vary according to circumstances.

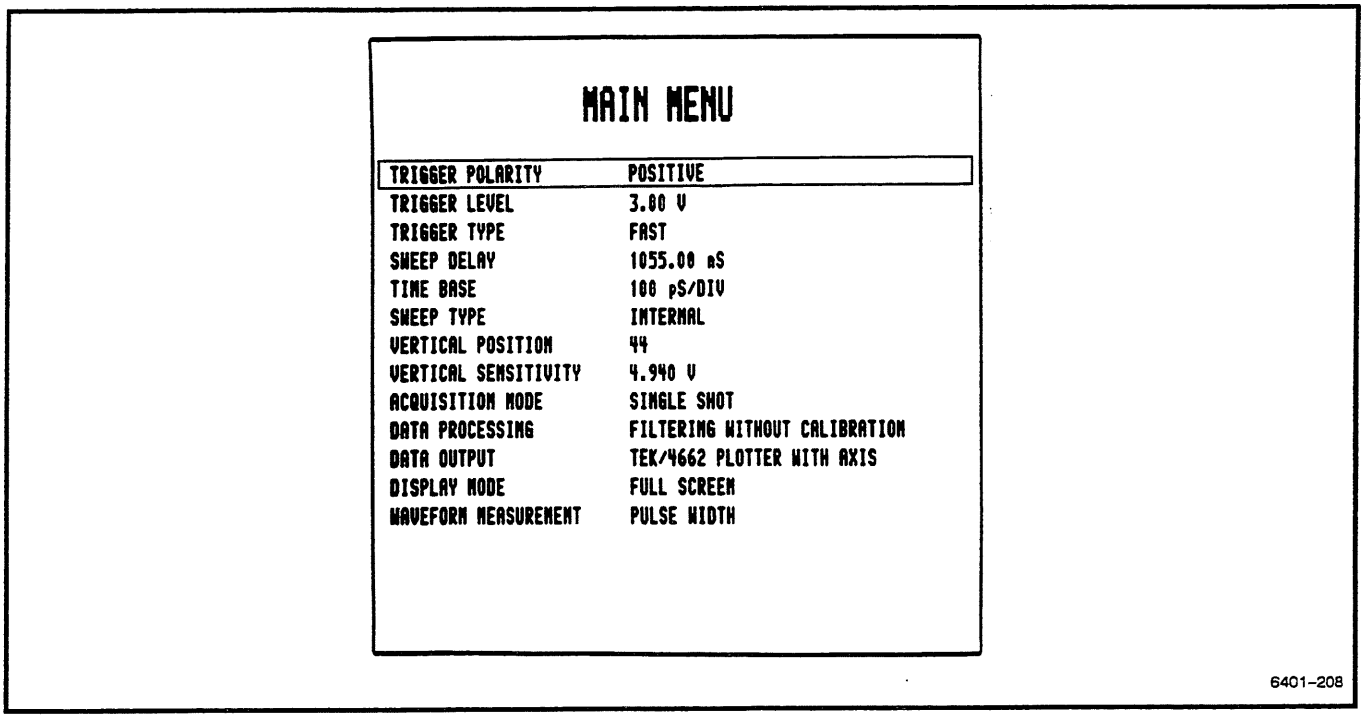

Figure 2–14. Main Menu.

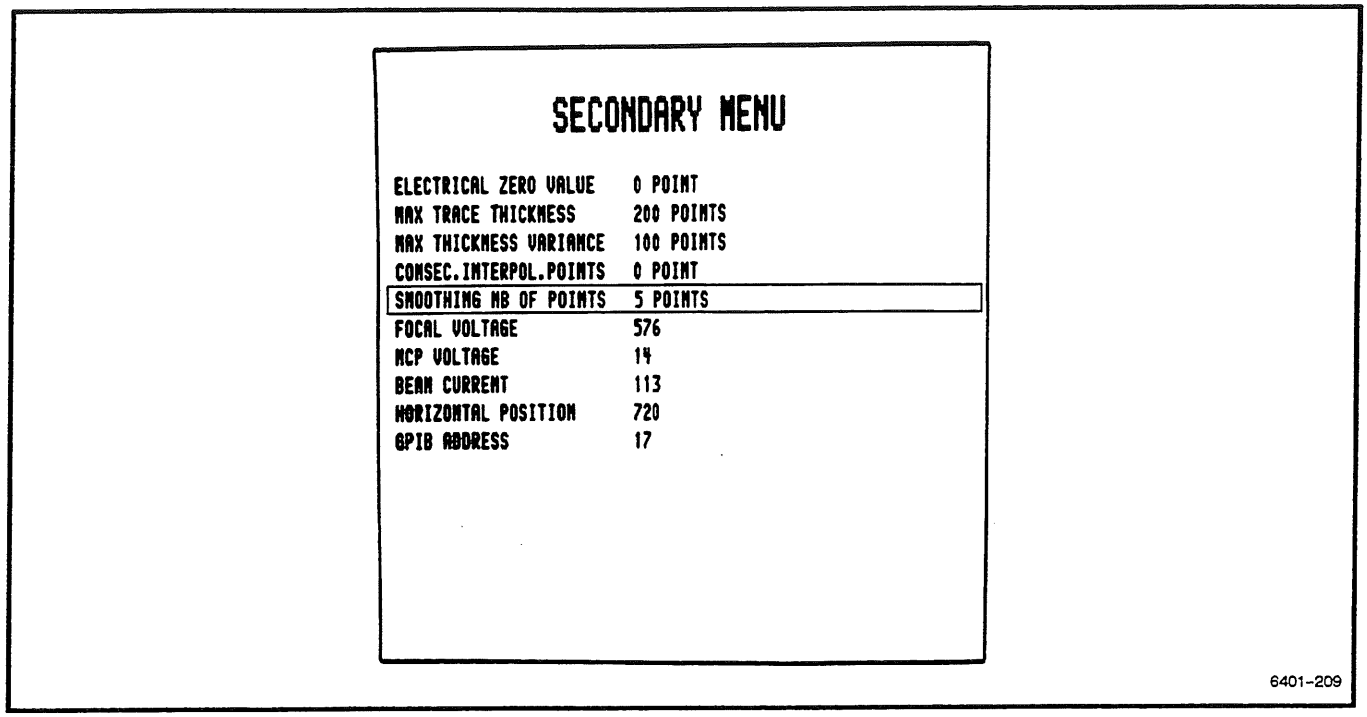

Figure 2-15. Secondary Menu.

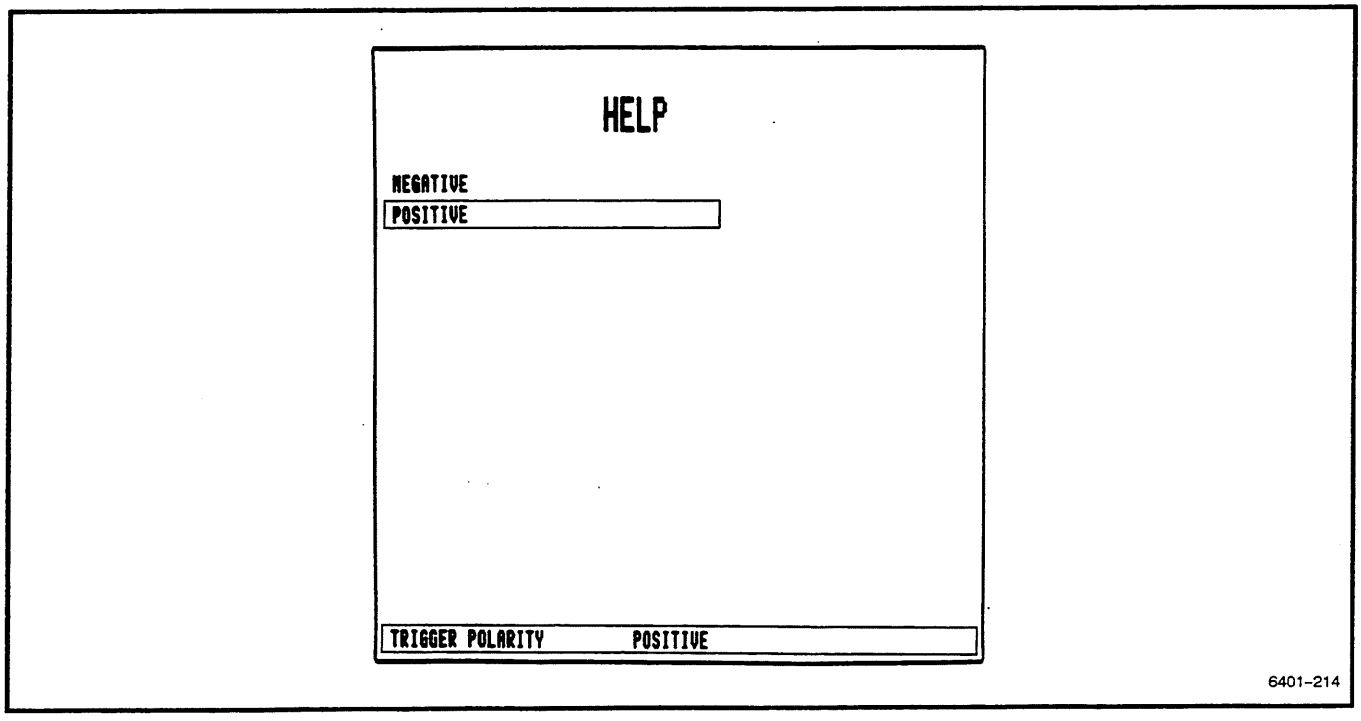

Figure 2-16. Trigger Polarity Help Menu.

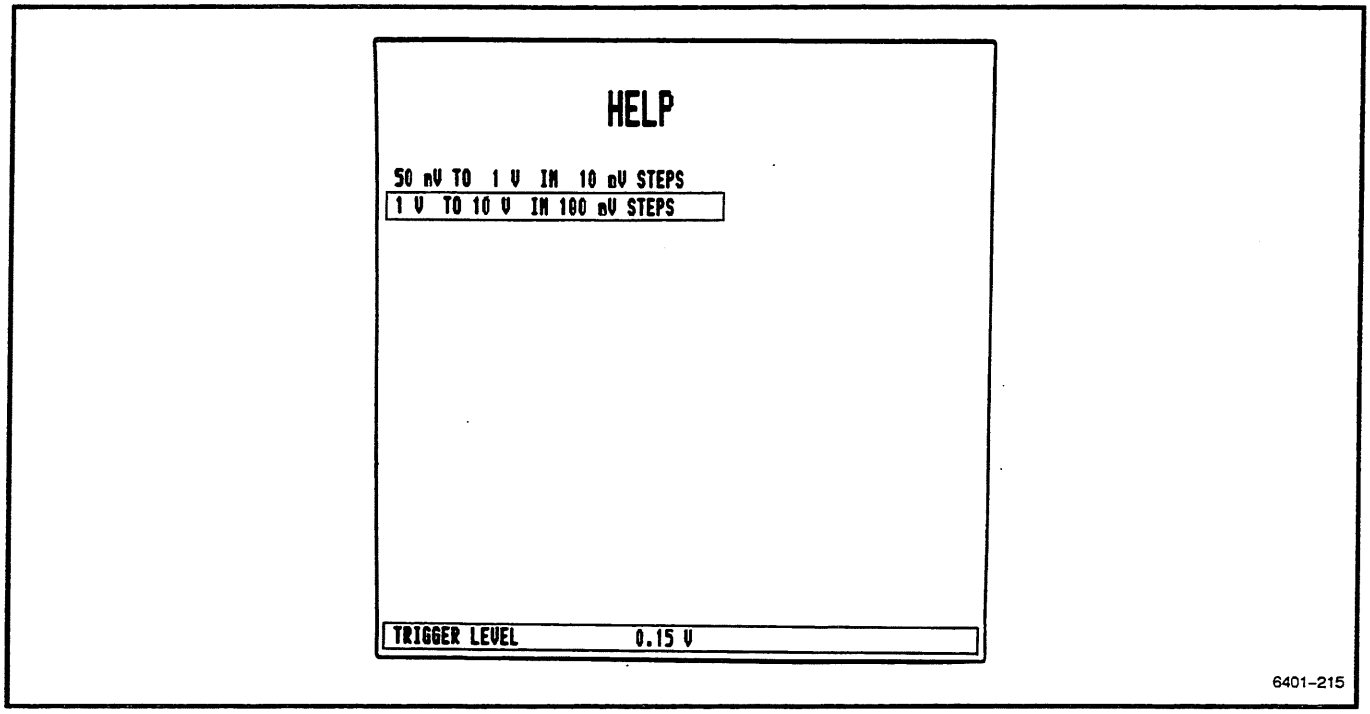

Figure 2-17. Trigger Level Help Menu.

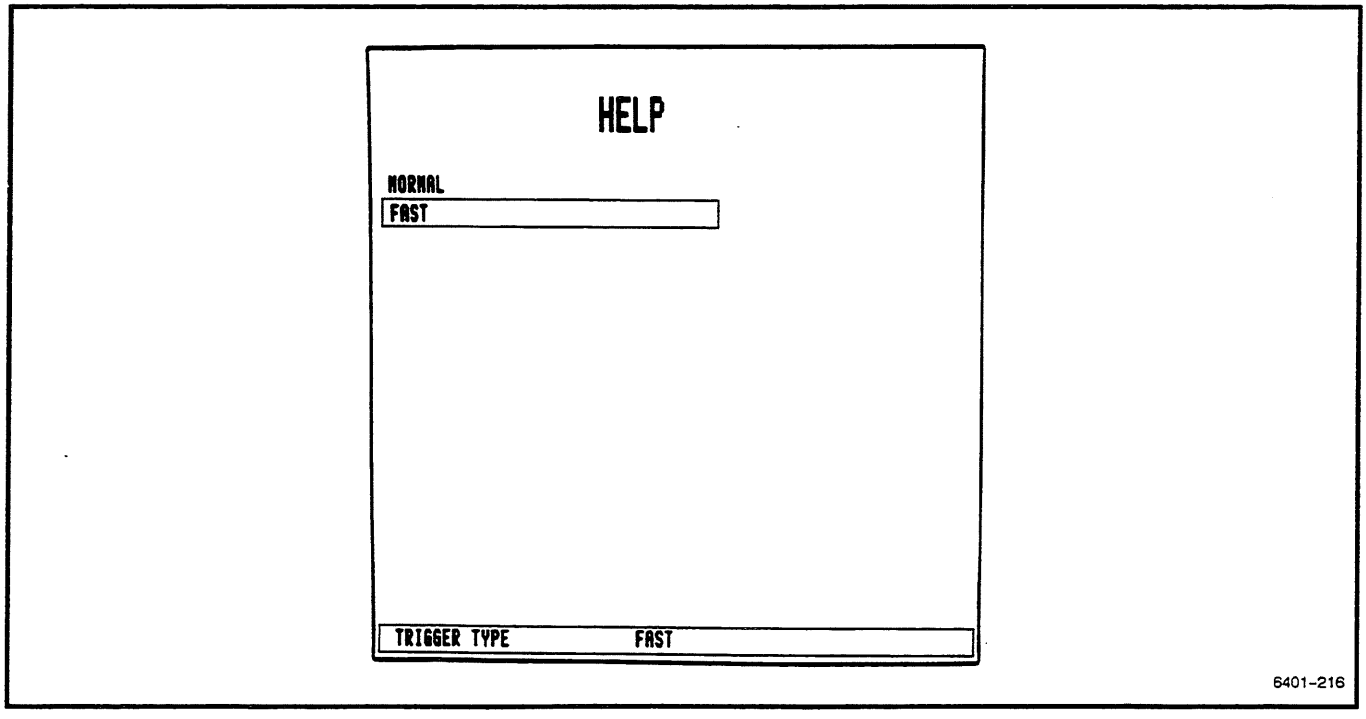

Figure 2-18. Trigger Type Help Menu.

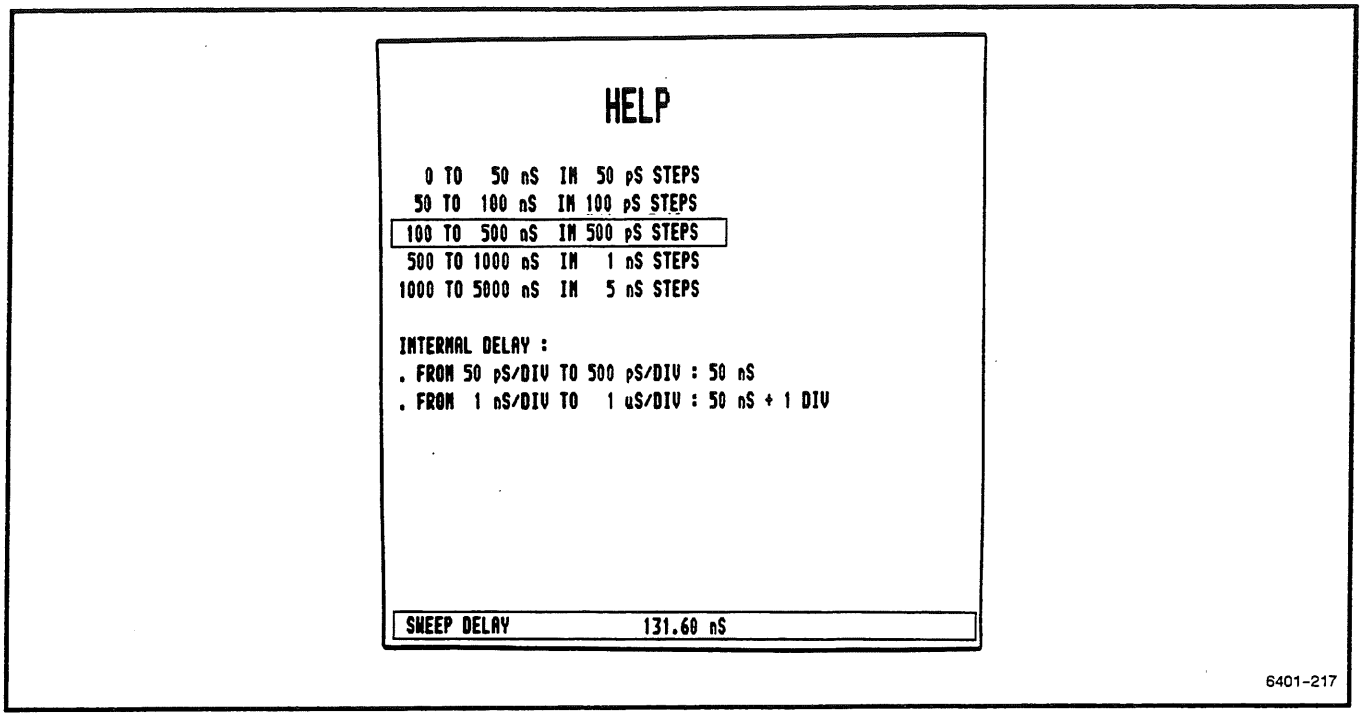

Figure 2–19. Sweep Delay Help Menu.

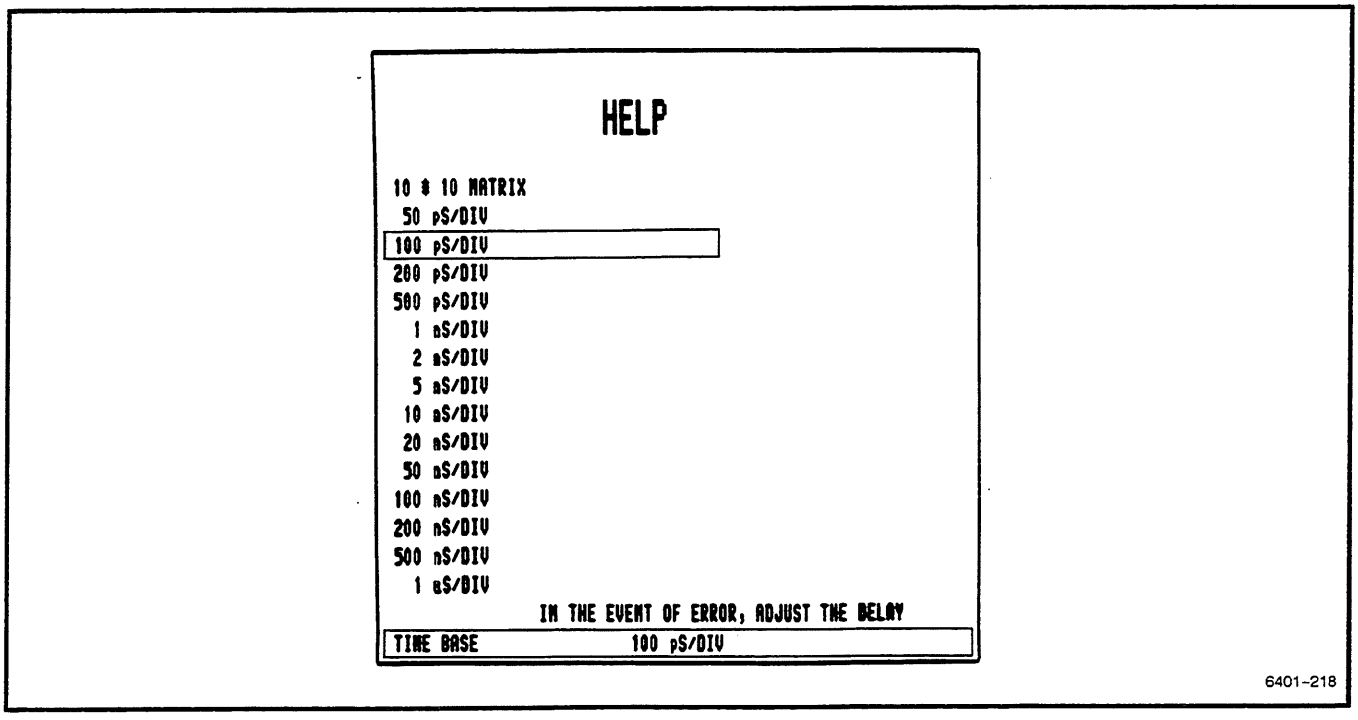

Figure 2–20. Time Base Help Menu.

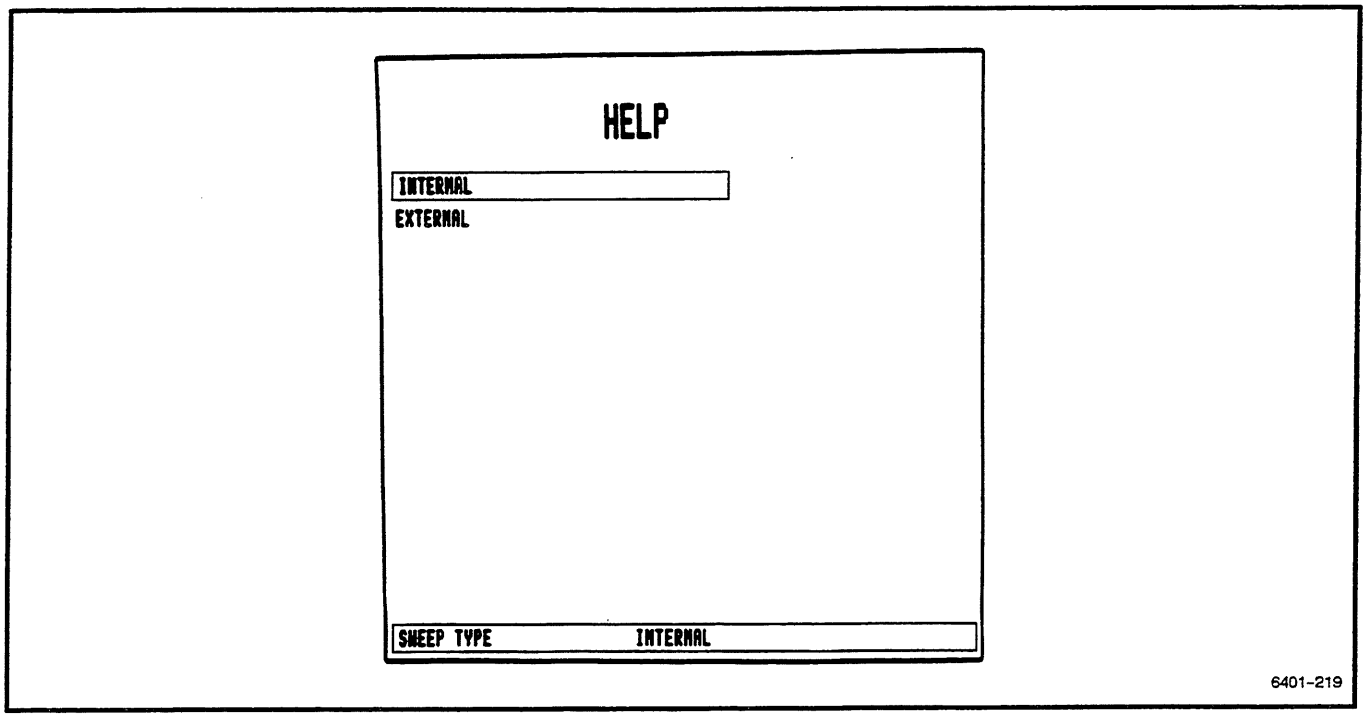

Figure 2-21. Sweep Type Help Menu.

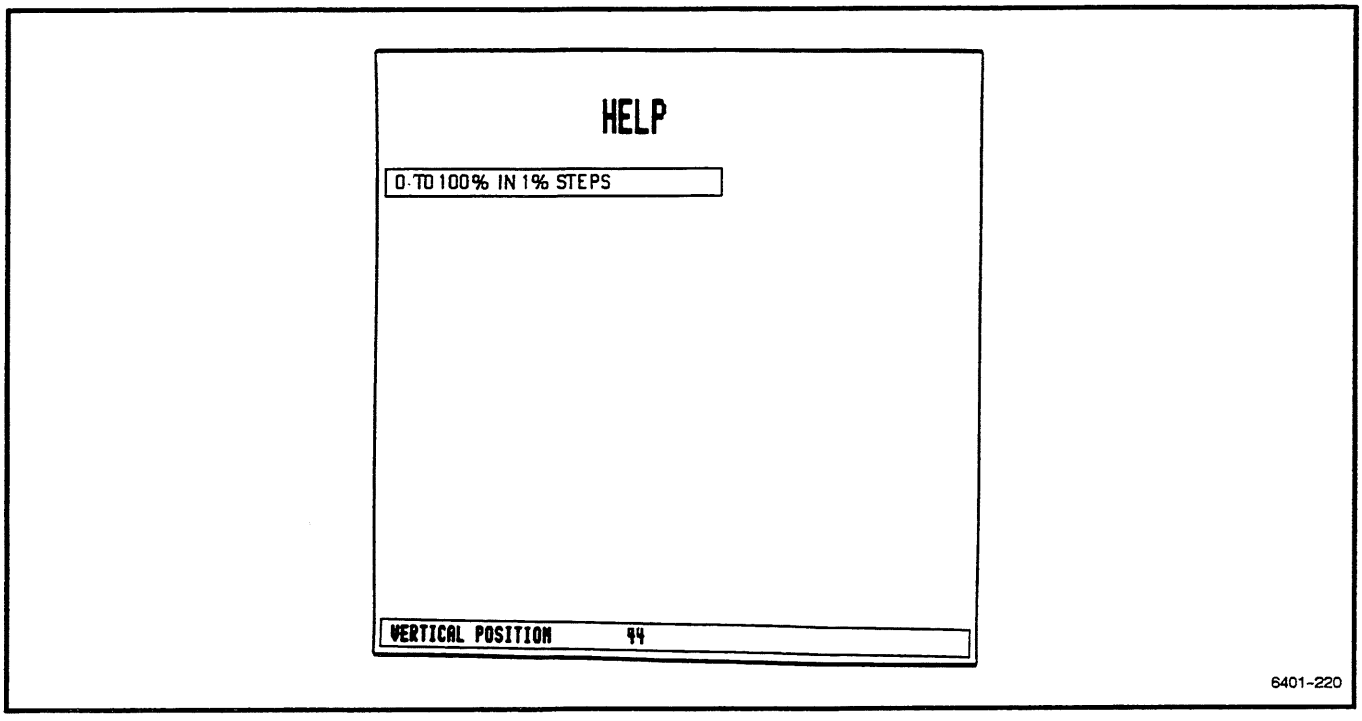

Figure 2-22. Vertical Position Help Menu.

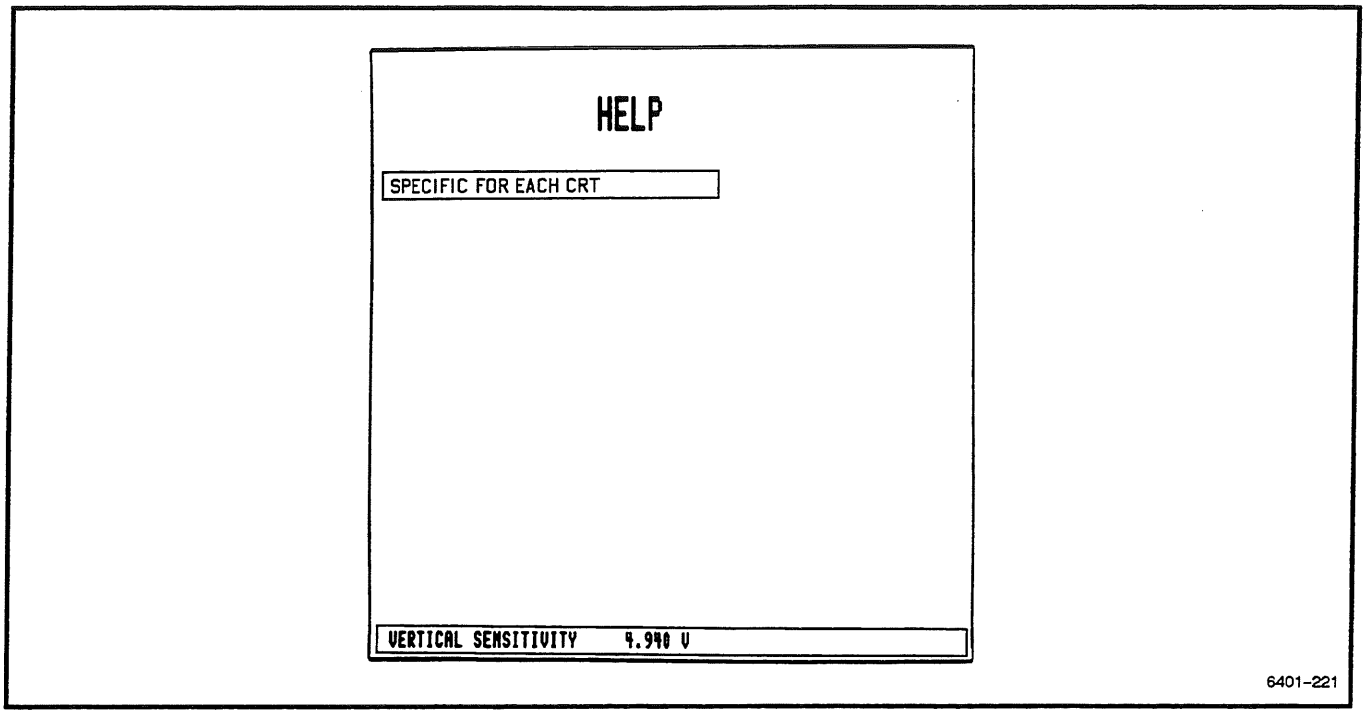

Figure 2-23. Vertical Sensitivity Help Menu.

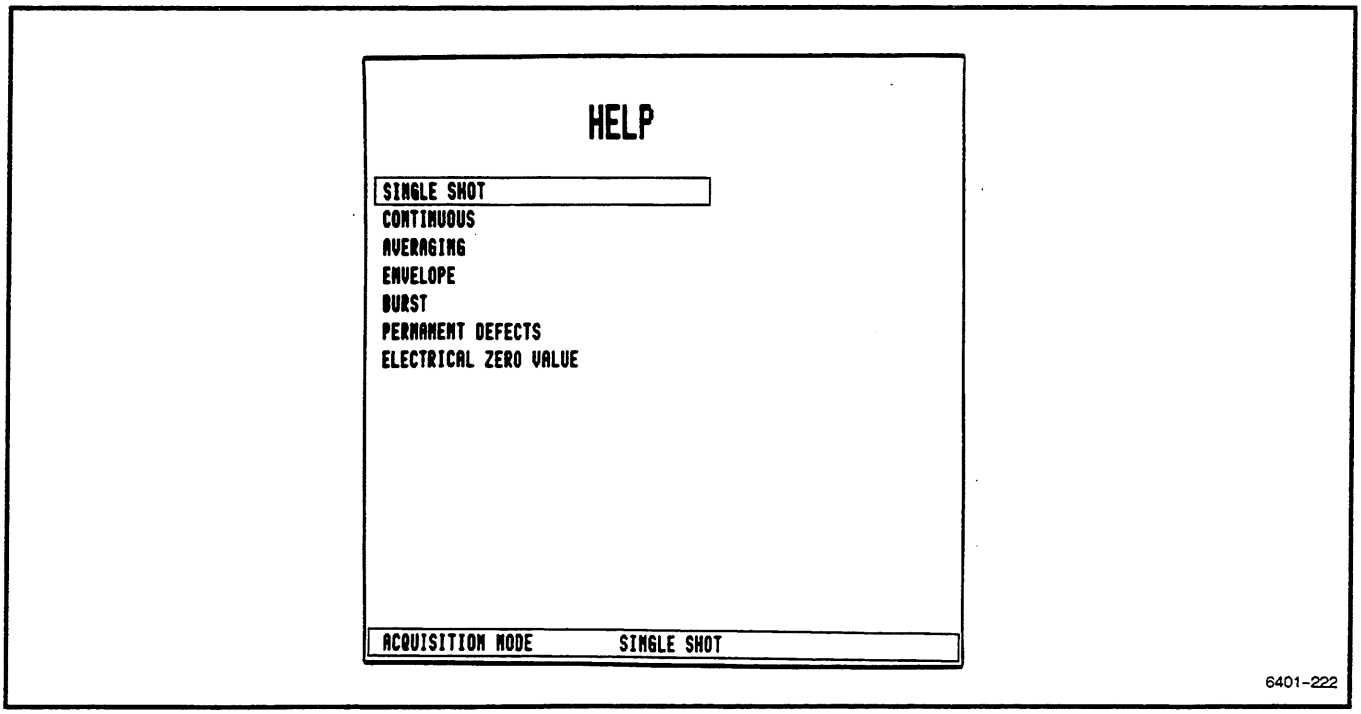

Figure 2-24. Acquisition Mode Help Menu.

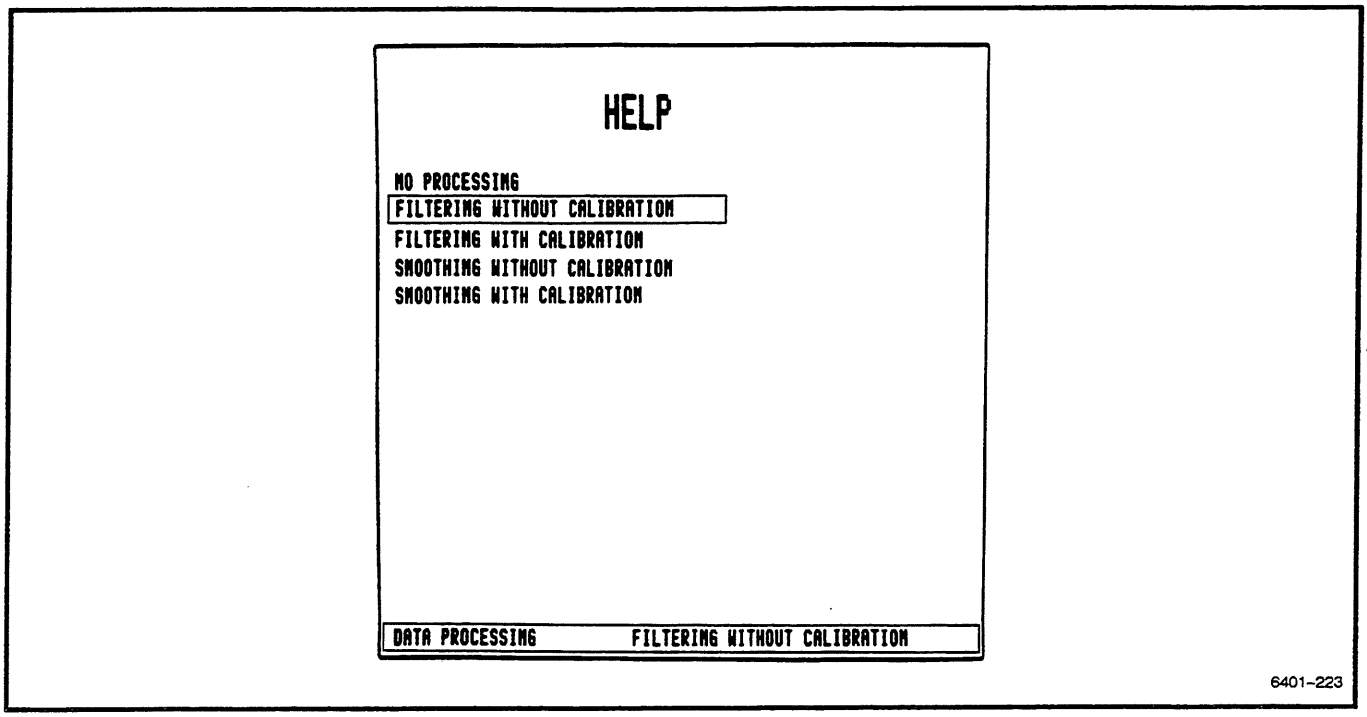

Figure 2-25. Data Processing Help Menu.

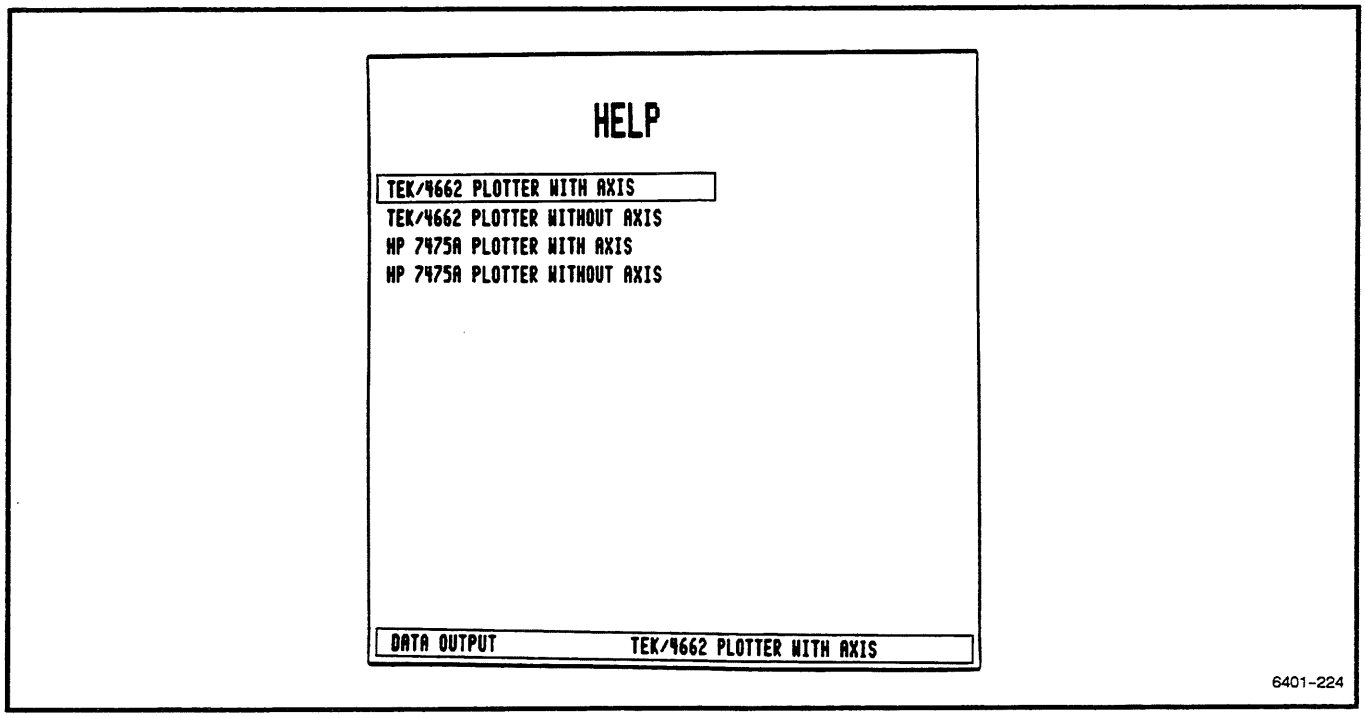

Figure 2-26. Data Output Help Menu.

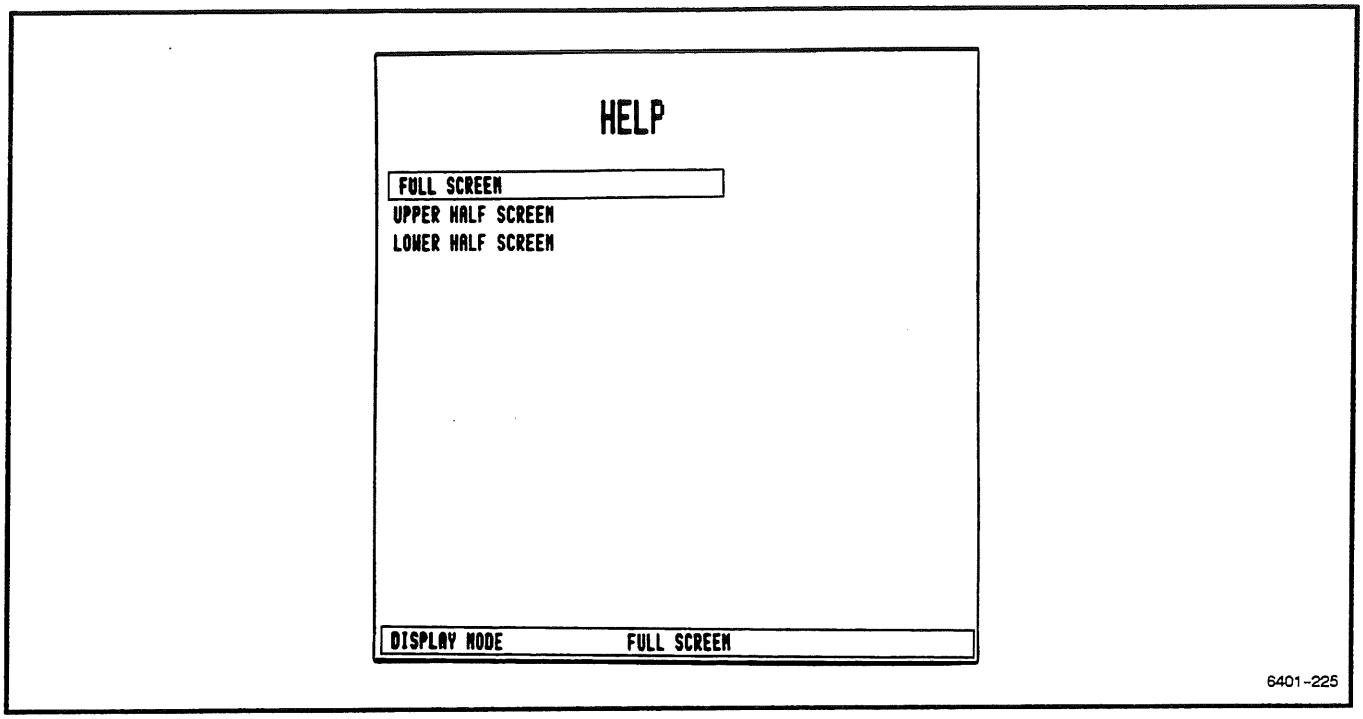

Figure 2-27. Display Mode Help Menu.

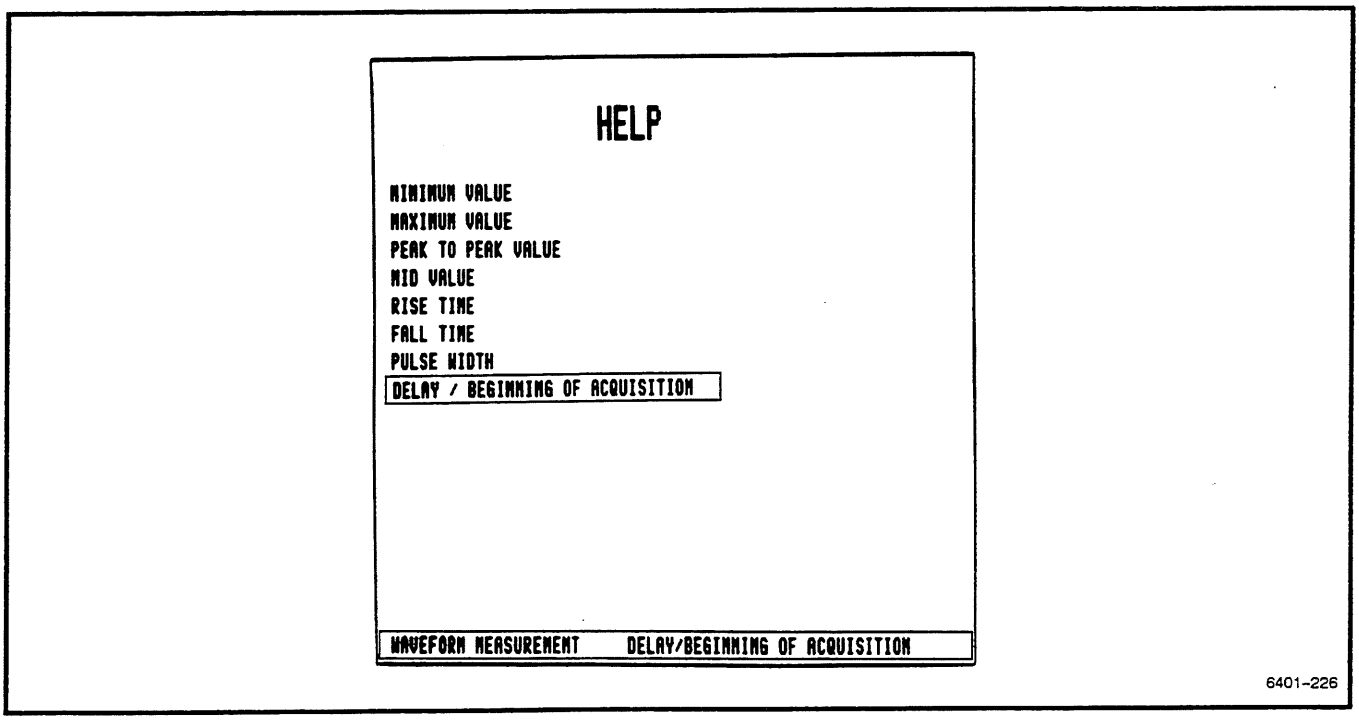

Figure 2-28. Waveform Measurement Help Menu.

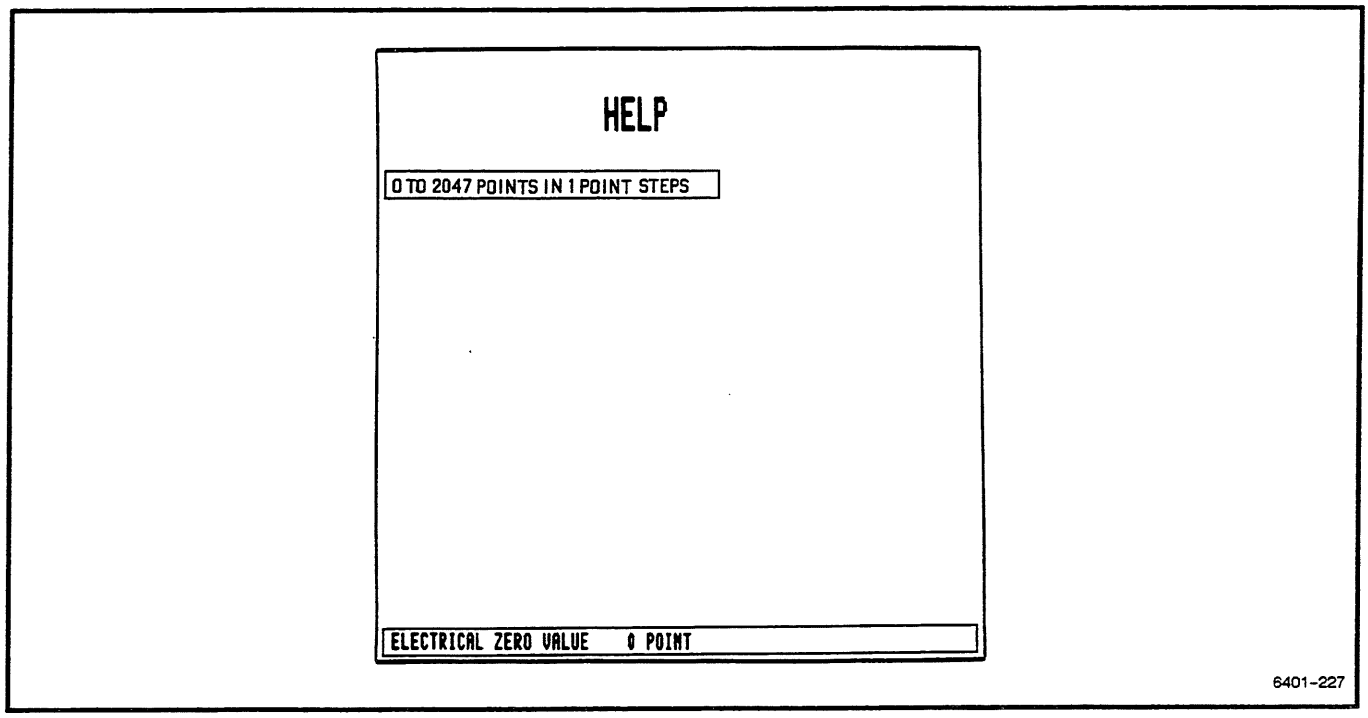

Figure 2-29. Electrical Zero Value Help Menu.

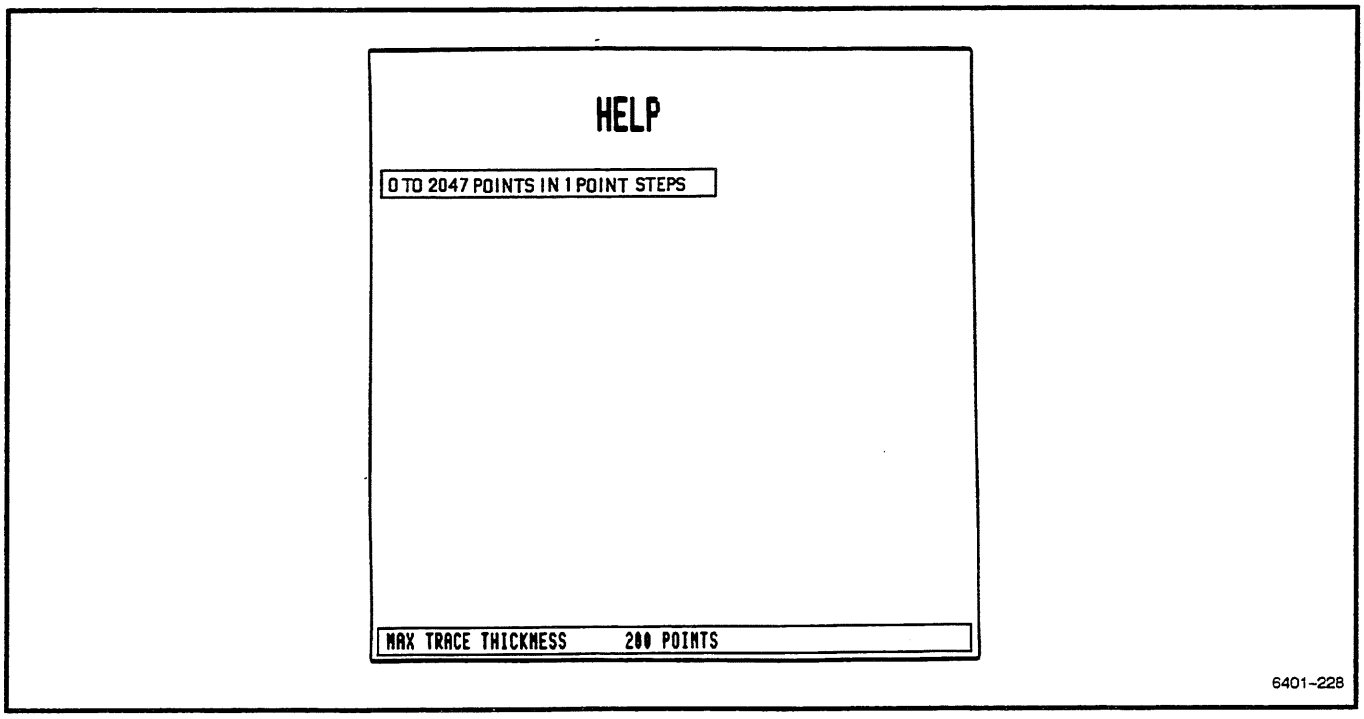

Figure 2-30. Max Trace Thickness Help Menu.

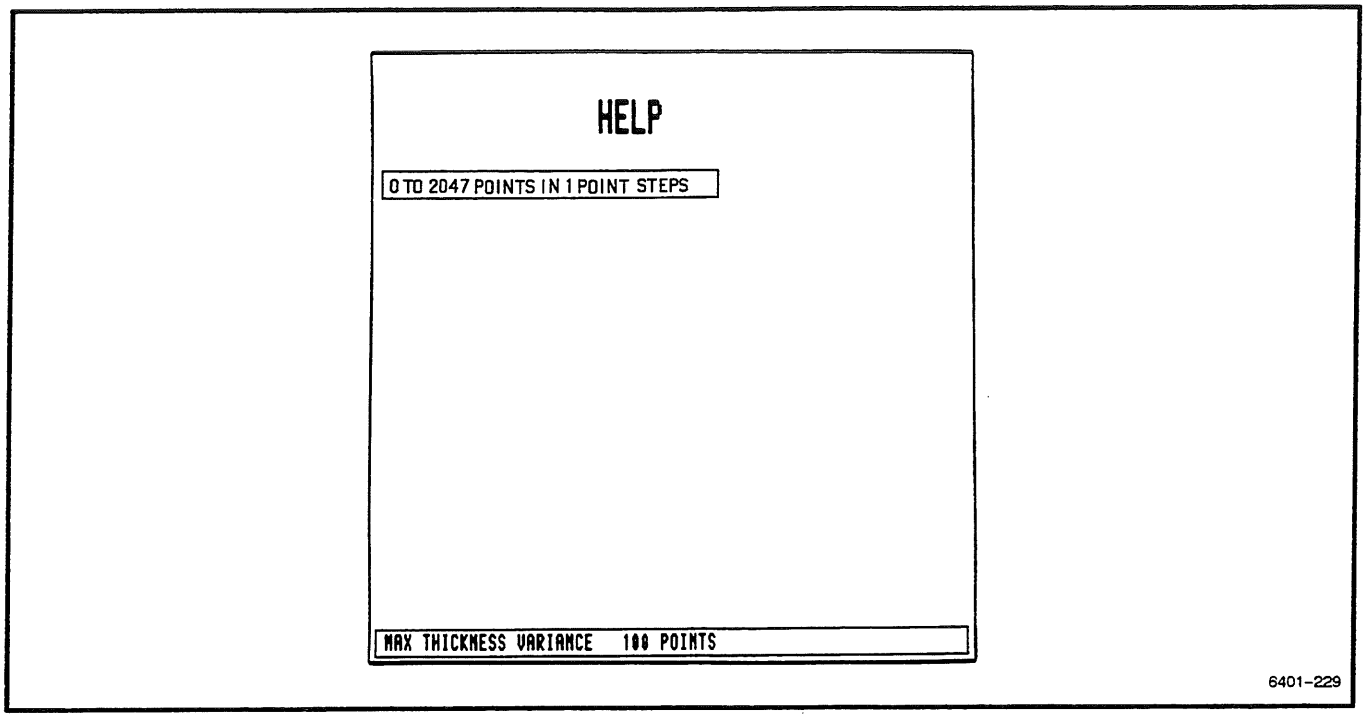

Figure 2-31. Max Thickness Variance Help Menu.

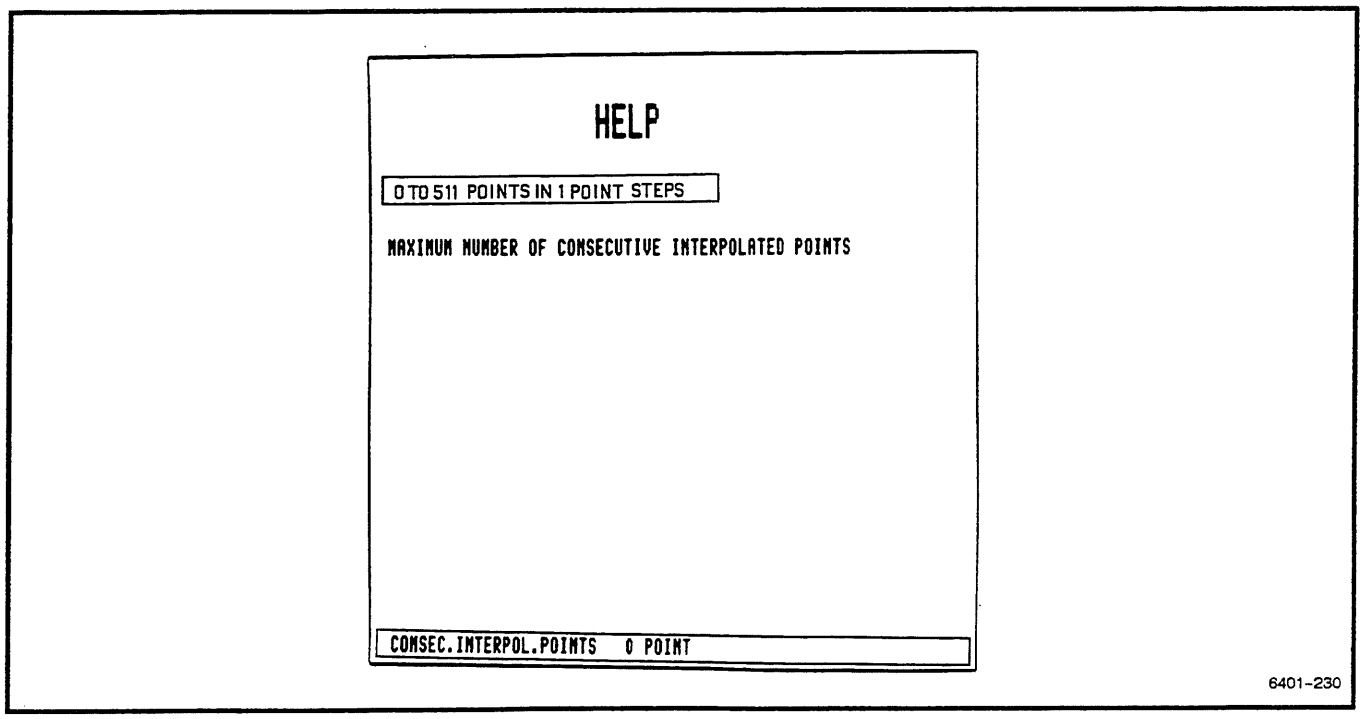

Figure 2-32. Consec. Interpol. Points Help Menu.

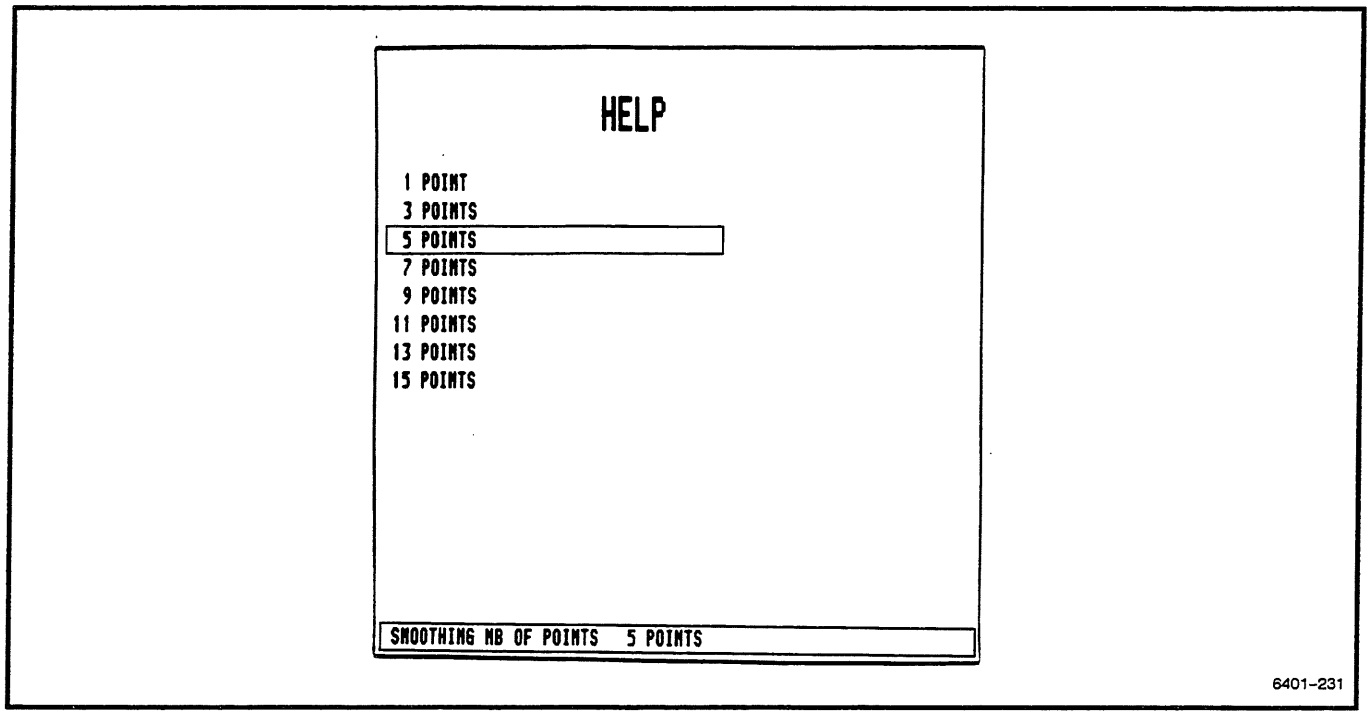

Figure 2-33. Smoothing NB of Points Help Menu.

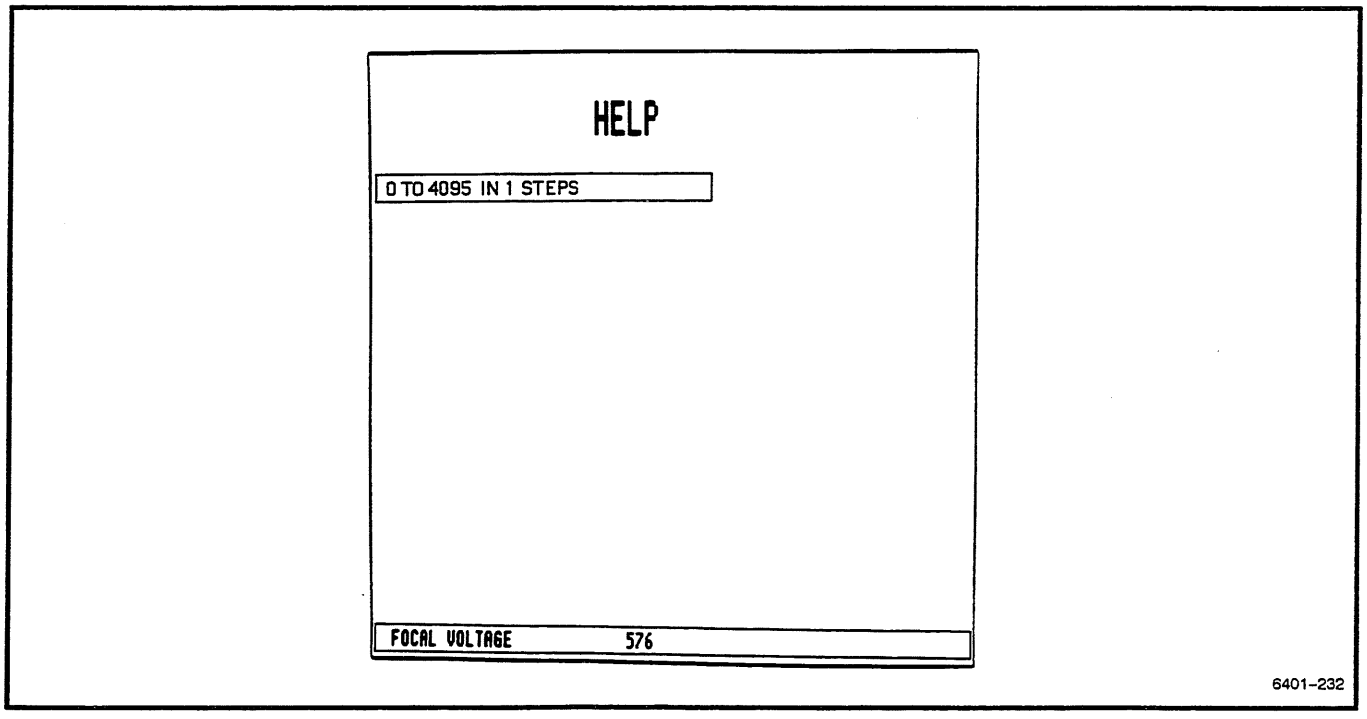

Figure 2-34. Focal Voltage Help Menu.

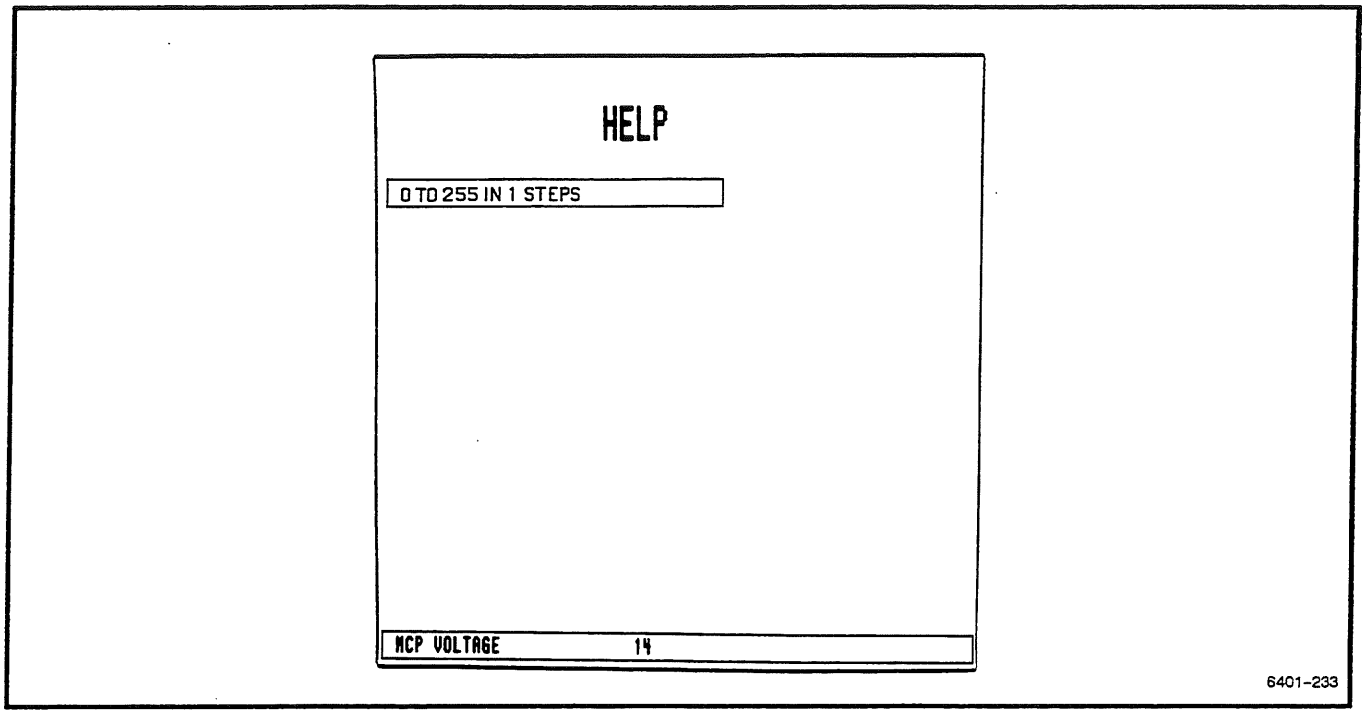

Figure 2-35. MCP Voltage Help Menu.

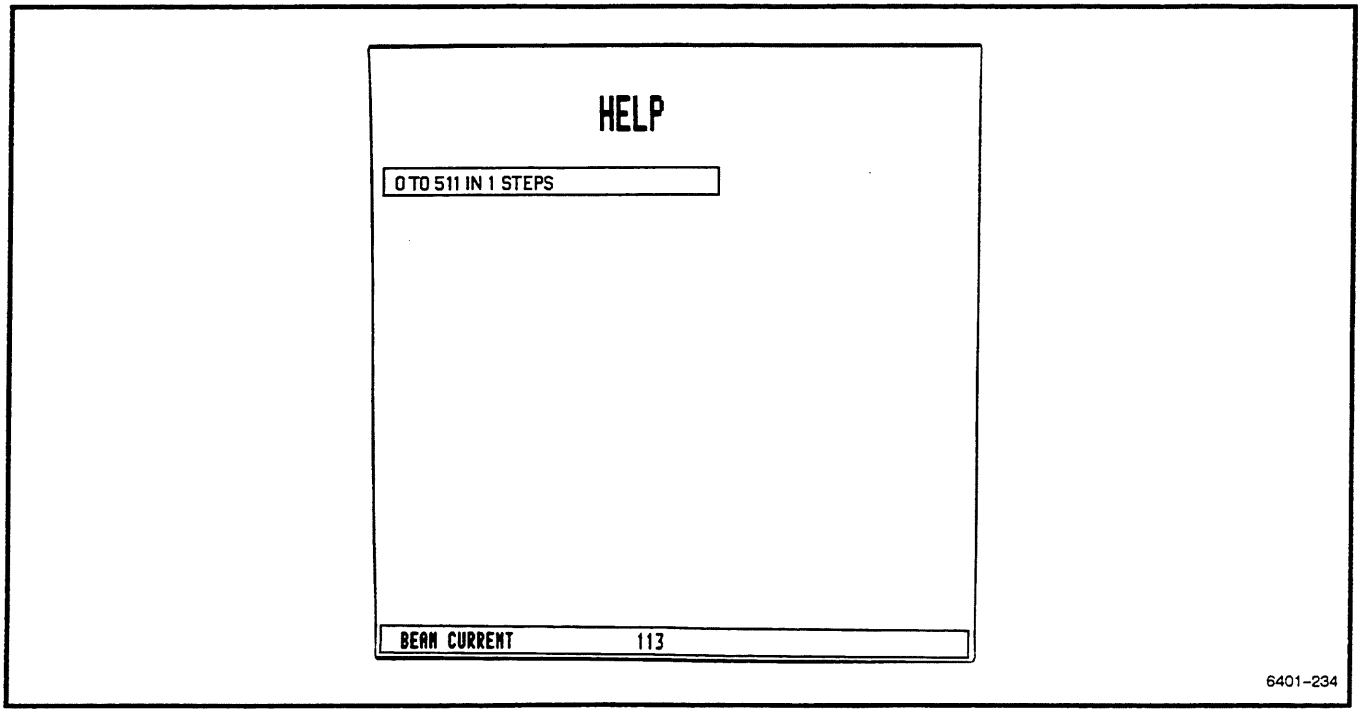

Figure 2-36. Beam Current Help Menu.

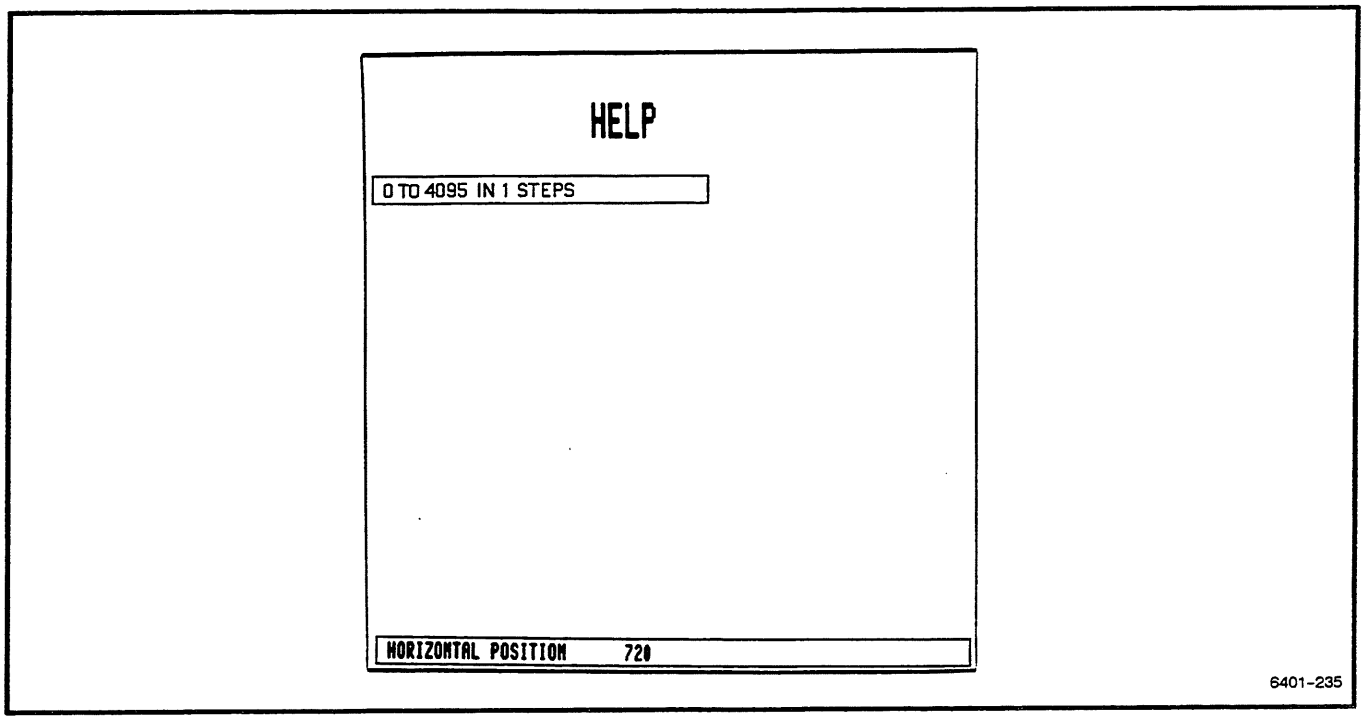

Figure 2-37. Horizontal Position Help Menu.

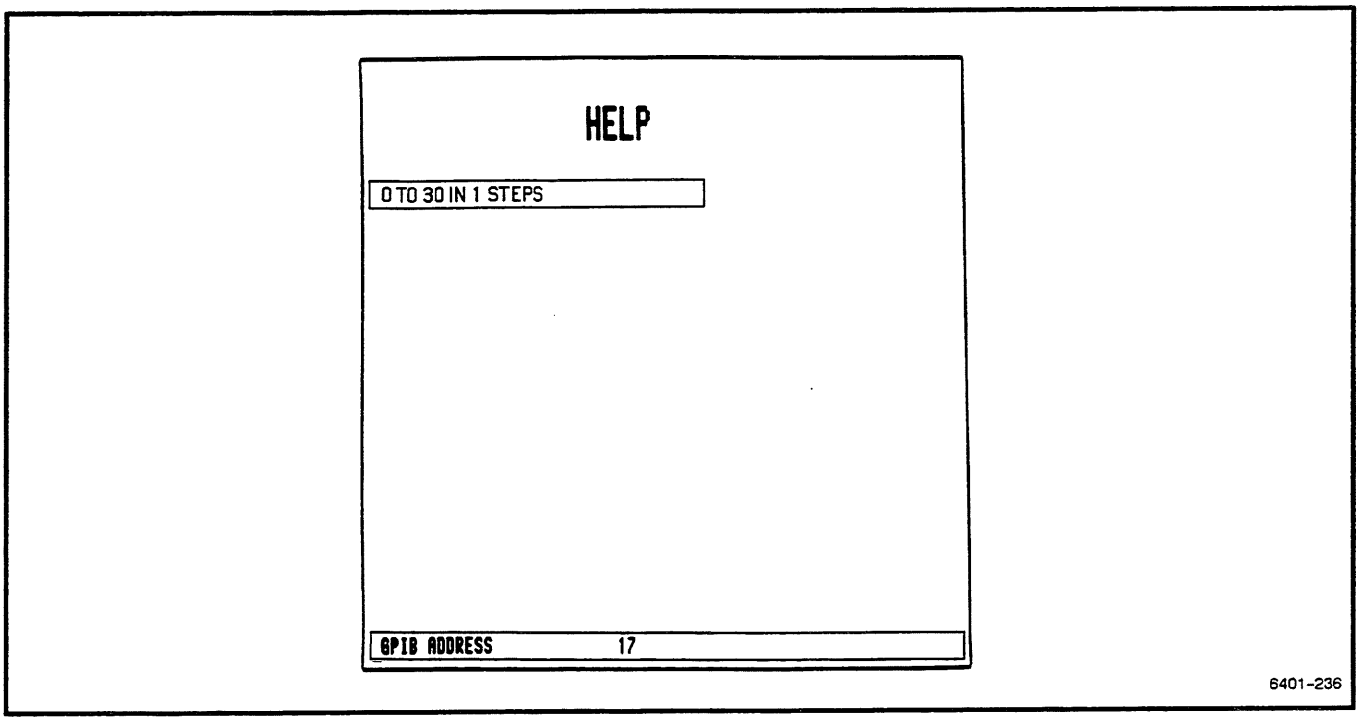

Figure 2-38. GPIB Address Help Menu.

Data Acquisition

Waveform acquisition is controlled by the four Acquisition control keys from the front panel (see Fig. 2–39).

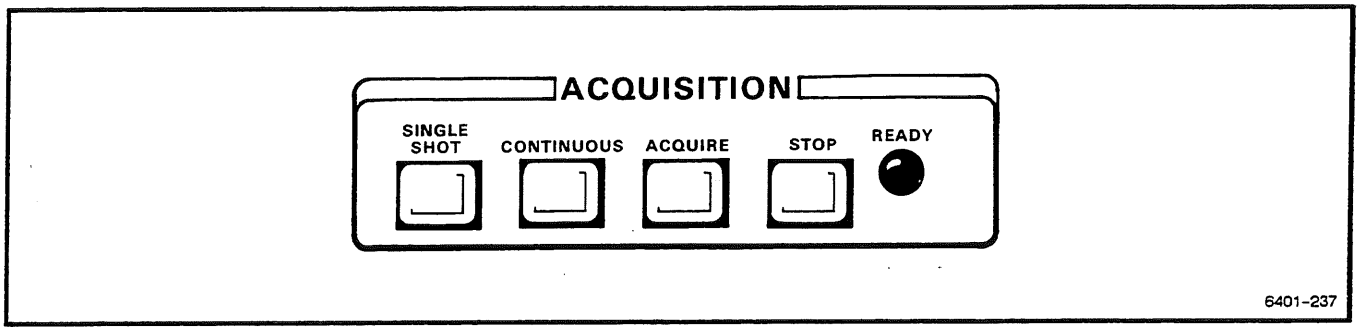

Figure 2–39. The Acquisition control keys.

The 7250 has seven acquisition modes which are set from the Main Menu. (Select Acquisition Mode on the Main Menu, then press Help to display the acquisition modes.) They are:

- Single Shot
- Envelope
- Electrical Zero Value
- Continuous
- Burst
- Averaging
- Permanent Defects

Definitions are given at the end of this section.

Acquisition Control Keys

Each key functions as follows:

Single Shot: Pressing this key sets the 7250 to the Single Shot mode and arms the 7250 for a single waveform acquisition, which when triggered, is stored at Address 0.

Continuous: Pressing this key programs the 7250 to the Continuous acquisition mode and arms the 7250 for successive acquisitions which are triggered at the rate of 1 per second until stopped.

Acquire: Pressing this key initiates the acquisition mode which is set on the Main Menu. A number may be put on the screen using the Numeric Keyboard immediately before pressing the Acquire key to specify the number of acquisitions for the Averaging, Envelope, Burst, Permanent Defects, or Electrical Zero Value modes. By default, the number is set to 1.

Stop: Pressing this key terminates the continuous acquisition mode when in progress.

Example—Acquisitions:

Assume the acquisition mode is set to Averaging. Enter 100 with the numeric keys, then press Acquire. The resultant waveform, averaged over 100 acquisitions, is displayed on the screen.

Assume the acquisition mode is set to the Burst. Pressing 5, then Acquire will result in 5 successive acquisitions which will be stored in Blocks 0 to 4.

Pressing the Continuous key will set the instrument to the Continuous mode. Each acquisition will be followed by a display. To stop the Continuous mode, press the Stop key.

The 7250 Acquisition Modes

Single Shot: The instrument acquires a waveform in Block 0, then displays this waveform on the video monitor.

Continuous: The instrument continuously acquires a waveform in Block 0 and displays this waveform on the video monitor until stopped. In this mode it is possible to modify the instrument settings (Time Base, Sweep Delay, etc.).

Averaging: The instrument carries out a number of acquisitions in Block 0 (this number is set by the user, between 1 and 255). At each acquisition, the average curve is updated in a buffer area (not battery backed-up). After the last acquisition and updating of the average curve, the contents of the buffer area are copied in Block 0 and then displayed.

Envelope: The instrument carries out a number of acquisitions in Block 0 (this number is set by the user, between 1 and 255). At each acquisition, the envelope curve is updated in a buffer area (not battery backed-up). After the last acquisition and updating of the envelope curve, the contents of the buffer area are copied to Block 0 and then displayed.

Burst: The instrument carries out a certain number of acquisitions in Block 0. (This number is set by the user, but cannot exceed 15, or 31, depending on the data memory configuration of 64 or 128 K-bytes.) Each acquisition is stored directly in memory blocks corresponding to the number of acquisitions. For example, if 10 acquisitions are programmed, then the acquisitions are stored in Block 0 through 9.

Permanent Defects: The instrument carries out a certain number of acquisitions in Block 0 (this number is set by the user, between 1 and 255). For each acquisition, a table of faults is updated in a buffer (not battery backed-up). After the last acquisition, the contents of the buffer area are copied into the table of faults (located in the reserved block of the non-volatile memory) and are then displayed. These faults can then be subtracted from every stored curve by filtering or smoothing.

Electrical Zero Value: The instrument carries out a number of acquisitions in Block 0 (this number is set by the user, between 1 and 255). At each acquisition, the average curve is updated in a buffer area (not battery backed-up). After the last acquisition and setting to zero of the average curve, the electrical zero value is calculated as the average of the ordinates of the average curve. This value is stored in the reserved memory block of the non-volatile memory and the average curve is displayed. The electrical zero value is systematically subtracted from the ordinate values displayed during utilization of the cursors. The user who does not wish to use this reference value should give it zero value.

Storing Waveforms: The Waveform Transfer Function

Every 7250 waveform can be stored in an entity called a data block. In addition to the digitized data, the main settings related to acquisition (Time Base, Vertical Sensitivity, and Block Number) are found in this block.

Layout of the Acquisition Memory

The acquisition memory (64 K-bytes) is divided into 16 blocks of 4 K-bytes each. One 4 K-byte block is reserved for sets 0, 1, 2, and 3, as well as the permanent acquisition faults. The other blocks are reserved for acquisitions and are numbered from 0 to 14. Option 2D provides memory for storing 16 additional blocks numbered 15 to 30. When power is applied, the instrument automatically determines its storage capacity (64 or 128 K-bytes).

The Waveform Transfer Function

Block 0 is transferred using the Waveform Transfer key grouped in the Numeric Keyboard section. The user can transfer the contents of block 0 to one of blocks 1 to n, where n = 14 or 30, depending on the memory configuration. No transfer between blocks is possible. Only block 0 can be transferred. The system does not check whether the addressee block already contains a stored waveform. This check must be carried out by the user.

Example—Waveform Transfer:

Press 7, then press the Waveform Transfer key. The contents of block 0 are transferred to block 7.

Display of Stored Waveforms

A stored waveform can be displayed by first pressing its block number on the numeric keyboard then pressing the Process key. The processing selected on the Data Processing setting in the Main Menu (e.g., filtering or smoothing) will be performed, then the waveform will be displayed. To view the waveform as it was stored, select No Processing for the Data Processing setting, then press its block number on the numeric keyboard and press the Process key.

The Clear Key

Pressing this key (see Fig. 2–40) clears the 7250 to the initial power-up state. The selftest, however, is not recycled and neither is the 180 second countdown. The 7250 does not lose the waveform nor menu settings used just before the Clear key was pressed. This control can sometimes clear the GPIB bus from the front panel, if it hangs.

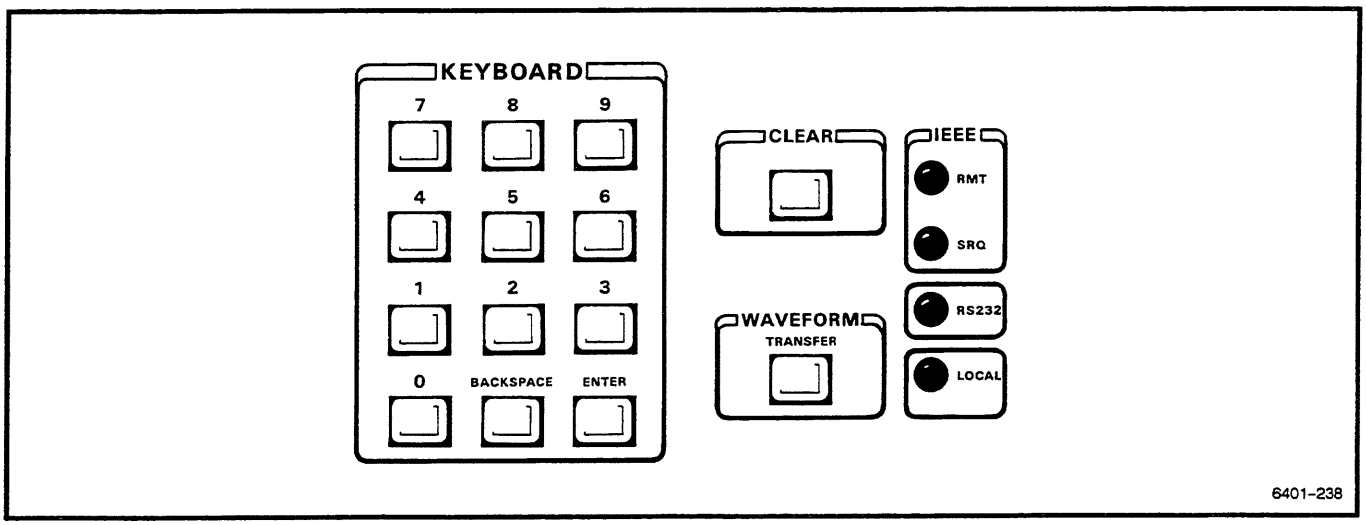

Figure 2–40. The Numeric Keyboard Section.

The Numeric Keyboard

The numeric keyboard is used for two purposes:

It is used in conjunction with other front panel functions to complete operations. For example, when storing a waveform, the address number of the memory block is pressed on the numeric keyboard, then the Waveform Transfer key is pressed.

The Numeric Keyboard also executes additional functions which are not included with the other front panel controls. For example, pressing the number 2 on the keyboard, then pressing the Enter key unlocks the four secondary settings normally locked by the software.

NOTE

Please study use of the Numeric Keyboard carefully to avoid mistaken command execution.

The numeric keyboard consists of twelve keys which function as follows:

Numeric entry keys, 0–9:

Pressing one of these keys places the digit on the lower right corner of the display. This normally precedes use of another control key to complete an operation.

NOTE

On the 7250 it is not necessary to follow a numeric entry by pressing the Enter key. Simply pressing the numeric key enters the number. Pressing the Enter key after a numeric entry may execute a command, as will be explained below.

Backspace key

Pressing this key clears the last digit placed on the display. This is used to correct or clear numeric entries.

Enter key

This key functions in two ways:

- It displays a special Help Menu which lists functions executed with Numeric Keyboard. (With the screen cleared of numeric entries, press the Enter key. This will display the Help Menu as shown in Fig. 2–41. Pressing the Enter key again will switch the display to the Main Menu.)
- After a code number is placed on the screen, pressing the Enter key will execute a command identified by that number. some of these commands are listed in the special Help Menu, and are explained in the summary below. Other Menus for instrument service are also displayed with their appropriate code (not included in this manual).

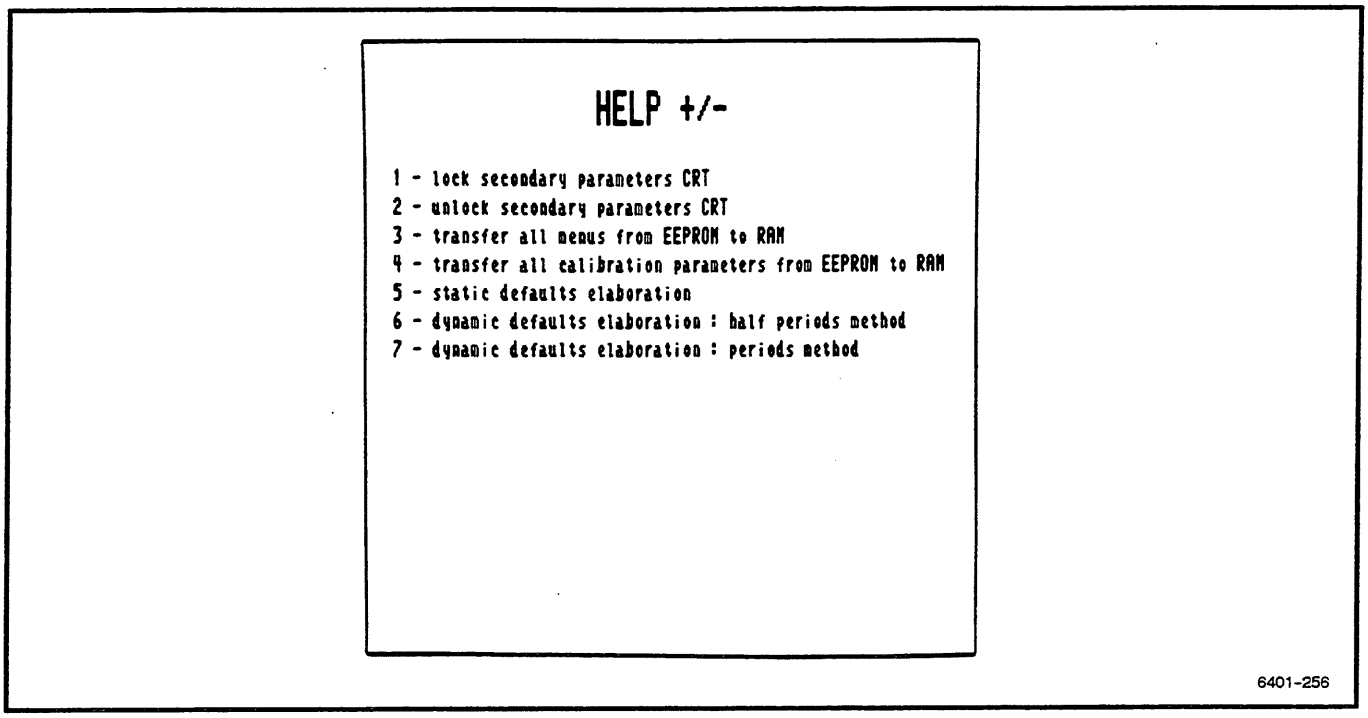

Figure 2–41. Help menu with additional instrument functions

Use of the Numeric Keyboard

Storing Setups: When an instrument setup is to be stored or recalled, the address number is entered first with the keyboard. The address range is 1 to 3. Then the Store Setup key or Recall Setup key is used.

Acquiring Waveforms: When one of the acquisition modes (Averaging, Envelope, Burst, Permanent Defects, or Electrical Zero Value) is selected, the number of sweeps is set using the keyboard. The range is 1 to 255. Then the Acquire key is pressed.

Storing Waveforms: When a waveform is stored, the address number is entered with the keyboard. Address range is 0 to 14. For instrument Option 2D with additional memory, the address range is 0 to 30.

Waveform Data Processing and Output: When a stored waveform is to be displayed, processed, measured, or plotted, the memory block address number is entered first with keyboard. Then the appropriate Outputs control key is used. The address range is 0 to 14. For instrument Option 2D with additional memory, the address range is 0 to 30.

Magnifier: When the Magnifier is turned on, the magnification factor (range 1 to 16) for either or both axes is set using the keyboard.

Special Numeric Keyboard Functions: These functions are executed by first entering the code with the keyboard, then pressing the Enter key.

1, Enter, and 2, Enter: Four of the settings on the Secondary Menu; Focal Voltage, GNC Voltage, Beam Current, and Horizontal Position are set at the factory for optimum performance, and ordinarily do not need to be changed. To change a setting, press 2, then Enter to unlock the selected setting. The value may then be changed using the Menu Arrow keys. Pressing 1, then Enter locks the setting value again.

CAUTION

Prolonged operation of the 7250 with these values altered may cause equipment damage.

NOTE

This procedure to unlock secondary settings can be done with the Main Menu displayed, even though the command applies to Secondary Menu items. Be careful not to accidentally unlock settings while the Main Menu is displayed.

3, Enter and 4, Enter: Refer to Transfer Commands for Non-volatile Data in RAM and EEPROM near the end of this section for a description of the proper use of these functions.

Entering the number 1956, then pressing Enter will eliminate the 180 second countdown on the 7250 after the power-up selftests. This may be desirable if the power needs to be recycled to clear a locked-up instrument and to resume immediate operation. This procedure should only be done only when the instrument is warmed-up.

5, Enter, 6, Enter and 7, Enter: Refer to Section 4, Acquisition Calibration, for a description of the proper use of these functions.

Data Processing

Waveform data processing, measurements and output functions are controlled by the four Outputs control keys (see Fig. 2–42).

The Outputs Control Keys

Each key functions as follows:

Plotter: outputs stored waveforms to a plotter.

Process: performs specified processing on stored waveforms.

Measure: performs specified measurements on stored waveforms, which have been processed.

Other: reserved for future output devices.

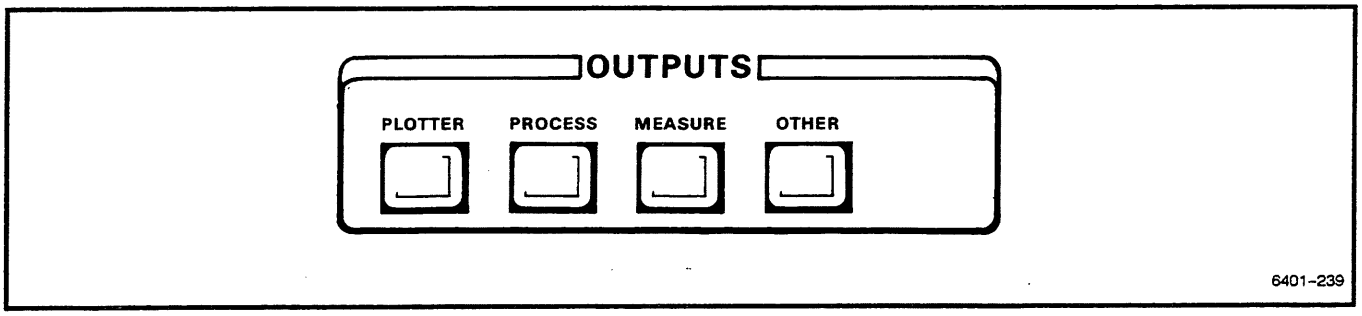

Figure 2–42. The Outputs control keys.

Processing Stored Waveforms

The 7250 has five selected types of data processing which can be used on stored waveforms. These are selected from the Data Processing setting on the Main Menu. (Select Data Processing on the Main Menu, then press Help to display the types).

The five types of Data Processing are:

- No Processing.
- Filtering without Calibration (suppresses permanent faults, filtering and interpolation).
- Filtering with Calibration (suppresses permanent faults, does corrections, filtering and interpolation).
- Smoothing without Calibration (suppresses permanent faults, does filtering, interpolation and smoothing).
- Smoothing with Calibration (suppresses permanent faults, does corrections, filtering interpolation and smoothing).

Filtering consists of creating a waveform with a Y by X (suppression of the redundant Ys and creation of the missing Ys).

NOTE

The missing Y values at the beginning and end of the sweep are not interpolated so an interpolated image contains less than 512 points.

Smoothing is the mathematical operation that eliminates the image irregularities.

The Consec. Interpol. Points function (Secondary Menu) permits a selective interpolation in the "holes" of an image. This involves an interpolation by parts/segments of the image.

The Process Key

Pressing the Process key activates the data processing function. A stored waveform is chosen and processed according to the type of processing selected for the Data Processing setting on the Main Menu. The storage location (block number, range 0 to 14, or 0 to 30 for instrument Option 2D) of the waveform to be processed is pressed immediately before the Process key. If No Processing is selected for the Data Processing setting, pressing the address number, then the Process key simply recalls the raw waveform to block 0.

Example—Data Processing:

Press 5, then Process: The processing indicated in the current set is applied to block 5 and the results are displayed on the screen. The contents of block 5 are not altered.

Press Process: By default, the data in block 0 is processed.

Waveform Measurement

Waveform measurements are performed on stored waveforms using the Measure control key. The measurement is carried out according to the Waveform Measurement setting selected on the Main Menu. Eight types of programmed measurement routines are available on the 7250. (Select Waveform Measurement on the Main Menu, then press Help to display the options).

The eight types of measurement are:

- Minimum Value
- Mid Value
- Pulse Width
- Maximum Value
- Rise time
- Delay time
- Peak to Peak
- Fall time

Each type of measurement will be defined and explained in the examples which follow.

To perform a measurement, a waveform must first be acquired and displayed, or a stored waveform must be displayed. Cursors must then be properly positioned on the display and the waveform must have been processed. The block number of a stored waveform must be entered, then the Measure key is pressed. Measurement results are displayed in the lower left corner of the screen. Measurements taken on raw data are noted by a decimal point in the result area. If a measurement is attempted that is not possible (e.g., a rise time measurement on a falling edge), the result area will display 'ERROR'.

Since setting cursors is necessary on most waveform measurements, the Cursor function, as well as the Magnification and Display Mode functions will be discussed next, then definitions and examples of the types of waveform measurements will be presented.

The Graphics Functions Keys

The Cursor and Magnification functions are found in the Graphics Functions control key section (see Fig. 2–43).

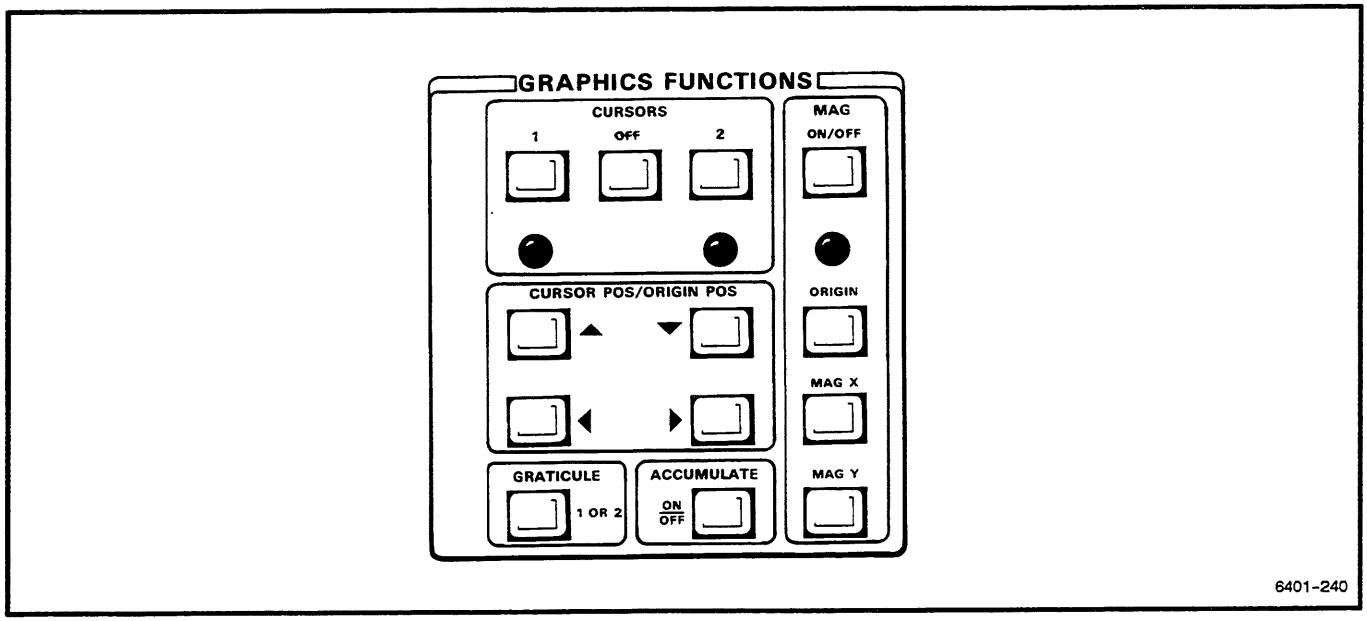

Figure 2–43. The Graphics Functions control keys.

Setting Cursors

To determine coordinates of curve pixels, two vertical cursors are used.

Three keys are used to select the cursors:

1: Display and selection of Cursor 1.

2: Display of Cursors 1 and 2 and selection of Cursor 2.

Off: Turns off displayed cursors.

The cursor X and Y coordinates on the waveform are given in the read-out area of the display.

Two cases occur:

- If only one cursor is present, the X and Y coordinates of Cursor 1 are displayed.
- If both cursors are present, the X and Y coordinates of Cursors 1 and 2 are displayed, as well as the difference between the cursor read-outs. This difference is labeled dX and dY.

Thus, by positioning the cursors on the waveform, the operator can easily determine the point to point time, or voltage difference.

When either of the cursors is selected (as indicated by the red lamp under each Cursor key), the Left Arrow and Right Arrow keys move the cursor left or right. See Figure 2–44 for a typical display of both cursors.

NOTE

The four arrow keys in the Cursor Pos/Origin Pos section perform a dual function:

- *When either of the cursors is selected (as indicated by the red lamp under each) the Left Arrow and Right Arrow keys move the cursors displayed.*
- *When the Magnifier is on (see Mag On/Off key) and the Origin key is pressed, all four arrow keys are now used to position the horizontal and vertical origin lines defining the magnifying window.*

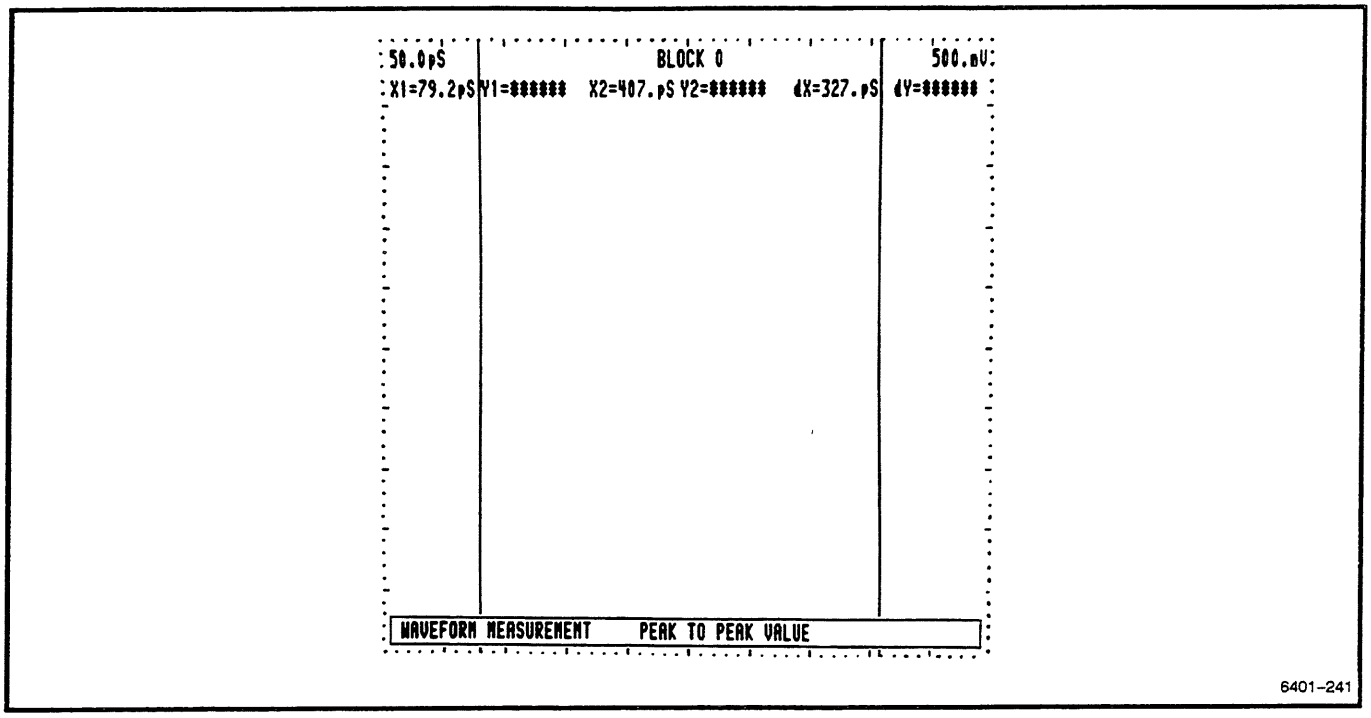

Figure 2–44. Display showing Cursor 1 and Cursor 2.

The Magnifier Function

The magnifier function allows a part of the display the magnified up to 16 times in the X axis, Y axis, or both. Magnification of one axis is independent of the other.

The four keys controlling the magnifier function are as follows:

On/Off: Toggles the magnifier on or off.

Origin: When the magnifier is off, pressing this key displays a horizontal cursor and a vertical cursor on the screen. The intersection of these two cursors determines the origin of the magnification window. The upper right quadrant defined by the cursors is the magnification window. The four arrow keys in the Cursor Pos/Origin Pos section are now used to position the horizontal and vertical cursors.

Mag X: Entering a number between 1 and 16 with the Keyboard, then pressing Mag X, sets the magnification of the X axis in the magnifying window.

Mag Y: Entering a number between 1 and 16 with the Keyboard, then pressing Mag Y, sets the magnification of the Y axis in the magnifying window.

To practice using the magnifier function:

1. Display a waveform on the screen similar to the one illustrated in Figure 2–45.

2. Press Origin: A horizontal and a vertical line should appear on the display.

3. Use the Cursor Pos/Origin Pos arrow keys to position the origin lines on the screen so that the upper part of the waveform is above and to the right of the origin lines. See Figure 2-45 which illustrates the origin lines properly positioned on the display.

4. Press Mag On/Off: The display should now start at the point on the waveform where the origin lines intersected in Figure 2-45.

5. Use the Cursor Pos/Origin Pos arrow keys to position the waveform to start at the bottom left corner of the screen.

6. Press keyboard number 2, then Mag X. The X-axis should magnify to twice its size (see Fig. 2-46).

7. Press keyboard number 2, then Mag Y. The Y-axis should magnify to twice its size (see Fig. 2-46).

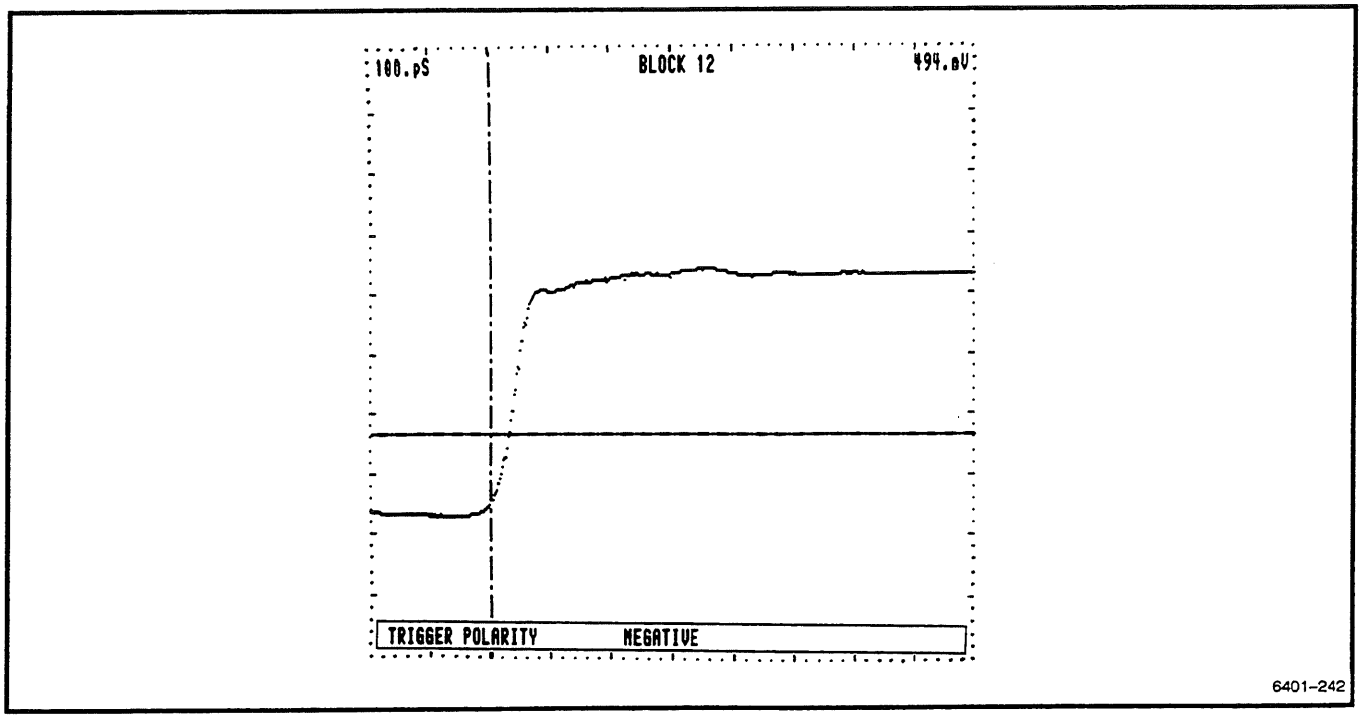

Figure 2-45. Origin lines positioned on waveform.

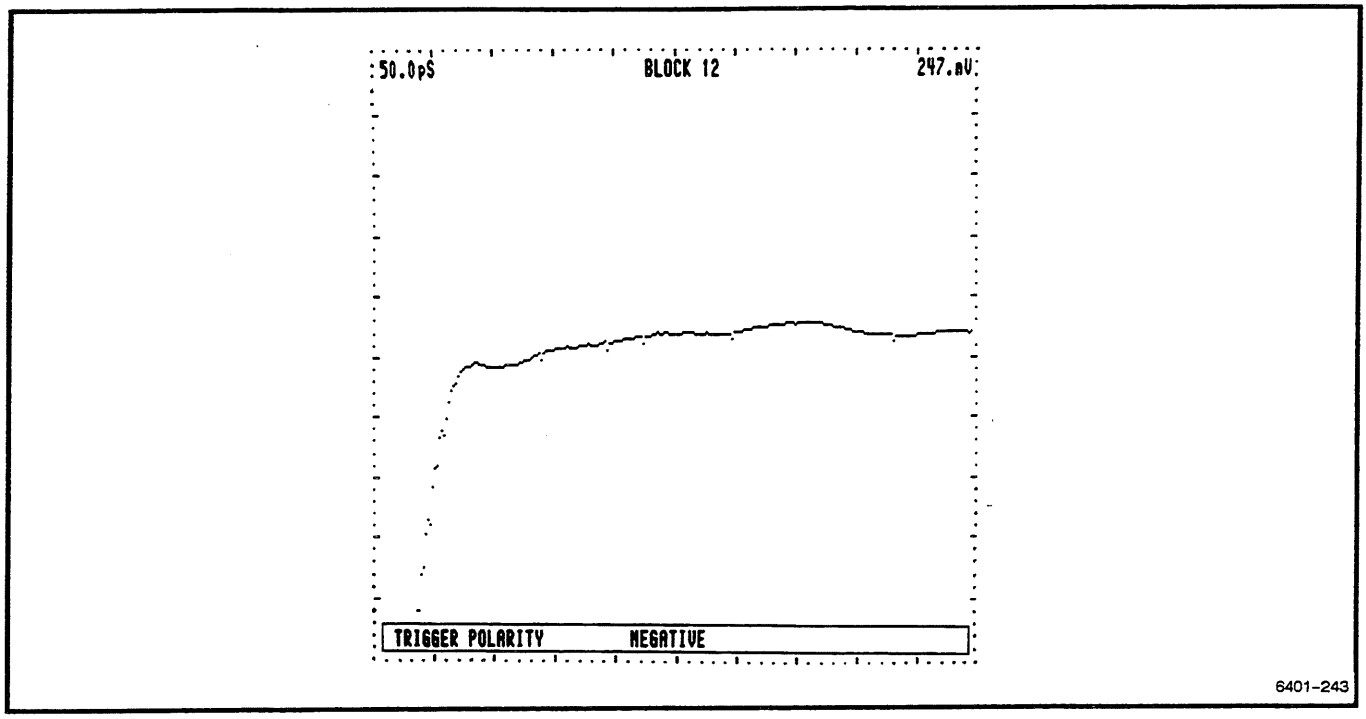

Figure 2–46. Waveform magnified 2X in both axes.

The Accumulate Key

Pressing the Accumulate key during consecutive acquisitions causes them to be super-imposed and displayed on the screen. This permits a visual comparison of several acquisitions. Pressing the Accumulate key again turns off the accumulation function.

The Graticule Key

Pressing the Graticule key switches the screen between two different graticules (see Figs. 2–6 and 2–7). The first consists of marks on the perimeter of the screen. The second consists of horizontal and vertical graticule lines that produce a 10 x 10 division grid on the screen for closer visual measurement resolution.

The Display Mode

The Display Mode function, selected either through the Main Menu or the Display Mode key in the Direct Access control key section, allows you to select a full–screen, upper half–screen, or lower half–screen display. When a half–screen display is selected, the same signal is shown as in the full–screen display except the Y–axis is reduced by half. Refer to Figure 2–47, which illustrates a comparison of 2 waveform acquisitions.

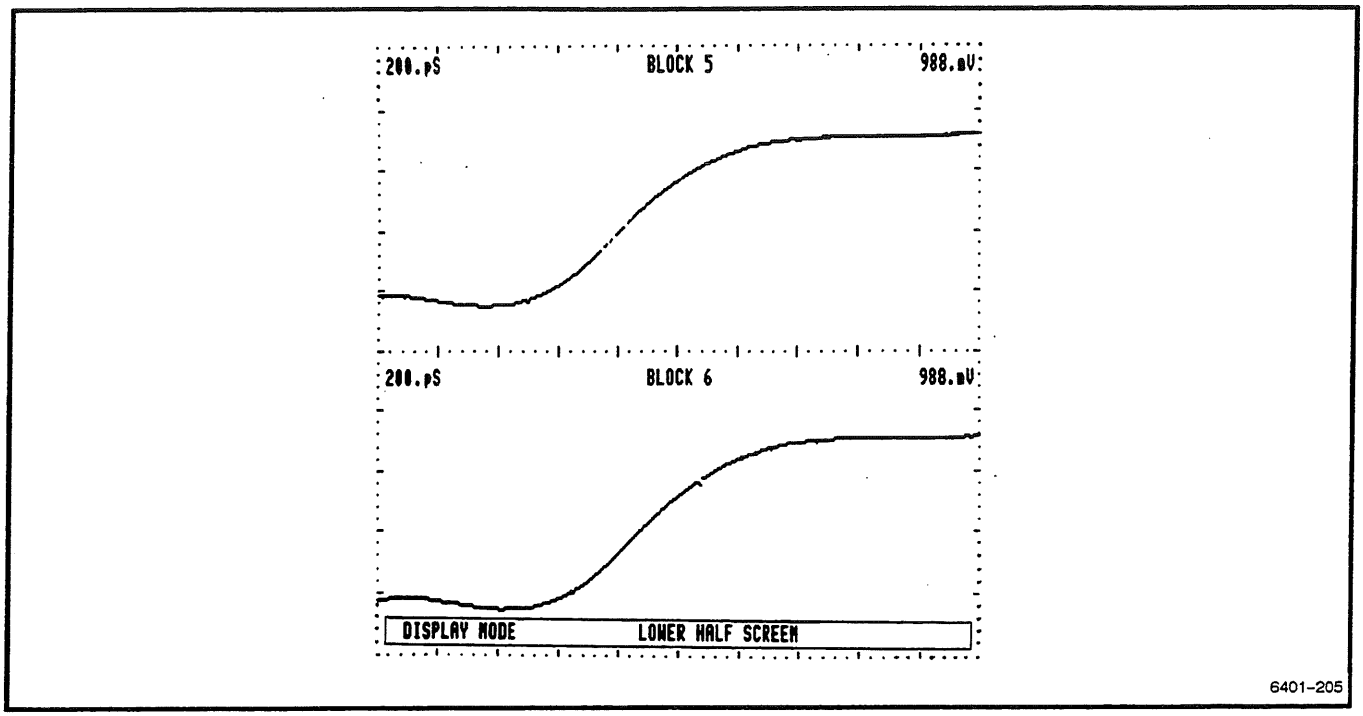

Figure 2–47. Display of signals on upper half and lower half of screen.

To practice changing a display mode:

1. Apply a test signal. (Refer to the Incoming Inspection Procedure for a typical signal.)
2. Use the Time Base, Vertical Position and Sweep Delay settings to position the rising edge at screen center.
3. Select Upper Half Screen on the Display Mode setting of the Main menu. Press the Display Mode key. The screen will display the signal on the upper half of the screen.
4. Select Full Screen on the Display Mode setting of the Main Menu. Press the Display Mode key.
5. Adjust the Time Base and Sweep Delay to place the falling edge of the signal at center screen.
6. Press Display Mode and select Lower Half Screen. The screen should show the rising edge on the upper half, and the falling edge on the lower half.

You may wish to become more familiar with the Acquisition Modes, Display Modes ands Accumulate by trying the exercises in the Demonstrations near the end of this section.

Examples and Explanations of Waveform Measurements

Cursor 1 is positioned on the left-most desired edge. Cursor 2 is positioned on the right-most desired edge. Calculations are always done on the zone between cursors, regardless of whether they are displayed or not. The resultant measurement value will be displayed in the lower left corner of the screen.

Minimum Value

Minimum value is defined as the most negative ordinate point in the waveform between Cursor 1 and Cursor 2. (See Fig. 2-48.)

Example Procedure:

1. Acquire and process a signal similar to the one shown.
2. Position the cursor as illustrated.
3. Select the Minimum Value function, then press the Measure key.

   After a few seconds, the result area will display the minimum value of the signal between the cursors.

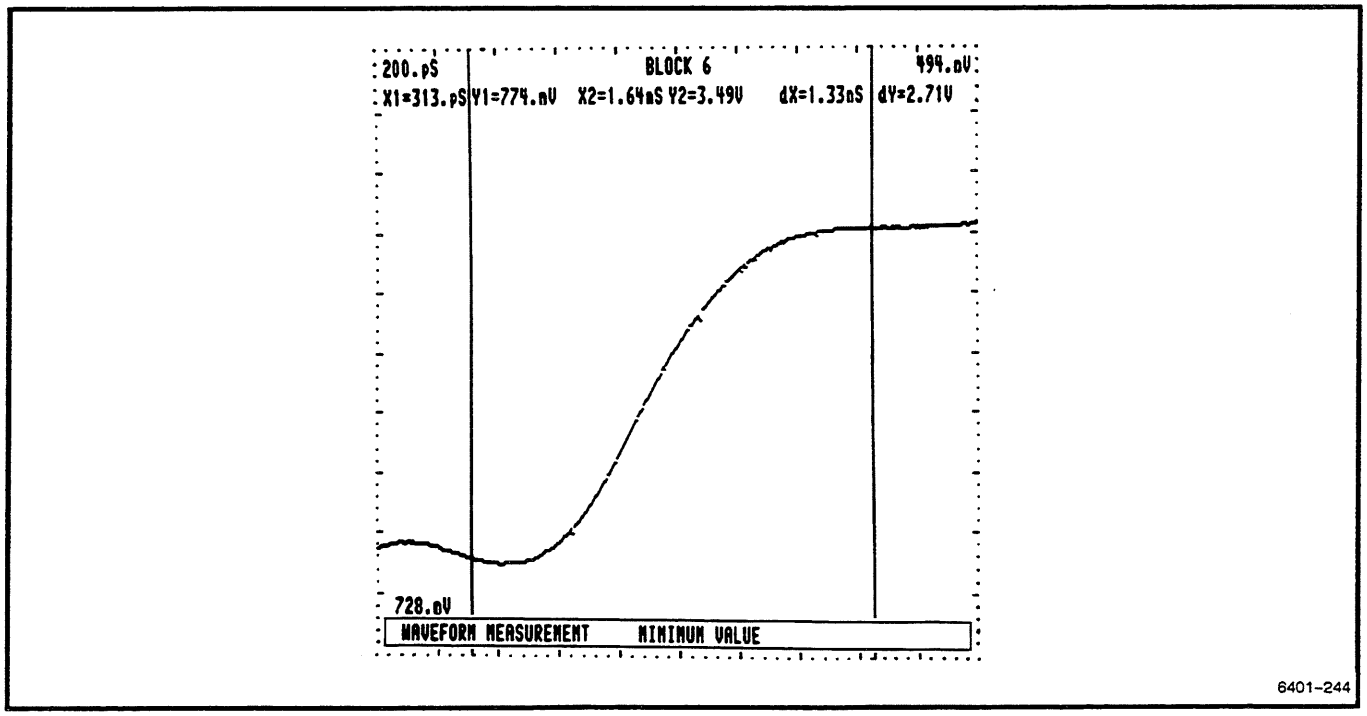

Figure 2-48. Minimum Value measurement.

Maximum Value

Maximum Value is defined as the most positive ordinate point on the waveform between Cursor 1 and Cursor 2. (See Fig. 2–49.)

Example Procedure:

1. Acquire and process a signal similar to the one shown.
2. Position the cursors as illustrated.
3. Select the Maximum Value function, then press the Measure key.

   After a few seconds, the result area will display the maximum value of the signal between the cursors.

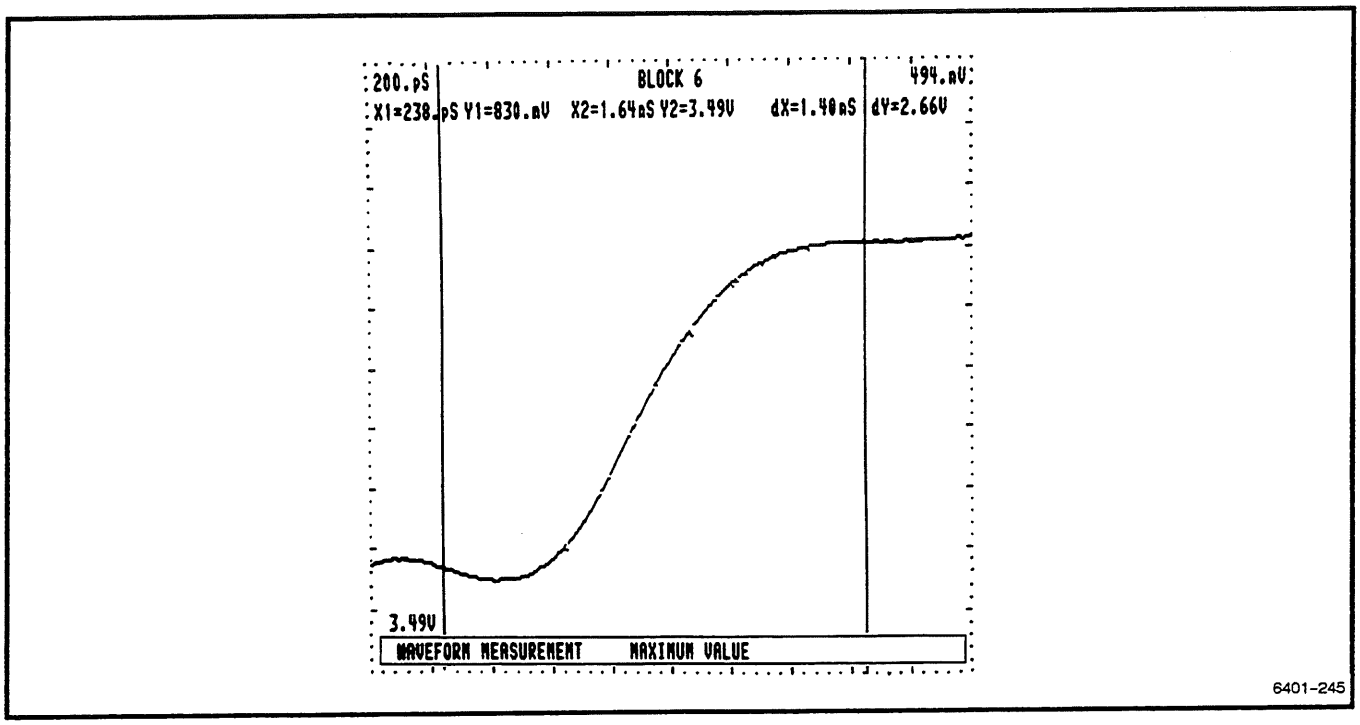

Figure 2–49. Maximum Value measurement.

Peak-to-Peak Value

Peak-to-Peak Value is defined as the difference between the maximum value and the minimum value . These two values are measured between Cursor 1 and Cursor 2. (See Fig. 2-50.)

Example Procedure:

1. Acquire and process a signal similar to the one shown.
2. Position the cursors as illustrated.
3. Select the Peak to Peak value function, then press the Measure key.

   The result area will display the peak to peak value of the signal between the cursors.

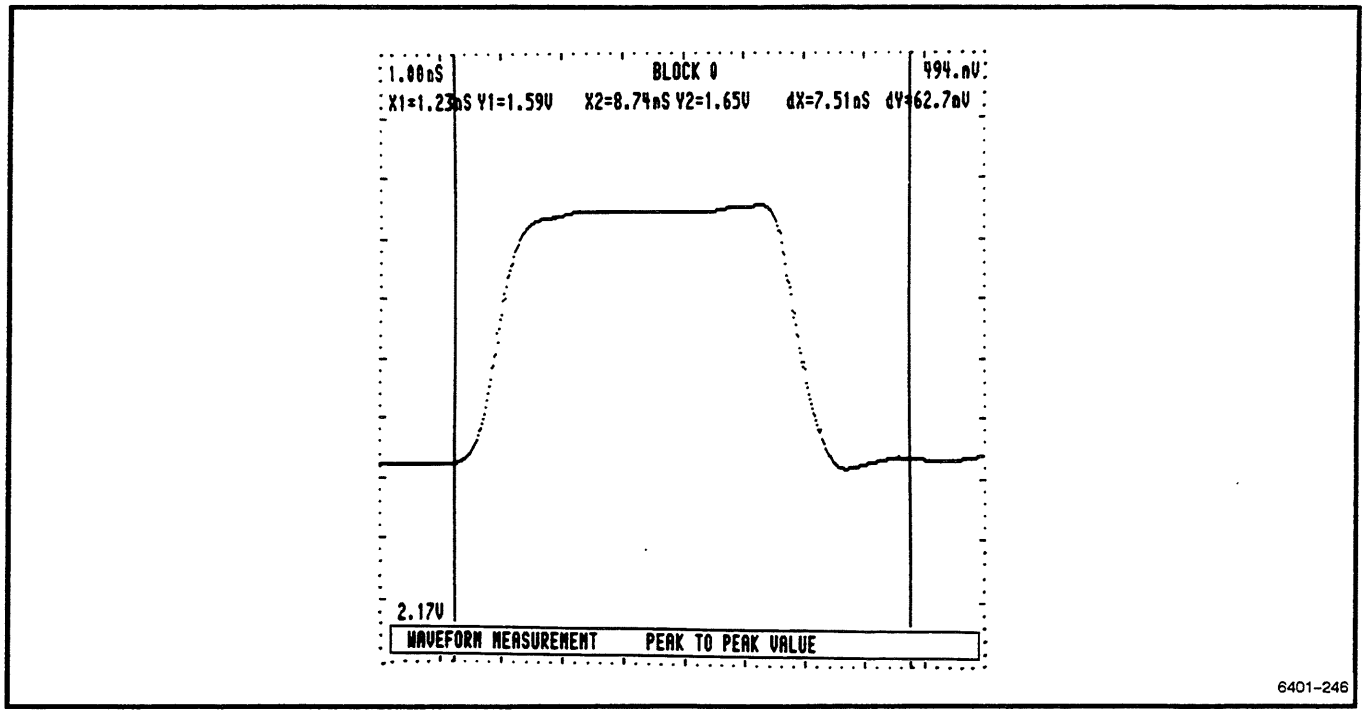

Figure 2-50. Peak to Peak Value measurement.

Mid Value

Mid Value is defined as the sum of the values of all the points on the signal between Cursor 1 and Cursor 2 divided by the number of points. (See Fig. 2–51.)

For example, let C1 and C2 identify points used as 0% and 100% references.

- Mid = 0.5(YC1 + YC2)
- Mid represents the 50% level.

Example Procedure:

1. Acquire and process a signal similar to the one shown.
2. Position the cursors as illustrated.
3. Select the Mid Value function, then press the Measure key.

   After a few seconds, the result are will display the mid value of the signal between the cursors.

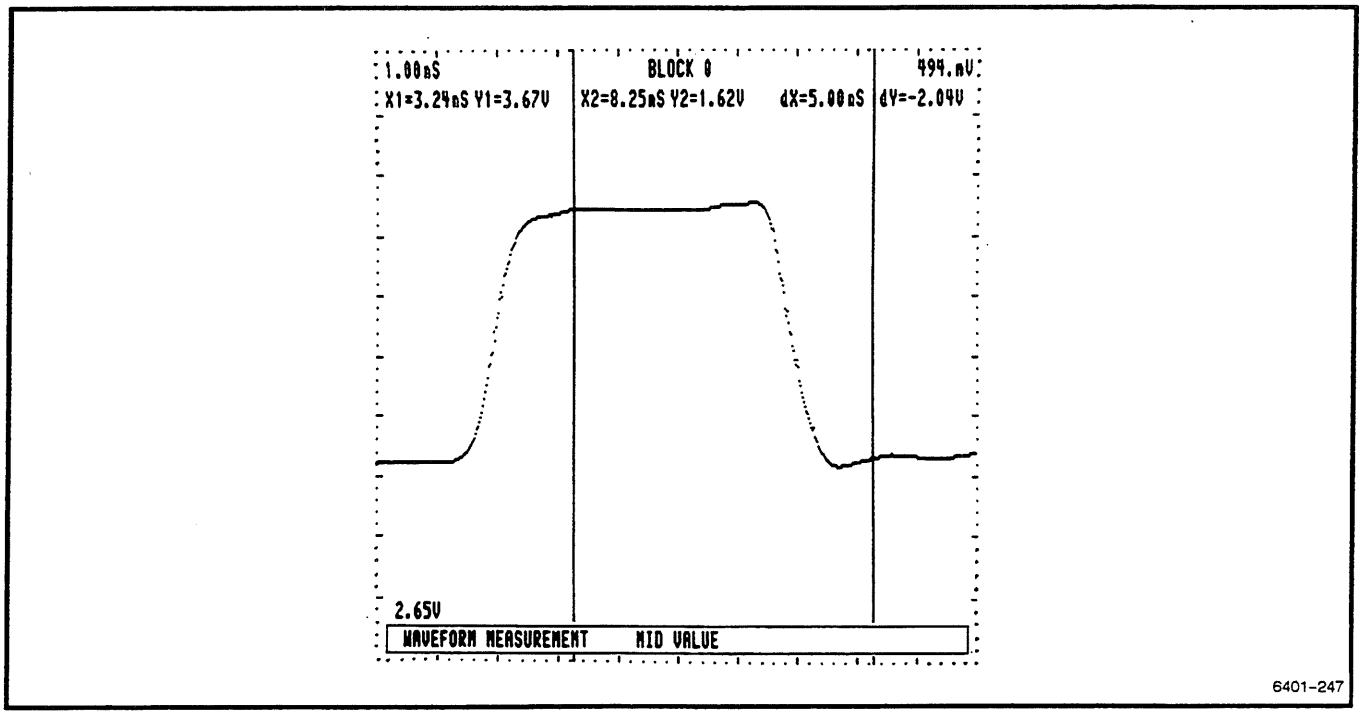

Figure 2–51. Mid Value measurement.

Rise Time

Rise Time is defined as the time elapsed from the point 10% above the base line to the point 90% above the base line. Cursor 1 is positioned to establish the 0% level, and Cursor 2 is positioned to establish the 100% level (see Fig. 2–52).

- 100% Level: The ordinate (Y value) at the (horizontal) abscissa point XC2(YC2).
- 0% Level: The ordinate (Y value) at the (horizontal) abscissa point XC1(YC1)
- 50% Level: 0.5(YC1 + YC2)
- 10% Level: YC1 + 0.1(YC2 – YC1)
- 90% Level: YC1 + 0.9(YC2 – YC1)
- X Ref: Abscissa (horizontal) at the first point lower than the 50% level, scanning from XC2 to XC1.
- X 90%: Abscissa (horizontal) at the first point higher than the 90% level scanning from the X Ref to XC2.
- X 10%: Abscissa (horizontal) at the first point lower than the 10% level scanning from the X Ref point to XC1.
- Rise Time = X 90% – X 10%

Example Procedure:

1. Acquire and process a signal similar to the one shown.
2. Position the cursors as illustrated.
3. Select the Rise Time function, then press the Measure key.

   The result area will display the rise time of the signal between the cursors.

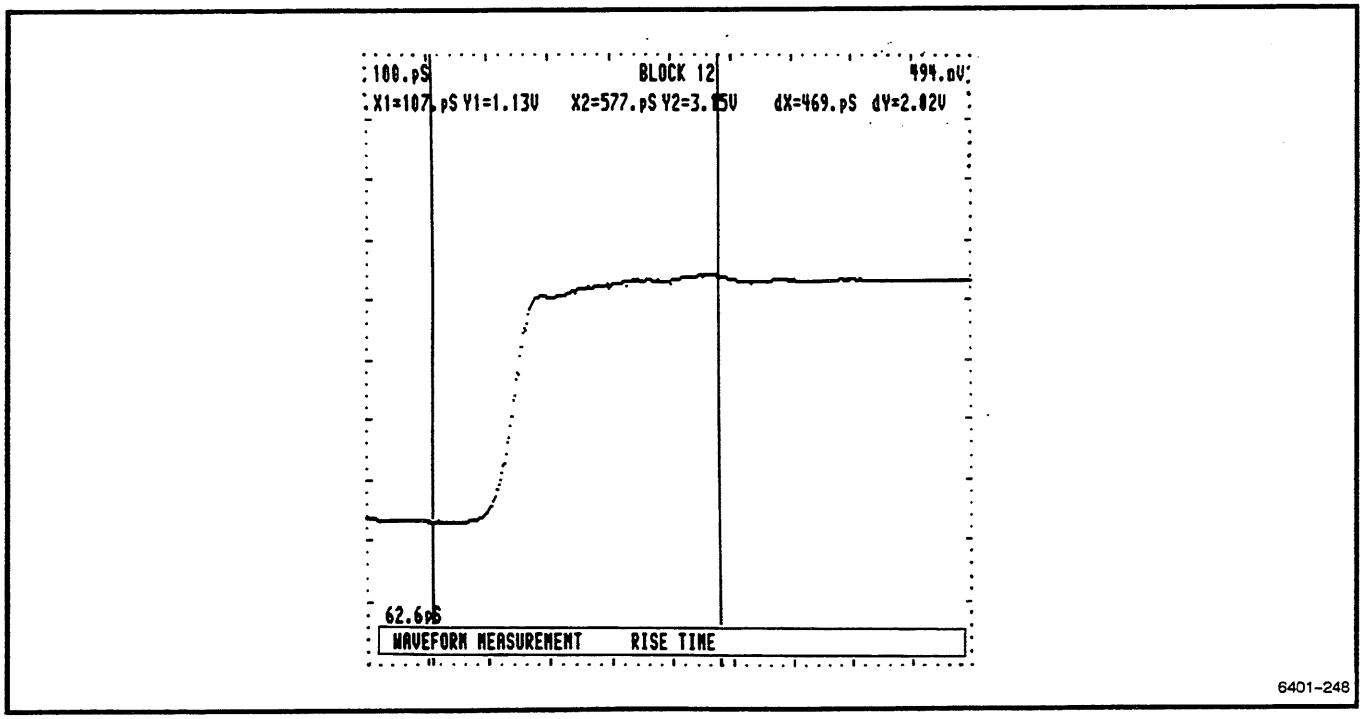

Figure 2–52. Rise Time measurement.

Fall Time

Fall Time is defined as the time elapsed from the point 90% above the base line to the point 10% above the base line. Cursor 1 is positioned to establish the 100% level, and Cursor 2 is positioned to establish the 0% level (see Fig. 2–53).

- 100% Level: The ordinate (Y value) at the (horizontal) abscissa point XC2(YC2).
- 0% Level: The ordinate (Y value) at the (horizontal) abscissa point XC1(YC1).
- 50% Level: 0.5(YC1 + YC2)
- 10% Level: YC1 + 0.1(YC2 - YC1)
- 90% Level: YC1YC1 + 0.9(YC2 - YC1)
- X Ref: Abscissa (horizontal) at the first point lower than the 50% level, scanning from XC2 to XC1.
- X 90%: Abscissa (horizontal) at the first point higher than the 90% level, scanning from the X Ref point to XC2.
- X 10%: Abscissa (horizontal) at the first point lower than the 10% level, scanning from the X Ref point to XC1.
- Fall Time = X 10% - X 90%

Example Procedure:

1. Acquire and process a signal similar to the one shown.
2. Position the cursors as illustrated.
3. Select the Fall Time function, then press the Measure key.

   The result area will display the fall time of the signal between the cursors.

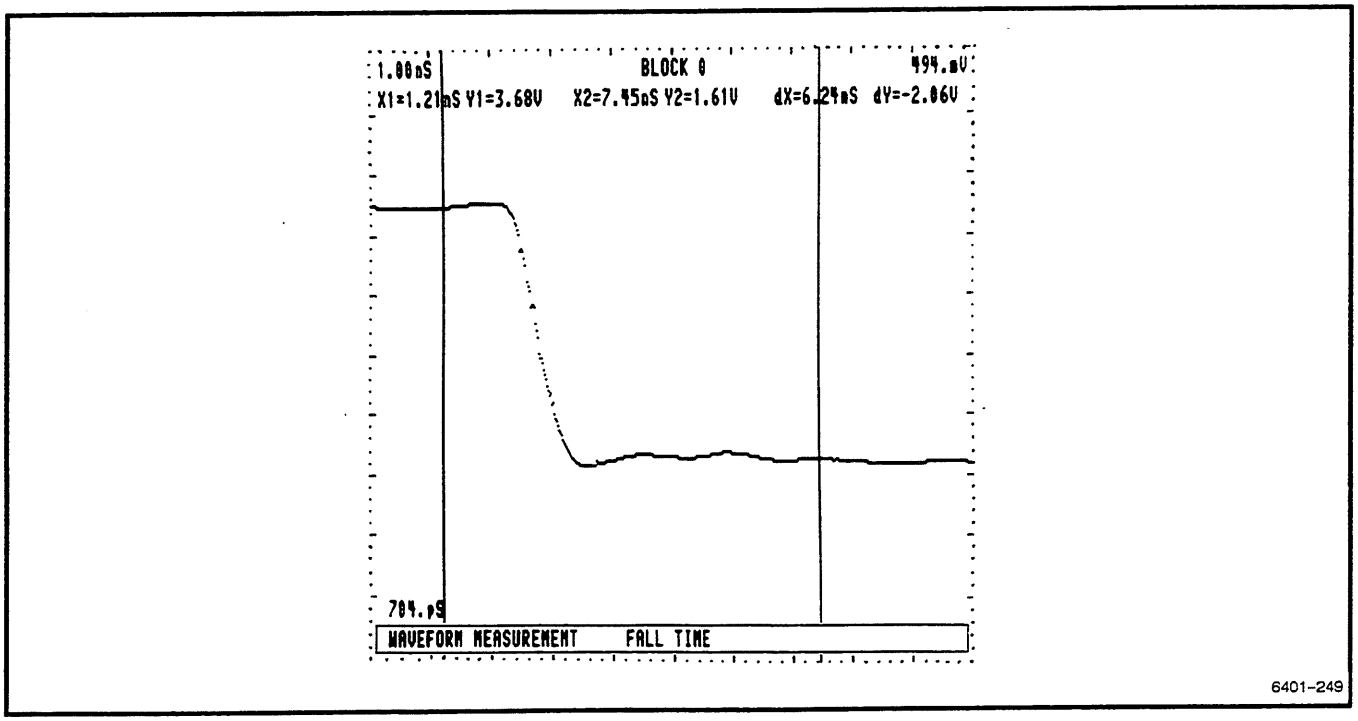

Figure 2–53. Fall Time measurement.

Pulse Width

Pulse Width is defined as the time interval between the first 50% level just before Cursor 2 and the first 50% level just after Cursor 2. Cursor 1 is set on the pulse base line. (See Fig. 2-54.)

100% Level: Ordinate (Y value) at abscissa point XC1 (or XC2): Y(100%)

0% Level: Ordinate (Y value) at abscissa point XC2 (or XC1): Y(0%)

50% Level: 0.5[Y(0%) + Y(100%)]

Example Procedure:

1. Acquire and process a signal similar to the one shown.
2. Position the cursors as illustrated.
3. Select the Pulse Width function, then press the Measure key.

   The result area will display the pulse width of the signal between the cursors.

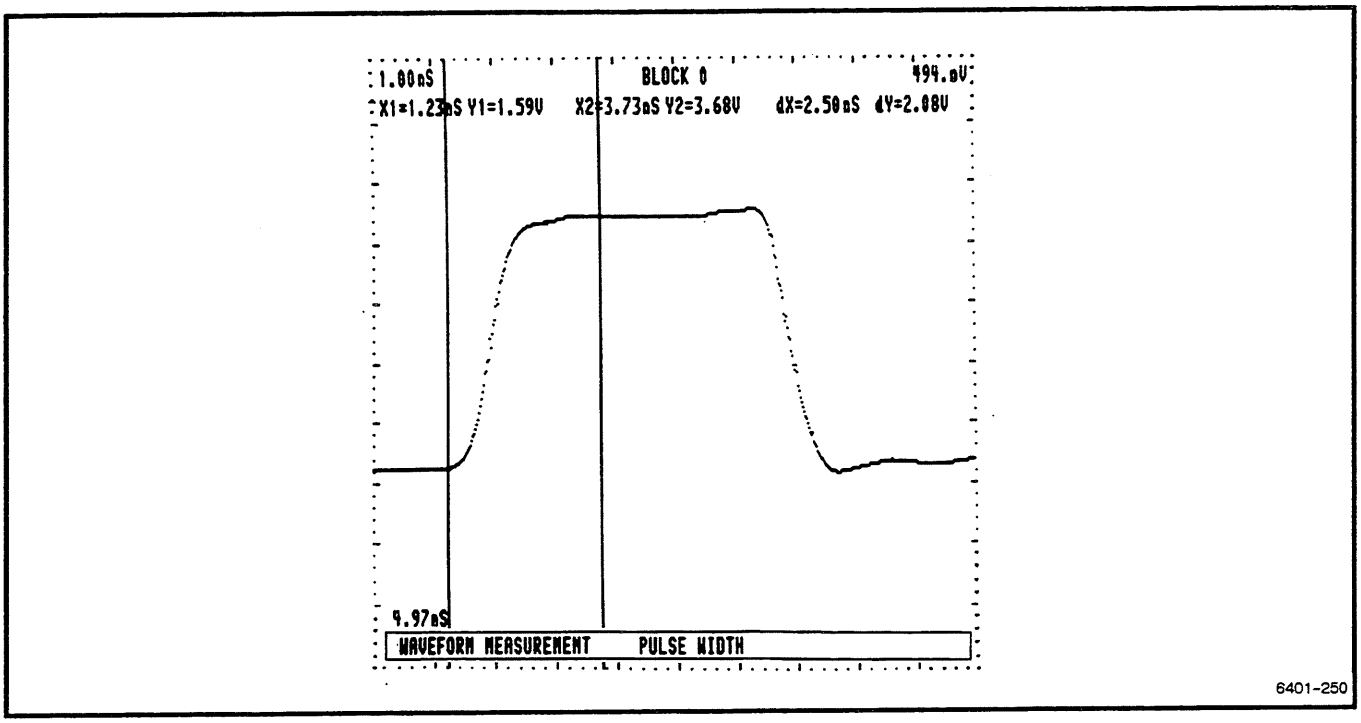

Figure 2-54. Pulse Width measurement

Delay/Beginning of Acquisition

Delay/Beginning of Acquisition measures the time delay from the beginning of the acquisition window to the beginning of the signal; that is, the time interval between the extreme left of the window and the first 50% level occurring between the two cursors. Cursor 1 is set on the pulse base line, and Cursor 2 is set at the top of the signal. (See Fig. 2-55.)

50% Level: The average of ordinates (Y values) for the abscissa points XC2 to XC1 = 0.5 (Y1 + Y2)

Example Procedure:

1. Acquire and process a signal similar to the one shown.
2. Position the cursors as illustrated.
3. Select Delay/Beginning of Acquisition function, then press the Measure key.

   The result area will display the time elapsed between the beginning of acquisition to the first 50% point on the signal between the cursors.

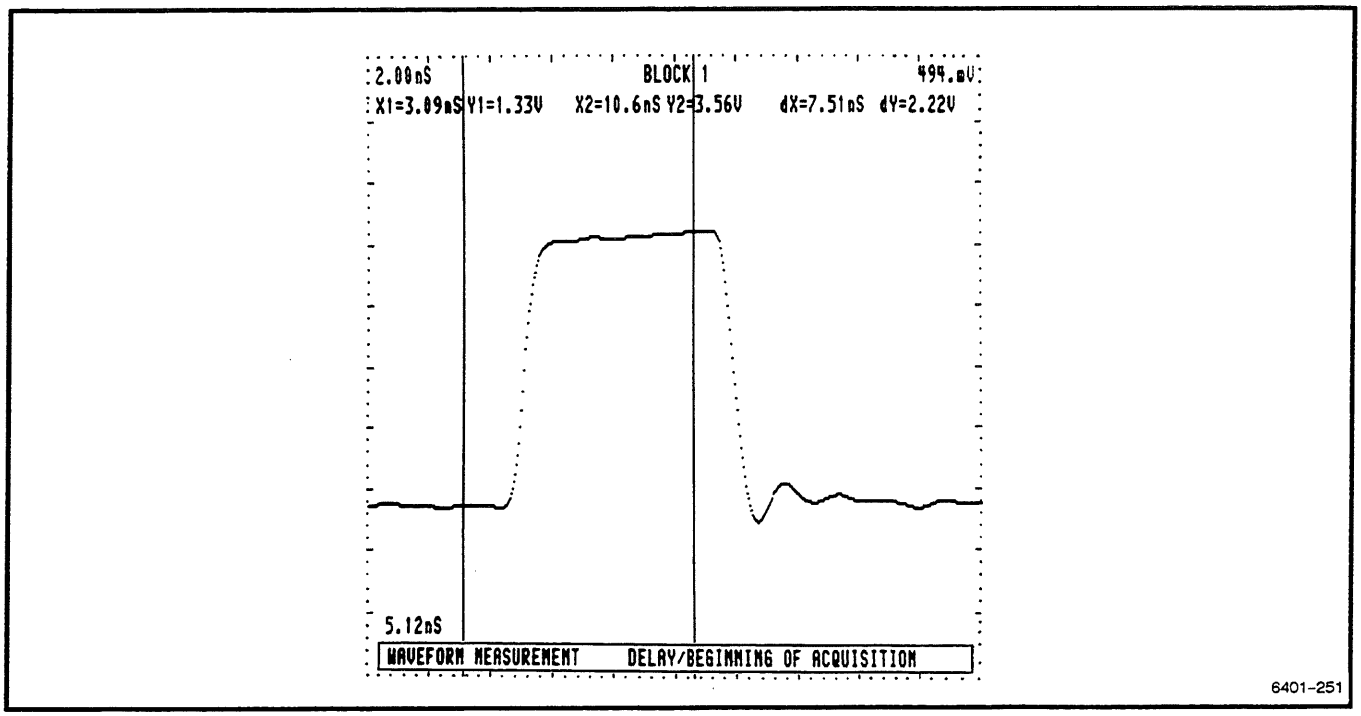

Figure 2-55. Delay/Beginning of Acquisition measurement.

Data Output to the Plotter

Stored waveforms may be output from the 7250 to either a Tektronix 4662 or a Hewlett Packard 7475A plotter. These outputs are controlled by the Plotter key in the Outputs control key section.

The Data Output setting on the 7250 Main Menu must first be set. Four options are listed in the menu:

- TEK/4662 Plotter with Axes
- TEK/4662 Plotter without Axes
- HP 7475A Plotter with Axes
- Hp 7475A Plotter without Axes

Choosing one of the two plotters 'with axes' will result in a waveform plot with scaled X and Y axes. Choosing one of the plotters 'without axes' will inhibit the plotting of scaled axes with the waveform. This may be desirable in the case of plotting several waveforms on one sheet.

The Plotter Key

To output a data block on the plotter, it is necessary to transfer its contents from the internal buffer. To do this, enter the block number, then press the Process key. This will select the stored waveform, perform the data processing specified on the Main Menu, and display the resultant waveform on the video monitor. Output to the plotter is now accomplished by pressing the Plotter key in the Outputs control key section on the front panel.

Connection between the 7250 and the plotter is performed via an RS232 link. The proper RS232 configuration and plotter settings are given in Appendix B. During plotting, the RS232 indicator light on the front panel is on.

The Other Key

This is reserved for future output devices.

Demonstrations

The following procedures are designed to familiarize the first-time operator with the 7250 functions and features. Included are procedure which demonstrate:

- Menu Functions
- Setup and Waveform Storage and Recall
- Acquisition Modes
- Display Functions
- Accumulate Function

The demonstrations are performed using a test signal with the following characteristics:

- Rise Time: 100 ps or less into 50 Ω
- Amplitude: 5 V into 50 Ω
- Trigger output: 5 V into 50 Ω
- Repetition Rate: at least 1 kHz

Menu Functions

This procedure demonstrates how the Menu and arrow keys are used to select and change menu settings.

1. Using the Up and Down Arrow keys from the Menu control key section, highlight each of the 13 menu settings with the reverse video. Stopping at each one, use the Left and Right Arrow keys to obtain the following displays:

   - Trigger Polarity: Range is Positive and Negative
   - Trigger Level: Range is 0.05 V to 10.00 V
   - Trigger Type: Range is Fast and Slow
   - Sweep Delay: Range is 50.00 to 5050.00 ns
   - Time Base: Range is 0.5 ns to 10 μs

NOTE

The maximum Time Base setting is restricted by the Sweep Delay setting:

Sweep Delay	*Max Time Base*
50–100 ns	*500 ps*
100–150 ns	*50 ns*
150–250 ns	*100 ns*
250–550 ns	*200 ns*
550–1050 ns	*500 ns*
1050–5050 ns	*1 μs*

- Sweep Type: Range is Internal and External.
- Vertical Position: Range is 0 to 100.
- Vertical Sensitivity: This factor is fixed by the CRT characteristics, but will range around 5 V, ±15%.
- Acquisition Mode: Range is Single Shot, Continuous, Averaging, Envelope, Burst, Permanent Defects, and Electrical Zero Value.
- Data Processing: Range is No Processing, Filtering with Calibration, Filtering without Calibration, Smoothing with Calibration, Smoothing without Calibration.
- Data Output: Range is TEK/4662 Plotter with Axes, TEK 4662 Plotter without Axes, HP 7475A Plotter with Axes, HP7475A Plotter without Axes.
- Display Mode: Range is Full Screen, Upper Half Screen, and Lower Half Screen.
- Waveform Measurement: Range is Minimum Value, Maximum Value, Peak to Peak Value, Averaging Value, Rise Time, Fall Time, Pulse Width, and Delay/Beginning of Acquisition.

2. Press the Menu key. The display should change to the Secondary Menu.
3. Using the Menu Up and Down Arrow keys, highlight each of 10 menu items with the reverse video. Stopping at each, use the Left and Right Arrow keys to obtain the following displays:

- Electrical Zero Level: Range is 0 to 2047 points
- Max Trace Thickness: Range is 1 to 2047 points
- Max Thickness Variance: Range is 1 to 2047 points
- Consecutive Interpolation of Points: Range is 0 to 511 points
- Smoothing NB of Points: Range is 1 to 15 points, odd integers only
- Focal Voltage*: Range is 0 to 4095

- MCP Voltage*: Range is 0 to 255
- Beam Current*: Range is 0 to 51.
- Horizontal Position*: Range is 0 to 4095
- GPIB Address: Range is 0 to 30, factory recommended setting is 17

***These menu settings are locked via software at factory. (See Numeric Keyboard section).**

4. Press the Menu key to display the Main Menu on the screen, then use the Menu Arrow keys to reset the menu as follows:

   - Trigger Polarity: Positive
   - Trigger Level: 4.00 V
   - Trigger Type: Fast
   - Sweep Delay: 100.00 ns
   - Time Base: 50 ns
   - Sweep Type: Internal
   - Vertical Position: 25
   - Display Mode: Full Screen

   The remaining settings can be left as set.

5. Store the current set by pressing 1 on the numeric keyboard, then press Store Setup. A small 1 will appear in the lower right corner of the screen, then disappear. This action stores the current set in setup memory location 1.

6. Change the following settings on the Main Menu using the Menu Arrow keys:

   - Trigger Level: 3.50 V
   - Sweep Delay: 95 ns
   - Time Base: 500 ns

7. Press 2 on the numeric keyboard, then press Store Setup. A small 2 will appear at the lower right corner of the screen, then disappear. This action stores this new set in setup memory location 2.

8. Press 1 on the numeric keyboard, then press Recall Setup. A small 1 will appear at the lower right corner of the screen, then disappear. This action recalls the setup in memory location 1 and places it in location 0, and displays it on the screen. Note that the values for Trigger Level, Sweep Delay, and Time Base have changed back to those set in step 6.

9. Press each of the Direct Access keys and note that the reverse video highlights the selected function.

10. Press the Graphics key. The display changes to a waveform display, but no waveform should be there yet as an acquisition has not been made.

11. Note that one of the menu items is displayed in the reverse video line across the bottom of the screen. Using the Menu Arrow keys, note also that any of the Main Menu items can be selected and be changed in value. Using any of the Direct Access keys, any of those functions can also be selected and changed in value.

12. Press Menu to display the Main Menu. Select Vertical Sensitivity with the Menu Arrow keys.

13. Press the Help key. The display will show the caption, "Specific for each CRT", and the reverse video line will show the actual sensitivity for this instrument. Pressing the Help key for each of the menu items on both the Main Menu and Secondary Menu produces a display of the ranges or choices for that function.

14. Press the Help key, then press each Direct Access key. The display will list the range or choices for each function.

Setup and Waveform Storage and Recall

This procedure demonstrates how to acquire, store, and recall waveforms. The storage and recall of setups is also demonstrated.

1. To display the setup in block 1, press 1 on the numeric keyboard, then press Recall Setup. Press Graphics, then press Continuous to begin arming successive acquisitions. The screen will produce images at the trigger arming rate.

2. Set the Time Base, Sweep Delay, and Vertical Position to display the rising edge of the acquired signal at screen center (see Fig. 2-56). Press Stop to discontinue the acquisitions. The last acquisition will remain displayed.

3. Press 1 on the numeric keyboard, then press Store Setup. This will store the setup in setup memory location 1.

4. Press 1 on the numeric keyboard, then press the Waveform Transfer key. This will store the waveform data in waveform memory location 1. This is not the same location as that used earlier for the setup data even though the address number is the same.

5. Again press Continuous to resume consecutive acquisitions. Alter the Sweep Delay and Time Base, as necessary, to display the trailing edge of the waveform. Press Stop to discontinue the acquisitions and display the last acquisition on screen.

6. Press 2 on the numeric keyboard, then press Store Setup. This will store the setup in memory location 2.

7. Press 2 on the numeric keyboard, then press Waveform Transfer. This will store the waveform data in memory location 2. Note this is not the same memory location as that used for setup data memory location 2 even though the address number is the same.

8. Press 1 on the numeric keyboard, then press Process. The rising edge of the waveform should be displayed on the screen. The Process function recalls the stored waveform, and performs whatever processing is selected by the Data Processing setting on the Main Menu. If "No Processing" is the selected Data Processing setting, the raw waveform is recalled.

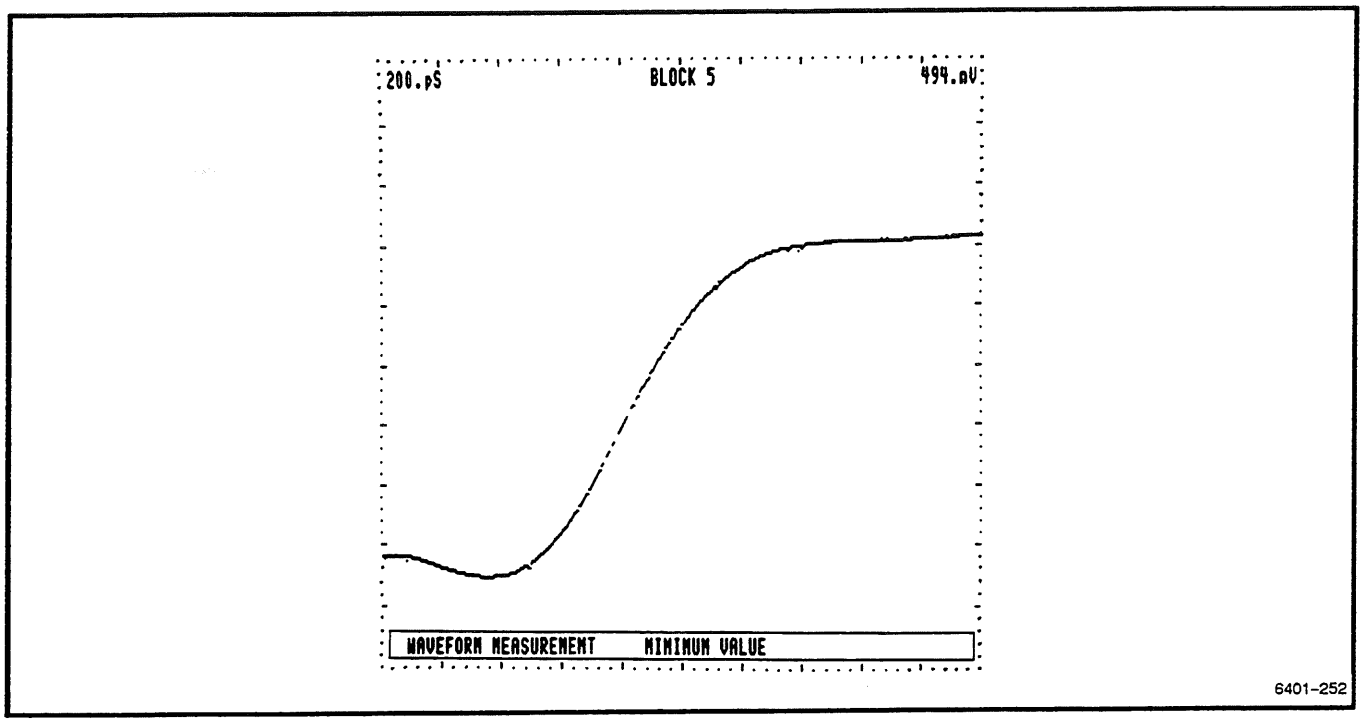

Figure 2-56. Waveform display showing rising portion of signal

Acquisition Modes

This procedure demonstrates how the Acquisition Modes function.

1. Press the Clear key. The display should return to the Main Menu, highlighting the last selection entered.
2. Press 1 on the numeric keyboard, then press Recall Setup. Setup 1 should be displayed on the screen.
3. Press Single Shot. The Ready indicator light should flash, and the screen will display the rising edge of the signal.
4. Press Continuous. The Ready indicator should flash repeatedly and the screen should display repeatedly the rising edge of the input signal. Press Stop.
5. Press Menu to select the Main Menu Display. Use the Menu Arrow keys to set the acquisition mode to Single shot.
6. Press Acquire. One acquisition and display should occur.
7. Using the Menu Arrow keys, select Continuous, and press Acquire. The display and indicator should indicate continuous acquisitions. Press Stop.
8. Using the Menu Arrow keys, select Averaging, press 5 on the numeric keyboard, then press Acquire. Five acquisitions should occur, with the average of the five waveforms being displayed after the last acquisition.
9. Using the Menu Arrow keys, select Envelope, press 8 on the numeric keyboard, then press Acquire. Eight acquisitions should occur, with the envelope curve being updated after each acquisition, and the result displayed.
10. Set the Time Base to 100 ns/div, and adjust the Delay to display a pulse on the screen. Store this pulse in locations 1 through 4 by pressing 1, then Waveform Transfer, then pressing 2, etc.
11. Press 1, then Recall Setup to recall setup 1.
12. Using the Menu Arrow keys, select Burst, press 4 on the numeric keyboard, then press Acquire. Four acquisitions should occur, with the first stored in location 0, the second in location 1, etc.
13. Press 4 on the numeric keyboard, then Process, to obtain a different display. Press 3, then Process. The display should match the one obtained with the Burst function.
14. Using the Menu Arrow keys, select Permanent Defects, press 4 on the numeric keyboard, then press Acquire. Four acquisitions should occur, and the table of faults will be stored and displayed. Other than the flashing of the indicator and the display, nothing else is shown if no defects are present.
15. Using the Menu Arrow keys, select Electrical Zero Value, press 8 on the numeric keyboard, then press Acquire. Eight acquisitions should occur, and the base line is displayed.

Display Functions

1. Set the Time Base to 10 μs/div.
2. Press the Graticule key. A 10 x 10 cm dotted graticule should appear.
3. Press the Cursor 1 key. The Cursor 1 indicator should light, a solid vertical line should appear, and X1 and Y1 coordinates should appear in the upper left corner of the display.
4. Press the Right or Left Arrow key to position the cursor on the left-most graticule line. The X1 readout should be 0.000 μs; the Y1 readout reflects the value of the vertical signal component at the point where the cursor intersects the trace.
5. Press the Right or Left Arrow key to position the cursor on the right-most graticule line. The X1 readout should be about 97.85 μs.
6. Press the Cursor 2 key. Both Cursor 1 and Cursor 2 should appear, but the Arrow keys control only Cursor 2.
7. Press the Right of Left Arrow key to position the cursor on the left-most graticule line. The X2 readout should be 0.000 ns. The Y2 readout reflects the value of the signal vertical component at the point where the cursor intersects the trace.
8. Press the Right or Left Arrow key to position the cursor on the right-most graticule line. The X2 readout should be about 97.85 μs.
9. Press Cursor Off. Both cursors should disappear.
10. Press Origin. A vertical line and a horizontal line should appear on the display.
11. Using the Cursor Arrow keys, position the lines to intersect graticule center.
12. Press Continuous to obtain a waveform, and position the rising edge of the waveform in the upper right quadrant of the display. This is the area to be magnified. Press Stop.
13. Press Mag On/Off. The upper right quadrant is now positioned in the lower left corner of the display. It may be necessary to reposition the display with the Cursor Arrow keys.
14. Press 2 on the numeric keyboard, then Mag X. Note that the display expands by 2 on the horizontal axis.
15. Press 2 on the numeric keyboard, then Mag Y. Note that the display expands by 2 on the vertical axis.
16. Press 8 and Mag X, then press 8 and Mag Y. Note that the display expands by 8 in both axes.
17. Press 1 and Mag X, then press 1 and Mag Y. The display should return to normal dimensions.

18. Press Mag On/Off to exit the magnify mode, then press Cursors Off to remove the origin lines on the display.

Accumulate

This procedure demonstrates how successive waveforms are superimposed and displayed.

1. Press Continuous and adjust the parameters for a rising edge at screen center.

2. Press Accumulate. The displayed waveform should continuously accumulate all consecutive displays, with the last imposed on the previous ones.

The 7250 Rear Panel

All input or output connections to the 7250 are made on the rear panel (see Fig. 2-57).

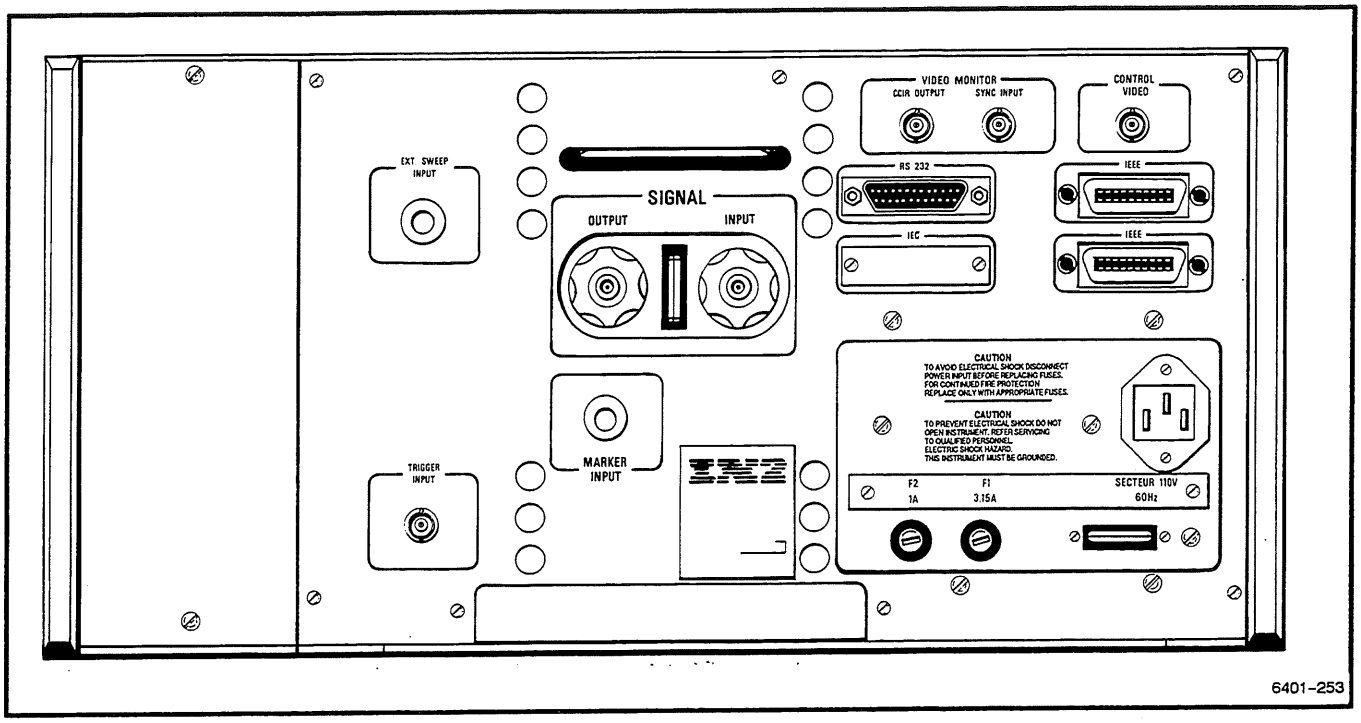

Figure 2-57. The 7250 rear panel.

Rear Panel Connectors

Ext Sweep Input: Type N connector that allows external application of a sweep signal (usually sinusoidal).

Trigger Input: BNC connector for application of the trigger input signal that initiates acquisition.

Signal-Output: Type N connector for signal output. This is the same signal that is applied for acquisition. This should be terminated in 50 Ω to avoid signal reflections interfering with data acquisitions.

Signal-Input: Type N connector for application of the signal to the acquisition circuits.

Marker Input: Type N connector used for application of time markers. These are used principally for relating time measurements to an external video system.

Video Monitor

CCIR Output: Used to drive external equipment, such as video monitors.

Sync Input: BNC connector for conveying the sync signal from an external device to synchronize the CCIR Output signal.

Control Video: BNC connector that conveys a vertical-scan, 625 line, 50 Hz signal that represents the acquired display. This is the unprocessed video signal.

IEEE: 24 pin connector for GPIB interface operations. The 7250 comes equipped with two such connectors in parallel.

RS 232: 24 pin connector that is used only for direct connection to a plotter, in conjunction with the Outputs control keys on the front panel.

IEC: Not used.

Transfer Commands for Non–Volatile Data in RAM and EEPROM

The following data are stored in non-volatile memory:

- Setups 0 to 3.
- The secondary parameters for each sweep speed.
- The image of permanent faults.
- Static and dynamic correction terms.

At power–up, the processor tests the validity of settings contained in non–volatile RAM (NVRAM). If these settings are incorrect, the processor tests the validity of settings contained in EEPROM. If these are correct, they are loaded into NVRAM. Otherwise, the non–volatile memory is loaded from the REPROM containing default settings. (See Fig. 2–58.)

The non–volatile data are arranged in two tables:

- One table containing setups 0 to 3, the secondary parameters, and the image of permanent faults
- One table containing the static and dynamic correction terms.

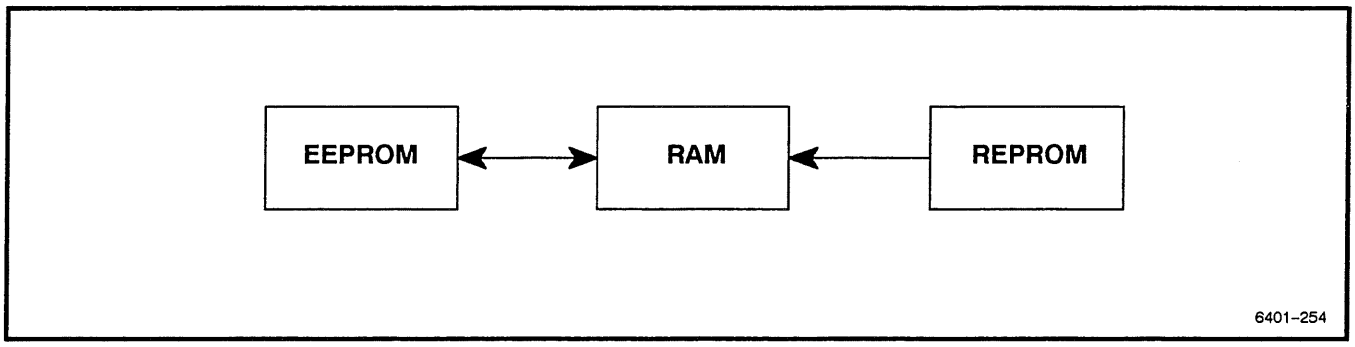

Figure 2–58. Non–volatile data transfer

Two commands are available for the user to transfer tables from EEPROM to NVRAM. Both commands are executed on the numeric keyboard by first entering a code number, then pressing Enter. These commands are listed in a special Help menu which is displayed by pressing the Enter key when there are no numeric entries on the screen. The two transfer commands on this list are as follows:

3. – transfer all menus from EEPROM to RAM

This command is executed by pressing the number 3 on the numeric keyboard, then pressing the Enter key. This action transfers the table containing setups, secondary parameters, and the image of permanent faults from EEPROM to NVRAM (see Fig. 2-59).

4. – transfer all calibration parameters from EEPROM to RAM

This command is executed by pressing the number 4 with the numeric keyboard, then pressing the Enter key. This action transfers the table containing the static and dynamic correction terms from EEPROM to NVRAM (see Fig. 2-59).

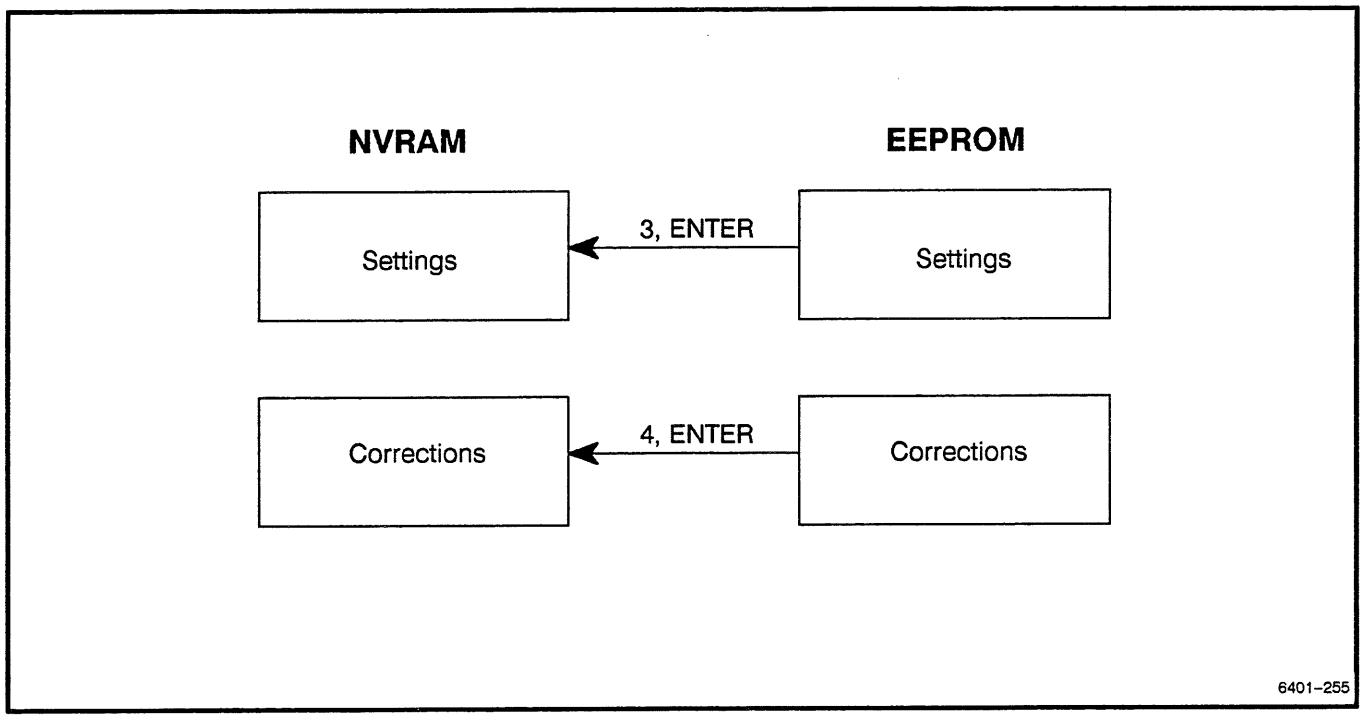

Figure 2-59. Transfer commands for non-volatile data in NVRAM and EEPROM

Section 3
GPIB Interface

This section contains instructions for remote operation of the 7250 over the IEEE-488 General Purpose Interface Bus (GPIB). All the 7250 front panel functions (except Power On/Off and CRT Intensity) can be performed over the GPIB. The 7250 can receive commands and data, or send waveform data over the GPIB. Also, the 7250 local display behaves in the same way, whether a setting comes from the local control keys or over the IEEE bus. This is true whether the instrument is in Menu mode showing current set contents, the Help mode, or the Graphics mode.

Included in this section are the following:

- Setting the GPIB Address
- Command and Processing Conventions
- The three stages of GPIB Operation:
  - Setting
  - Data Acquisition
  - Data Processing and Retrieval
- Special GPIB Commands
- 7250 GPIB Status Byte Information
- Examples of GPIB operation
- Command Description Reference, including an alphabetical listing of all commands with description of each.

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IEEE Functions Performed by the 7250

The 7250 is equipped with an interface that conforms to a subset of the provisions of IEEE-488, and to a part of the stipulations of TEK Codes and Formats. Table 3-1 lists the GPIB functions that are performed by the 7250.

TABLE 3-1
Interface Functions

Code	Function	Capability
SH1	Source Handshake	Full
AH1	Acceptor Handshake	Full
T5	Talker	Full*
L3	Listener	Full*
SR1	Service Request	Full
RL1	Remote/local	Full**
PP0	Parallel Poll	None
DC1	Device Clear	Full
DT1	Device Trigger	Full
C0	Controller	None

***No secondary addressing**
****Front panel indicator lights do not correctly indicate the internal remote and local states of the instrument.**

Although the 7250 responds to commands from a GPIB controller, certain aspects of its programming performance differ from standard GPIB programming conventions. The 7250 also operates using only a subset of the TEK Codes and Formats standard. Watch carefully for special programming notes.

Setting The GPIB Address

The GPIB Address is set on the 7250 front panel Secondary Menu. The address range is 0 to 30. However the factory designated address is 17 which normally should be used. Press the Menu key until the Secondary Menu is displayed. Select the GPIB Address setting with the menu arrow keys and set the address.

CAUTION

The GPIB Address can be changed if a sequence of TCH commands (TCH 6 or TCH 7) is sent to the 7250. The Secondary Menu must be selected and the reverse video must be on GPIB Address. If these commands are sent, the GPIB Address will change and the 7250 will not be controllable by remote operation.

7250 Commands and Processing Conventions

Command Headers

All device-dependent commands are abbreviated to two or three letter mnemonic labels called headers. For example, the Vertical Position setting has the command header VER. To alter this setting, the header VER (followed by an integer) is the necessary command message. If you attempt to enter the entire word, VERTICAL, the command is ignored and, if EXR (Execution Error) is on, an execution error is reported. For some commands, the header is all that is necessary to invoke the command.

Arguments

Some commands require the addition of an argument to the header. The argument further specifies the action to be taken. If an argument is necessary, it follows the header and must be separated by a space. For example, in the string:

ACQ SGL

ACQ is the header for Acquisition Mode and SGL is the argument specifying Single Shot.

7250 commands will specify arguments in three formats:

Mnemonic Arguments: in three or four letters, like FILC in the command PRO FILC

Word Arguments: like ON or OFF in the command RQS ON or RQS OFF

Numeric Arguments: in IEEE number format **<NR1>**, **<NR2>**, or **<NR3>**.

The syntax notation < > delimits the argument.

For example, the Sweep Delay setting specifies header DLY with numeric argument <NR3>: DLY <NR3>

<NR1>	Integer:	without decimal point, representation of zero by <NR1> must not contain a minus sign. **Examples:** +1245, -328, +0000, 0
<NR2>	Explicit Decimal Point:	fixed point number with decimal point, representation of zero by <NR2> must not contain a minus sign. **Examples:** 0.123, +5.41, -6.420, 0.0000

<NR3>	Floating Point, Exponential, or Scientific Notation:	The mantissa must always include a decimal point. The exponent following the mantissa begins with the character E followed by a plus or minus sign and one or more digits. Representation of zero by <NR3> must contain a fixed point representation of zero, followed by an exponent with plus sign and one or more digits, all zero. **Examples:** –1.5E+03, 2.E–1, 5.0E–2, +0.0E+00

Both signed and unsigned (+ or –) numbers are accepted in all three formats, with unsigned numbers changed to be positive. Numbers returned as the result of a query will be in the format specified in the command.

Example: The Sweep Delay setting, with header and numeric argument format DLY <NR3>, could be expressed DLY 1.147E–07

Query Commands

A query command requests the 7250 to output information. Query format is a command header with a question mark (?).

Example:

The ID? query requests instrument identification. The response from the 7250 to the controller is "ID TEK/7250,V4.3".

NOTE

Avoid command messages containing multiple queries. If a command message contains more than 1 query, the 7250 will send a response only to the last query in the message.

Command Format

All command messages (headers and arguments) can be entered in all upper case, lower case, or mixed upper and lower case letters.

Group Command Messages

Command messages may be sent as individual commands, or as group commands. Each command in a group message must be separated by a semicolon. Group command messages sent to the 7250 can be any length. A semicolon at the end of a command message is optional.

Example:

TRI NOR;SWP INT;ACQ CON;

Message Terminator

The message terminator is used to indicate the end of a message transfer. The most common terminators are the EOI (End Or Identify) signal line, the character LF (Line Feed), and the character CR (Carriage Return).

The 7250 receives input messages terminated by any of three sequences of characters:

CR, LF

CR, EOI

CR, LF, EOI

All output messages from the 7250 are terminated by the character sequences:

CR, LF, EOI

Using the 7250 with the GPIB

Operation of the 7250 with the GPIB is described in three categories:

- Setting up the instrument
- Data Acquisition
- Data Processing (and Retrieval)

It is recommended that you study Table 3-2 at this time to become generally familiar with all the GPIB commands, paying particular attention to the Trigger, Main Settings, Secondary Settings, Data Acquisition, and Data Processing command groups. The GPIB Command Reference at the end of Section Three provides more complete information about each command.

The following directory lists all GPIB commands, with a brief description of each. The commands are organized into functional groups.

TABLE 3-2
GPIB Command Listing

Description	Command	Argument
TRIGGER		
Trigger Polarity:	POL	
Positive		POS
Negative		NEG
Sweep Delay:		
Range is 50 to 5000 ns.	DLY	<NR3>
Trigger Level:		
Range is 50 mV to 10 V.	LEV	<NR2>
Trigger Type:	TRI	
Normal		NOR
Fast		FAS

TABLE 3–2 (cont)
GPIB Command Listing

Description	Command	Argument
MAIN SETTINGS		
Sweep Type:	SWP	
Internal		INT
External		EXT
Time Base:		
Range is 50 ps to 1 μs in 14 steps.	HOR	<NR3>
Vertical Position:		
0 to 100% in 1% steps.	VER	<NR1>
SECONDARY SETTINGS		
Beam Current:*		
Range is 0 to 511.	XBE	<NR1>
Focal Voltage:*		
Range is 0 to 4095.	XFO	<NR1>
Microchannel Plate Voltage:*		
Range is 0 to 255	XMC	<NR1>
Horizontal Position:*		
Range is 0 to 4095	XHO	<NR1>

CAUTION

Prolonged operation of the 7250 with altered values may damage the 7250.

***NOTE**

These secondary settings must be unlocked before they can be changed. (Press 2, then Enter to unlock settings from front panel.) The TCH 27;TCH 36 group command unlocks settings from remote. (Press 1, then Enter to re-lock settings from front panel.) The TCH 26;TCH 36 group command locks settings from remote.

TABLE 3-2 (cont)
GPIB Command Listing

Description	Command	Argument
DATA ACQUISITION		
Acquisition Mode:	ACQ	
Single Shot		SGL
Continuous		CON
Averaging		AVG
Envelope		ENV
Burst		BUR
Permanent Defects		DEF
Electrical Zero Value		ZER
Arm:		
Trigger enable for selected Acquisition Mode. <NR1> is required for BUR, AVG, ENV, DEF, and ZER arguments.	ARM	<NR1>
No numeric argument for CON or SGL.	ARM	(none)
<NR1> ranges: AVG: 1-1000 ENV: 1-1000 DEF: 1-1000 ZER: 1-1000 BUR: 15 (31 for Option 2D).		
DATA PROCESSING AND RETRIEVAL		
Data Processing:	PRO	
No processing		RAW
Filtering without Calibration		FIL
Filtering with Calibration		FILC
Smoothing without Calibration		SMO
Smoothing with Calibration		SMOC
Execute selected data processing on waveform stored in memory address <NR1> and place in block 0.	EXE	<NR1>
Retrieve processed waveform data stored in memory location 0 over the GPIB.	WFR?	

TABLE 3-2 (cont)
GPIB Command Listing

Description	Command	Argument
FRONT PANEL EMULATION		
GPIB emulation of front panel functions. Executing the TCH <NR1> command emulates pushing the corresponding front panel control key.		
Front Panel Function:	**TCH**	**<NR1>**
Menu (Main/Secondary)		1
Help Menu		2
Graphics mode		3
Up Arrow		4
Down Arrow		5
Left Arrow		6
Right Arrow		7
Trigger Level		8
Sweep Delay		9
Time Base		10
Vertical Position		11
Display Mode		12
Waveform Measurement		13
Single Shot		14
Continuous		15
Acquire		16
*Stop		17
Process		18
Other		19
Plotter		20
Measure		21
Waveform Transfer		22
Store Setup		23
Recall Setup		24
Zero		25
One		26
Two		27
Three		28
Four		29
Five		30
Six		31
Seven		32
Eight		33
Nine		34
Backspace		35

TABLE 3-2 (cont)
GPIB Command Listing

Description	Command	Argument
FRONT PANEL EMULATION (cont)		
Front Panel Function:	**TCH**	**< NR1 >**
Enter		36
Cursor 1		37
Cursor 2		38
(Cursor) Off		39
Graticule		40
Accumulate		41
Cursor Pos/Origin Pos Up		42
Cursor Pos/Origin Pos Down		43
Cursor Pos/Origin Pos Left		44
Cursor Pos/Origin Pos Right		45
Origin		46
Mag X		47
Mag Y		48
Mag On/Off		49
*Clear		50

***NOTE**

The commands TCH 17 (STOP) and TCH 50 (CLEAR) do not operate identically to the front panel controls. For TCH 17, the SDC or DCL command operates as the stop key.

INSTRUMENT PARAMETER COMMANDS AND QUERIES	
Returns values of setting parameters.	SET?
Initializes current settings to pre-determined set.	INI
Execute selftest sequence Note: Requires 16 seconds to complete; to avoid possible time out, do not use bus until operation is complete.	TES
Queries instrument identification	ID?

TABLE 3-2 (cont)
GPIB Command Listing

Description	Command	Argument
SERVICE REQUEST COMMANDS AND QUERIES		
Service Request function:	RQS	
Enable (all functions except Power-On):		ON
Disable (all functions except Power-On):		OFF
Queries RQS message function	RQS?	
Operation Complete Service Request:	OPC	
Enable		ON
Disable		OFF
Queries OPC message function	OPC?	
Command Error Service Request:	CER	
Enable		ON
Disable		OFF
Queries CER message function	CER?	
End of Sweep Service Request:	EOS	
Enable		ON
Disable		OFF
Queries EOS message function	EOS?	
Execution Error Service Request:	EXR	
Enable		ON
Disable		OFF
Queries EXR message function	EXR?	

TABLE 3-2 (cont)
GPIB Command Listing

Description	Command	Argument
INTERFACE COMMANDS		
Device Clear: Reinitializes communication between the 7250 and controller. The 7250 clears any input and output messages, unexecuted control settings, or errors and events waiting to be reported, except power-on. The Device Clear command is abbreviated DCL (not a header).		
Selected Device Clear: Functions the same as Device Clear, except only instruments addressed as listener respond. Selected Device is abbreviated SDC (not a header).		
Local Lock-Out: Locks out operation of the 7250 with the keyboard. Local Lock Out is abbreviated LLO (not a header).		
Go To Local: When the Local Lock-Out condition has been entered, Go To Local allows use of the keyboard until the next GPIB message causes the 7250 to again enter Remote mode and the keyboard is again locked-out. Go To Local is abbreviated GTL (not a header).		

Setting the Instrument

Setting up the instrument involves primarily the Trigger, Main Setting and Secondary Setting command groups. Secondary settings are automatically set to default values unless the user overrides them. (Emulation of other front panel functions is done using the TCH command.) The settings are selected and set using the commands composed of header and argument.

An example setup follows:

POL POS	Selects Trigger Polarity and sets to Positive
DLY 4.E-07	Selects Sweep Delay and sets to 450 ns
LEV 1	Selects Trigger Level and sets to 1 V
TRI FAS	Selects Trigger Type and sets to Fast
SWP INT	Selects Sweep Type and sets to Internal
HOR 2.0E-09	Selects Time Base and sets to 20 ns/div
VER 25	Selects Vertical Position and sets to 25%
PRO FILC	Selects Data Processing and sets to Filtering with Calibration
ACQ SGL	Selects Acquisition Mode and sets to Single Shot

Each setting command sent can be monitored using the SET? query, after which the 7250 sends a list of all the settings in the current set. An example SET? query looks like this:

POL NEG;LEV 0.08;TRI FAS;DLY 1.717E+17;HOR 2E-09;SWP INT;VER 40;XFO 1888; XMC 48;XBE 511;XHO 100; ACQ SGL;PRO SMO<13><10> (count=113)

Data Acquisition

Waveform acquisitions are done by first selecting the acquisition mode, then giving the ARM command. (See The 7250 Acquisition Modes in Section 2 for definitions of the acquisition modes.) The type of acquisition mode is selected using one of the following GPIB commands:

ACQ SGL	Single Shot
ACQ CON	Continuous
ACQ AVG	Averaging
ACQ ENV	Envelope
ACQ BUR	Burst
ACQ DEF	Permanent Defects
ACQ ZER	Electrical Zero Value

After the acquisition mode is set the ARM command is given. This command arms the instrument; the acquisition is initiated upon receipt of a trigger signal. The usual format for this command is ARM <NR1>. The <NR1> parameter specifies the number of acquisitions to be performed. This applies to the Averaging, Envelope, Burst, Permanent Defects, and Electrical Zero Value acquisition modes. The range for <NR1> is 1 to 1000. No numeric argument is required for the Single Shot or Continuous modes.

An example acquisition setup follows:

ACQ AVG	Selects averaging mode
ARM 10	Arms the 7250 for ten acquisitions

Data Processing and Retrieval

Processing waveform data and retrieving the results are accomplished in three steps:

- The type of data processing to be used is selected using the PRO command with the appropriate argument
- The EXE <NR1> command is given to execute the processing
- The WFR? command is given to retrieve the processed waveform data over the GPIB

The type of data processing used is selected using one of the following GPIB commands:

PRO RAW	No Processing
PRO FILC	Filtering with Calibration (suppression of permanent faults, with corrections, filtering and interpolation).
PRO FIL	Filtering without Calibration (suppression permanent faults, filtering and interpolation).
PRO SMOC	Smoothing with Calibration (removal of permanent faults, with corrections, filtering, interpolation and smoothing).
PRO SMO	Smoothing without Calibration (suppression of permanent faults, filtering, interpolation and smoothing).

Once the type of data processing is selected, the EXE <NR1> command is given to execute the processing. The resulting waveform is displayed on the local screen. <NR1> selects the memory address of the stored waveform.

To retrieve the waveform data over the GPIB, the WFR? command is given. This command retrieves the last data processed on the 7250.

NOTE

In response to the WFR? Query, the 7250 sends a proprietary data stream. See Appendix A, Data Structure

Example:

After the processing is set, a processing and retrieval setup is shown as follows:

EXE 0	Initiates data processing specified in current set. The data stored in block 0 is processed, displayed on the local screen and stored in location 0.
WFR?	Sends the data stored in location 0 over the GPIB.

The TCH Command: Front Panel Emulation via IEEE Bus

The front panel control key functions are not accessible with a direct GPIB command. This includes such operations as:

- Changing menus
- Changing the display mode
- Using the display functions
- Executing numeric keyboard commands
- Making waveform measurements
- Waveform and setup storage and recall
- Output of waveform data to a plotter

The TCH command permits emulation of the front panel keys. The syntax is TCH <NR1>, in which <NR1> designates a code number between 1 and 50. In most cases, executing the TCH command with the appropriate code emulates pressing the corresponding control key. Refer to Table 3-2 or the Command Reference at the rear of this section for a listing of the argument codes and corresponding front panel function.

NOTE

The commands TCH 17 (STOP) and TCH 50 (CLEAR) do not operate identically to the front panel controls. For TCH 17, the SDC/DCL command operates as the STOP key.

Menu items for which there is no GPIB command can also be accessed using the TCH command. For example, emulating the Secondary menu key, then the Down Arrow key to the Smoothing NB of Points setting, then emulating the Right or Left Arrow key will change the value of the setting.

Getting Started

The first step in getting started is to review the 7250 capabilities which are described in detail in Section Two. Then review the GPIB command descriptions, the other GPIB functions, and special programming notes in this section before proceeding further.

Connecting Your System

All connections to the 7250 are made at the rear panel (see Fig. 2–56) including power, signal, GPIB, and RS 232 (plotter only). There are two IEEE 488 connectors, which are connected in parallel.

WARNING

Dangerous voltages exist in the 7250, even when the power is off. To avoid personal injury, refer line voltage setting charges to a qualified service technician.

Power Up Selftest and SRQ

When the power is turned on the 7250 front panel, a selftest procedure is initiated. Upon completion of this procedure (and after a 180 second countdown) the 7250 sends a service request (SRQ) on the IEEE–488 bus. The service request can be canceled by a serial poll or any valid control signal from the 7250.

The SRQ indicator light:

- Is on when the 7250 places an SRQ on the IEEE bus.
- Is off when the controller sends a serial poll.
- Is always on in the absence of a controller.

IEEE Mode Special Commands

Instrument Parameter Commands and Queries

The following commands and queries give the operator additional information such as checking or reinitializing the current setup, proper command execution, or instrument identification and functioning.

The ID? Query: Instrument Identification

The ID? query gives the instrument model and firmware version. The 7250 responds to ID? with ID TEK/7250,V4.3.

The SET? Query: Current Settings

Upon receipt of the query SET?, the 7250 sends a list of all settings stored in the current set. The user can monitor reception of setting commands on the 7250 using this query. An example SET? response:

POL NEG;LEV 0.08;TRI FAS;DLY 1.717E+17;HOR 2E-09;SWP INT;VER 40;XFO 1888; XMC 48; XBE 511; XHO 100; ACQ SGL;PRO SMO<13><10> (COUNT=113)

Avoid command messages containing multiple queries. If a command message contains more than 1 query, the 7250 will send a response only to the last query in the message.

Example:

If the message SET?; ID? is sent, the response will be to the ID? query only: ID TEK/7250,V4.3.

The TES Command: 7250 Selftests

This command permits execution of a series of selftests similar to those executed at power-on. Upon completion of these tests, the 7250 presents the message OPERATION COMPLETE (66 or 2) if no defect has been detected, or INTERNAL ERROR (99 or 35) if a defect has been detected. The sequence of tests lasts 16 seconds and is not interruptable. Placing another command on the bus before the operation is complete may cause a time-out situation.

The INI Command: Initialization to Pre-determined Set

This command resets the 7250 to a pre-determined set as follows:

Trigger Polarity	Positive
Trigger Level	1.00 V
Trigger Type	Normal
Trigger Delay	100 ns
Sweep Speed	10 ns/div
Sweep Type	Internal
Vertical Position	0%
Acquisition Mode	Single Shot
Data Processing	No processing

The Device Clear (DCL) and Selected Device Clear (SDC) Commands

The Device Clear (DCL) and Selected Device Clear (SDC) messages are used to restart device-dependent message processing between the 7250 and the controller. The 7250 answers a Device Clear or Selected Device Clear message by doing the following:

- Clearing any service requests (SRQ) (errors or events waiting to be reported)
- Clearing input and output messages or any acquisitions in process
- Not changing any settings or stored data

The Selected Device Clear message will clear only the device addressed as listener, whereas the Device Clear message will clear all devices so the communication channel is again ready for device-dependent messages.

When the IFC (Interface Clear) line changes to status 1, any data input or output is interrupted. If the 7250 is in talk mode or listen mode, the data transfer is also interrupted.

The Local Lock-Out (LLO) and Go To Local (GTL) Commands

Upon completion of the selftests at power-on, the 7250 is in LOCAL mode: the keyboard is operative and the LOCAL indicator light is on. The SRQ indicator light is also on to indicate that the instrument has placed an SRQ on the IEEE bus. The 7250 is operational for front panel controls. A message sent to the 7250 over the GPIB puts the 7250 into the REMOTE mode; the RMT indicator light is on and the LOCAL indicator light is off.

The user can lock-out local keyboard operation, if necessary, by sending the Local Lock-Out (LLO) command. This command has no effect on the current LOCAL or REMOTE mode of the 7250. However after the LLO command is sent, if the user places the 7250 in the REMOTE mode with a GPIB message, all further activity from the keyboard will have no effect.

To re-enable the keyboard, the Go To Local (GTL) command is used. The keyboard will remain functional only until the user sends a message via GPIB to again enter the REMOTE state. The 7250 cannot be changed from the REMOTE to the LOCAL state from the front panel. The LLO command controls front panel lock-out, the GTL command re-enables front panel use (and therefore LOCAL state) but only until another GPIB message causes the 7250 to enter REMOTE mode. The 7250 then is again in the Local Lock- out condition.

REN FALSE will cause an exit from the Local Lock-Out state. This will allow the front panel to be used in a normal manner even when the device returns to remote since all keys generate the local Return To Local (RTL) command and will cause the device to go to a local control condition.

Status Reporting

Through the service request function, the 7250 can report operating status to the controller. Its purpose is to inform the controller of conditions warranting attention, such as an error condition or the completion of an operation. This function can aid in debugging and in high-level troubleshooting.

Using SRQ with IEEE-488

The term SRQ is the title of a GPIB line used for a service request. The standard GPIB status and error reporting system used by the 7250 sends interrupts to the bus controller by asserting the SRQ line on the bus. The SRQ line is one of eight control lines defined in the IEEE-488 standard. When that line is asserted by any device, the controller performs a serial poll to determine which of the connected devices asserted the SRQ line. This poll consists of reading a special byte (called Status Byte) from each instrument which is decoded by the user to determine the reason for the SRQ. Status Bytes report the category of the event that caused the SRQ, returning information such as "Power On", "Execution Error", and so on. They can be used to initiate corrective action, or to recover the performance of a command. A list of Status Bytes that can occur is found in Table 3-3.

NOTE

The 7250 does not have an EVEnt? query to further specify the status condition.

Service Request Commands

The RQS command controls the instrument ability to request service. A subset of SRQs for communicating that certain instrument processes or conditions have been finished are listed below. They can be set enabled (ON) or disabled (OFF) as necessary, but all are subordinate to whether the RQS command is enabled (ON) or disabled (OFF). When switching on the system, all the service request functions are initialized in the enabled (ON) state. Each service request function has a query which responds with its enabled/disabled status. The service request commands and respective queries are listed as follows:

RQS	ON OFF	Service Request: enables (ON) or disables (OFF) the service request function.
RQS?		Queries whether service request is enabled or disabled.
OPC	ON OFF	Operation Complete: enables (ON) or disables (OFF) service request concerning completion of a control operation.
OPC?		Queries whether OPC is enabled or disabled.
CER	ON OF	Control Error: enables (ON) or disables (OFF) a service request concerning a control error.

CER?		Queries whether CER is enabled or disabled.
EXR	ON OFF	Execution Error: enables (ON) or disables (OFF) a service request concerning an execution error.
EXR?		Queries whether EXR is enabled or disabled.
EOS	ON OFF	End Of Sweep: enables (ON) or disables (OFF) a service request do to an end of sweep.
EOS?		Queries whether EOS is enabled or disabled.

The RQS command has two major functions:

1. It controls the Data Input/Output bit 7 (DIO7) of the status byte. The command RQS ON enables DIO7 assertion. The command RQS OFF disables DIO7 assertion. RQS interrupts are masked.

2. This command also controls whether the oscilloscope can request service from a controller. When the instrument has RQS OFF, bit 7 (DIO7) of the status byte will always be set to 0 and no SRQ will be generated over the GPIB. When the instrument has RQS ON and at least one other service request command ON, (i.e., OPC, CER, EXR or EOS) and SRQ will be generated by the 7250 for those enabled service requests.

Examples:

RQS ON and OPC ON: Each command will generate an SRQ

RQS ON and OPC OFF: No Operation Complete SRQs generated

RQS OFF and OPC ON: No SRQs produced

RQS OFF and OPC OFF: No SRQs produced

When RQS is off, the controller may periodically check status bytes to monitor the state of the 7250. When RQS is ON, the system will generate interrupts to the controller. This mode is best when the controller is working with several devices.

NOTE

When RQS is ON, each command asserts SRQ with a status byte of 66 (Operation Complete). When RQS is off, a status byte of 2 is reported (operation complete and bit 7 reset). As a result, auto-polling is not effective with the 7250.

Status Byte Definition

A Status Byte consists of eight bits of information. Bit 8 is the Most Significant Bit (MSB) and bit 1 is the Least Significant Bit (LSB). The bit assignments are as follows:

Bit 8: Data Ready bit
Bit 7: Request service bit (set to 1 when service is requested)
Bit 6: Abnormal status bit (set to 1 when the system is abnormal)
Bit 5: Busy bit (set to 1 when the device is busy)
Bit 4: System status bit 4
Bit 3: System status bit 3
Bit 2: System status bit 2
Bit 1: System status bit 1

The last four bits make up the status byte code that identifies each type of status reported. Overall, the value of the eight bits represents a single system status condition. Status conditions divide into two classes, normal (bit 6 not set) and abnormal (bit 6 set).

Five normal conditions are defined:

1. **No Status To Report:** reported when there is no event or device dependent status to report.
2. **Power On:** reported when the oscilloscope has finished its power-on sequence. This action informs the controller that the oscilloscope is ready for operation.
3. **Operation Complete:** tells the controller that a task has been completed.
4. **End Of Sweep:** reported when the end of a sweep occurs.
5. **Busy:** Indicates the 7250 has not completed an operation.

NOTE

A message sent to the 7250 when it is in the BUSY state will be ignored. However, a group command sent to the 7250 will be executed successively, while the 7250 is the the BUSY state. This is particularly important for instrument control involving command sequences using the Continuous acquisition mode (refer ACQ CON in the Command Description Reference).

Four abnormal conditions are:

1. **Command Error:** reported when a message cannot be parsed or lexically analyzed.
2. **Execution Error:** reported when a message is parsed but cannot be executed.
3. **Internal Error:** reported when the 7250 has detected a malfunction which could cause the instrument to operate incorrectly.
4. **Warning:** reported when the 7250 is operational, but the user should be aware of potential problems.

TABLE 3-3
Status Bytes

	BINARY		DECIMAL	
Condition	**DIO: 8765**	**4321**	**RQS ON**	**RQS OFF**
Device Dependent Status:				
Data Ready	1R0X	0001	193	129
Abnormal:				
Command Error	0R1X	0001	97	33
Execution Error	0R1X	0010	98	34
Internal Error	0R1X	0011	99	35
Warning	0R1X	0100	100	36
Normal:				
No Status To Report	000X	0000	0	0
Power On	0R0X	0001	65	*
Operation Complete	0R0X	0010	66	2
End Of Sweep	0R0X	0011	67	3
Busy	0R01	0000		16

NOTE

Bit 7 (DIO7), shown as R in this table, is asserted when specifically enabled by the device dependent RQS command. Otherwise, the R bit is 0. Bit 5 (DIO5) is 1 when the 7250 is busy. Since the 7250 powers up with all SRQs unmasked, a Power On status byte of 1 will never appear.

Operating Notes

A command string must begin with a non-blank character. If the string contains a leading blank, the 7250 will not execute the command string and will report an Operation Complete (66).

When the 7250 is placed in talk mode and has no data to send, it sends the message TWNTS (Talk With Nothing To Say). The controller, after having placed the 7250 in talk mode and after having received the last character of a message (on the EOI line) must send a command which deactivates the talk function, such as UNT or OTA.

Any attempt to modify the value of one of the secondary settings (XFO, XMC, XBE, or XHO) if these settings are locked, the 7250 issues the status word "Warning", and does not modify the setting.

- If RQS is OFF, then Status = 36
- If RQS is ON, then Status = 100

IEEE Mode Examples: Command Sequences and Status Bytes

General Command Processing Sequence

The general command processing sequence for the 7250 is as follows::

When the instrument receives a group message with several commands, it:

- issues the status word Busy (16)
- executes the commands in the message
- issues the status word Operation Complete (66 or 2)

After a waveform acquisition, or after processing a waveform:

- The 7250 issues the status word Data Ready (193 or 129) when the image is seen on the local screen.

Programming the Instrument

1. The controller sends POL POS;SWP INT

   The 7250 receives the message, sets the status word to Busy (16), processes the message, executes the commands, and then issues the status word, Operation Complete (66 or 2). On the 7250 screen, it can be verified that the polarity of the trigger is positive, and that the sweep type is internal. This can also be verified by executing a SET? query and checking the parameter values in the response.

2. The controller sends PAL POS.

   The 7250 sets the status byte to Busy and processes the message. An error is detected; the mnemonic PAL is not in the 7250 command list. The status byte is set to Command Error (97 or 33).

3. The controller sends SWP SGL.

   The 7250 sets the status byte to Busy and processes the message. An error is detected; the argument SGL is not in the list of arguments for the SWP command. The 7250 sets the status byte to Execution Error (98 or 34).

Query Responses

1. The controller sends the ID? query.

   The 7250 receives the message, sets the status byte to BUSY, and processes the message. The response is ID TEK/7250, V4.3 and the status byte is set to Operation Complete (66 or 2).

2. The controller sends the SET? query.

   The 7250 responds with a listing of all current settings in command format.

The waveform data query WFR? follows the same principle: The controller sends WFR? and waits for the status word Operation Complete (66 or 2). The controller then places the 7250 in the talker mode to receive the response.

3. Data Retrieval: WFR?

   Assume the 7250 acquisition mode is set to Single Shot. The controller sends ARM. The 7250 sets the status word to Busy, then to Operation Complete (66 or 2) after processing the command. The 7250 is first armed and awaits a trigger. When the trigger arrives, the 7250 digitizes the waveform of the present signal on arrival, displays this waveform and sends the status word Data Ready (193 or 129). To retrieve the data, the controller sends WFR?.

4. Selftests

   The controller issues the TES command. The 7250 begins a 16 second selftest sequence. The 7250 sets the status word to Busy (16). If an error is found, it issues the status word Internal Error (99 or 35). If the selftests complete with no error detected, the 7250 issues the status word Operation Complete (66 or 2).

GPIB Command Description Reference

Each GPIB command used with the 7250 is given individual description. The commands are in alphabetical order. The Group heading corresponds to the command grouping in Table 3-2.

ACQ

Group: Data Acquisition

Purpose: Set Data Acquisition mode.

Syntax and Description:

Header	Argument	Description
ACQ	SGL	Selects Single Shot acquisition mode: When the 7250 is armed and triggered, one waveform is acquired in block 0 and displayed on the the CRT. No argument is necessary for the ARM command.
	CON	Selects Continuous acquisition mode: The 7250 acquires waveforms in consecutive intervals of one each second. The current waveform is placed in block 0 and displayed on 7250 CRT. Each waveform is displayed consecutively. The ARM command is used to arm the instrument. Successive acquisitions begin with a trigger signal. No argument is necessary for ARM for the continuous mode. **Example:** ACQ CON Sets the 7250 to continuous mode. ARM Arms the 7250 for consecutive acquisitions. This mode is exited by pressing the front panel STOP key or by using the DCL or SDC command over the GPIB. **NOTE** When the 7250 enters the Continuous mode it is then in the BUSY state. It will not respond to the device-dependent TCH 17 command to stop the Continuous mode. The Continuous mode is exited using a DCL or SDC command.

ACQ (cont)

Syntax and Description (cont):

Header	Argument	Description
	AVG	Selects Averaging acquisition mode: When the instrument is armed and triggered, it acquires the number of acquisitions specified by the ARM command in block 0. With each acquisition, the average curve is updated. Following the last acquisition and updating, the waveform is moved to block 0 and displayed. The ARM command is used to set the number of acquisitions for the averaging operation (range is 1 to 1000). **Example:** ACQ AVG Sets the 7250 to Averaging mode. ARM 3 Arms the 7250 for three acquisitions.
	ENV	Selects Envelope acquisition mode: When the instrument is armed and triggered, it acquires the number of acquisitions specified by the ARM command in block 0. With each acquisition, the envelope curve is updated. Following the last acquisition and updating the waveform is moved to block 0 and displayed. The ARM command is used to set the number of acquisitions for the envelope operation (range is 1 to 1000). **Example:** ACQ ENV Sets the 7250 to Envelope mode. ARM 7 Arms the 7250 to perform 7 acquisitions.
	BUR	Selects Burst acquisition mode: When the instrument is armed and triggered, it acquires the number of acquisitions specified by the ARM command, each to a different block (the first to block 0, second to block 1, etc.). The number of acquisitions is limited by the number of blocks available: 15 with 64 K-byte configuration, and 31 with the 128 K-byte configuration. The ARM command is used to set the number of acquisitions for the Burst operation (range is 1 to 1000). **Example:** ACQ BUR Sets the 7250 to Burst mode. ARM 12 Arms the 7250 to perform 12 acquisitions.

ACQ (cont)

Syntax and Description (cont):

Header	Argument	Description
	DEF	Selects Permanent Defects acquisition mode: The 7250 acquires a specified number of acquisitions in block 0. With each acquisition, a table of faults is updated. Following the last acquisition and update, the table of faults is copied to a block in non-volatile memory, then displayed. The faults can then be subtracted from other waveforms during data processing using the commands PRO FILC and PRO SMOC. **Example:** ACQ DEF Sets the 7250 to Permanent Defects mode. ARM 7 Arms the 7250 to perform seven acquisitions.
	ZER	Selects Electrical Zero Value acquisition mode: The 7250 acquires a specified number waveforms in block 0. With each acquisition the average curve is updated in a volatile buffer area. Following the last acquisition, and setting of the average curve to zero, the electrical zero value is calculated as the average of ordinates of the average curve. The value is stored in non-volatile memory, and the average curve is displayed. The electrical zero value is systematically subtracted from the ordinate values displayed when cursors are used. If this reference value is not used, it should be set to zero. **Example:** ACQ ZER Sets the 7250 to Electrical Zero Value mode. ARM 7 Arms the 7250 to perform seven acquisitions.

ARM

Group: Data Acquisition

Purpose: Arms the instrument for acquisitions upon reception of a trigger signal.

Syntax and Description:

Header	Argument	Description
ARM	<NR1>	This command is given after the acquisition mode is selected. It Arms the instrument for the number of acquisitions specified by <NR1>. Upon reception of a trigger signal the acquisitions are initiated. The range for <NR1> is 1 to 1000, except for the Burst acquisition mode, which is limited to 15 (for 64 K-byte memory) or 31 (for 128 K-byte memory). <NR1> is specified for the following acquisition modes: • Averaging (ACQ AVG) • Envelope (ACQ ENV) • Burst (ACQ BUR) • Permanent Defects (ACQ DEF) • Electrical Zero Value (ACQ ZER)
	(none)	No argument is used with the ARM command when the instrument is armed for these two acquisition modes: • Single Shot (ACQ SGL) • Continuous (ACQ CON) The ARM command enables the trigger and sets the status byte to 66 or 2 to indicate that arming is complete. When triggered and a waveform has been acquired into memory, the 7250 sets a second status byte of 193 or 129 to indicate data ready. **Example**: ARM 12 Arms the 7250 for 12 acquisition triggers.

CER
CER?

Group: Service Request

Purpose: CER: Enable/disable command error SRQ.
CER?: Queries enable or disable status.

Syntax and Description:

Header	Argument	Description
CER	ON	Enables command error service requests. With CER ON, command errors will be reported as 97 (RQS ON) or as 33 (RQS OFF)
	OFF	Disables command error service requests. With CER OFF, no SRQs are generated, and the SRQ status is reported as 33.
		Example:
		For an erroneous command given, for:
		CER ON RQS ON The status byte is set to 97, and an SRQ is generated.
		CER ON RQS OFF The status byte is set to 33.
		CER OFF RQS ON The status byte is set to 33.
		CER OFF RQS OFF The status byte is set to 33.
CER?		Queries enable or disable status.
		Example: Responses to CER? are CER ON or CER OFF

DLY

Group: Trigger

Purpose: Set sweep delay setting

Syntax and Description:

Header	Argument	Description
DLY	<NR3>	Selects and sets Sweep Delay setting. <NR3> range is 50 to 5000 ns as follows:

Minimum internal Delay:
From 50–500 ps/div: 50 ns
From 1 ns/div to 1 μs/div: 50 ns + 1 div.

NOTE: *parameters in <NR3> format*

Example: 50 ns is expressed 5.0E-08

Range	Delay Adjustment	Resolution
1	0–50 ns	by 50 ps steps
2	50–100 ns	by 100 ps steps
3	100–500 ns	by 500 ps steps
4	500–1000 ns	by 1 μs steps
5	1000–5000 ns	by 5 μs steps

NOTE: *Time Base is limited by the Sweep Delay setting:*

Sweep Delay	Maximum Time Base
50–100 ns	500 ps
100–150 ns	50 ns
150–250 ns	100 ns
250–550 ns	200 ns
550–1050 ns	500 ns
1050–5000 ns	1 μs

If sweep delay and time base settings are incompatible, an ERROR message is displayed.

EOS
EOS?

Group: Service Requests

Purpose: EOS: Enable/disable end-of-sweep service requests.
EOS?: Queries enable or disable status.

Syntax and Description:

Header	Argument	Description
EOS	ON	Enables End Of Sweep service requests. Status = 67
	OFF	Disables End Of Sweep service requests. Status = 3
EOS?		Queries enable or disable status. **Example:** Responses to EOS?: EOS OFF or EOS ON

EXE

Group: Data Processing and Retrieval

Purpose: Execute selected data processing.

Syntax and Description:

Header	Argument	Description
EXE	<NR1>	Starts the execution of the data processing selected in the menu on the block indicated by <NR1>. The resulting data is displayed on the 7250 CRT and can be retrieved with the WFR? query. <NR1> range is 1 to 3.
EXE	(none)	Executes processing specified in menu on block 0.

EXR

Group: Service Request

Purpose: EXR: Execution error SRQ enable or disable.
EXR?: Queries enable or disable status.

Syntax and Description:

Header	Argument	Description
EXR	ON	Enables Execution Error service requests. Status = 98
	OFF	Disables Execution Error service requests. Status = 34
EXR?		Queries EXR enable or disable status. **Example:** Responses to EXR?: EXR ON or EXR OFF

HOR

Group: Main Settings

Purpose: Set Time Base setting.

Syntax and Description:

Header	Argument	Description
HOR	<NR3>	Sets time base. <NR3> range is 50 ps/div to 1 μs/div in 14 steps. <NR3> coding is as follows:

5.0E–11	50 ps/div
1.0E–10	100 ps/div
2.0E–10	200 ps/div
5.0E–10	500 ps/div
1.0E–09	1 ns/div
2.0E–09	2 ns/div
5.0E–09	5 ns/div
1.0E–08	10 ns/div
2.0E–08	20 ns/div
5.0E–08	50 ns/div
1.0E–07	100 ns/div
2.0E–07	200 ns/div
5.0E–07	500 ns/div
1.0E–06	1 μs/div

The Time Base is limited by the Sweep Delay setting as follows:

Sweep Delay	Maximum Time/Div
150– 100 ns	500 ps
100– 150 ns	50 ns
150– 250 ns	100 ns
250– 550 ns	200 ns
550–1050 ns	500 ns
1050–5000 ns	1 μs

NOTE

The HOR command rounds values to the nearest Time Base setting (i.e., the command HOR 74.0E–12 will set Time Base to 50 ps/div. The command HOR 75.0E–12 will set the Time Base to 100 ps/div).

The HOR command is valid for <NR3> parameters in the range 25.0E–12 and 1.00001E–6. Requests for settings outside this range will generate an Execution Error (97 or 33).

ID?

Group: Instrument Parameter Commands and Queries

Purpose: Queries Instrument Identification

Syntax and Description:

Header	Argument	Description
ID?		Queries instrument identification. Response gives instrument model and firmware version in the form: ID TEK/7250,V4.3

INI

Group: Instrument Parameter Command and Queries.

Purpose: Initializes 7250 to pre-determined setup.

Syntax and Description:

Header	Argument	Description
INI		Initializes the 7250 to the following predetermined setup:

Trigger Polarity	Positive
Trigger Level	1.00 V
Trigger Type	Normal
Trigger Delay	100 ns
Sweep Speed	10 ns/Div
Sweep Type	Internal
Vertical Position	0%
Acquisition Mode	Single Shot
Data Processing	No Processing

LEV

Group: Trigger

Purpose: Set Trigger Level setting

Syntax and Description:

Header	Argument	Description
LEV	<NR2>	Selects and sets trigger level setting. <NR2> range: 50 mV to 1 V in 10 mV steps 1 V to 10 V in 100 mV steps **Example:** <NR2> notation: 80 mV = 0.08

OPC
OPC?

Group: Service Request Commands and Queries

Purpose: OPC: Operation Complete SRQ enable or disable.
OPC?: Queries enable or disable status.

Syntax and Description:

Header	Argument	Description
OPC	ON	Enables operation complete service requests. Status = 66
	OFF	Disables operation complete service requests. Status = 2
OPC?		Queries OPC enable or disable status. **Example:** Responses to OPC?: OPC ON or OPC OFF

POL

Group: Trigger

Purpose: Set Trigger Polarity Setting

Syntax and Description:

Header	Argument	Description
POL	POS	Sets positive trigger polarity.
	NEG	Sets negative trigger polarity.

PRO

Group: Data Processing and Retrieval

Purpose: Process stored waveform data.

Syntax and Description:

Header	Argument	Description
PRO		This command specifies the processing, to be performed on stored waveform acquisitions.
	RAW	No Processing.
	FIL	Filtering without Calibration (suppression of permanent defects, with filtering and interpolation).
	FILC	Filtering with Calibration (suppression of permanent defects, with corrections, filtering and interpolation).
	SMO	Smoothing without Calibration (suppression of permanent defects, with filtering, interpolation and smoothing).
	SMOC	Smoothing without Calibration (suppression of permanent defects, with corrections, filtering, interpolation and smoothing).
		The processing is executed on the stored waveform using the EXE < NR1 > command. Data can then be retrieved over the GPIB using the WFR? command.

RQS
RQS?

Group: Service Request Commands

Purpose: RQS: Enable/ disable service request functions.
RQS?: Queries enable or disable status.

Syntax and Description:

Header	Argument	Description
RQS	ON	Sets status byte bit D107 to 1. Enables all service request functions (OPC, CER, EXR, and EOS). Status = 66.
	OFF	Sets status byte bit D107 to 0. Disables all service request functions (OPC, CER, EXR, and EOS). Status = 2. The state of the SRQ line is not affected by this bit. At power-up, all RQS functions are in the enabled state.
RQS?		Queries RQS enable or disable status. **Example:** Responses to RQS?: RQS ON or RQS OFF

SET?

Group: Instrument Parameter Command and Queries

Purpose: Outputs current menu to controller.

Syntax and Description:

Header	Argument	Description
SET?		In response to SET?, the 7250 outputs its current menu and parameters as follows: POL NEG;LEV 0.08;TRI FAS;DLY 1.0E-08; HOR 2E-09;SWP INT;VER 40;XFO 1888; XMC 48;XBE 511;XHO 100;ACQ SGL; PRO SMO<13><10 (count=113) The SET? query can be especially useful in checking each setting command.

SWP

Group: Main Settings

Purpose: Selects Sweep Type

Syntax and Description:

Header	Argument	Description
SWP	INT	Selects internal sweep source.
	EXT	Selects external sweep source.

TCH

Group: Front Panel Emulation

Purpose: Emulates front panel functions.

Syntax and Description:

Header	Argument	Description	
		The front panel control keys do not have a unique command header for each function. Instead, one command allows remote control of all front panel functions, with a unique <NR1> argument code (range 1 to 50) for each function. Thus, executing TCH <NR1> is equivalent to pressing (Touching) the control key indicated by <NR1>. Example: The command can be used sequentially to perform functions which require pushing several keys to activate, such as TCH 29;TCH 16 would instruct the 7250 to trigger 4 waveform acquisitions according to whatever the current acquisition mode is (except single shot).	
		Code:	Front-panel Control Key:
TCH	<NR1>	1	Menu (Main/Secondary)
		2	Help Menu
		3	Graphics mode
		4	Up Arrow
		5	Down Arrow
		6	Left Arrow
		7	Right Arrow
		8	Trigger Level
		9	Sweep Delay
		10	Time Base
		11	Vertical Position
		12	Display Mode
		13	Waveform Measurement
		14	Single Shot
		15	Continuous
		16	Acquire
		*17	Stop
		18	Process
		19	Other
		20	Plotter

TCH (cont)

Syntax and Description (cont):

Header	Argument	Description
	Code:	Front-panel Control Key:
	21	Measure
	22	Waveform Transfer
	23	Store Setup
	24	Recall Setup
	25	Zero
	26	One
	27	Two
	28	Three
	29	Four
	30	Five
	31	Six
	32	Seven
	33	Eight
	34	Nine
	35	Backspace
	36	Enter
	37	Cursor 1
	38	Cursor 2
	39	Both Off
	40	Graticule
	41	Accumulate
	42	Cursor Pos/Origin Pos Up
	43	Cursor Pos/Origin Pos Down
	44	Cursor Pos/Origin Pos Left
	45	Cursor Pos/Origin Pos Right
	46	Origin
	47	Mag X
	48	Mag Y
	49	Mag On/Off
	*50	Clear

***NOTE**

The commands TCH 17 (stop) and TCH 50 (Clear) do not operate identically to the front panel controls. For TCH 17, the SDC or DCL command operates as the STOP key.

TES

Group: Instrument Parameter Commands and Queries

Purpose: Execute a selftest sequence.

Syntax and Description:

Header	Argument	Description
TES		Execute a selftest sequence.

NOTE

The test sequence requires 16 seconds to complete and is not interruptable. To avoid a possible time-out condition, do not attempt to put a message on the bus until the selftest operation is complete.

In the case of faults detected during test:

For RQS ON, Status = 99
For RQS OFF, Status = 35

In case of no fault detected:

For RQS ON, Status = 66
For RQS OFF, Status = 2

TRI

Group: Trigger

Purpose: Set Trigger Type Setting

Syntax and Description:

Header	Argument	Description
TRI	NOR	Sets normal trigger. Typical pulse duration > 10 ns
	FAS	Sets fast trigger. Typical pulse duration ≥400 ps to ≤20 ns

VER

Group: Main Setting

Purpose: Set Vertical Position Setting

Syntax and Description:

Header	Argument	Description
VER	<NR1>	Set Vertical Position: <NR1> range is 0 to 100% in 1% steps. For clarity using <NR1>, 1% is 1, 2% is 2, etc.

WFR?

Group: Data Processing and Retrieval

Purpose: Retrieves data last processed by the 7250.

Syntax and Description:

Header	Argument	Description
WFR?		After the type of data processing has been set using the PRO command, and that processing has been executed using the EXE command, the WFR? command retrieves the last processed data from block 0 over the GPIB.

NOTE

In response to the WFR? query, the 7250 sends a proprietary data stream. See Appendix A, Data Structure.

XBE

Group: Secondary Settings

Purpose: Set Beam Current

Syntax and Description:

Header	Argument	Description
XBE	<NR1>	Sets Beam Current to desired value. <NR1> range is 0 to 511. At factory setting: For RQS OFF, Status = 36 For RQS ON, Status = 100

CAUTION

Extended use of the 7250 at other than the factory-set value may cause instrument damage.

NOTE

This setting is locked and must be unlocked prior to changing. The setting may be unlocked from the front panel or over the GPIB. Please make note of factory setting value before changing.

- *To unlock the setting from the front panel press 2, then press Enter*
- *To unlock the setting by remote, use the command TCH 27; TCH 36*

The value may now be changed.

- *To re-lock the setting from the front panel press 1, then press Enter*
- *To re-lock the setting by remote, use the command TCH 26; TCH 36*

XFO

Group: Secondary Settings

Purpose: Set Focal Voltage

Syntax and Description:

Header	Argument	Description
XFO	<NR1>	Set focal voltage to desired value. <NR1> range is 0 to 4095. At factory setting: For RQS OFF, Status = 36 For RQS ON, Status = 100

CAUTION

Extended use of the 7250 at other than the factory-set value may cause instrument damage.

NOTE

This setting is locked and must be unlocked prior to changing. The setting may be unlocked from the front panel or over the GPIB. Please make note of factory setting value before changing.

- *To unlock the setting from the front panel press 2, then press Enter*
- *To unlock the setting by remote, use the command TCH 27; TCH 36*

The value may now be changed.

- *To re-lock the setting from the front panel press 1, then press Enter*
- *To re-lock the setting by remote, use the command TCH 26; TCH 36*

XMC

Group: Secondary Setting

Purpose: Set Microchannel Plate Voltage

Syntax and Description:

Header	Argument	Description
XMC	<NR1>	Sets Microchannel Plate Voltage to desired value. <NR1> range is 0 to 255. At factory setting: For RQS OFF, Status = 36 For RQS ON, Status = 100

CAUTION

Extended use of the 7250 at other than the factory-set value may cause instrument damage.

NOTE

This setting is locked and must be unlocked prior to changing. The setting may be unlocked from the front panel or over the GPIB. Please make note of the factory setting before changing.

- *To unlock the setting from the front panel press 2, then press Enter*
- *To unlock the setting by remote, use the command TCH 27; TCH 36*

The value may now be changed.

- *To re-lock the setting from the front panel press 1, then press Enter*
- *To re-lock the setting by remote, use the command TCH 26; TCH 36*

XHO

Group: Secondary Settings

Purpose: Set Horizontal Position

Syntax and Description:

Header	Argument	Description
XHO	<NR1>	Sets Horizontal Position. <NR1> range is 0 to 4095. At factory setting: For RQS OFF, Status = 36 For RQS ON, Status = 100

CAUTION

Extended use of the 7250 at other than the factory-set value may cause instrument damage.

NOTE

This setting is locked and must be unlocked prior to changing. The setting may be unlocked from the front panel or over the GPIB. Please make note of factory setting before changing.

- *To unlock the setting from the front panel press 2, then press Enter*
- *To unlock the setting by remote, use the command TCH 27; TCH 36*

The value may now be changed.

- *To re-lock the setting from the front panel press 1, then press Enter*
- *To re-lock the setting by remote, use the command TCH 26; TCH 36*

Section 4
Acquisition Calibration

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Static Calibration

Determination of static calibration correction terms consists in evaluating the importance of two types of faults:

- Error in positioning the tube screen and the camera screen (translation and rotation of the image).
- Optical errors in the camera.

An image is defined as 512 abscissa points by 2048 ordinate points for a total of 1,048,576 points.

To make a correction at every point would require the use of tremendous memory space. Therefore, a method is used which reduces the number of correction terms. This method assumes that the image distortions are minor (less than 5%) and regular . For correction, the screen is divided into a regular mosaic. All the points in each cell are corrected by a single correction factor. There are many possibilities for the choice of the cell dimensions and reference points by which to determine the correction applied to each cell. The method chosen consists of:

- the acquisition of a test pattern of 10 x 10 points regularly spaced
- determining corrections for these 100 points
- by linear interpolation, deducing the corrections for a hypothetical test pattern of 32 x 32 points.

The 10 x 10 test pattern is chosen first because it is technically difficult to acquire and display more than 100 points at one time. The final 32 x 32 point mosaic is chosen as a good compromise between having enough cells for precise correction terms and the memory requirement as the number of correction terms

increases. The resultant image has a 32 x 32 point mosaic (for a total of 1024 points). For each cell the quantities dX and dY represent the correction that is to be applied to each point in the cell.

Acquisition of a 10 x 10 Test Pattern

The test pattern by is acquired by selecting 10 * 10 MATRIX for the Time Base setting on the Main Menu. This Time Base setting is used because acquisition of the test pattern is done with the aid of specific secondary setting parameters. Each Time Base has four secondary parameters; Focal Voltage, MCP Voltage, Beam Current, and Horizontal Position. For the test pattern, Horizontal Position is not used, and may be any value.

Acquiring the test pattern requires the following steps:

- Disconnect the signal input and external sweep input
- Install a 50 Ω load on the signal output

The processor will inhibit the internal sweep. The acquisition is done with the Single Shot and Continuous acquisition modes.

Method of Determination of Static Correction Terms

A point of the test pattern which is displayed on the screen is the result of the digitization of several points, from which the processor determines an average value. The average value is determined by classifying digitized points into groups as follows:

- All groups of less than three points are eliminated
- Each remaining group is classified in a cell of the 10 x 10 mosaic

The cell is considered valid when it contains one group and one individual point. The number of valid cells must be greater than 91 to declare the test pattern correct; otherwise the test pattern is rejected and an error message is displayed (with the number of valid cells displayed in the result area).

The three secondary parameters; Focal Voltage, MCP Voltage, and Beam Current, can be modified in order to obtain a correct test pattern. On each cell of a correct test pattern, the processor determines the positional error of the average point in relationship to the cell center (dX and dY). The missing cell corrections are generated by linear interpolation from neighboring cells. The last step is to interpolate the 10 x 10 matrix to a 32 x 32 matrix.

Determination of Static Correction Terms

When a correct test pattern has been acquired, the static correction terms can be determined. The program is activated by pushing the 5 key, then the Enter key. If the program detects defects in the image, an error message is displayed and the previous correction terms are preserved. Otherwise, the new terms overwrite the previous in the non-volatile memory and the number of valid cells is displayed in the result zone.

Dynamic Calibration

Determination of dynamic correction terms consists of evaluating the magnitude of the distortions from non-linearity in the sawtooth applied to the horizontal deflection of the CRT. It is assumed that dynamic distortions occur only in the horizontal axis (abscissa of the digitized points) and not in the vertical axis (ordinate values).

The method for determining correction terms consists in calculating the average period of a periodic calibration signal on the interval 10% to 90% of the screen for each sweep range. From this the correction terms for all the points on the screen are derived.

Acquisition of Calibration Signal

The procedure described is for one sweep speed. It must be repeated 14 times for calibration of all 14 sweep speeds. The user must program the instrument to a desired sweep speed, and apply to the input a calibration signal (periodic or half-periodic) according to the table which follows:

TABLE 4–1
Table of Calibration Frequencies

Speed	F1	F2	F3	F4	F5
50 ps/div	20 GHz	16 GHz	12 GHz	10 GHz	8 GHz
100 ps/div	10 GHz	8 GHz	6 GHz	5 GHz	4 GHz
200 ps/div	5 GHz	4 GHz	3 GHz	2.5 GHz	2 GHz
500 ps/div	2 GHz	1.6 GHz	1.2 GHz	1 GHz	800 MHz
1 ns/div	1 GHz	800 MHz	600 MHz	500 MHz	400 MHz
2 ns/div	500 MHz	400 MHz	300 MHz	300 MHz	200 MHz
5 ns/div	200 MHz	160 MHz	120 MHz	100 MHz	80 MHz
10 ns/div	100 MHz	80 MHz	60 MHz	50 MHz	40 MHz
20 ns/div	50 MHz	40 MHz	30 MHz	25 MHz	20 MHz
50 ns/div	20 MHz	16 MHz	12 MHz	10 MHz	8 MHz
100 ns/div	10 MHz	8 MHz	6 MHz	5 MHz	4 MHz
200 ns/div	5 MHz	4 MHz	3 MHz	2.5 MHz	2 MHz
500 ns/div	2 MHz	1.6 MHz	1.2 MHz	1 MHz	800 kHz
1 µs/div	1 MHz	800 kHz	600 kHz	500 kHz	400 kHz

The signal amplitude must be in the range of 0.5 to 2 V peak to peak. Acquisition may be in Single Shot or Continuous mode. Secondary control setups for Focal Voltage, MCP Voltage, Beam Current, and Horizontal Position may be adjusted, if necessary, using the Menu Arrow keys. (Note these settings will have to be unlocked first: Press 2, then Enter to unlock. Press 1, then Enter to re-lock settings with new values.)

CAUTION

Extended use of the 7250 at other than factory values may cause instrument damage.

The calibration signal is corrected statically, then filtered. The processor then calculates the average signal in order to determine the zero crossings which serve as points of reference for determination of errors. The zero crossings closest to the 10% and 90% points are taken as references for calculation of the average period (or half period). These then serve for determination of the theoretical zero crossings. The error is calculated as the difference between the real and theoretical zero crossings. By this method, the reference zero crossings (10% and 90%) have no correction. The correction applied to each of the 512 abscissas is determined by linear interpolation of the errors calculated at the zero crossings.

Determination of Dynamic Correction Terms

When a correct image has been acquired, the dynamic correction terms can be determined. Several programs are available. They correspond to different methods of calculation and are available through the following commands:

- To begin the method of half-periods, press the 6 key, then the Enter key
- To begin the method of periods, press the 7 key, then the Enter key

If a program detects defects in the image, an error message is displayed and the previous correction terms are conserved; otherwise the new terms overwrite the previous in the non-volatile memory.

Remark: Following a calibration operation, the processor displays the measured duration of the time base. The duration of the time base is calculated based on the hypothesis that the calibration generator is set to a "round number" frequency.

Example: If the sweep speed is programmed to 10 ns/div and there are 10 periods in the digitized image, it is assumed that the calibration generator is programmed exactly to 100 MHz and the value of the duration of the waveform is displayed (101.5 ns, for example).

Appendix A
Data Structure

Definition of the Data Block Concept

Any image generated in the 7250 is stored in an entity called a data block. There are two fields located in a data block:

- A "Main Setting" field
- An "Acquisition Data" field

The acquisition memory (64 K-bytes) is divided into 16 blocks of 4 K-bytes. One block is reserved for storage of the permanent faults of the target and the sets in non-volatile memory. Available to the user are 15 storage locations numbered from 0 to 14. All the acquisitions are carried out in block 0, except in the case of the Burst acquisition mode, in which the first is carried out in block 0, the second in block 1, and so on.

Digitization Principle

The acquisition system consists of a writing tube coupled by fiber optics to a reading tube (see Fig. A-1). The writing tube generates the signal image to be analyzed. The reading tube stores the image on its screen (target) and an associated digitization device (clock and binary counters) converts the image pixels into digital values. The resolution of the digitization system is 512 pixels in abscissa (X) and 2047 pixels in the ordinate (Y).

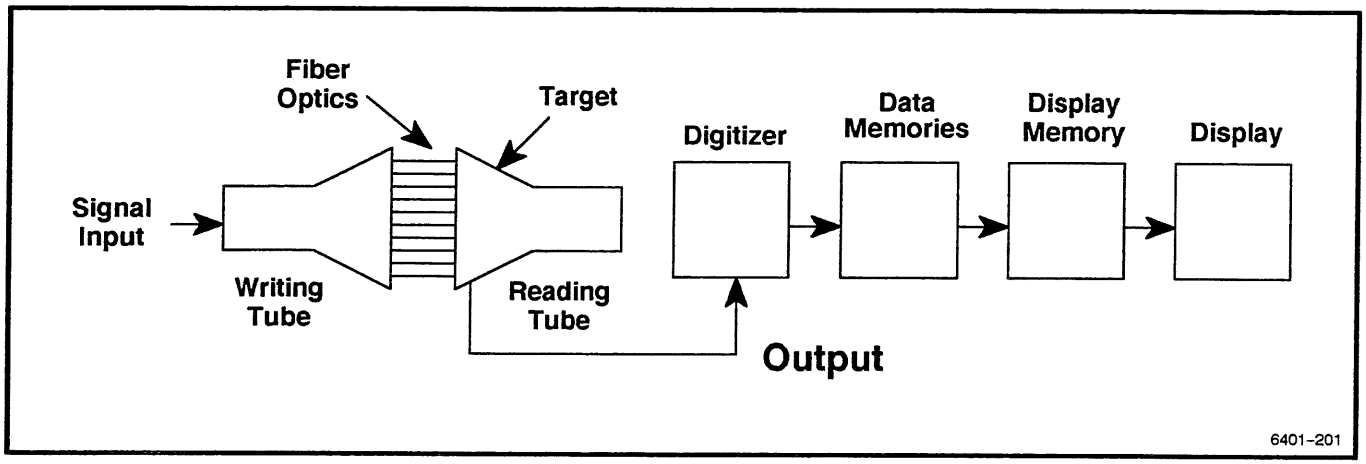

Figure A-1. 7250 Simplified block diagram

The beam of the reading tube continuously moves over its screen and successively sweeps it from bottom to top and from left to right. More exactly, the sweep takes place from pixel X=0, Y=0 to pixel X=0, Y=2047, and then from pixel X=1, Y=0 to pixel X=1, Y=2047, and so on. When the beam arrives at pixel X=511, Y=2047, sweeping resumes at pixel X=0, Y=0. (See Fig. A-2.)

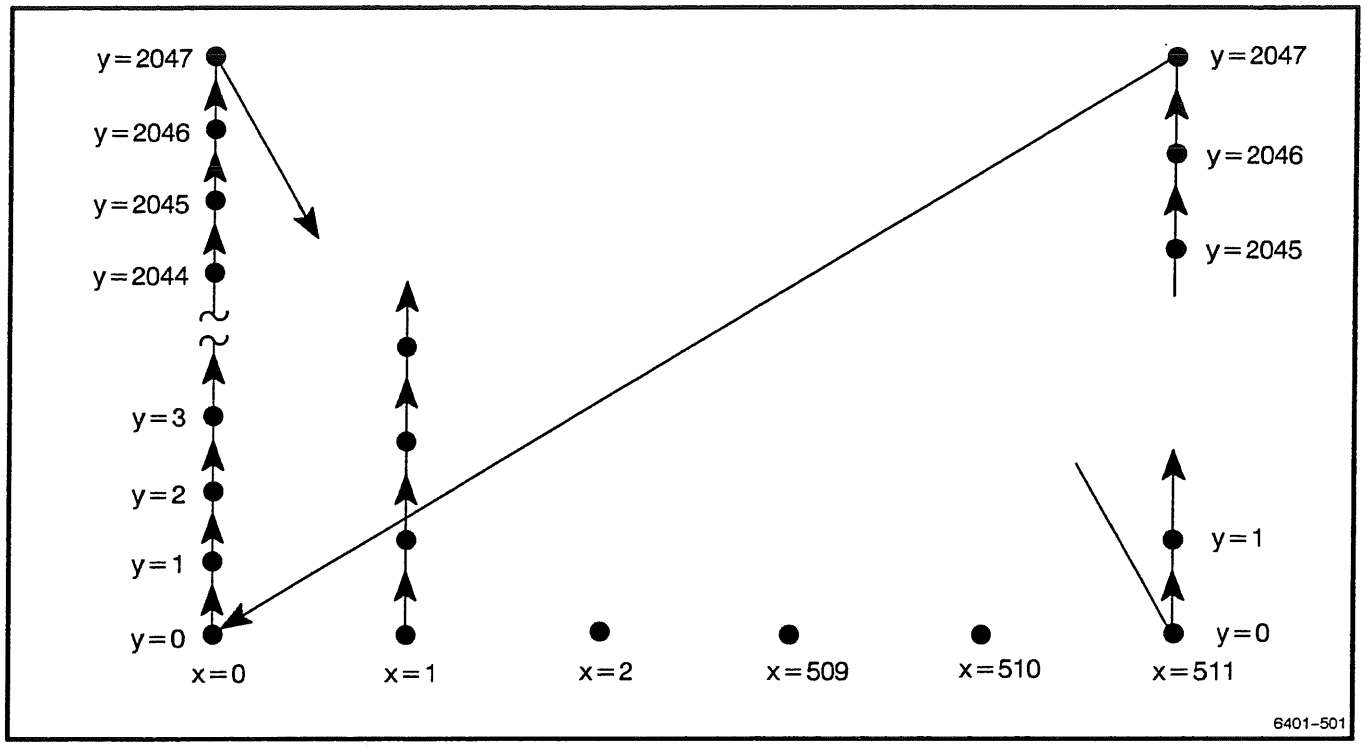

Figure A–2. Digitization Principle.

After receiving the trigger signal, the digitization system stores the digital values of the signal image pixels in the data memory by direct memory access channel (DMA). The triggering of acquisition can start on any vertical sweep, that is, any abscissa value included between X=0, Y=0 and X=511, Y=0. For each new vertical sweep, the digitization system stores in memory the value of the abscissa corresponding to the sweep vertical line followed by the ordinate values of possible pixels which it detected on this line.

There can be zero, one, or several digitized ordinate values at each sweep due to spurious phenomena (see below). Detection of the image pixels is carried out using a threshold device. Depending on the image lighting which mainly varies according to the writing speed of the screen of the reading tube (and thus a function of the analyzed signal slope and of the selected light intensity), the number of digitized pixels varies.

Spurious phenomena also alter the acquisition. These are light holes (i.e. no pixels) and the permanent pixels (which are always digitized regardless of what the signal is). Over-intensity of the signal image will also create additional ordinate value (greater thickness of the trace). The defects called light holes and permanent pixels are few. A maximum number of defects is determined in order to qualify correct or faulty conditions of the digitization system.

Main Setting Format

The main setting field is 20 bytes long and has the following format:

Byte 1	Block number
Bytes 2 & 3	Electrical zero value (expressed in points: 0 to 2047).
Bytes 4 & 5	Vertical Sensitivity (expressed in tens of mV; e.g. 502 means 5020 mV).
Byte 6	Time/div setting. The range is specified by a two-digit code, as follows:

00: 0.5 ns	07: 100 ns
01: 1 ns	08: 200 ns
02: 2 ns	09: 500 ns
03: 5 ns	0A: 1 µs
04: 10 ns	0B: 2 µs
05: 20 ns	0C: 5 µs
06: 50 ns	0D: 10 µs

Bytes 7 & 8	Number of coordinates. That is, total number of X plus Y values returned. Each value is two bytes in length. The response to the WFR? contains 512 X values; the remainder are Y values. Curve information is not returned as XY coordinate pairs.

Subsequent bytes contain the coordinates of the image pixels.

Acquisition Data Format

The acquisition data is stored in the acquisition data field. The acquisition data field contains the X and Y waveform values and consists of 4076 bytes maximum. Two bytes are used to describe an X or Y value so a maximum of 2038 values, X or Y, can be stored in a waveform.

The acquisition data is stored in the form:

```
XYXYXYXYXXY...
```

The X or Y values, described using two bytes, are coded in hexadecimal. To understand the data encoding used, it is best to visualize the data within the acquisition data field as hexadecimal numbers which are two bytes long.

Assume that the following byte string, corresponding to the above example but expressed in hexadecimal, is received:

```
00, 64, 83, E8, 00, 65, 83, EC, 85, DC, 00, 66, 00, 67,
00, 68, 84, 4C . . . .
```

Combining the bytes to form four-place hexadecimal numbers will yield:

```
0064, 83E8, 0065, 83EC, 85DC, 0066, 0067, 0068, 844C
```

So, the succession of values could be:

```
  X    Y    X    Y    Y    X    Y    X    X    Y
0064  83E8 0065 83EC 85DC 0066 83FO 0067 0068 844C
```

The most significant bit (MSB) of the abscissa (X values) are 0. The most significant bit of the ordinate values is 8. The values stored in the acquisition data field are therefore:

```
X, Y = 064, 3E8                (one Y value)
X, Y = 065, 3EC, 5DC           (two Y values)
X, Y = 066                     (no Y value)
X, Y = 067                     (no Y value)
X, Y = 068, 44C                (one Y value)
```

Decoding the hexadecimal to decimal yields the following X and Y values:

```
X, Y = 100, 1000
X, Y = 101, 1006, 1500
X, Y = 104, 1102
```

The ordinate Y = 1500 may be a spurious pixel. The values X = 102 and X = 103 were skipped since there were no corresponding Y data points. This can be due to either a significant decrease of the lighting (from a steep signal front) or a light hole.

In this example, the abscissa succession is:

```
100 101 104....510 511  0  1  2 .... 98 99
```

Acquisition does not necessarily begin on abscissa X = 0. This data, stored in memory without processing, is called raw data. Waveform points are arranged in

the order X=0 to X=511 after all processing (filtering, smoothing, averaging, envelope, etc.). Existence of the external sweep input is used to carry out a sine sweep.

Acquisition Data Processing

All data is restored in ASCII-coded hexadecimal, whatever processing method has been used.

Raw Data: The data is subjected to any processing. All digitized points are displayed.

Suppression of Permanent Defects: All the pixels listed in the table of permanent spurious pixels are suppressed.

Corrected Data: The reading tube is subject to certain distortions called static faults. The linearity faults of the write tube sweep sawtooth generates distortions called dynamic faults.

Static Corrections: These defects concern abscissas and ordinates. The static fault variations are slow and continuous. That is why the image is cut into a regular mosaic of 32 x 32 meshes. For each mesh, the mesh center corrections have been determined. The mesh center corrections are assigned to each image pixel concerned.

Dynamic Corrections: These faults do not affect the abscissas. For each one of the 512 abscissas and for each scanning speed, a correction value has been determined.

Filtered Data: The values are reclassified in the order (X=0) to (X=511). When an abscissa includes several ordinate values, an algorithm is used for selection of the most probable value. When an abscissa includes no ordinates, a linear interpolation is used to recreate the missing value. This filtering is only applicable in linear sweep.

Filtering Algorithm: There are two parameters defined by the filtering:

- the maximum thickness of the trace,
- the maximum variation of the trace thickness.

An abscissa (X) with several ordinates (Y) will be processed in the following manner:

- If the difference between Ymin and Ymax is greater than the maximum thickness of the trace, all the Ys are refused.
- If the difference between the measured variation from the previous abscissa is higher than the maximum trace thickness variation, all the Ys are also refused.
- If the two previous conditions are fulfilled, the Ys are replaced by Y average.

Smoothed Data: Smoothing is carried out by means of the following method:

Each pixel is recalculated using the arithmetic average of the ordinates of the pixel itself and its neighbors. On the edges, the ordinate of the pixel is repeated as many times as necessary. Example of smoothing over five pixels (two pixels before and two pixels after):

Calculation of pixel X = 10

$$Y10 = \frac{Y8 + Y9 + Y10 + Y11 + Y12}{5}$$

Calculation of pixel X = 0

$$Y0 = \frac{Y0 + Y0 + Y0 + Y1 + Y2}{5}$$

Appendix B
RS 232 Link Between 7250 and Plotter

7250 to Tek 4662 Plotter

Connector configuration:

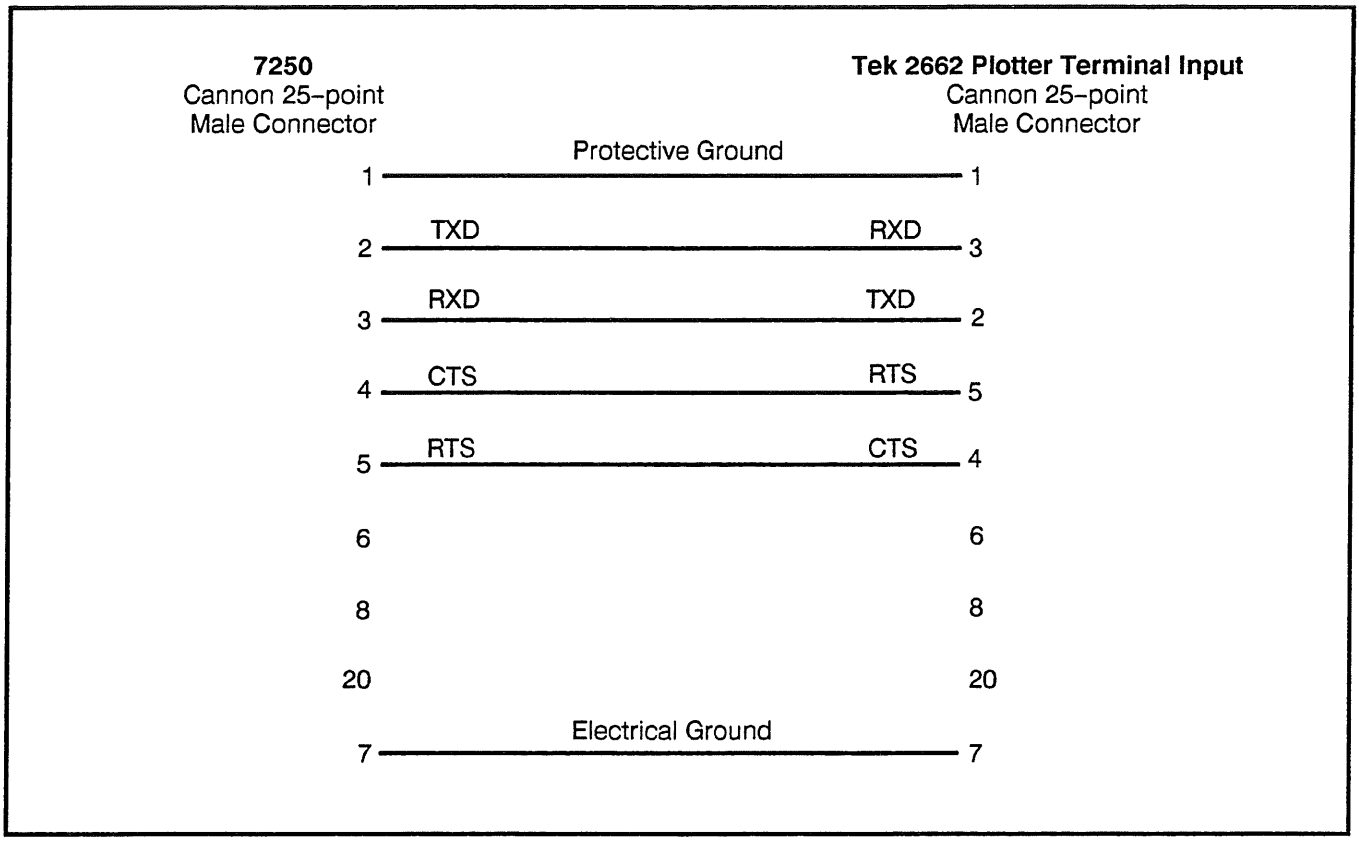

Figure B–1. RS 232 Cable Configuration for Tek 4662 Plotter.

Configuration of switches on the TEK 4662 Plotter:

"Local" mode selected, the other buttons unselected.

Rear panel switches (Address A)	A	5 → without copy made
	B	2 → 2 stop bits
	C	2 → Parity = none
	D	3 → 1200 Baud

NOTE

Pins 6, 8, and 20 are not connected in the 7250. The 7250 does not determine if the plotter is ready to receive data before it sends data.

7250 to HP 7475A Plotter

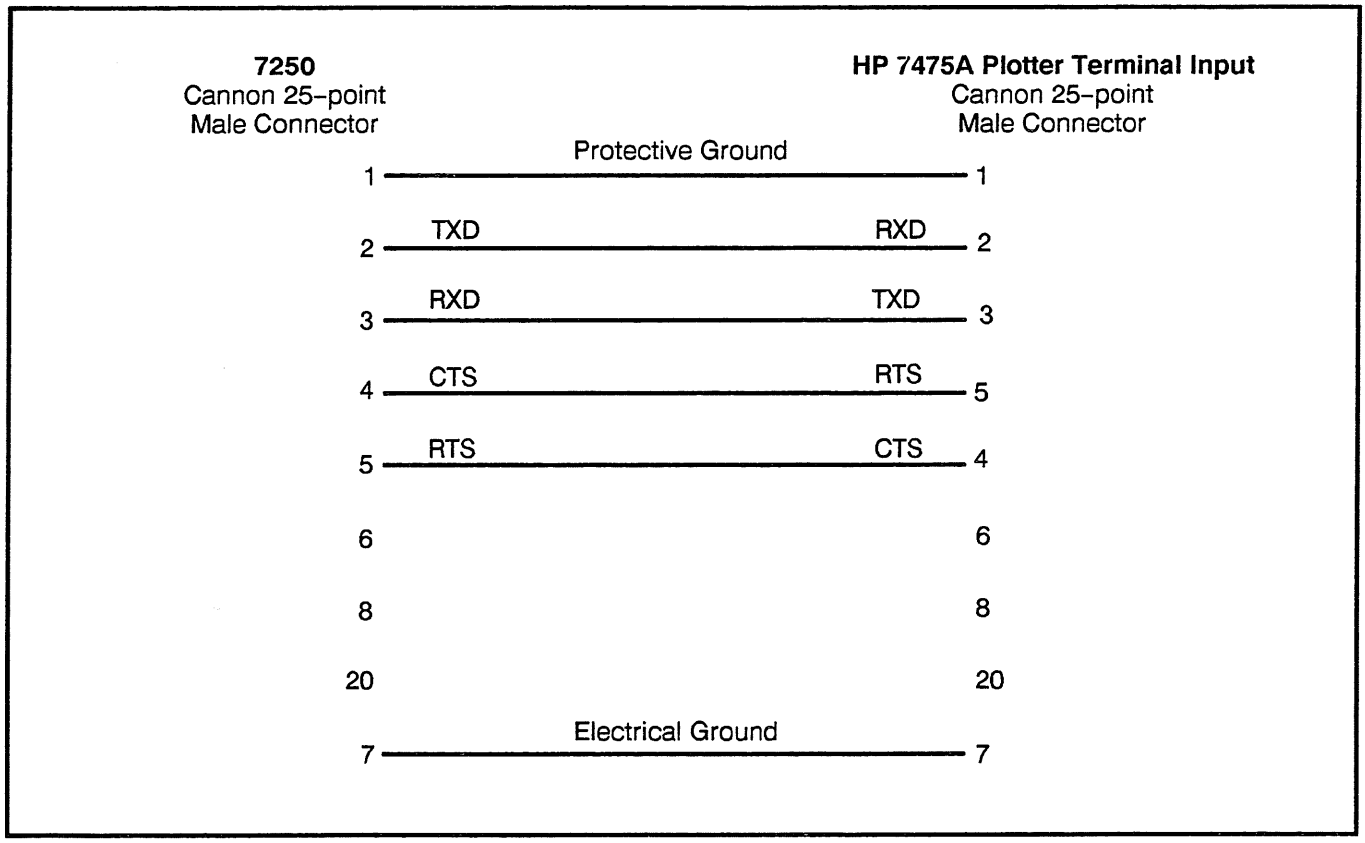

Figure B-2. RS 232 Cable Configuration for HP 7475A Plotter.

Configuration of switches on the HP 7475A Plotter:

Parity = 0 **1200 Baud** **1 Stop bit**	**Switch Setting (0 or 1)**	**Switch**
	0	S2
	0	S1
	0	Y
	1	US
	0	A3
	0	B4
	1	B3
	1	B2
	1	B1

NOTE

Pins 6, 8, and 20 are not connected in the 7250. The 7250 does not determine if the plotter is ready to receive data before it sends data.

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.