User Manual

WFM 1125
Digital Television Waveform Monitor
Option 0A/0B/0C/0D

071-0260-05

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Repair Protection extends priority repair services beyond the product's warranty period; you may purchase up to three years of Repair Protection.

Calibration Services provide annual calibration of your product, standards compliance and required audit documentation, recall assurance, and reminder notification of scheduled calibration. Coverage begins upon registration; you may purchase up to five years of Calibration Services.

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- Avoid delays for service by eliminating the need for separate purchase authorizations from your company
- Eliminates unexpected service expenses

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For more information or to order Service Assurance, contact your Tektronix representative and provide the information below. Service Assurance may not be available in locations outside the United States of America.

Name	VISA or Master Card number and expiration
Company	date or purchase order number
Address	Repair Protection (1,2, or 3 years)
City, State, Postal code	Calibration Services (1,2,3,4, or 5 years)
Country	Instrument model and serial number
Phone	Instrument purchase date

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

Ground the Product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Do Not Operate around Conductive Pollutants.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

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

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:

WARNING
High Voltage

Protective Ground
(Earth) Terminal

CAUTION
Refer to Manual

Double
Insulated

Preface

This manual describes the capabilities of the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D and its features and specifications.

To install and configure the waveform monitor for use in your operating environment, refer to the first section, *Getting Started*. For detailed information about a feature, refer to the third section, *Reference*.

About This Manual

This manual is composed of the following sections:

- *Getting Started* provides a product description and installation instructions. Standard and optional accessories are also listed.
- *Operating Basics* briefly describes the front panel controls, rear panel connections, and brief menu operations.
- *Reference* provides an alphabetized reference for all display modes and configurable features of the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D.
- *Appendices* provides additional information including the specifications, remote control interfaces, and maintenance procedures.

Contacting Tektronix

Product Support	For application-oriented questions about a Tektronix measurement product, call toll free in North America: 1-800-TEK-WIDE (1-800-835-9433 ext. 2400) 6:00 a.m. – 5:00 p.m. Pacific time Or contact us by e-mail: tm_app_supp@tek.com For product support outside of North America, contact your local Tektronix distributor or sales office.
Service Support	Contact your local Tektronix distributor or sales office. Or visit our web site for a listing of worldwide service locations. http://www.tek.com
For other information	In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call.
To write us	Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000

Getting Started

Getting Started

This section presents information you need to set up your WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. This section contains the following information:

- *Product Description*. Gives an overview of the product capabilities.
- *Options and Accessories.* Lists the standard and optional accessories.
- *Installation.* Describes how to set up the waveform monitor for use.
- *Operating Environment.* Describes the environmental requirements to ensure proper operation and long instrument life.

Product Description

The WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D measures and displays HDTV serial digital signals. The waveform monitor is a fully digital waveform monitor with a variety of standard measurement modes displayed on an internal VGA display. An external VGA display output is also provided. The digital architecture of the waveform monitor allows you to save the displayed waveform to an internal memory. In order to properly display intermittent events that may be missed in a single-line select mode, the waveform monitor has a persistence display feature combining information from many TV lines, much like an analog waveform monitor.

Refer to *Appendix A: Specifications,* for details of the waveform monitor performance.

Features

The waveform monitor offers the following features:

- Supports the following system formats:
  - Option 0A: 1035/60i, 1035/59.94i, 1080/60i, and 1080/59.94i
  - Option 0B: 720/60p and 720/59.94p
  - Option 0C: 1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 720/60p, and 720/59.94p
  - Option 0D: 1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 1080/50i, 720/60p, 720/59.94p, 1080/30sF, 1080/29.97sF, 1080/25sF, 1080/24sF, 1080/23.98sF, 1080/24p, and 1080/23.98p
- Digital component video signal displays, parade and vector modes

- Save and Display feature that saves and recalls the currently displayed signal
- CRC error detection
- Gamut error detection
- Infinite mode in persistence display that retains the image of transient signals
- Overlay and Parade displays
- Diamond, Lightning, and Bowtie displays
- Four graticules for waveform display
- Serial digital monitor output and CRC error monitor output
- Analog external reference input with passive loop through, bi-level or tri-level sync
- AES/EBU digital audio output (except for 720/60p, 720/59.94p, 1080/24p, and 1080/23.98p)
- Y, P_b, P_r picture monitor analog output from selected serial digital signal input

Options and Accessories

The waveform monitor is shipped with several standard accessories. These standard accessories and any optional accessories are listed here.

Standard Accessories

The waveform monitor comes standard with the accessories listed in Table 1–1.

Table 1–1: Standard accessories

Accessory	Part number
User Manual	071-0260-XX
U.S. Power Cord	161-0216-XX

Optional Accessories

The following optional accessories listed in Table 1–2 can be ordered with the waveform monitor or purchased through a Tektronix field office or distributor. When ordering, include both the name and part number (if available) of the optional accessory.

Table 1–2: Optional accessories

Accessory	Part number
Front Panel Cover	200-3897-01
Plain Cabinet	1700F00
Carrying Case	1700F02
Side-by-Side Rack Adaptor	1700F05
Blank Panel	1700F06
Utility Drawer	1700F07
Service Manual	071-0455-00

Front Panel Cover. The front panel cover protects the display face from damage and dust.

1700F00 Plain Cabinet. This cabinet is made of durable metal and is painted silver-gray. Ventilating holes in the top, bottom, and sides of the cabinet help dissipate heat.

1700F02 Carrying Case. This portable cabinet is similar to the 1700F00, but it has rubber feet, a carrying handle, a flipstand, and a front cover.

1700F05 Side-by-Side Rack Adapter. The 1700F05 enclosure allows you to mount two half-rack width instruments in a standard 19-inch rack.

1700F06 Blank Panel. When you use only one side of a 1700F05 enclosure, insert a 1700F06 Blank Panel in the unused side to improve appearance and air flow.

1700F07 Utility Drawer. When you use only one side of a 1700F05 enclosure, install the 1700F07 utility drawer in the unused side to provide storage and improve appearance and air flow. The drawer opens and closes freely, unless latched for transport.

Installation

This section provides instructions for installing the waveform monitor into a standard rack or one of the optional cases. At installation time, save the shipping carton and packing materials (including the anti-static bag) in case you need to ship the instrument.

Included Accessories

The waveform monitor is shipped with several accessory items which may be required for normal use. For more information on accessories, refer to page 1–2.

Hardware Installation

Because operating environments vary, the waveform monitor is not shipped with a cabinet unless you have ordered one. All qualification testing for the waveform monitor was performed in a 1700F00 cabinet. To guarantee compliance with specifications, you should operate the waveform monitor in one of the cabinets described here.

Cabinet Options. The cabinets offered for the waveform monitor provide EMI shielding, protect against electrical shock, and protect against the accumulation of dust. Figure 1–1 shows the plain cabinet, option 1700F00. A rear panel fan supplies filtered, cooling air which exits through the cabinet vent holes. Restricting the air flow through the vents or the rear fan can lead to an excessive internal temperature.

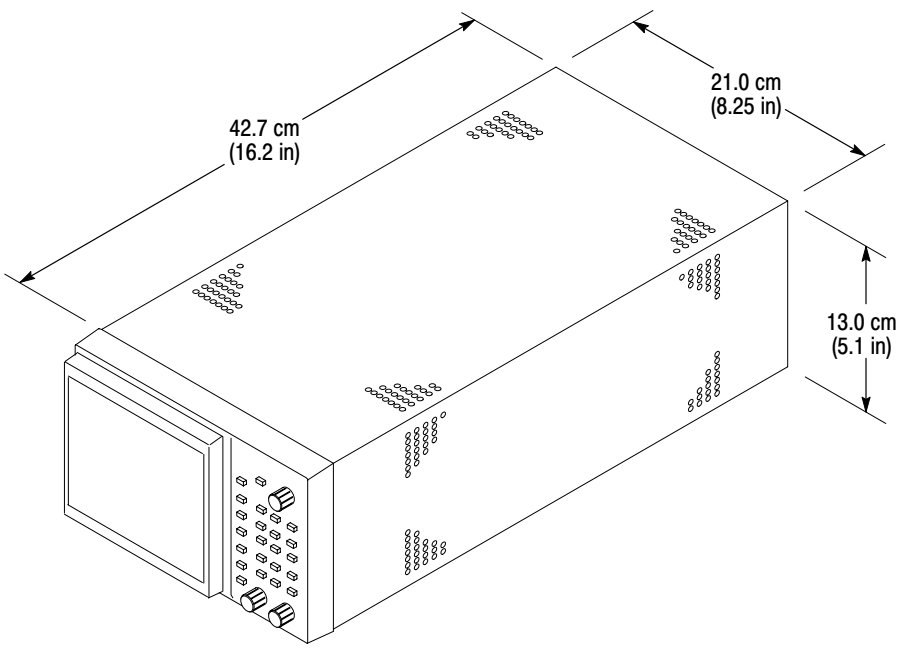


Figure 1–1: Dimensions of the 1700F00 plain cabinet

WARNING. *To meet EMI emission and safety specifications, the waveform monitor must be installed in a Tektronix 1700F00, 1700F02, or 1700F05 enclosure. The enclosure front edges must securely contact the conductive front bezel on all four sides.*

The optional 1700F00 cabinet is the basic element for all of the cabinets. The 1700F02 portable carrying case is an enhanced version of the 1700F00 cabinet, as is the 1700F05 side-by-side rack mount assembly. All cabinets are available from your Tektronix representative.

The portable cabinet, 1700F02, is shown in Figure 1–2. The 1700F02 has a handle, four feet, and a flip-up stand. The mounting hole sizes and spacing are different from those of the 1700F00.

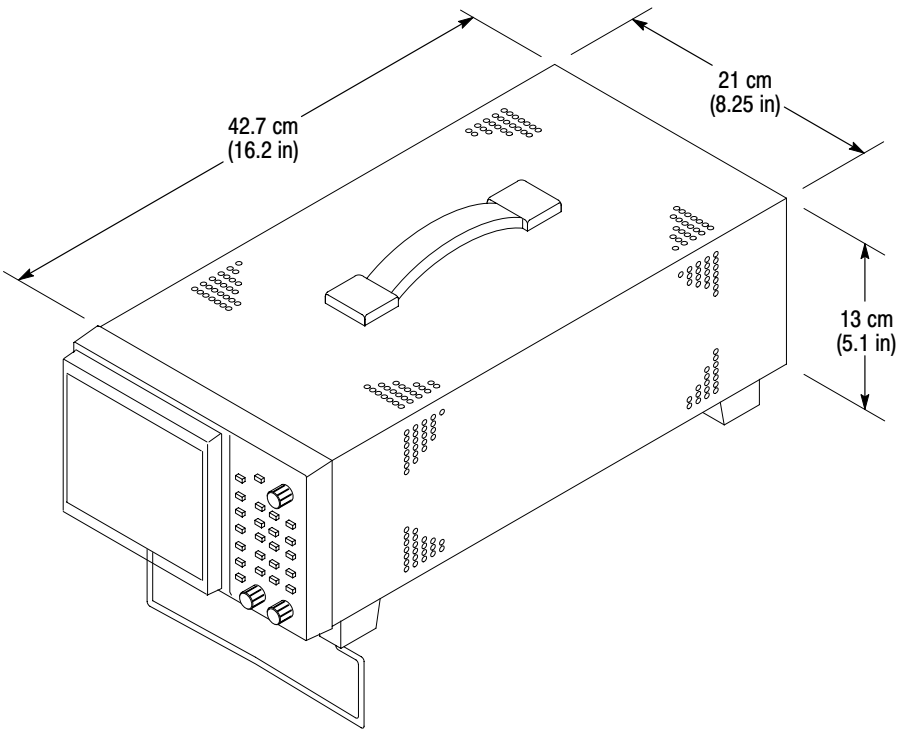


Figure 1–2: 1700F02 portable cabinet

Cabinet Installation. Secure the waveform monitor in a cabinet using two Torx T-15 screws. Figure 1–3 shows the location of these screws on the rear panel.

CAUTION. *Do not carry the waveform monitor in a cabinet without installing the rear panel mounting screws. Without the mounting screws, there is nothing to keep the waveform monitor in its cabinet.*

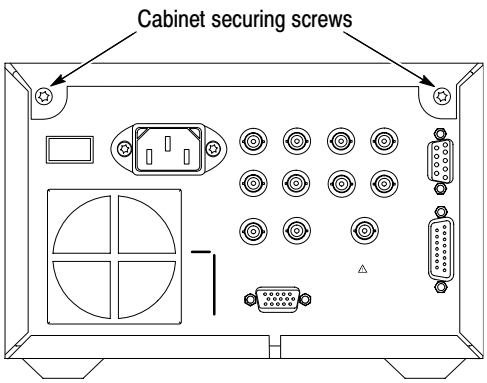


Figure 1–3: Rear view of the waveform monitor in a 1700F02 cabinet

Rack Adapter Installation. The optional 1700F05 side-by-side rack adapter, shown in Figure 1–4, consists of two attached cabinets. Use it to mount the waveform monitor and another half-rack width instrument, such as an analog component monitor, in a standard 19-inch rack.

You can adjust the rack adapter so that the waveform monitor is aligned with other equipment in the rack. See Figure 1–4.

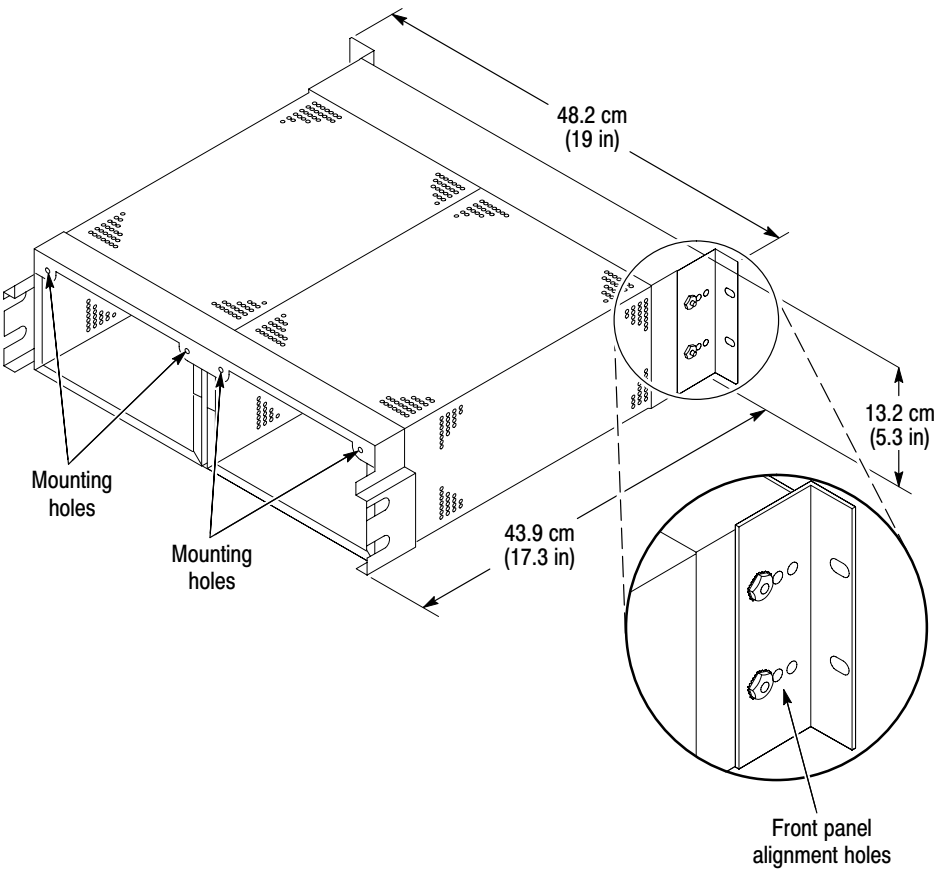


Figure 1–4: The 1700F05 rack cabinet holds two instruments

If you are using only one side of the rack adapter, insert a blank panel (1700F06) or an accessory drawer (1700F07) in the unused section to improve airflow and appearance. Figure 1–5 shows the blank panel and drawer.

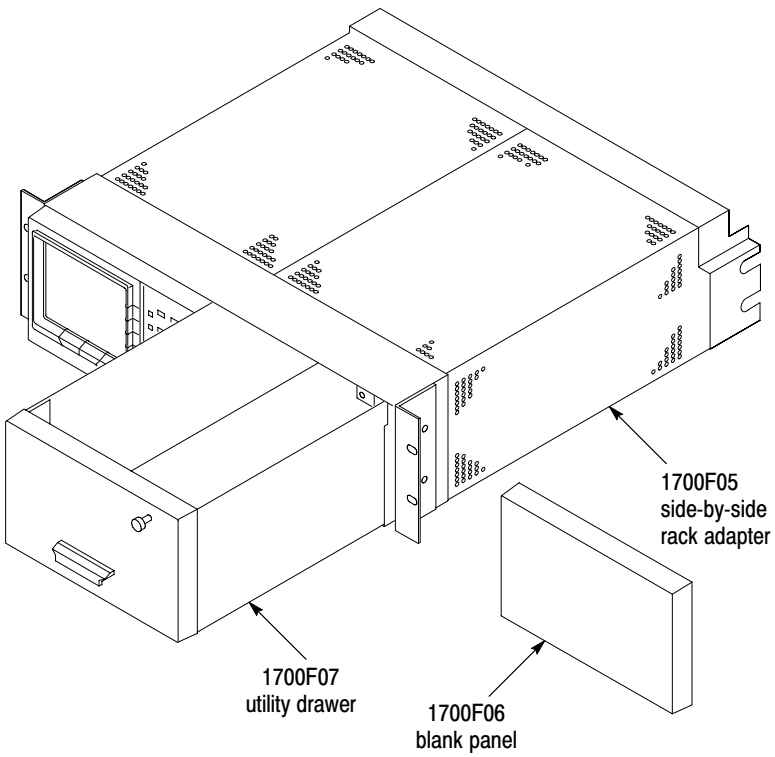


Figure 1–5: 1700F05 cabinet showing utility drawer and blank panel

Operating Environment

The following environmental requirements ensure proper operation and long instrument life.

Operating Temperature

Operate the waveform monitor where the ambient air temperature is from 0° C to +40° C. Store the waveform monitor in ambient temperatures from –20° C to +60° C. After storage at temperatures outside the operating limits, allow the chassis to stabilize at a safe operating temperature before applying power.

Ventilation Requirements

The waveform monitor is cooled by air drawn in and exhausted through its cabinet side panels by an internal fan. To ensure proper cooling, allow at least two inches (5 cm) clearance on both sides, one inch (2.5 cm) on the bottom and top, and six inches (15 cm) on the rear. (The feet on the bottom provide the required clearance when set on a flat surface.)

Connecting Power

The waveform monitor operates from a single-phase power source with the neutral conductor at or near earth ground. The line conductor is fused for over-current protection. A protective ground connection through the grounding conductor in the power cord is essential for safe operation.

AC Power Requirements

The waveform monitor operates from an AC line frequency of 48 or 63 Hz, over the range of 90 to 240 Volts, without the need for configuration, except the power cord. The typical power draw is 75 W. Refer to *Appendix A: Specifications* for additional information on power, clearance, and environmental requirements.

CRT Blinking

CAUTION. *If the CRT blinks, turn off the power. Internal components could be damaged.*

The CRT blinks if the fan on the rear panel stops working. If the CRT blinks, turn off the power switch and contact Tektronix for servicing.

Operating Basics

Functional Overview

This section provides an overview of front-panel features and rear-panel connectors. For more detailed information on functions, refer to section 3, *Reference*.

Front Panel Overview

Figure 2–1 shows the front panel of the waveform monitor. A brief discussion of each feature follows the illustration.

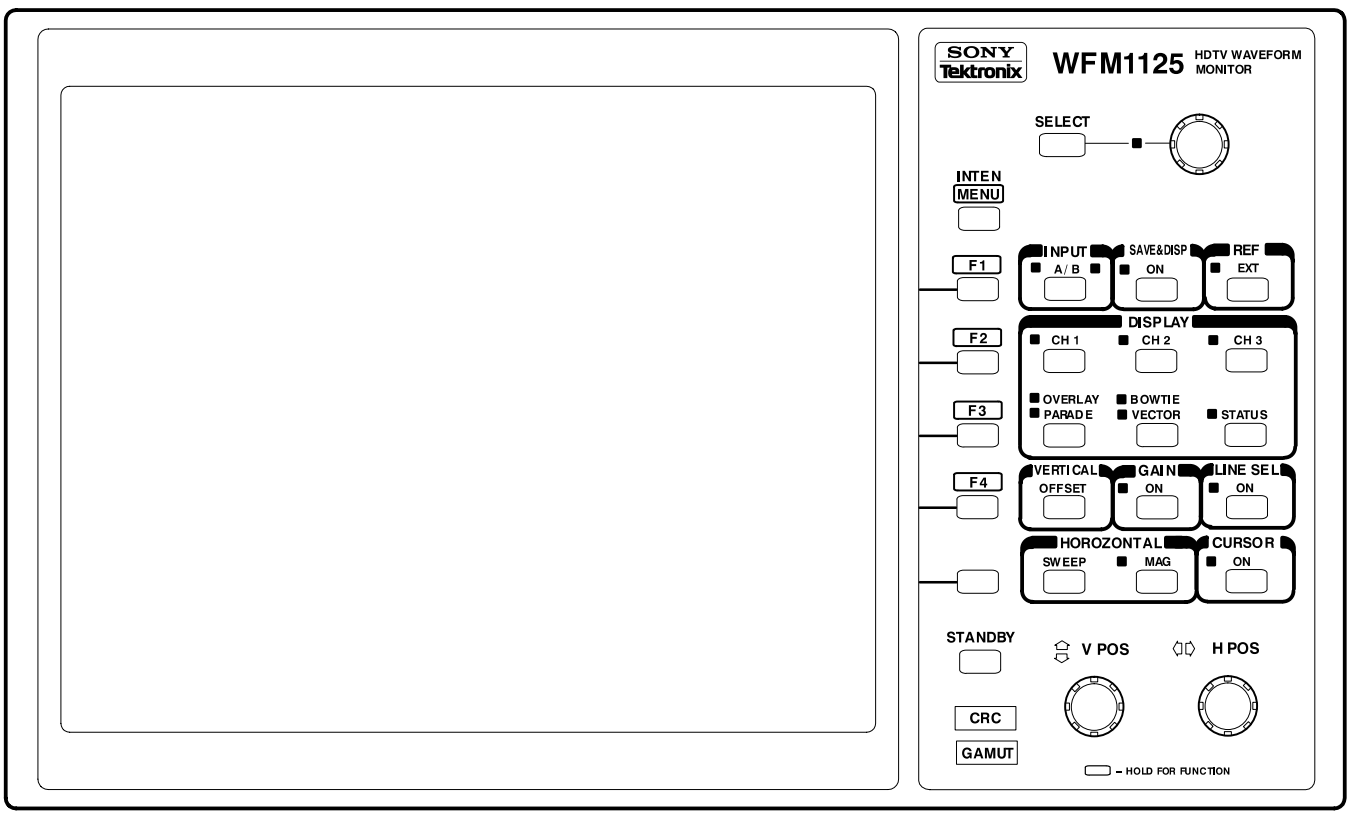


Figure 2–1: WFM 1125 Digital Television Waveform Monitor front panel

Table 2–1: Front panel functions

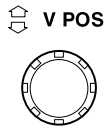
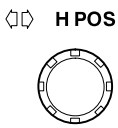
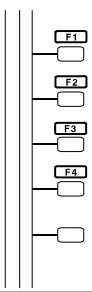
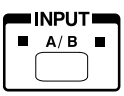
Front panel items	Item name	Descriptions
	SELECT button and knob	The function of the SELECT button and knob varies depending on the menu currently selected. For details, refer to *Using the Menus* on page 2–9.
	V POS knob	Moves the displayed waveform vertically as you turn the knob. When you turn the knob clockwise, the waveform moves upward, and when you turn it counter-clockwise, the waveform moves downward on the monitor. Press the VERTICAL OFFSET button and then select from the menu the waveform you want to move. Note that you can not move waveforms stored with the Save and Display function.
	H POS knob	Moves the displayed waveform horizontally as you turn the knob. Note that you can not move either waveforms stored with the Save and Display function or waveforms in parade mode.
	INTEN/MENU button	Operates as an intensity control button when you press this button in the usual manner. If you press and hold the button, the menu items and parameters are listed on the display to allow you to make a selection from the menu. In both cases, pressing the button again causes the mode to quit.
	INTEN	Adjusts the intensity of the selected display. Press the bezel button corresponding to the WAVEFORM, GRATICLE, READOUT, or CURSOR menus, and turn the SELECT knob to adjust the intensity. Turn the knob clockwise to increase the intensity or turn it counterclockwise to reduce the intensity.
	MENU	Displays all menu items of the configure menu on the display. You can select the menu items using the SELECT knob and button on the front panel. For details, refer to *Using the Menus* on page 2–9.
	Bezel buttons (Recall Setting buttons)	Provides multiple functions. The five bezel buttons along the right side of the VGA monitor either step through a list of two or more functions or turn a function on or off. The current function of each button depends on your selection of DISPLAY modes, MENU functions, or on-screen items from the displayed menus. A label adjacent to each button indicates its current selection. To recall front panel settings stored in memory, press and hold one of the bezel buttons labelled F–1 to F–4.
	STANDBY button	Sets the display intensity to 0 and turns off all of the indicators except STANDBY and INPUT A/B. Also, all of the function buttons except for the INPUT A/B and STANDBY are disabled. Press this button again to enable all of the function buttons.
	INPUT A/B button	Selects video signal input to the CH A or CH B connectors on the rear panel. The LED indicates the channel currently selected.

Table 2–1: Front panel functions (cont.)

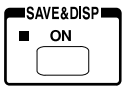
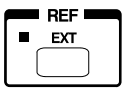
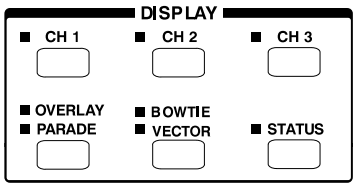
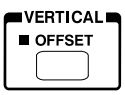
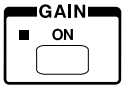
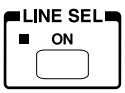
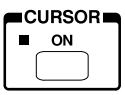
Front panel items	Item name		Descriptions
	SAVE&DISP ON button		Stores the displayed waveform in the internal memory and re-displays the stored waveform on the screen. When the waveform stored in the memory is displayed, the LED lights. For the purpose of comparison, the incoming video signal is also displayed. When you switch to another display mode or press this button again, this mode will be cancelled.
	REF EXT button		Selects either internal serial digital or external composite video input for the instrument synchronization reference.
	DISPLAY		Controls the type of display. The six buttons in the DISPLAY area generally represent two related types of displays. Press a button to select one of its two displays. Press the button again to select the other. When you select a display type, the indicator beside it lights up.
		CH1, CH2, and CH3 buttons	Allow you to select the corresponding channel. When you select a channel with the button, the video signal coming from that channel is displayed in the volts vs. time graticule on the screen.
		OVERLAY / PARADE button	Displays three channels of the video signal at the same time or displays up to three channels of the video signal in succession.
		BOWTIE / VECTOR button	Displays a bowtie test signal or displays the component signals in Vector displays. You can toggle between the Bowtie and Vector display. For the Vector display, you can select from among three display modes: VECTOR, LIGHTNING, and DIAMOND. For Option 0A, 240M/274M format mode of Option 0C, or Interlace and Segment Frame modes of Option 0D, in VECTOR or LIGHTNING mode, you can choose either of two scales: one for BTA format or one for ITU-R format.
		STATUS button	Displays digital component video signal in hex or decimal.
	VERTICAL OFFSET button		Selects a waveform to which the V POS knob operates. This mode will be disabled if you select the Vector display or Status display. Only the RESET is available if you perform a single channel display. You have several options from the menu: CH1 : Selects channel 1. CH2 : Selects channel 2. CH3 : Selects channel 3. ALL : Selects all channels. RESET : Resets the offset of the currently selected channel to the default value.

Table 2–1: Front panel functions (cont.)

Front panel items	Item name	Descriptions
	GAIN ON button	Selects the vertical magnification from the bezel menu. If the gain is enlarged, the LED lights. The bezel menu is dismissed when you press this button again. For the Waveform display, the scale value varies according to the magnification; for the Vector display, the current magnification setting is shown at the bottom right corner of the display. Note that, for the Lightning display, the gain setting is not available. You have the following options: X1 : Selects the 1 magnification gain. X5 : Selects the 5 magnification gain. X10 : Selects the 10 magnification gain. CENTER/0mV : Selects the center with respect to which the scaling to change the gain works. For the Vector or Status display, this item is not selectable. Selects the vertical magnification registration or pivot point as either the display center or 0 mV setting. Those portions of the waveform near the 0 mV graticule line will remain on screen when X5 or X10 magnification is selected.
	HORIZONTAL SWEEP button	Selects sweep rate from the menu. When CH1, CH2, or CH3 is selected in the DISPLAY, pressing this button displays the bezel menu on the CRT to allow you to select 1 LINE, 2 LINE, 1 FIELD, or 2 FIELD[1]. When PARADE is selected in the DISPLAY, pressing this button displays the bezel menu on the CRT to allow you to select 3 LINE or 3 FIELD. This mode is disabled if OVERLAY, BOWTIE, VECTOR, or STATUS is selected in the DISPLAY.
	MAG button	Provides horizontal magnification of waveform signals. Use the H POS knob to move left or right through the waveform.
	LINE SEL ON button	Displays only selected lines. Press the SELECT button to select a field, or turn the SELECT knob to select a line number. The number of lines currently selected is displayed on the screen. You can select from all the lines including vertical blanking. This function is disabled in field sweep rate mode.
	CURSOR ON button	Displays Voltage (V) cursors, Time (T) cursors, or both (V@T) cursors. You can select a cursor type from the bezel menu. Use the SELECT knob to move the cursor, and use the SELECT button to change to the active cursor. Press the CHANGE V@T bezel button to select and adjust the Voltage or the Time mode. When you press the CURSOR button, menu readouts related to the cursors will disappear, but the cursor, the cursor readouts, and the feature to assign a function to the knob are still available. Press CURSOR again to recall the menu readouts. Select OFF from the bezel menu to terminate the cursor functions.

1 **Option 0A or 240M/274M format mode of Option 0C or Interlace and Segment Frame modes of Option 0D only.**

Table 2–1: Front panel functions (cont.)

Front panel items	Item name	Descriptions
CRC	CRC indicator	Indicates data integrity errors. If you set the CRC LED menu to ON, the CRC LED indicator will light for 0.5 seconds when an error is detected.
GAMUT	GAMUT indicator	Indicates color signal level errors. If you set the GAMUT menu to ON, the GAMUT LED indicator will light for 10 milliseconds when any R, G, or B component goes over 105 % or drops below –5 %.

Rear Panel Overview

Figure 2–2 shows the rear panel of the waveform monitor. A brief discussion of each connector follows the illustration.

Power Connector

The waveform monitor is designed to operate from a single-phase power source with the neutral conductor at or near earth ground. Only the line conductor is fused for over-current protection. A protective ground connection through the grounding conductor in the power cord is essential for safe operation.

WARNING. *Dangerous potentials are present on the Power circuit board. Do not connect power to the waveform monitor if it is not enclosed in a prescribed cabinet.*

The waveform monitor operates from an AC line frequency of 50 or 60 Hz, over the range of 90 to 240 VAC, without the need for configuration. Refer to *Appendix A: Specifications* for additional information on power and environmental requirements.

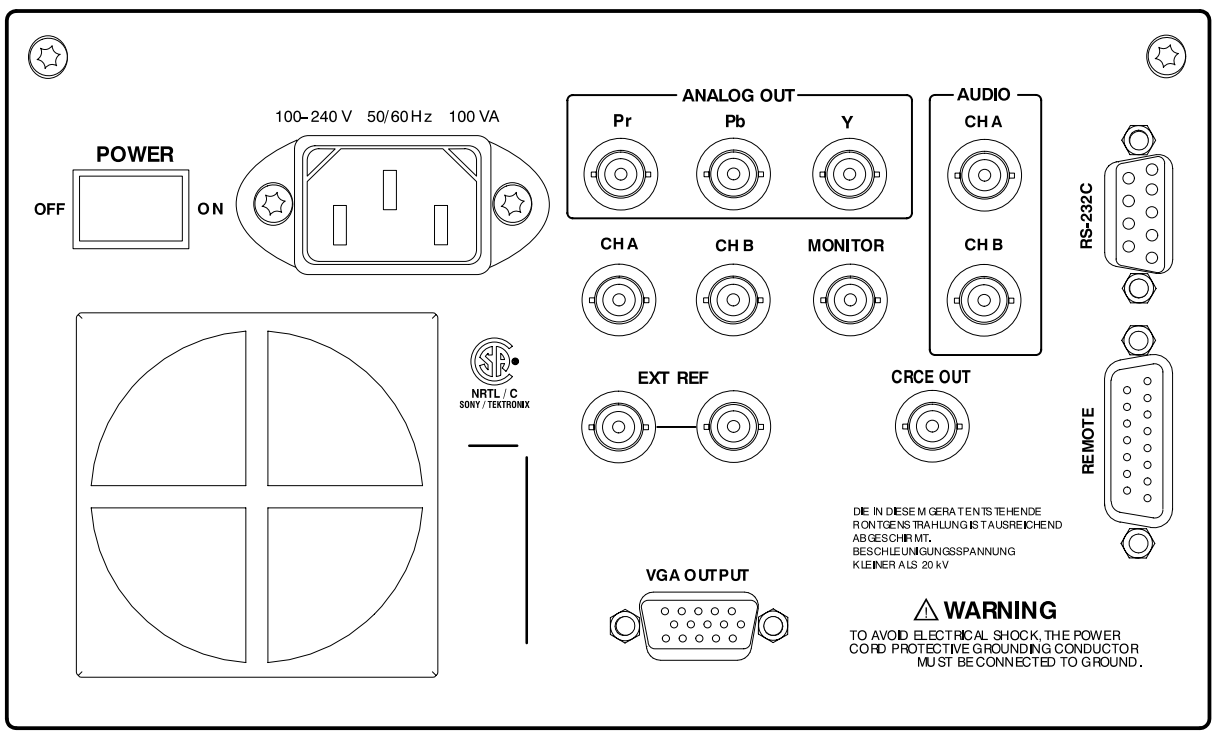


Figure 2–2: Rear panel

Table 2–2: Rear panel functions

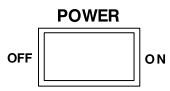
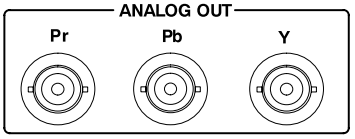
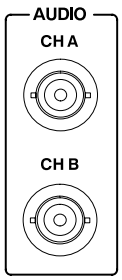
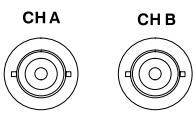
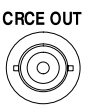
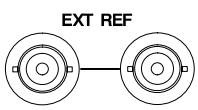
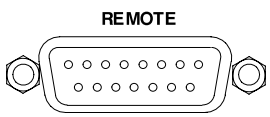
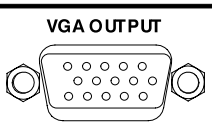
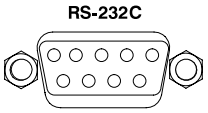
Rear panel items	Item name	Descriptions
	POWER button	Powers the waveform monitor on or off.
	ANALOG OUT(Pr, Pb, Y) connectors	Provides three 75 Ω component signal outputs to drive a component picture monitor. The output format is YP_bP_r as SMPTE 240M/274M or SMPTE 296M. Tri-level sync is on Y.
	AUDIO (CH A, CH B) connectors	Provide digital audio outputs compliant with ANSI S4.40 and SMPTE 276M. The audio channel output on CHA or CHB connectors is selected in the AUDIO A or AUDIO B menu. These outputs are available only for Option 0A, 240M/274M format mode of Option 0C, or Interlace and Segment Frame modes of Option 0D.
	CH A and CH B connectors	Provides for connection of serial digital signals which comply with SMPTE 292M.
	MONITOR connector	Provides a serial digital monitor output signal from the currently selected channel. Rise/fall times and jitter are not specified for this output.
	CRCE OUT connector	Provides TTL output when CRC errors are detected. Connecting this signal to an oscilloscope, for example, allows you to get more detailed information on when these errors occur.
	EXT REF connectors (loop through inputs)	Provides for connection of an analog external synchronization signal. These inputs are compensated for 75 Ω impedance and require proper termination at one end of the loop-through connector or at the receiver in a monitored system.
	REMOTE connector	This 15-pin subminiature D-type connector provides limited remote control functions.

Table 2–2: Rear panel functions (Cont.)

Rear panel items	Item name	Descriptions
	VGA OUTPUT connector	Provides a VGA signal output identical to the signal displayed on the screen. Connect this output to a VGA monitor or projector to display screen information, or connect the output to a video printer to make a screen hardcopy.
	RS-232C connector	This 9-pin subminiature D-type connector provides a serial interface for data output and calibration.

Using the Menus

You can set most functions with either context sensitive bezel button menus or general configuration menus. The following subsections outline and describe how to make selections from these menus. Figure 2–3 shows the buttons and knob used for menu selection.

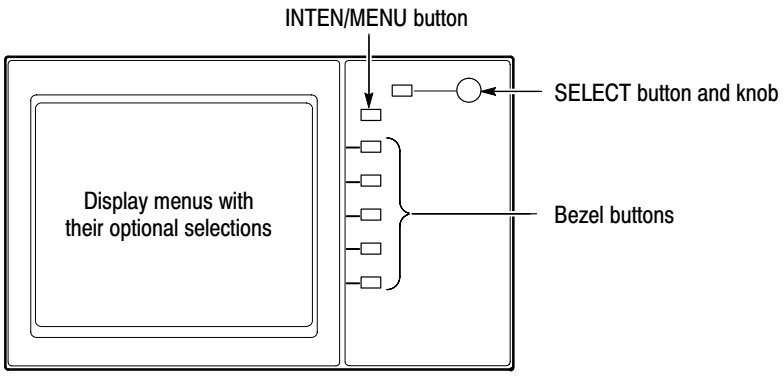


Figure 2–3: Elements of the WFM 1125 menu controls

Bezel menu

This menu directly relates to display mode settings. When you change the display mode by pressing any of the front panel function buttons, the menu item associated with it appears at the right side of the display.

To select a bezel menu item, press the bezel button associated with the displayed menu item.

Configure menu

This menu consists of general configuration menu items and operating modes which are changed infrequently. If you press and hold the front panel INTEN/MENU button, the menu items are listed on the display.

If you turn the SELECT knob when the menu items are on display, the highlighted box moves across the menu. Press the SELECT button to select the desired parameter item; it is highlighted to indicate that it takes effect.

For menu items which affect the whole hardware setting, a bezel menu item prompts you to confirm your selection. Select OK or CANCEL.

To quit the menu mode, press the INTEN/MENU button again.

For additional information on this menu, refer to *Configure Menu* on page 3–3.

Screen Readouts

In addition to the areas displaying waveforms and menus, the waveform monitor has six readout areas that display settings and error status information, as shown in Figure 2–4. A brief discussion of each feature follows the illustration.

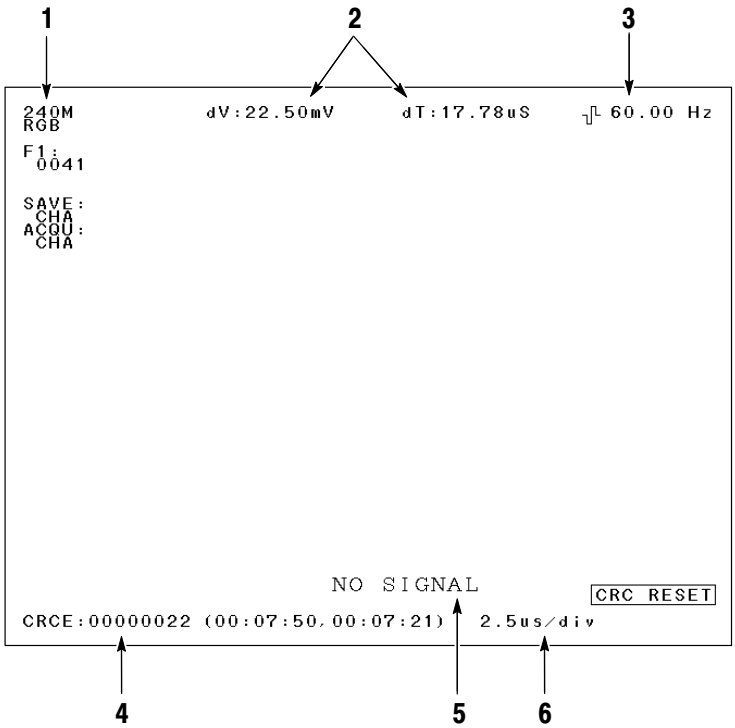


Figure 2–4: Six readout areas on the screen

1. Display format, Line selection, and Save and Display

   This sections indicates the Display format currently used, line number if you are using the line selection function, stored waveform if you are using the Save and Display function, and the channel of the currently displayed waveform.

2. Cursor readouts

   This section indicates changes in volt (dV) and time (dT) values if you are using the cursor function.

3. Field rate and Scanning format

This section displays the field rate for the reference signal. For Option 0D, the scanning format (i, p, or p(sF)) is also displayed. If the field rate is no supported value, then “??.?? Hz” is displayed and “Missing Reference” appears at the bottom of the display. When the external signal is selected as a reference signal, an icon indicating the sync format (bi-level SDTV or tri-level HDTV) is prefixed to the field rate value.

4. CRC error count

If you have set the CRC DISP menu for COUNT, this section displays the error count value and the elapsed time since reset. When the error count goes over 99999999, the display changes to ********, and the time is no longer updated. If you have set the CRC DISP menu to RATE, this section displays the Err/Sec value, the error count value divided by the elapsed time since reset.

5. No Signal and Missing Reference

This section displays two items as follows:

- No Signal. This message will appear when no incoming signal is present; no waveform can be displayed and no clock can be generated.
- Missing Reference. This message will appear when the field rate is no supported value. At this time, the waveform is displayed; however, the waveform may not be properly synchronized. When the frame rate of the SDI signal is different from that of the external reference signal, the AES/EBU audio signal cannot be properly extracted and is not output correctly.

***NOTE**. For the instrument with serial number J340101 and above, No Signal is not displayed except for the instrument failure. In this case, Missing Reference can be displayed.*

6. Sweep rate

The sweep rate that you set in the Waveform display mode is indicated. No readout is present in field sweep mode.

Reference

Reference

This section presents detailed information on menus and functions of the waveform monitor. The topics are organized alphabetically. Most topics are named after the front panel labels and button names.

Bowtie Display

The Bowtie display evaluates the relative amplitude and timing among the three video channels. This display requires a special test signal from the monitored source. See Figure 3–1. The Tektronix TSG 1001 Programmable TV Generator and PSC1125 Digital Television Parallel-to-Serial Converter can produce a bowtie signal with 1 ns time marks, which aid in signal evaluation. The signal is a 5 MHz sinewave on CH 1 (luminance) and 5.002 MHz (5.003126 MHz for SMPTE 296M) sine waves on CH 2 (Pb) and CH 3 (Pr).

The display is made up of two separate waveforms as shown in Figure 3–1. The left waveform always compares CH 1 to CH 2. The right waveform always compares CH 1 to CH 3. Also, by the common reference of CH1, the CH2 to CH3 timing is implicitly given.

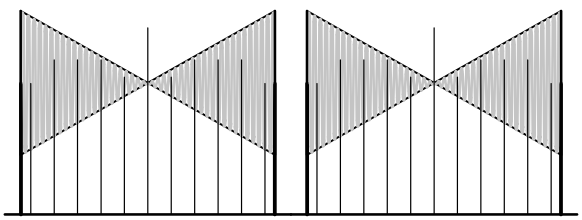


Figure 3–1: Typical Bowtie display on the WFM 1125

Timing Measurement

The timing measurement is based on alignment of the center marker and the null point at the center of the waveform. The generator provides a center marker, which is centered on the null point when interchannel timing is correct. A shift of the null to the left or right indicates a difference in the relative timing. If the null shifts two full time markers, the relative timing error between channels would be 2 ns. If the null is to the left of the center marker, the color difference channel is advanced relative to the luminance channel. When either of the nulls is shifted to the right, that color difference signal is delayed relative to the luminance channel. In Figure 3–2, the chrominance channel, CH 3 (Pr), is advanced relative to the luminance channel by 1 ns.

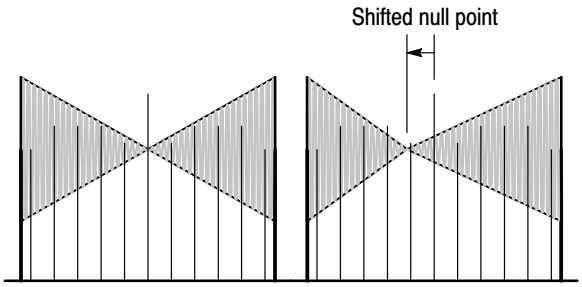


Figure 3–2: Bowtie waveform showing a timing error in CH 3

Although you can use Waveform or Lightning displays to determine channel timing with most test signals, the Bowtie method provides better resolution of channel timing and is the easiest to use when the Bowtie test signal is available.

Relative Gain Check

The bowtie measurement also provides a method to determine whether the relative channel gain is correct. If the gains are not equal, the center null point will not be a complete null. Figure 3–3 shows a Bowtie display with an incomplete null in the right waveform. If the gain error is in CH 1, neither waveform has a complete null. If CH 2 gain is off, the left waveform will not null completely, but the right one will. If the gain is off for CH 3, as in Figure 3–3, the left waveform will be normal and the right one will not reach a complete null.

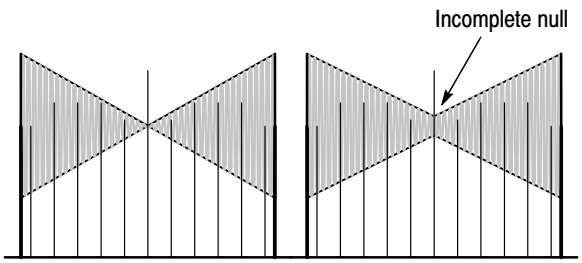


Figure 3–3: Bowtie waveform showing gain error in CH 3

Configure Menu

The Configure menu allow you to set or select a persistence mode or perform various other tasks. Press and hold the INTEN/MENU button on the front panel to bring up the Configure menu. For information on moving the highlight from column to column, refer to *Using the Menus* on page 2–9.

Figure 3–4 shows the Configure menu display, and Table 3–1 lists all Configure menu functions.

The displayed menu items little vary with the type of options.

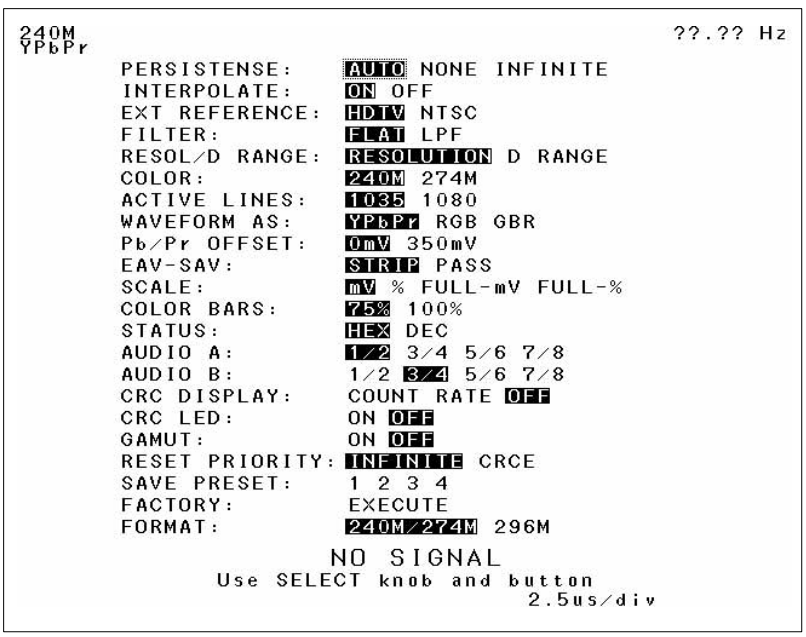


Figure 3–4: Configure menu display of Option 0C

Turning the SELECT knob causes a selection box to scroll through the menu list. Press the SELECT button to select one of the menu items; the menu item is highlighted and enabled.

Press the INTEN/MENU button again to remove the Configure menu.

Table 3–1: Menu functions

Menu name	Menu items	Descriptions
PERSISTENCE	AUTO	AUTO sets the optimum screen persistence. AUTO is the default setting.
	NONE	NONE sets zero persistence.
	INFINITE	INFINITE sets the persistence to infinite. When a waveform is displayed in INFINITE, press the INF RESET bezel button to reset the waveform display. (Note that you must have selected INFINITE from the RESET PRIORITY menu if COUNT or RATE are enabled in the CRC DISPLAY menu.)
INTERPOLATE	ON	The waveform points will be interpolated with a digital filter when INTERPOLATE is set to ON.
	OFF	When you set it to OFF, the waveform data values are graphed as dots. The P_b/P_r signal has a rate half that of the Y signal, so that a dot is always created between each two input data value dots by internal calculation. When INTERPOLATE is set to OFF, pedestal values for each input data word are displayed.
EXT REFERENCE		Sets the format for the external reference input signal.
	HDTV	HDTV sets the format depending on the option: Option 0A: 1035/60i, 1035/59.94i, 1080/60i, or 1080/59.94i Option 0B: 720/60p or 720/59.94p Option 0C: 1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 720/60p, or 720/59.94p
	NTSC	NTSC sets the format to 525/59.94i.
		For Option 0D, the following two items are appeared instead of HDTV and NTSC.
	3–LEVEL	3–LEVEL set the format to 1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 1080/50i, 1080/30sF, 1080/29.97sF, 1080/25sF, 1080/24sF, 1080/23.98sF, 720/60p, 720/59.94p, 1080/24p, or 1080/23.98p.
	2–LEVEL	2–LEVEL set the format to 525/59.94i or 625/50i.
FILTER	FLAT	When FLAT is selected, the unfiltered signal is displayed. FLAT is the default setting.
	LPF	When LPF is selected, the signal is displayed after it passes through the 15 MHz low pass filter.
RESOL/D RANGE		Specifies internal calculation mode.
	RESOLUTION	RESOLUTION (Resolution mode) monitors signal fractions in detail. RESOLUTION is the default setting, but amplitude clipping may occur on large signals transcoded to RGB.
	D RANGE	D RANGE (D Range mode) prevents an overflow in calculation (clipped waveform) when the level of signal input is excessive.

Table 3–1: Menu functions (Cont.)

Menu name	Menu items	Descriptions
COLOR		Selects color matrix coefficient for converting $Y/P_b/P_r$ signal to RGB and selects graticules for vector display. Affects transcoded RGB or GBR waveform, diamond display, and VECTOR color-bar target values. This menu is available for Option 0A, 240M/274M format mode of Option 0C or Interlace mode of Option 0D.
	240M	Select 240M for SMPTE240M, BTA S-001A. 240M is the default setting.
	274M	Select 274M for SMPTE274M.
ACTIVE LINES		Selects the number of lines that will be masked when the EAV-SAV menu is set to STRIP or the Vector display is in use. This menu is available for Option 0A, 240M/274M format mode of Option 0C, or Interlace mode of Option 0D.
	1035	If you choose 1035, the following lines are masked: Line 1121 in Field 2 to Line 40 in Field 1 Line 558 in Field 1 to Line 602 in Field 2 If you choose 1080, the following lines are masked: Line 1124 in Field 2 to Line 20 in Field 1 Line 561 in Field 1 to Line 583 in Field 2 The default setting is 1035.
	1080	If you choose 1080, the following lines are masked: Line 1124 in Field 2 to Line 20 in Field 1 Line 561 in Field 1 to Line 583 in Field 2
WAVEFORM AS	YPbPr	In Waveform or Parade modes, these settings determine if channels 1, 2, and 3 are displayed in their native Y, P_b, P_r format (YP_bP_r) or transcoded to R, G, B (RGB). WAVEFORM AS does not affect the picture monitor output signal (MON OUT). RGB values are computed from selected colorimetry (240M or 274M).
	RGB	
	GBR	
Pb/Pr OFFSET	0mV	The default setting is 0 mV.
	350mV	Adds 350 mV of positive offset to the P_b/P_r channel. This facilitates comparison with the Y channel.
EAV-SAV		Determines whether sync data, line number, and auxiliary data in the incoming serial digital data is passed or not.
	STRIP	When the STRIP is set, horizontal and vertical blanking is masked. STRIP is the default setting.
	PASS	When the PASS is set, horizontal and vertical blanking is not masked. If you set the EAV-SAV to PASS when ON is selected in the GAMUT menu, the GAMUT menu will change to OFF to prevent detecting gamut errors on EAV-SAV data values.

Table 3–1: Menu functions (Cont.)

Menu name	Menu items	Descriptions
SCALE		Provides the selection of graticule type in waveform display mode.
	mV	–300 to 800 mV full scale with mV graticule. The default setting is mV.
	%	–300 to 800 mV full scale with % graticule as a percent of 700 mV
	FULL mV	0 to 700 mV full scale with mV graticule
	FULL %	0 to 700 mV full scale with % graticule as a percent of 700 mV
COLOR BARS	75%	Selects 75% graticule for the vector display mode. The default setting is 75 %.
	100%	Selects 100% graticule for the vector display mode.
STATUS		Selects display radix for the status display mode.
	HEX	Hexadecimal
	DEC	Decimal
AUDIO A, AUDIO B	1/2	Selects embedded audio channels output from AUDIO CHA and CHB connectors on the rear panel. Note that you can not assign the same audio channels for CHA and CHB audio outputs. The default setting is 1/2 for CHA and 3/4 for CHB. This menu is available for Option 0A , 240M/274M format mode of Option 0C, or Interlace and Segment Frame modes of Option 0D.
	3/4	
	5/6	
	7/8	
CRC DISPLAY		Selects whether the CRC error count is displayed on the screen or not.
	COUNT	When COUNT is selected, the error count, the time elapsed since this function was enabled, and the time when the latest error was detected are displayed at the lower left part of the screen. When the count goes over 99999999, the value readout is changed to ********, and the time is no longer updated.
	RATE	When RATE is selected, the Err/Sec value (the error count value divided by the elapsed time since reset) is displayed. To restart the error count, press the bottom bezel button. (Note that you must have selected CRCE from the RESET PRIORITY menu if you have selected INFINITE from the PERSISTENCE menu.) The error count resolution is about 10 ms. Time can reach up to 99 hours 59 minutes 59 seconds. OFF is the default setting.
	OFF	OFF is the default setting.
CRC LED		Indicates data integrity errors.
	ON	If you set the CRC LED to ON, the CRC LED indicator will light for 0.5 seconds when an error is detected.
	OFF	OFF is the default setting.
GAMUT		Indicates color signal level errors.
	ON	If you set the GAMUT to ON, the GAMUT LED indicator will light when any RGB level goes over 105 % or drops below –5 %. When this mode is set to ON, the EAV-SAV menu is also set to STRIP.
	OFF	When OFF is selected, the gamut error alarm is disabled.

Table 3–1: Menu functions (Cont.)

Menu name	Menu items	Descriptions
RESET PRIORITY		Specifies the menu for which the reset through the bezel button will operate. You should use this item if you have selected both INFINITE in the PERSISTENCE menu or RATE or COUNT in the CRC DISPLAY menu together. If you have selected only one of the above items, selection of this menu item is disabled.
	INFINITE	If you select INFINITE, the reset through the bezel button will operate in PERSISTENCE menu INFINITE mode. The default setting is INFINITE.
	CRC	If you select CRCE, it will operate in CRC DISP menu COUNT/RATE mode.
SAVE PRESET	1 to 4	Allows storing the front panel menu settings in the corresponding memory area (1 to 4). Selecting the preset number displays the bezel menu (OK or CANCEL) to confirm operation. Press the OK bezel button to execute the operation. Press CANCEL to cancel the operation and return to the state prior to selecting the preset number.
FACTORY	EXECUTE	Resets all the instrument settings to the factory defaults. Selecting EXECUTE displays the bezel menu (OK or CANCEL) to confirm operation. Press the OK bezel button to execute the operation. Press CANCEL to cancel the operation and return to the state prior to selecting this menu item.
FORMAT		Selects the interface format that the waveform monitor expects at the CH A and CHB input. Selecting the format displays the bezel menu (OK or CANCEL) to confirm operation. Press the OK bezel button to execute the operation. Wait 5 seconds for the operation to complete, or press CANCEL to cancel the operation and return to the prior state. This menu is only available for Option 0C and Option 0D.
		The following two items are available for Option 0C.
	240M/274M	Select 240M/274M for SMPTE 240M and SMPTE 274M.
	296M	Select 296M for SMPTE 296 M.
		The following three items are available for Option 0D.
	i (Interlace)	Select Interlace for 1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, and 1080/50i.
	p(sF) (Segment Frame)	Select Segment Frame for 1080/30sFp, 1080/29.97sF, 1080/25sF, 1080/24sF, and 1080/23.98sF.
	p (Progressive)	Select Progressive for 1080/24p, 1080/23.98p, 720/60p, and 720/59.94p.

Diamond Display

The Diamond display is very effective at showing the relationship between the R, G, and B video signals. The waveform monitor converts the Y, $P_{b,}$ and P_r components recovered from the serial signal to R, G, and B to form the Diamond display. Figure 3–5 shows how the Diamond plot is developed.

Press the BOWTIE/VECTOR button to select VECTOR. Press the DIAMOND bezel button to select Diamond display.

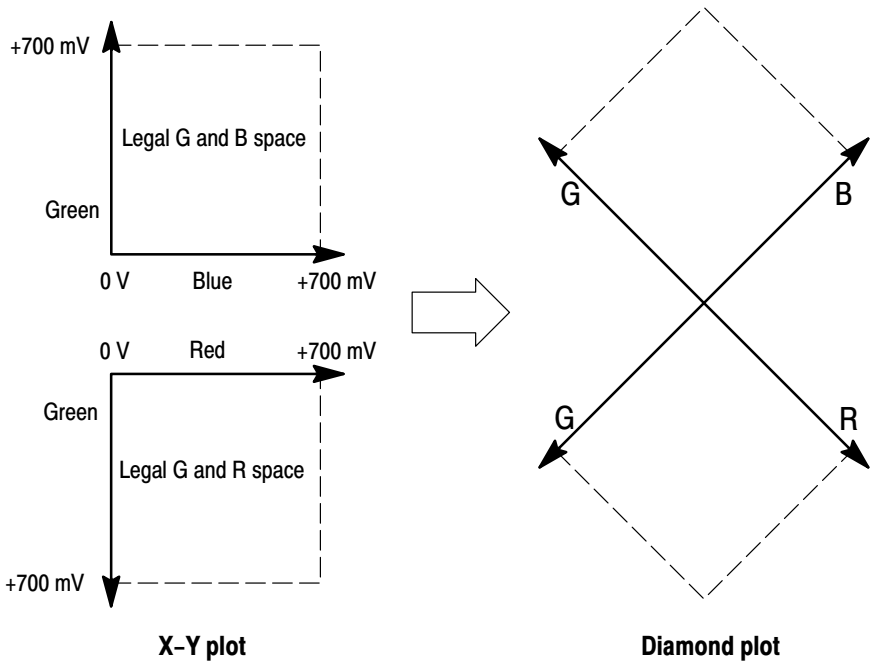


Figure 3–5: Construction of the Diamond display

Ultimately all color video signals are coded as RGB for display on a picture monitor. For a color monitor to predictably display all three components, the components must lie between peak white, 700 mV, and black, 0 V. Picture monitors handle excursions outside the standard range (gamut) in different and unpredictable ways.

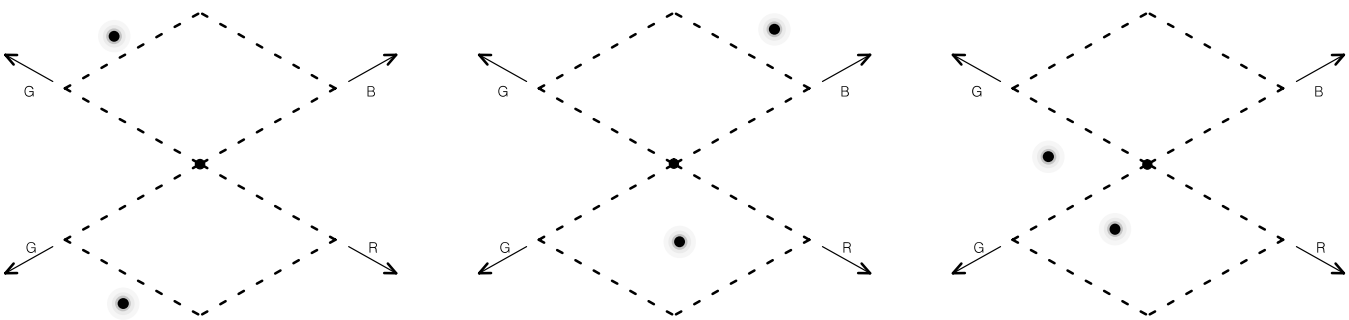
Checking RGB Gamut

For a signal to be in gamut, all signal vectors must lie within the G-B and G-R diamonds. Conversely, if a vector extends outside the diamond, it is out of gamut. The direction of an excursion out of gamut indicates which signal is excessive. Errors in green amplitude affect both diamonds equally, while blue amplitude errors affect only the top diamond and red errors affect only the bottom diamond. If ON is selected in the GAMUT menu, when the signal exceeds the RGB gamut by more than 5%, the GAMUT LED on the front panel lights, even if the signal is only momentarily out of gamut.

In the Diamond display, the intensity of a vector indicates its duration. A momentary out-of-gamut condition appears as a faint trace outside the diamonds. Long duration violations show as a bright trace outside the diamonds. Figure 3–6 gives some sample out-of-gamut signals on the Diamond display.

On the Diamond display, monochrome signals appear as vertical lines. Signals of constant hue and variable saturation or intensity appear as straight lines. Nonlinear component processing, such as from a gamma corrector that alters white balance, can cause deviations.

As with the Lightning display, bending transitions on test signals, such as color-bars, indicate timing delays. When a color bar signal is applied, the vertical axis becomes an indicator of delay errors.



Example A:
R – OK
G > 700 mV
B – Ok

Example B:
R – OK
G – OK
B > 700 mV

Example C:
R – OK
G – OK, 350 mV
B < 0 mV

Figure 3–6: Out-of-gamut signals on a Diamond display

Digital Intensity

The digital intensity feature displays waveforms in two-valued level (no grey-scale) when the intensity of the waveform is set to maximum. With this feature, you can avoid missing specific waveform phenomena due to lack of trace intensity.

Use the following steps to display waveforms in two-valued level.

1. Press the INTEN/MENU button on the front panel.
2. Press the WAVEFORM bezel button.
3. Turn the SELECT knob clockwise until it stops to display waveforms in two-valued level.

Graticules

The waveform monitor has four waveform display mode graticules: millivolt, percent, full millivolt, and full percent.

To select a graticule for waveform display mode, follow the steps below. (For information on how to move the highlight from column to column in the menu, refer to *Using the Menus* on page 2–9.)

1. Press the INTEN/MENU button on the front panel.
2. Choose one of the waveform display modes in the SCALE menu. Available options are mV, %, FULL mV, and FULL %.

Millivolts (mV) Graticule

Figure 3–7 shows the Waveform display mode in mV graticule.

- Vertical Scale. The vertical scale is marked in millivolts (mV) and extends from –300 mV to +800 mV in 100 mV increments. Each major division is divided into 5 minor divisions which equal 20 mV each.
- Horizontal Scale. The horizontal line represents time and has 12 major divisions. Each major divisions is divided into 5 minor divisions. Refer to Table 3–2 and Table 3–3 for how the sweep setting affects the horizontal scale.

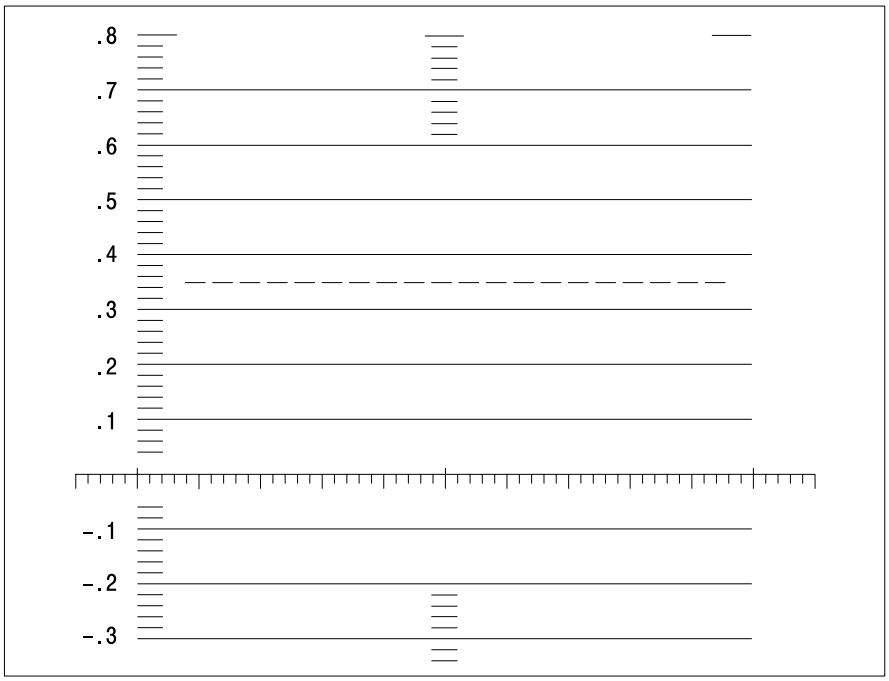


Figure 3–7: Waveform display mode, mV graticule

Table 3–2: Horizontal scale

Sweep setting	Major divisions	Minor divisions	Availability
1 line	2.5 μs	0.5 μs	Option 0A Option 0C in 240M/274M format mode
	2.0 μs	0.4 μs	Option 0B Option 0C in 296M format mode
	100 ns	20 ns	magnified sweep
2 lines	5.0 μs	1.0 μs	Option 0A Option 0C in 240M/274M format mode
	4.0 μs	0.8 μs	Option 0B Option 0C in 296M format mode
	200 ns	40 ns	magnified sweep

Table 3–3: Horizontal scale for Option 0D

Sweep setting	MAG off	MAG on	Availability
1 line	3.0 μs	0.1 μs	1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 1080/50i, 1080/30sF, 1080/29.97sF, 1080/25sF, 1080/24sF, 1080/23.98sF, 1080/24p, 1080/23.98p
	2.0 μs	0.1 μs	720/60p, 720/59.94p
2 lines	6.0 μs	0.4 μs	1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 1080/30sF, 1080/29.97sF
		1.0 μs	1080/50i, 1080/25sF
		1.2 μs	1080/24sF, 1080/23.98sF, 1080/24p, 1080/23.98p
	4.0 μs	0.5 μs	720/60p, 720/59.94p
3 lines	9.0 μs		1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 1080/50i, 1080/30sF, 1080/29.97sF, 1080/25sF, 1080/24sF, 1080/23.98sF, 1080/60p, 1080/59.94p
	6.0 μs		720/60p, 720/59.94p

Percent (%) Graticule

Figure 3–8 shows the Waveform display mode in % graticule.

- Vertical Scale. The scale is marked in percent (%) of 700 mV (100 %) and extends from –40 % to +120 % in 10 % increments. Each major division is divided into 2 minor divisions which equal 5 % each.
- Horizontal Scale. The horizontal line represents time and has 12 major divisions. Each major divisions is divided into 5 minor divisions. Refer to Table 3–2 for how the sweep setting affects the horizontal scale.

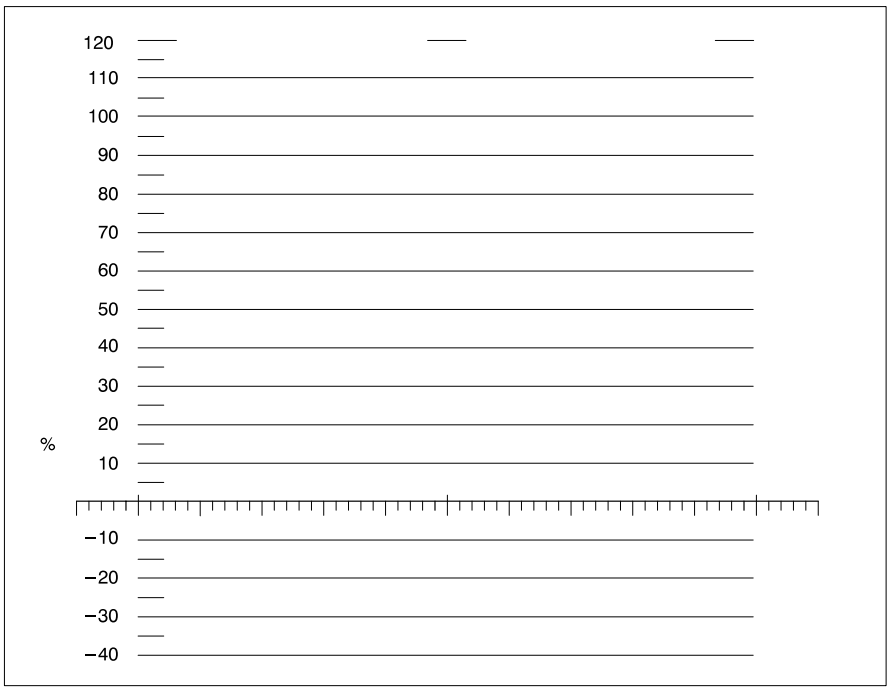


Figure 3–8: Waveform display mode, % graticule

Full Millivolts (mV) Graticule

Figure 3–9 shows the Waveform display mode in Full mV graticule.

- Vertical Scale. The vertical scale is marked in millivolts (mV) and extends from 0 mV to +700 mV in 100 mV increments. Each major division is divided into 5 minor divisions which equal 20 mV each.
- Horizontal Scale. The horizontal line represents time and has 12 major divisions. Each major divisions is divided into 5 minor divisions. Refer to Table 3–2 for how the sweep setting affects the horizontal scale.

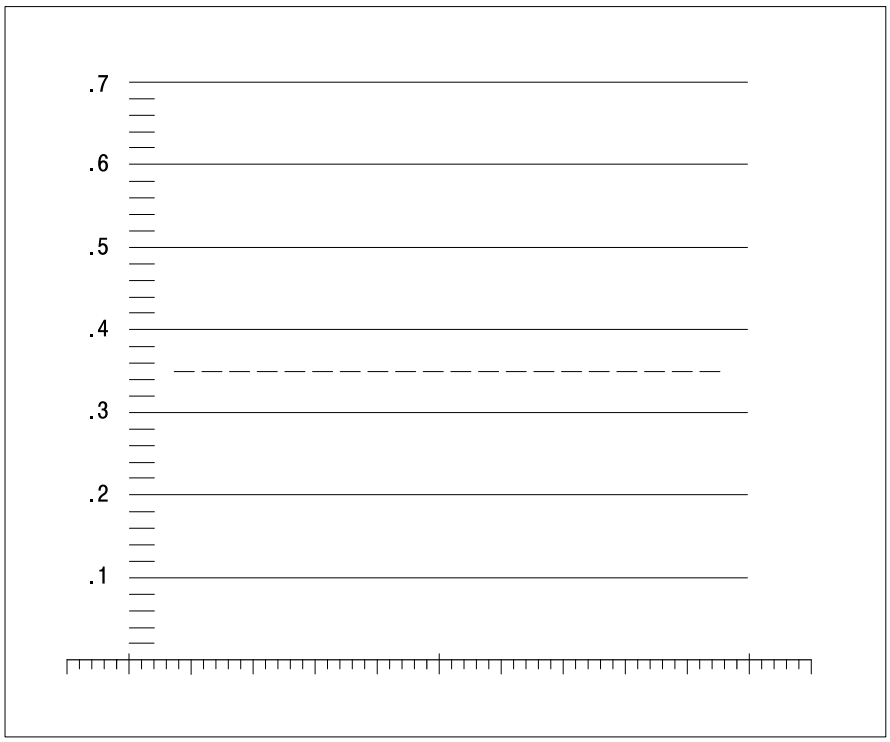


Figure 3–9: Waveform display mode, Full mV graticule

Full Percent (%) Graticule

Figure 3–10 shows the Waveform display mode in full % graticule.

- Vertical Scale. The scale is marked in percent (%) of 700 mV (100 %) and extends from 0 % to +100 % in 10 % increments. Each major division is divided into 5 minor divisions which equal 2 % each.
- Horizontal Scale. The horizontal line represents time and has 12 major divisions. Each major divisions is divided into 5 minor divisions. Refer to Table 3–2 for how the sweep setting affects the horizontal scale.

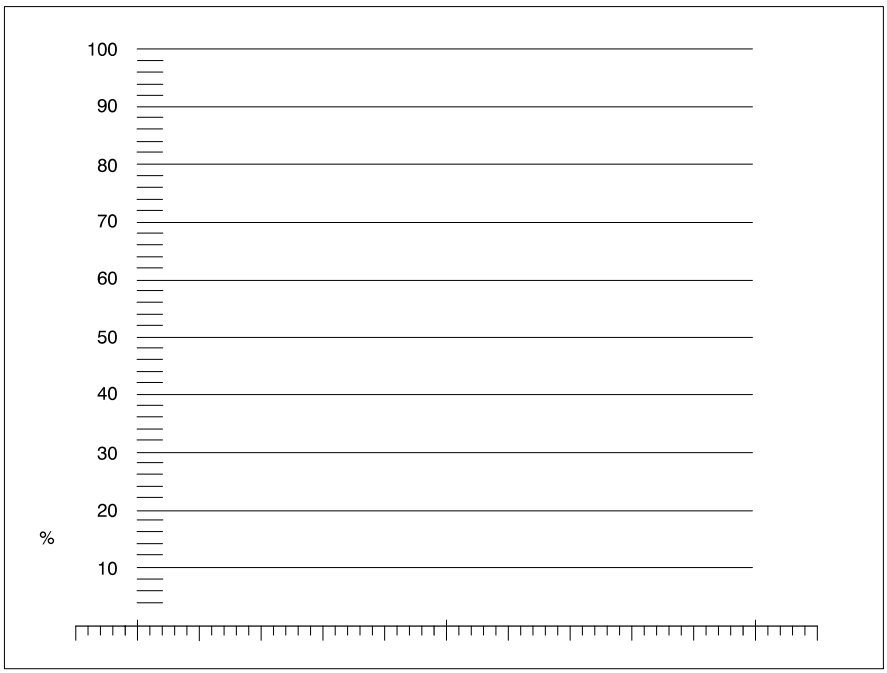


Figure 3–10: Waveform display mode, Full % graticule

Lightning Display

The Lightning display plots the color difference signals, P_b and P_r, against the luminance (Y) signal. In the top half of the Lightning display, P_b is plotted against Y, and on the bottom half, P_r is plotted against inverted Y. The vertical center is the 0 V or black-clamp point. This display is useful for evaluating component signal amplitude and timing.

Press the BOWTIE/VECTOR button to select VECTOR. Press the LIGHTNING bezel button to select Lightning display.

Lightning modes can operate with 75% or 100% color bar signals. Press the INTEN/MENU button and select the COLOR BARS menu to select the 75% or 100% graticule to match your test signal.

For Option 0A, 240M/274M format mode of Option 0C, or Interlace mode of Option 0D, you may select either the BTA or the SMPTE graticule by pressing the INTEN/MENU button and then choosing 240M (BTA S-001A or SMPTE 240M) or 274M (SMPTE 274M) in the COLOR menu.

Figure 3–11 shows how the waveform monitor plots the Lightning display from the three component signals.

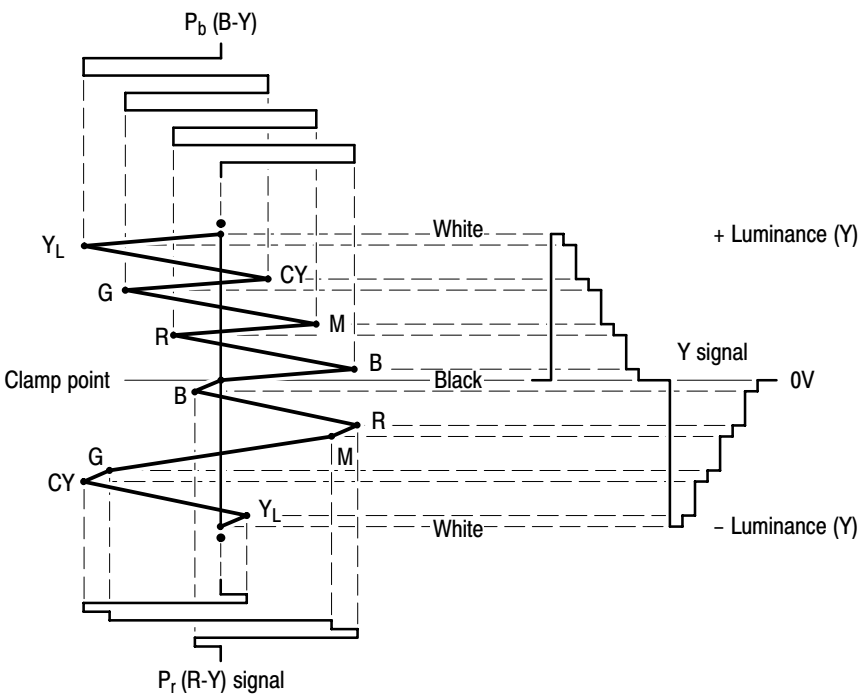


Figure 3–11: Construction of the Lightning display

Figure 3–12 shows the Lightning graticule with a trace. The target boxes at the end of each vector indicate a tolerance of ±14 mV. The closely spaced small dots provide a guide for checking transitions. These dots are spaced respectively 2 ns, 5 ns, and 13.5 ns apart from the vertical center. The electronic graticule eliminates the effects of CRT nonlinearity.

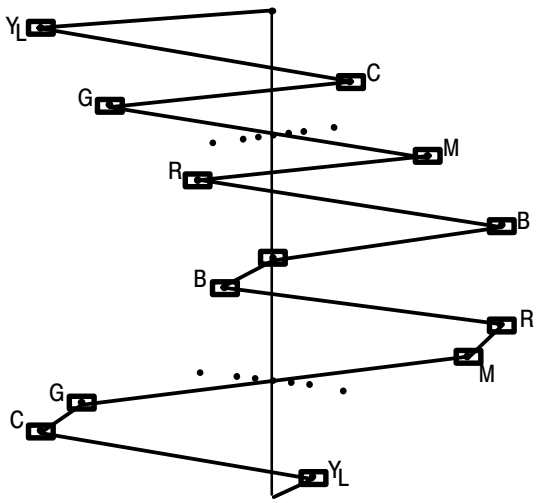


Figure 3–12: Lightning graticule showing interchannel timing errors

The color difference signals are line alternated, and the luminance signal is inverted on alternate lines.

The information available from the Lightning display is color difference signal accuracy (horizontal displacement of either half of the display), luminance gain (vertical displacement between the black and white levels), and timing delay between either color difference signal and luminance (bending of the green/magenta transitions). Figure 3–12 shows the graticule and the measurement targets and timing delay scales.

Luminance Gain Measurement

The signal is driven along the vertical axis above and below the center box by the luminance signal. The lower half is driven down from the center. The luminance gain is correct when the center dot is centered in the target box and the positive and negative excursions end at the top and bottom of the graticule. Perfect monochrome signals appear as a thin vertical line. Any deviation or bending off the center line indicates a color variation from the monochrome setup of the display monitor. Luminance gain alone can be measured more accurately in either the Waveform or Parade display modes.

Interchannel Timing Measurement

The scale (sequence of dots) between the green and magenta targets provides a way to check interchannel timing (CH-2 to CH-1 and CH-3 to CH-1) or signal delay. If the color difference signal is not coincident with luminance, the transitions between color dots will bend. The amount of this bending represents the relative signal delay between luminance and the color difference signal. The upper half of the display measures the P_b-to-Y timing, while the bottom half measures the P_r-to-Y Timing. If the transition bends in toward the vertical center or black region, the color difference signal is delayed with respect to luminance. If the transition bends out toward white, the color difference signal is leading the luminance signal.

Pr and Pb Gain Measurement

The horizontal deflection of the top half of the display is an indication of the P_b gain and the lower half indicates the P_r gain. If the color bar signal dots are within the horizontal dimensions of the appropriate graticule targets, the P_b and P_r gains are within 2% of the correct amplitude.

Since the vertical and horizontal dimensions of the graticule target boxes indicate 2% luminance and color difference gain errors, respectively, you can evaluate each color bar for encoding accuracy with these limits. The Lightning display shows the relative level or coding accuracy for Y, P_b, and P_r for each of the eight primary colors much better than the Parade display mode.

Parade Display

This mode displays the component signals Y (CH 1), P_b (CH 2), and P_r (CH 3) one at a time, two at a time, or all three waveforms at once. Measure the waveforms using the graticule or Cursors.

Gain selections operate as they do in the Waveform display mode and are available to expand the waveforms vertically to aid in measurement.

Press the OVERLAY/PARADE button on the front panel once or twice so as to light the PARADE indicator.

Figure 3–13 shows how the waveforms in parade display mode appear on the graticule.

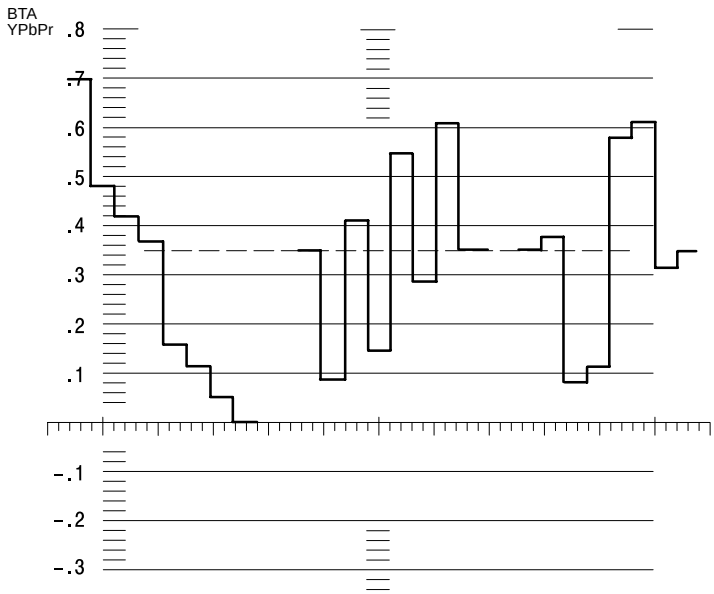


Figure 3–13: Parade display of Y and P_b signals

Persistence Display

In this mode, the waveform is repeatedly over-written on the graticule so that you can detect waveform transients.

Press the INTEN/MENU button on the front panel and then choose one of the persistence mode from the PERSISTENCE menu. The following options can be selected:

- AUTO: Sets the optimum persistence to the screen. Waveforms over-written on the screen will remain within the persistence period.
- NONE: Persistence is disabled. The waveform displayed on the screen is repeatedly updated for each scan.
- INFINITE: Sets the persistence to infinite. Waveforms over-written on the screen will remain until you press the bottom bezel button.

When INFINITE is selected, INF RESET is assigned to the bottom bezel button. Press this button to reset the screen display and restart overwriting. (Note that you must have selected INFINITE from the RESET PRIORITY menu if you have selected COUNT or RATE from the CRC DISPLAY menu.)

Figure 3–14 shows an example where the waveforms in Persistence display mode appear on the graticule when the incoming signal to the instrument is temporally disrupted.

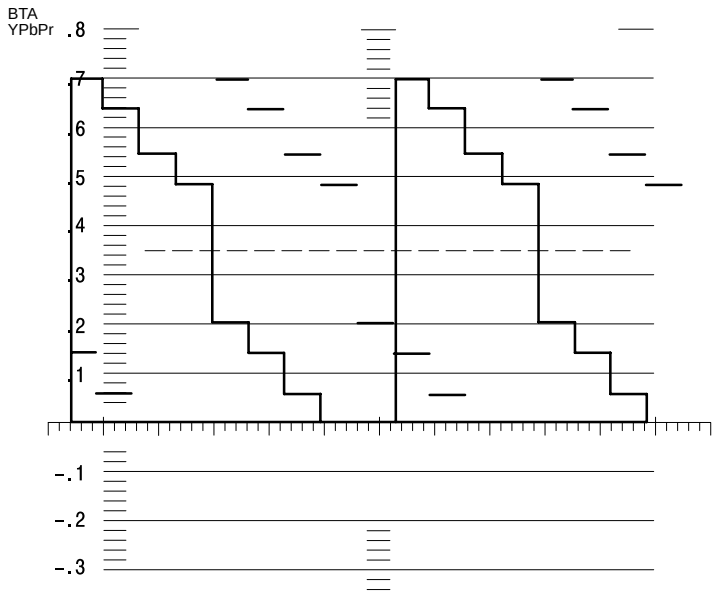


Figure 3–14: Example of Persistence display

Save and Display

The waveform monitor provides the Save and Display feature that allows you to save an incoming signal to the internal memory and put it back to the screen soon to display together with incoming signal continuously updated. This feature is useful when you adjust the level between two waveform monitors used together with the channel select feature.

Press the SAVE&DISP button on the front panel while waveform is being acquired to save the signal into the memory and redisplay it on the screen. The waveform captured in the memory will be displayed over the waveform being continuously acquired. Use the V POS and H POS knobs on the front panel to move the incoming waveform being displayed. The LED lights while the waveform in the memory is being displayed.

Press the SAVE&DISP button again or select another display mode to disable the Save and Display feature.

Figure 3–15 shows an example how the waveform appears when the Save and Display feature is used.

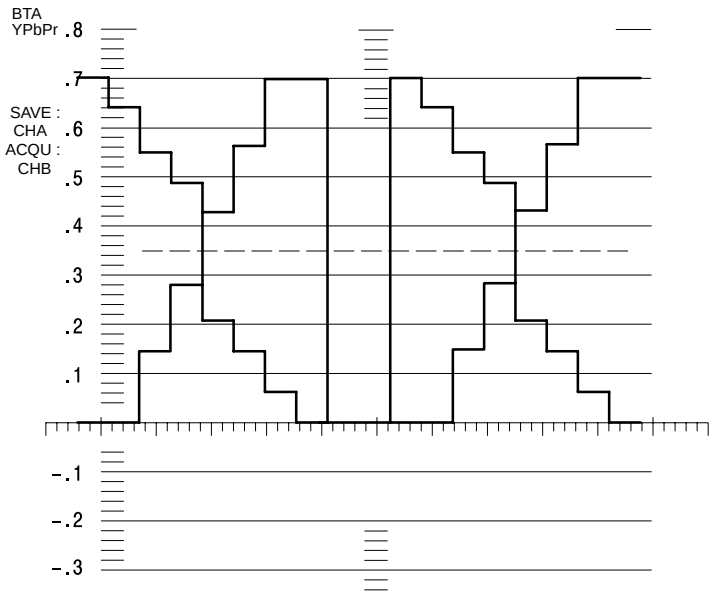


Figure 3–15: Waveform display example in Save and Display mode

Setting Sweep

The sweep rate for the horizontal axis and magnification along the horizontal axis can be changed using the SWEEP button and MAG button, respectively.

Sweep

The sweep rate can be selected from the bezel menu, however the sweep rate readout on the bezel menu is available only when CH1, CH2, CH3, or PARADE is selected. In Overlay, Vector, Bowtie, and Status modes, the sweep mode is disabled.

The following options are available when channel 1, 2 or 3 is selected:

- 1 LINE: Waveform of 1 line is displayed. You can choose a line from field or frame by using the line selection feature. For more information about the relation between the sweep setting and the horizontal scale for each option, refer to Table 3–2 and Table 3–3 on page 3–12.
- 2 LINE: Waveforms of 2 line is displayed successively. You can choose lines from field or frame by using the line selection feature. For more information about the relation between the sweep setting and the horizontal scale for each option, refer to Table 3–2 and Table 3–3 on page 3–12.
- 1 FIELD: All the lines in 1 video field are displayed.

- 2 FIELD: All the lines in 2 video fields are displayed. This mode is available for Option 0A, 240M/274M format mode of Option 0C, or Interlace mode of Option 0D.

The following options are available when Parade is selected:

- 3 LINE: Waveforms of 3 line is displayed successively. You can choose lines from field or frame by using the line selection feature. For more information about the relation between the sweep setting and the horizontal scale for each option, refer to Table 3–2 and Table 3–3 on page 3–12.
- 3 FIELD: All the lines in 3 video fields are displayed.

MAG Pressing the MAG button on the front panel provides the magnification around the center of the display along the horizontal axis. Use the H POS knob to move the waveform to right or to left. This mode is disabled when Parade display mode or field sweep rate is currently selected.

Status Display

In Status display mode, the data words of the incoming serial digital signal are displayed. This display will help you analyze the status of the $Y/P_b/P_r$ signal.

Press the STATUS button on the front panel to select and bring up the status display. In this mode, the signal data words are displayed as shown in Figure 3–16. In addition, the selected line number, the CRC error counts (only when RATE or COUNT is set in the CRC DISPLAY menu), and the Field and Field rate of the incoming signal are displayed.

The Status display mode allows a one-line dump of data. Beginning from EAV (End of Active Video) of the selected status line, the data is transferred to the remote RS-232C connector with a remote command. For details of the RS-232C remote command, refer to *RS-232C Remote Command* on page B–2.

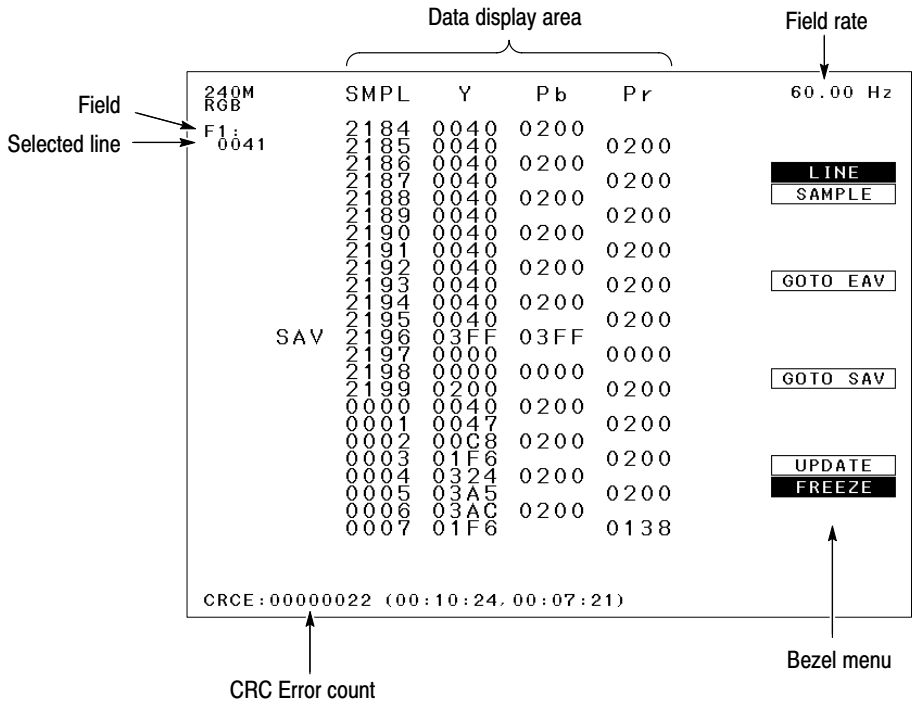


Figure 3–16: Status display example

Explanations of each type of information that appears in the Status display follow. Refer to labels in Figure 3–16 as you read on.

Selected Line Displays the currently selected line.

CRC Error Count If you have set the CRC DISP menu for COUNT, this section indicates the error count value and the elapsed time since reset. When the error count goes over 99999999, the display changes to ********, and the time is no longer updated. If you have set the CRC DISP menu for RATE, this section indicates the Err/Sec value (the error count value divided by the elapsed time since reset).

Field Rate and Scanning Format Displays the field rate of the currently selected reference signal. For Option 0D, the scanning format is also displayed.

Bezel Menu There are four bezel menu items. The following functions are assigned to each item.

LINE/SAMPLE. Assigns LINE (line selection) or SAMPLE (sample address setting) function to the SELECT knob.

GOTO EAV. Jumps to the sample address at which the EAV (End of Active Video) exists, and displays the data starting from that sample address.

GOTO SAV. Jumps to the sample address at which the SAV (Start of Active Video) exists, and displays the data starting from that sample address.

UPDATE/FREEZE. Determines whether the status display is updated (UPDATE) or not (FREEZE).

Data Display Area

Data of 24 words are displayed in this area. From left to right column, they are as follows: sample address, Y data, P_b data, and P_r data.

When SAMPLE is assigned to the SELECT knob with the LINE/SAMPLE bezel menu, turning the knob clockwise or counterclockwise scrolls the displayed data up or down, respectively.

Pressing the **SELECT** button toggles F1 and F2 (field 1 and field 2).

Line Selection in Status Display

The line selection function is always active in the Status display mode. When you enter into the Status display from an another display mode, the line selection mode will automatically be available, and the line number previously selected will be used. All lines, including vertical blanking, can be selected.

Vector Display

The waveform monitor provides a conventional vector display that plots the two color difference signals, P_b and P_r, against each other. The Vector display is useful for checking the chrominance phase and amplitude.

Press the BOWTIE/VECTOR button to select VECTOR. Press the VECTOR bezel button to select Vector display.

Vector modes can operate with 75% or 100% color bar signals. Press the INTEN/MENU button and select the COLOR BARS menu to select the 75% or 100% graticule to match your test signal.

For Option 0A, 240M/274M format mode of Option 0C, or Interlace mode of Option 0D, you may select either the BTA or the SMPTE graticule by pressing the INTEN/MENU button and then choosing 240M (BTA S-001M or SMPTE 240M) or 274M (SMPTE 274M) in the COLOR menu.

The Vector display plots the two color difference signals, P_b and P_r, against each other, similar, but not identical, to a composite vectorscope. Figure 3–17 shows how the color difference signals are plotted to create the Vector display.

Figure 3–18 shows the actual graticule with trace lines indicating how a trace would appear on the graticule.

Unlike a composite vectorscope, P_b and P_r are displayed with equal gains. Signals do not have the same magnitude and angle as represented on a PAL/ NTSC composite encoded signal vectorscope. For example, signals with constant composite chroma magnitude have an elliptical rather than circular locus.

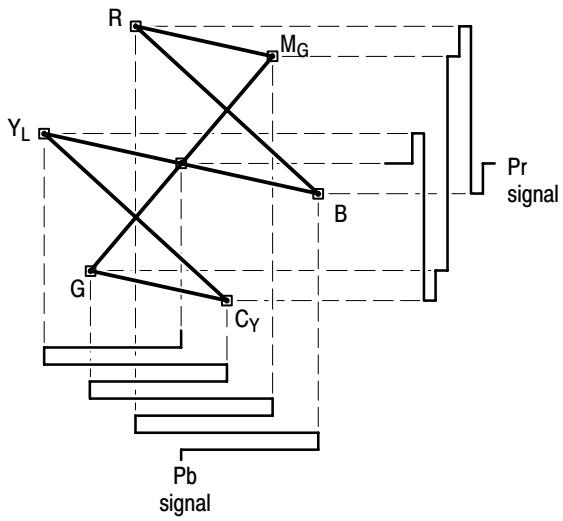


Figure 3–17: Vector display relationship of the Pr and Pb signals

Vector Graticule

The Vector graticule, shown in Figure 3–18, operates as a component vectorscope. Each chrominance vector terminates as a bright dot in a target. The dot brightness corresponds to the duration of the color bar. The distance from the center box to the target box corresponds to the magnitude of the color being measured. The dimension of each target box represents 2% (±14 mV) of a 700 mV P_b and P_r amplitude.

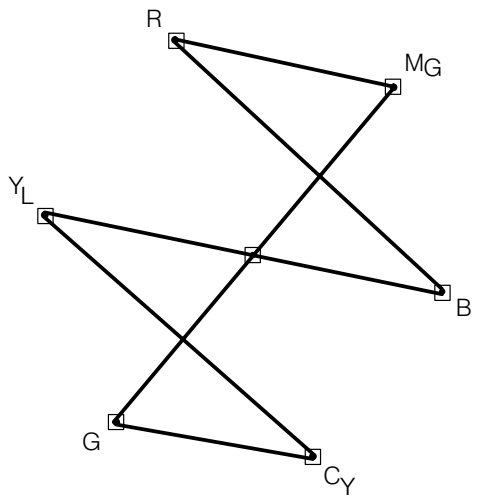


Figure 3–18: Vector display graticule

Phase and Amplitude Measurements

With the Vector display, you can check the encoder accuracy for both phase and amplitude errors proportional to those after composite encoding. When taking measurements, make certain your source signal amplitude matches the Vector graticule. For example, if the source is a 75% Color Bar signal, then choose the 75% graticule in the COLOR BARS of the VECTOR menu.

The displayed error is measured in terms of percent P_b or P_r since the signal may never be encoded into composite PAL/NTSC where the errors are traditionally expressed in terms of subcarrier magnitude and angle.

Vector Timing Measurements

In the component domain there is no decoding required and therefore the color bar transitions contain useful timing information. These timing differences appear as looping or bowing of the transitions. It is possible to measure the amount of bowing and to convert the results to a coarse delay value.

Appendices

Appendix A: Specifications

Tables A–1 through A–20 list the electrical specifications for the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. Performance requirements are generally quantitative and can be tested by qualified service personnel. Reference information describes useful operating parameters and typical characteristics and performance.

The performance requirements listed in the electrical specification portion of these specifications apply over an ambient temperature range of 0° C to +40° C. The rated accuracies are valid when the instrument is calibrated at an ambient temperature range of +20° C to +30° C, after a warm-up time of 20 minutes.

Electrical Specifications

Table A–1: Vertical deflection system

Characteristic	Performance requirements	Reference information
Frequency Response		
Luminance Channel (Y)	50 kHz to 30 MHz: ≤ ±0.5 % of the frequency response at 50 kHz.	37.125 MHz: ≤ –12 dB
Chrominance Channel (P_b, P_r)	50 kHz to 15 MHz: ≤ ±0.7 % of the frequency response at 50 kHz.	18.5625 MHz: ≤ –12 dB
Low Pass Filter	≤ –10 dB at 15 MHz.	The response at 15 kHz does not vary more than 0.5 % between FLAT and LPF.
Gain		Frequency response and gain accuracy are maintained in X5 and X10.
Offset Range		±350 mV for CH 2 and 3 to CH 1
Cursor Error		≤ 0.25 % of full scale
Scale		
mV		Resolution of 40 pixel/100 mV (div), Standard Resolution of 60 pixel/100 mV (div), Full
%		Resolution of 28 pixel/10 % (div), Standard Resolution of 42 pixel/10 % (div), Full

Table A–2: Horizontal deflection system

Characteristic	Performance requirements	Reference information
Sweep Rate		When there is no signal input, the message "No Signal" appears and no waveform is displayed.
Option 0A or 240M/274M format mode of Option 0C		
1 Line		2.5 µs/div, 0.1 µs/div (MAG ON) Refreshed 1/4 line rate of applied video sync.
2 Lines		5.0 µs/div, 0.2 µs/div (MAG ON) Refreshed 1/8 line rate of applied video sync.
3 Lines		7.5 µs/div Refreshed 1/13 line rate of applied video sync.
Overlay		2.5 µs/div, 0.1 µs/div (MAG ON) Refreshed 1/13 line rate of applied video sync.
1 Field		Equal to the field rate of applied video sync.
2 Field		Equal to the frame rate of applied video sync.
3 Field		Equal to the field rate of applied video sync.
Option 0B or 296M format mode of Option 0C		
1 Line		2.0 µs/div, 0.1 µs/div (MAG ON) Refreshed 1/5.17 line rate of applied video sync.
2 Lines		4.0 µs/div, 0.2 µs/div (MAG ON) Refreshed 1/11 line rate of applied video sync.
3 Lines		6.0 µs/div Refreshed 1/17 line rate of applied video sync.
Overlay		2.0 µs/div, 0.1 µs/div (MAG ON) Refreshed 1/17 line rate of applied video sync.
1 Field		Equal to the field rate of applied video sync.
3 Field		Equal to the field rate of applied video sync.

Table A–2: Horizontal deflection system (Cont.)

Characteristic	Performance requirements	Reference information
Option 0D (Interlace mode)		
1 Line		3.0 µs/div, 0.1 µs/div (MAG ON) Refreshed 1/4 line rate of applied video sync.
2 Lines		6.0 µs/div, 0.4 µs/div (MAG ON) : 1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i 6.0 µs/div, 1.0 µs/div (MAG ON) : 1125/50i Refreshed 1/8 line rate of applied video sync.
3 Lines		9.0 µs/div Refreshed 1/13 line rate of applied video sync.
Overlay		3.0 µs/div, 0.1 µs/div (MAG ON) Refreshed 1/13 line rate of applied video sync.
1 Field		Equal to the field rate of applied video sync.
2 Field		Equal to the field rate of applied video sync.
3 Field		Equal to the field rate of applied video sync.
Option 0D (Segment Frame mode)		
1 Line		3.0 µs/div, 0.1 µs/div (MAG ON) Refreshed 1/4 line rate of applied video sync.
2 Lines		6.0 µs/div, 0.4 µs/div (MAG ON) : 1080/30sF, 1080/29.97sF 6.0 µs/div, 1.0 µs/div (MAG ON) : 1080/25sF 6.0 µs/div, 1.2 µs/div (MAG ON) : 1080/24sF, 1080/23.98sF Refreshed 1/8 line rate of applied video sync.
3 Lines		9.0 µs/div Refreshed 1/13 line rate of applied video sync.
Overlay		3.0 µs/div, 0.1 µs/div (MAG ON) Refreshed 1/13 line rate of applied video sync.
1 Field		Equal to the field rate of applied video sync.
2 Field		Equal to the field rate of applied video sync.
3 Field		Equal to the field rate of applied video sync.

Table A–2: Horizontal deflection system (Cont.)

Characteristic	Performance requirements	Reference information
Option 0D (Progressive mode)		
1 Line		2.0 µs/div, 0.1 µs/div (MAG ON) : 720/60p, 720/59.94p 3.0 µs/div, 0.1 µs/div (MAG ON) : 1080/24p, 1080/23.98p Refreshed 1/17 line rate of applied video sync : 720/60p, 720/59.94p Refreshed 1/4 line rate of applied video sync : 1080/24p, 1080/23.98p
2 Lines		4.0 µs/div, 0.5 µs/div (MAG ON) : 720/60p, 720/59.94p 6.0 µs/div, 1.2 µs/div (MAG ON) : 1080/24p, 1080/23.98p Refreshed 1/11 line rate of applied video sync : 720/60p, 720/59.94p Refreshed 1/8 line rate of applied video sync : 1080/24p, 1080/23.98p
3 Lines		6.0 µs/div : 720/60p, 720/59.94p 9.0 µs/div : 1080/24p, 1080/23.98p Refreshed 1/17 line rate of applied video sync : 720/60p, 720/59.94p Refreshed 1/13 line rate of applied video sync : 1080/24p, 1080/23.98p
Overlay		2.0 µs/div, 0.1 µs/div (MAG ON) : 720/60p, 720/59.94p 3.0 µs/div, 0.1 µs/div (MAG ON) : 1080/24p, 1080/23.98p Refreshed 1/17 line rate of applied video sync : 720/60p, 720/59.94p Refreshed 1/13 line rate of applied video sync : 1080/24p, 1080/23.98p
1 Field		Equal to the field rate of applied video sync.
3 Field		Equal to the field rate of applied video sync.
Horizontal Position		Any positions of the synchronized video signal in all sweep modes except for Save and Display mode and Parade display mode.
Line Selection		Displays selected line in 1 LINE. Display selected line first in 2 LINE.
Cursor Error		≤ 0.25 % of full scale
Scale Resolution		45 pixel/div (Option 0A) 48.566 pixel/div (Option 0B, Option 0D) For Option 0C, either of these resolutions is applied depending on the mode selected in the FORMAT menu.

Table A–3: Serial digital video interface

Characteristic	Performance requirements	Reference information
Format		1.4835 to 1.485 Gbps, complying with BTA-S004A, SMAPTE 292M.
Serial Input		
Impedance		75 Ω Unbalanced
Monitor Output		
Level	800 mVp-p ±10 %.	800 mVp-p ±10 %
Impedance		75 Ω Unbalanced
Return Loss		≧ 15 dB at 5 MHz to 742.5 MHz ≧ 10 dB at 742.5 MHz to 1.5 GHz

Table A–4: Analog Output

Characteristic	Performance requirements	Reference information
Format		SMPTE 240M, SMPTE 274M, or SMPTE 296M (Option 0D) SMPTE 240M or SMPTE 274M (Option 0A or 240M/274M format mode of Option 0C) SMPTE 296M (Option 0B or 296M format mode of Option 0C)
DAC Resolution		Luminance Channel (Y) : 9 bit Chrominance Channel (P_b, P_r) : 10 bit
Impedance		75 Ω Unbalanced
Sync		tri-level sync on Y channel

Table A–5: Stripped AES/EBU digital audio output [1]

Characteristic	Performance requirements	Reference information
Format		ANSI S4.40
Impedance		75 Ω Unbalanced
Return Loss		> 25 dB at 0.1 MHz to 6 MHz
Amplitude	1.0 V ± 10 %	
DC Offset	0.0 V ± 50 mV	
Rise/Fall Time	30 ns to 44 ns	
Sampling Rate		48 kHz (locked to video signal)

Table A–5: Stripped AES/EBU digital audio output [1] (Cont.)

Characteristic	Performance requirements	Reference information
Phase Lock Time		< 15 s
Output Channel		CH A:1/2, 3/4, 5/6, 7/8 CH B:1/2, 3/4, 5/6, 7/8 The same channel is not selected on CHA and CHB at the same time.
Output Control		If the Audio Data Packet does not exist in the serial signal, the corresponding output is disabled.

1 Available only for Option 0A, 240M/274M fomat mode of Option 0C, or Interlace and Segment Frame modes of Option 0D.

Table A–6: External reference input

Characteristic	Performance requirements	Reference information
Sync Format		RS-170A, PAL (2-LEVEL mode of Option 0D) SMPTE 240M, SMPTE 274M, SMPTE 296M (3-LEVEL mode of Option 0D) SMPTE 240M, SMPTE 274M (Option 0A or 240M/274M format mode of Option 0C) SMPTE 296M (Option 0B or 296M format mode of Option 0C)
DC Input Impedance	> 15 kΩ	Unterminated
Return Loss		> 30 dB to 30 MHz
Display Resolution		2 clock ≃ 27 ns
Uncertain Time Width	< 5 ns	

Table A–7: Format display

Characteristic	Performance requirements	Reference information
Display Contents		
240M		When 240M in the COLOR menu is selected.
274M		When 274M in the COLOR menu is selected or 1080/24p format signal is inputted.
296M		When 720/60p or 720/59.94p format signal is inputted.

Table A–8: Field rate display

Characteristic	Performance requirements	Reference information
Target Signal		Selected Reference Signal
Display Contents		Internal Detected Field Rate
60.00 Hz		59.97 Hz to 60.03 Hz
59.94 Hz		59.91 Hz to 59.97 Hz
??.?? Hz		> 60.03 Hz or < 59.91 Hz (Display “Missing Reference”)
Display Contents (Interlace mode of Option 0D)		Internal Detected Field Rate
60i		59.97 Hz to 60.03 Hz
59.94i		59.91 Hz to 59.97 Hz
50i		48.024 Hz to 59.91 Hz
??.??		Unknown field late (Display “Missing Reference”)
Display Contents (Segment Frame mode of Option 0D)		Internal Detected Field Rate
30sF		95.97 Hz to 60.03 Hz
29.97sF		59.91 Hz to 59.97 Hz
25sF		48.024 Hz to 59.92 Hz
24sF		47.976 Hz to 48.024 Hz
23.98sF		47.928 Hz to 47.976 Hz
??.??		Unknown field late (Display “Missing Reference”)
Display Contents (Progressive mode of Option 0D)		Internal Detected Field Rate
60p		59.97 Hz to 60.03 Hz
59.94p		59.91 Hz to 59.97 Hz
24p		23.988 Hz to 24.012 Hz
23.98p		23.98 Hz to 23.988 Hz
??.??		Unknown field late (Display “Missing Reference”)

Table A–9: RBG transcoder

Characteristic	Performance requirements	Reference information
Matrix coefficient		
SMPTE240M		$G' = Y' - 0.2266\ P_b' - 0.4766\ P_r'$ $B' = Y' + 1.826\ P_b'$ $R' = Y' + 1.576\ P_r'$
SMPTE274M, SMPTE296M		$G' = Y' - 0.1870\ P_b' - 0.4678\ P_r'$ $B' = Y' + 1.8558\ P_b'$ $R' = Y' + 1.575\ P_r'$

Table A–10: Component vector mode

Characteristic	Performance requirements	Reference information
Frequency Response		> 14 MHz
Vertical Gain Error		< 0.25 %
Horizontal Gain Error		< 0.25 %
Magnification		X5 and X10
Display		P_b: Horizontal P_r: Vertical

Table A–11: Lightning and diamond mode

Characteristic	Performance requirements	Reference information
Vertical Gain Error		< 0.25 %
Horizontal Gain Error		< 0.25 %
Electronic Graticule Display		
Lightning		Y is displayed vertically. P_b is displayed horizontally on top half of display. P_r is displayed horizontally on bottom half of display.
Diamond		GBR Deflection axis indicated

Table A–12: Bowtie mode

Characteristic	Performance requirements	Reference information
Common Mode Rejection Ratio		> 44 dB to 15 MHz
Amplitude Error		< 0.25 %
Internal Timing Match		Zero error (co-sited data)

Table A–13: Status display mode

Characteristic	Performance requirements	Reference information
Display Capability		4000 words
Format		HEX and DEC

Table A–14: Save and display mode

Characteristic	Performance requirements	Reference information
Delay Time (from time of button pushed)		< 3 frames
Length of Reference Memories		1 frame

Table A–15: Warning display

Characteristic	Performance requirements	Reference information
CRC Error LED		LED lights for 0.5 seconds at error detected.
CRC Error Count		CRC error count, elapsed time in this mode, and the time of latest error detected are displayed.
Resolution		10 ms
GAMUT Error		LED lights for 10 milliseconds at error detected. Error check timing is made at the same time as the waveform is displayed. Warning is derived from input data.
Error Detection Level		
Positive		735 mV ±7 mV (105 % of legal RGB, Nom),
Negative		–35 mV ±7 mV.

Table A–16: Calculation dynamic range

Characteristic	Performance requirements	Reference information
Resolution Mode		With 10-bit-calculation: Y, R, G, B: –50 to 760 mV, P_b/P_r:–390 to +390 mV. Waveform may have some distortion when input data in analog level goes out of above ranges.
D Range Mode		With 9-bit-calculation: Y, R, G, B: –450 to +1170 mV, P_b/P_r:–790 to +790 mV. Waveform may have some distortion when input data in analog level goes out of the above ranges.

Table A–17: Setup memory

Characteristic	Performance requirements	Reference information
Number of memory setups		4 setups (Option 0A/0B/0C) 100 setups (Option 0D)
Save and Recall		This function is performed from front panel menu and remote connector (ground closure) for the memory location number 1 to 4. For the other memory location number, it is controlled through the RS-232C connector.

Table A–18: CRT display

Characteristic	Performance requirements	Reference information
CRT Viewing Area		71 (V) X 95 (H) mm
Resolution		Horizontal: 640 pixels Vertical: 480 pixels

Table A–19: AC power source

Characteristic	Performance requirements	Reference information
Range		90 – 240 VAC, 48 to 63 Hz
Power Consumption		90 W, 100 VA
Maximum Current		1.0 A

Table A–19: AC power source (Cont.)

Characteristic	Performance requirements	Reference information
Peak Inrush Current		10 A [2]
Supply Connection		Detachable cord set

2 Per EN 55103-1 Annex B

Table A–20: Installation requirements

Characteristic	Performance requirements	Reference information
Heat Dissipation		
Maximum Power		90 W max, 1.0 A rms at 50 Hz
Maximum Dissipation Voltage		90 V with 5 % clipping
Surge Current		40 A peak for equal to or less than 5 line cycles, after the instrument has been turned off for at least 30 seconds.
Clearance		
Top and Bottom		2.5 cm
Side		5 cm
Rear		15 cm

Environmental Characteristics

Table A–21: Environmental characteristics

Characteristic	Standard and reference information
Temperature	
Operating	0° to +40° C
Non-operating	–20° to +60° C
Altitude	
Operating	4,500 m Maximum operating temperature decreases 1° C each 300 m above 1,500 km.
Non-operating	15,000 m
Relative humidity	
Operating	20 % to 80 % (No condensation)
Non-operating	5 % to 90 % (No condensation)
Vibration	
Operating	10 minutes at 5 – 500 Hz with 0.32 g rms
Non-operating	10 minutes at 5 – 500 Hz with 2.46 g rms
Mechanical shock	
Non-operating	294 m/s^2 (30 g) 1/2 sine, 11 ms duration, 3 shocks per surface (18 total)
Equipment Type	Test and Measuring
Equipment Class	Class I: Grounded product (as defined in IEC 1010-1, Annex H)
Installation Category	Category II (as defined in IEC 1010-1, Annex J). Note: Rated for indoor use only.
	Category — Examples of Products in this Category:
	CAT III — Distribution-level mains, fixed installation
	CAT II — Local-level mains, appliances, portable equipment
	CAT I — Signal levels in special equipment or parts of equipment, telecommunications, electronics
Pollution Degree	Pollution Degree 2: Do not operate in environments where conductive pollutants may be present.

Physical Characteristics

Table A–22: Physical characteristics

Characteristics	Descriptions
Dimensions	
Height	133 mm
Width	216 mm
Depth	432 mm
Weight	
Net	Approximately 6.0 kg
Shipping	Approximately 8.3 kg

Safety and EMI

Table A–23: Certifications and compliances[3]

Category	Standards or description
EC Declaration of Conformity – EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Union: EN 55103-1: 1996 Emissions EN 55022 Class B Radiated and Conducted Emissions EN 61000-3-2 AC Power Line Harmonic Current Emissions EN 61000-3-3 Line Voltage Alteration and Flicker EN 55103-1 Annex A Magnetic Field Emissions EN 55103-1 Annex B Power Line Inrush Current EN 55103-2: 1996 Immunity IEC 61000-4-2 Electrostatic Discharge Immunity IEC 61000-4-3 RF Electromagnetic Field Amplitude Immunity IEC 61000-4-4 Electrical Fast Transient/Burst Immunity IEC 61000-4-5 AC Mains Surge Immunity IEC 61000-4-6 Conducted RF Immunity IEC 61000-4-8 Power Frequency Electromagnetic Field Immunity IEC 61000-4-11 Mains Voltage Dip & Interruption Immunity EN 55103-2 Annex A Magnetic Field Immunity Environmental Class E2
Australia/New Zealand Declaration of Conformity – EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s): AS/NZS 2064.1/2Industrial, Scientific, and Medical Equipment: 1992
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

Table A–23: Certifications and compliances[3] (Cont.)

Category	Standards or description
EC Declaration of Conformity – Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union: Low Voltage Directive 73/23/EEC, amended by 93/69/EEC EN 61010-1:1993 Safety requirements for electrical equipment for measurement control and laboratory use.
U.S. Nationally Recognized Testing Laboratory Listing	UL3111-1 Standard for electrical measuring and test equipment.
Canadian Certification	CAN/CSA C22.2 No. 1010.1 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Additional Compliance	IEC61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Installation (Overvoltage) Category	Terminals on this product may have different installation (overvoltage) category designations. The installation categories are: CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location. CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected. CAT I Secondary (signal level) or battery operated circuits of electronic equipment.
Pollution Degree	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated. Pollution Degree 2 Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
Safety Certification Compliance	
Equipment Type	Test and measuring
Safety Class	Class 1 (as defined in IEC 1010-1, Annex H) – grounded product
Overvoltage Category	Overvoltage Category II (as defined in IEC 1010-1, Annex J)
Pollution Degree	Pollution Degree 2 (as defined in IEC 1010-1). Note: Rated for indoor use only.

3 For EMC compliance and safety, use only high quality, shielded cables and operate the instrument in one of the following Tektronix instrument enclosures:

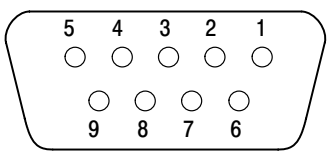
1700F00 (Tektronix part number 437–0100–04)
1700F02 (Tektronix part number 437–0018–07)
1700F05 (Tektronix part number 437–0095–04)

Appendix B: Remote Operation

The waveform monitor has two multi-pin connectors on the rear panel that provide different types of remote control. The RS-232C port provides for a status data output and factory servicing. The REMOTE connector provides a way to load or save presets.

RS–232C Connector

The RS-232C connector is a 9-pin D-type connector that provides a status data output and a remote verification interface. Figure B–1 shows the pin assignments and the communication parameters for the RS-232C interface.



Communication parameters

Baud: 9600 pbs (Power cycle always reset to 9600 pbs. From 300 to 115200 bps can be set while communicating.)

Data bits: 8 (unselectable)

Stop bits: 1 (unselectable)

Parity: None (unselectable)

Flow control: Hard flagging (unselectable)

Pin Number	Data Connection	Required
1	DCD (Received line signal detector)	
2	RXD (Received data)	✓
3	TXD (Transmitted data)	✓
4	DTR (DTE ready)	
5	Signal ground	✓
6	DCR (DCE ready)	
7	RTS (Request to send)	✓
8	CTS (Clear to send)	✓
9	Not connected	

Figure B–1: Pin assignments for the RS-232C connector

RS-232C Remote Command

The following remote command can be sent through the RS-232C connector:

```
DUMP
```

When this command is received on STATUS mode, the waveform monitor outputs the selected one line data from EAV. If this command is received on any other mode, the waveform monitor returns an error message. The data output format is CSV.

The following is an output example:

```
Line_number=0041
SMPL,Y, Pb, Pr
1920,03ff,03ff,
1921,0000,,0000
1922,0000,0000,
      .
      .
```

```
SAVE #
```

This command stores the current instrument settings in the memory location specified #.

```
RECALL #
```

This command recalls the instrument settings from the memory location specified #.

Remote Connector

The rear-panel REMOTE connector is a 15-pin, D-type female connector that allows low-level remote control.

All the active control lines go to low level by grounding or TTL low level input.

Low means the function that can be effective when that pin is grounded or becomes TTL low level (0 to +0.8 V), and High means the function can be effective when that pin is opened or becomes TTL high level (2 to 5 V).

Pin assignments for the REMOTE connector are shown in Figure B–2 and described in Table B–1. You enable functions by ground closures (TTL lows) on specified pins. Functions with "overbars" indicate an active low state.

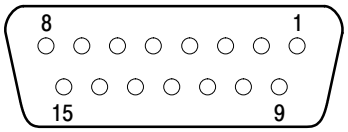


Figure B–2: Pin assignments for the REMOTE connector

Table B–1: Remote connector pin assignments and functions

Pin number	Function	Information
1	Line, Field	Option 0A, 240M/274M format mode of Option 0C, or Interlace mode of Option 0D. Field is set to ON and line is set to OFF when TTL signal level goes from High to Low. Field is set to OFF and line is set to ON when TTL signal level goes from Low to High.
		Option 0B, 296M format mode of Option 0C, or Progressive mode of Option 0D. Field is set to ON and line is set to OFF when TTL signal level goes from High to Low (1 Line Display). Going from High to Low is ignored (2 Line Display). Field is set to OFF and line is set to ON when TTL signal level goes from Low to High.
2	$\overline{\text{RGB}}$	RGB transcoder becomes available when TTL level goes from High to Low. RBG transcoder becomes disabled when TTL level goes from Low to High.
3	ONE, TWO	Option 0A, 240M/274M format mode of Option 0C, or Interlace mode of Option 0D. 2 Line or 2 Field is selected when TTL level goes from High to Low. 1 Line or 1 Field is selected when TTL level goes from Low to High.
		Option 0B, 296M format mode of Option 0C, or Progressive mode of Option 0D. 2 Line is selected when TTL level goes from High to Low (1 Line Display). Going from High to Low is ignored (1 Field Display). 1 Line or 1 Field is selected when TTL level goes from Low to High.
4	Interlace, Segment Frame, Progressive 0	The interface format for Option 0D is set by the following combinations of levels for pins 4 and 8 when the TTL level goes from High to Low. *Pin 4* *Pin 8* *Mode* High High (Ignored) High Low Interlace Low High Progressive Low Low Segment Frame

Table B–1: Remote connector pin assignments and functions (cont.)

Pin number	Function	Information
5	Recall 1	Front panel settings are recalled from the memory location specified by the following combinations of levels for pins 5 and 7 when the TTL level goes from Low to High. *Memory Location* / *Pin 5* / *Pin 7* 1 / Low / Low 2 / Low / High 3 / High / Low 4 / High / High
6	$\overline{\text{Store}}$	The current front panel settings are stored into the memory location specified by the combined of pins 5 and 7 when the TTL level of pin 6 goes from High to Low. Refer to pin 5 description for memory locations.
7	$\overline{\text{Recall 0}}$	See pin 5 information.
8	Interlace, Segment Frame, Progressive 1	See pin 4 information.
9	Ground	
10	$\overline{\text{Save \& Disp}}$	Save and Display mode is set to ON when the TTL level goes from High to Low. Save and Display mode is set to OFF when the TTL level goes from Low to High.
11	$\overline{\text{Edge}}$	The display mode is selected according to the combined status of of pins 12, 13 and 14 when the TTL level goes from High to Low. *Mode* / *Pin 12* / *Pin 13* / *Pin 14* CH 1 / Low / Low / Low CH 2 / Low / Low / High CH 3 / Low / High / Low Bowtie / Low / High / High Parade / High / Low / Low Overlay / High / Low / High Vector / High / High / Low Status / High / High / High
12	Display 2	See pin 11 description.
13	Display 1	See pin 11 description.
14	Display 0	See pin 11 description.
15	A, $\overline{\text{B}}$	Channel B input becomes available when the TTL level goes from High to Low. Channel A input becomes available when the TTL level goes from High to Low.

Appendix C: Cleaning & Service

This appendix describes how to clean the exterior of the WFM 1125 Digital Television Waveform Monitor. Regularly scheduled cleaning is not necessary for the waveform monitor. However, when done regularly, cleaning may help prevent instrument malfunction and may enhance its reliability.

Preventative maintenance consists of visually inspecting and cleaning the instrument and using general care when operating it.

How often to do maintenance depends on the severity of the environment in which the waveform monitor is used. Perform preventive maintenance just before adjustment and/or calibration.

General Care

The cabinet helps keep dust out of the instrument and should be in place during instrument operation. The optional front panel cover protects the front panel and display from dust and damage. It is recommended to install the optional front panel cover when storing or transporting the waveform monitor.

Inspection and Cleaning

Inspect and clean the waveform monitor as often as operating conditions require. The collection of dirt on components inside can cause them to overheat and breakdown. (Dirt acts as an insulating blanket, preventing efficient heat dissipation.) Dirt also provides an electrical conduction path that could cause instrument failure, especially under high-humidity conditions.

CAUTION. *Avoid the use of chemical cleaning agents which might damage the plastics. Use only deionized water when cleaning the menu buttons or front-panel buttons. For the rest of the instrument, use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

Inspection

Inspect the outside of the waveform monitor for damage, wear, and missing parts, using Table C–1 as a guide. A waveform monitor that appears to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Immediately repair any defects that could cause personal injury or lead to further damage to the instrument.

Table C–1: External inspection check list

Item	Inspect for	Repair action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware or gaskets.	Repair or replace defective module.
Front-panel knobs	Missing, damaged, or loose knobs.	Repair or replace missing or defective knobs.
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors.	Repair or replace defective modules. Clear or wash out dirt.
Carrying handle, bail, and cabinet feet	Correct operation.	Repair or replace defective module.
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors.	Repair or replace damaged or missing items, frayed cables, and defective modules.

Cleaning Procedures

To clean the instrument exterior, do the following steps:

1. Remove loose dust on the outside of the waveform monitor with a lint free cloth.

CAUTION. *To prevent getting moisture inside the waveform monitor during external cleaning, use only enough liquid to dampen the cloth or applicator.*

2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.

3. Clean the light filter protecting the monitor screen with a lint-free cloth dampened with either isopropyl alcohol or, preferably, a gentle, general purpose detergent-and-water solution.

Repackaging for Shipment

To ship the waveform monitor to a Tektronix Service Center for service, follow these instructions:

1. Attach a tag showing the name of the owner, the complete address, the phone number, the instrument serial number and a description of the required service.
2. Repackage the waveform monitor in the original packaging materials. If the original packaging materials are not available, follow these instructions:
   a. Obtain a carton of corrugated cardboard having inside dimensions at least six inches greater than the dimensions of the instrument. Use a shipping carton that has a test strength of at least 275 pounds.
   b. Surround the instrument with a protective bag (anti-static preferred). For instruments that are not in a cabinet, wrap a cardboard piece around the bagged instrument to protect internal components.
   c. Pack dunnage or urethane foam between the instrument and the carton. If using Styrofoam kernels, overfill the box and compress when closing the lid. You need three inches of cushioning on all sides of the instrument.
3. Seal the carton with shipping tape or industrial staples.

Glossary

Glossary

Accuracy
The closeness of the indicated value to the true value.

Bandwidth
The range of frequencies over which signal amplitude remains constant (within some limit) as it is passed through a system.

Black Burst
Analog timing reference signal containing composite sync and color-burst with a black luminance level. See SMPTE RP-154-1994 for specifications.

Blanking Level
Refers to the 0 IRE level for NTSC systems (0.3 volt level, with respect to sync tip, for PAL systems) which exists before and after horizontal sync and during the vertical interval.

Burst (NTSC)
A small reference packet of the subcarrier sine wave, typically 8 or 9 cycles, which is sent on every line of video. Since the carrier is suppressed, this phase and frequency reference is required for synchronous demodulation of the color information in the receiver.

Burst (PAL)
A small reference packet of the subcarrier sine wave sent during the horizontal blanking interval on every line of video. Since the carrier is suppressed, this phase and frequency reference is required for synchronous demodulation of the color difference signals in the receiver.

Color Black
See Black Burst.

Color Difference Signals
Signals used by color television systems to convey color information in such a way that the signals go to zero when there is no color in the picture. R–Y, B–Y, I, and Q are all color difference signals for the NTSC system; U and V are color difference signals for the PAL system. The component system color difference signal are Y, P_B, P_R as specified by SMPTE and CCIR standards.

Color Gamut
The area between minimum and maximum reproducible limits for elements of the color difference or RGB signals.

Component Video
Video which exists in the form of three separate signals, all of which are required in order to completely specify the color picture. For example, R, G, and B; or Y, R–Y, and B–Y.

Composite Video
A single video signal containing all of the necessary information to reproduce a color picture. Created by adding quadrature amplitude modulated R–Y and B–Y to the luminance signal for NTSC systems or U and V to the luminance signal for PAL systems.

CRC
Cyclic Redundancy Code.

dB (Decibel)
A decibel is a logarithmic unit used to describe signal ratios. For voltages, $dB = 20\ Log_{10}\ (V_1/V_2)$.

EDH
Error detection and handling. Supports the standard SMPTE RP-165, which proposes a technique for recognizing inaccuracies in the serial digital signal.

Field
In interlaced scan systems, the information for one picture is divided up into two fields. Each field contains one half of the lines required to produce the entire picture. Adjacent lines in the picture are in alternate fields.

Frame
Contains all the information required for a complete picture. For interlaced scan systems, there are two fields in a frame.

Gamma
A measure that compares the contrast in the original and reproduced television picture. Since picture monitors have a nonlinear relationship between the input voltage and brightness, the signal must be correspondingly enhanced to nullify the nonlinear distortion. Gamma correction is always done at the source (camera) in television systems: the R, G, and B signals are converted to $R^{1}/_{V}$, $G^{1}/_{V}$, and $B^{1}/_{V}$. Values of about 2.2 are typically used for gamma.

Gamut
See Color Gamut.

GBR
See RGB.

Graticule
The scale which is used to quantify the information on a waveform monitor or vectorscope display. Graticules may either be screened onto the faceplate of the CRT itself (internal graticule), or onto a piece of glass or plastic which fits in front of the CRT (external graticule). They can also be electronically generated.

Hue
The property of color that allows us to distinguish between colors such as red, yellow, purple, etc.

LSB
Least Significant Bit. The lowest weighted bit or signal line.

Luminance
The signal (Y) which represents brightness or the amount of light in the picture. Luminance is the only signal required for black and white pictures. For color systems, it is obtained as a weighted sum (Y = 0.3R + 0.59G + 0.11B) of the R, G, and B signals.

MSB
Most Significant Bit. The highest weighted bit or signal line.

NTSC
National Television System Committee. The organization which developed the television standard currently in use in the United States, Canada, and Japan. Now generally used to refer to that standard.

PAL
Phase Alternate Line. Refers to one of the television systems used in Europe and many other parts of the world. The phase of one of the color difference signals alternates from line to line to help cancel out phase errors.

P_B
A color difference signal used in component video systems. It is derived by subtracting the B (blue) signal from Y.

P_R
A color difference signal used in component video systems. It is derived by subtracting the R (red) signal from Y.

RF
Radio Frequency. In television applications, RF generally refers to the television signal after the picture carrier modulation process.

RGB
Red, Green, and Blue. Also referred to as GBR in SMPTE specifications. The three primary colors used in color television's additive color reproduction system. These are the three color signals generated by the camera and used by the picture monitor to produce a picture.

R–Y
One of the color difference signals obtained by subtracting luminance (Y) from the red camera signal.

Saturation
The property of color which relates to the amount of white light in the color. Highly saturated colors are vivid, while less saturated colors have more white mixed in and, therefore, appear pastel. For example, red is highly saturated, while pink is the same hue, but less saturated.

In signal terms, saturation is determined by the ratio between luminance level and chrominance amplitude. It should be noted that a vectorscope does not display saturation; the length of the vectors represents chrominance amplitude. In order to verify that the saturation of the colors in a color bar signal is correct, you must check luminance amplitudes with a waveform monitor in addition to observing the vectors.

Termination

In order to accurately send a signal through a transmission line, there must be an impedance at the end which matches the impedance of the source and of the line itself. Amplitude errors and reflections will otherwise result. Video is a 75 Ω system, so a 75 Ω terminator must be put at the end of the signal path.

U

The B–Y signal after a weighting factor of 0.493 has been applied. The weighting is necessary to reduce peak modulation in the composite signal.

V

The R–Y signal after a weighting factor of 0.877 has been applied. The weighting is necessary to reduce peak modulation in the composite signal.

Vectorscope

A specialized oscilloscope which demodulates the video signal and presents a display of R–Y versus B–Y in NTSC systems (or V versus U in PAL systems). The angle and magnitude of the displayed vectors are respectively related to hue and saturation.

Vertical Interval

The synchronizing information which appears between fields and signals the picture monitor to go back to the top of the screen to begin another vertical scan.

Waveform Monitor

A specialized oscilloscope that plots voltage versus time to evaluate television signals.

Y

See Luminance.

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