User Manual

Tektronix

WFM700HD, WFM700A, & WFM700M Waveform Monitors

071-0916-02

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www.tektronix.com

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

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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.

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 apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

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

Use Proper Fuse. Use only the fuse type and rating specified for this product.

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.

Keep Product Surfaces Clean and Dry.

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

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:

CAUTION
Refer to Manual

WARNING
High Voltage

Protective Ground
(Earth) Terminal

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface

This manual describes configuring and using the WFM700HD, WFM700A, and WFM700M multi-format, multi-standard waveform monitors.

Contents of This Manual

This manual consists of the following sections:

Getting Started briefly describes the capabilities of the waveform monitor. This section also includes the accessories list, the installation procedure for portable cabinet or rack, and the functional check.

Operating Basics discusses the operation of the user interface and describes the measurements, setups, displays, and reporting capabilities.

Reference provides details of how to perform measurement tasks.

Appendix A: Specifications lists the performance specifications and environmental operating limits.

Appendix B: Supported Video Standards lists the signal formats that are supported. This section includes a table of compatible combinations of input signal formats and reference formats.

Appendix C: LED Fault Codes describes the fault conditions that are indicated by the front-panel Fault LED.

Appendix D: User Service describes instrument maintenance that can be performed by the user.

Appendix E: Firmware Upgrade describes how to install a new version of firmware in your instrument.

Appendix F: Cabinet and Rack Adapter Installation desribes how to install or remove the instrument from the WFM7F02 portable cabinet, the WFM7F03 plain cabinet, and the WFM7F05 rack adapter.

Appendix G: Module Installation describes how to install or remove an input module. These instructions are for qualified service personnel only.

Index provides page number references to topics in alphabetical order.

Related User Documents

The following related user documents are available:

- *WFM700 Release Notes* (Tektronix part number 061-4247-XX). This document describes new features provided by a firmware release and also describes problems or behaviors that you might encounter while using the waveform monitor. This document is provided as a standard accessory when you order a new instrument. If you upgrade your instrument firmware from the Tektronix, Inc. website, an updated version of this document is provided.
- *WFM700 Service Manual* (Tektronix part number 071-0915-XX). This document provides servicing information for qualified service personnel.

Related Reference Documents

The following related reference documents are available at the Tektronix, Inc. website (www.tektronix.com):

- *Preventing Illegal Colors*. This application note describes how the Diamond, Arrowhead, and Lightning displays on the waveform monitor can be used to help prevent the undesired impact of color gamut violations and to simplify the assessment of proper gamut compliance.
- *Understanding Colors and Gamut*. This poster provides a large visual display of how the Diamond, Arrowhead, and Lightning displays on the waveform monitor can be used to help prevent the undesired impact of color gamut violations.
- *A Guide to Standard and High Definition Digital Measurements*. This book is a primer for understanding the basics for making standard and high-definition, digital-video measurements.

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 6:00 a.m. – 5:00 p.m. Pacific time

* **This phone number is toll free in North America. After office hours, please leave a voice mail message.**
Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.

Getting Started

Getting Started

This section contains a list of accessories, an installation procedure, and a functional check to verify the primary functions of your waveform monitor. For instrument specifications, refer to *Appendix A*.

Product Description

The WFM700 waveform monitor is designed to meet the multi-format monitoring and measurement needs of serial digital program production, post-production, and transmission. For a complete list of supported video input formats, refer to *Appendix B*.

The WFM700 waveform monitor combines the features of traditional waveform monitors with the advantages of digital technology. Digital processing provides accuracy and repeatability of measurements.

The waveform monitor can be configured for different applications within a TV facility. Feature enhancements can be achieved by installing additional modules or by downloading software.

The waveform monitor has three base models:

- WFM700HD. Monitors high-definition (SMPTE 292M) video.
- WFM700A. Monitors standard-definition (ITU-R BT.601) and high-definition (SMPTE 292M) video.
- WFM700M. Measurement instrument for standard-definition (ITU-R BT.601), high-definition (SMPTE 292M), and hybrid serial digital operations.

Each waveform monitor includes:

- External Reference module
- One video input module (with two inputs)

Platform Features

The waveform monitor platform provides the following features:

- Accommodates ITU-R BT.601 and SMPTE 292M standards in one product (refer to *Appendix B* for a table of supported formats)
- Accommodates new video standards by adding modules
- Configurable as a monitoring or measurement instrument
- Can have up to four inputs (two inputs on each input card, up to two cards allowed)
- Color picture display with touch screen
- Picture monitor and VGA display outputs
- Digital signal processing from video input to on-screen display for accurate and repeatable measurements

Features by Module Type

The WFM700HD, WFM700A, and WFM700M provide specific features, as listed here:

WFM700HD

The WFM700HD monitors the high-definition digital signal path. The HD formats monitored are shown in *Appendix B*. The WFM700 waveform monitor includes:

- Two terminating inputs for SMPTE 292M serial digital video
- Auto detection of input format
- Selectable colorimetry
- Integrated TFT color LCD display with touch screen
- VGA output that replicates the integrated display
- Picture monitor output, selectable RGB, YPbPr, with bright-up
- Picture monitor output for computer display (RGB H & V sync)
- Looping inputs for bi-level and tri-level sync reference
- Auto detection of external reference input format
- Waveform parade and overlay displays, RGB, YRGB, YPbPr, and composite display of component input

- Line select
- Component Vector display
- Lightning display for use with color difference signals
- Diamond display for RGB domain gamut limits
- Arrowhead display for NTSC/PAL composite domain gamut limits
- Freeze mode for comparing input signal levels
- Detection of embedded audio channels
- Error detection and reporting per SMPTE RP-165 for standard definition and SMPTE 292M for high definition
- Electronic graticules
- Digital timing and voltage cursors
- User definable presets
- Alarms with adjustable thresholds
- One switched output, follows selected input (serial digital out)
- Thumbnail picture available on waveform, vector, and gamut signals

WFM700A The WFM700A monitor includes all the features of the WFM700HD, with the added capability of monitoring ITU-R BT.601.

WFM700M The WFM700M monitor includes all the features of the WFM700A, plus:

- Eye pattern display of the selected input signal
- Eye pattern timing cursors
- Eye pattern voltage cursors
- Logic analyzer data word listing for detailed pixel analysis
- Data value waveform
- Jitter demodulator with numeric jitter readout and video correlated jitter waveform display

Options

You can order any of the following instrument options with your waveform monitor. Some of these instrument options are also available separately as optional accessories (refer to page 1–6).

Cabinets

Two cabinet options are available:

- Option 01. Adds the WFM7F02 Portable Cabinet, described on page 1–6.
- Option 02. Adds the WFM7F05 Rack Adapter, described on page 1–6.

Additional Inputs

You can add a video input module to increase the number of inputs on a unit to four. You can have a maximum of two video input modules in any one unit; you can mix them any way you want.

You can add any of the following video input modules to a unit:

- Option 2HD. Adds the WFM7HD, which is a second video input module for serial digital monitoring (SMPTE 292 M).
- Option 2A. Adds the WFM7A, which is a second video input module for serial digital monitoring (ITU-RBT.601 and SMPTE 292M).
- Option 2M. Adds the WFM7M, which is a second video input module for serial digital measurement (ITU-R BT.601 and SMPTE 292M).

Services

You can order the following services:

- Option R3. Extends the instrument warranty to 3 years.
- Option R5. Extends the instrument warranty to 5 years.
- Option C3. Provides calibration services for 3 years.
- Option C5. Provides calibration services for 5 years.
- Option D1. Provides test data.
- Option D3. Provides test data for 3 years.
- Option D5. Provides test data for 5 years.

Power Cord Options

Table 1–1 on page 1–5 lists the available power cords.

Standard Accessories

The following accessories are shipped with each waveform monitor:

Documents

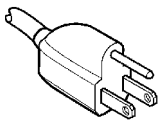
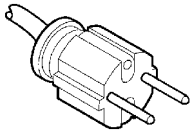
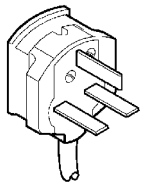
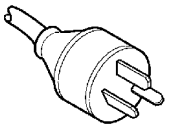
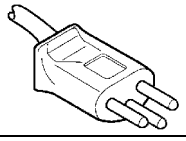
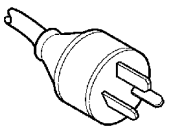
The following documents are standard accessories:

- *WFM700 User Manual*, Tektronix part number 071-0916-XX.
- *WFM700 Release Notes*, Tektronix part number 061-4247-XX.

Power Cords

All WFM700 waveform monitors are shipped with one of the following power cord options. Power cords for use in North America are UL listed and CSA certified. Cords for use in areas other than North America are approved by at least one authority acceptable in the country to which the product is shipped.

Table 1-1: Power cord options

Plug configuration	Nominal usage	Option number	Tektronix part number
	North America 125 V/15 A	Standard	161-0216-00
	Europe 230 V/16 A	A1	161-0215-00
	United Kingdom 230 V/15 A	A2	161-0066-10
	Australia 230 V/10 A	A3	161-0066-11
	Switzerland 230 V/10 A	A5	161-0154-00
	China 240 V/10 A	AC	161-0304-00

Optional Accessories

You can order any of the following optional accessories to use with your waveform monitor. These can also be ordered as instrument options when you order a waveform monitor (refer to page 1–4).

Additional Inputs

You add a video input module to increase the number of inputs on a unit to four. You can have a maximum of two video input modules in any one unit, but you can mix them any way you want.

You can add any of the following video input modules to a unit:

- WFM7HD. Serial digital video monitor module for HD (included in the WFM700HD).
- WFM7A. Serial digital video monitor module for SD and HD (included in the WFM700A).
- WFM7M. Serial digital video measurement module for SD and HD (included in the WFM700M).

Cabinets

You can order one of these cabinets (installation instructions are in *Appendix F*):

- WFM7F02 Portable Cabinet. Portable carrying case with handle and feet. The front feet flip down to form a stand. This cabinet includes a protective cover for the front of the instrument. You can also order this cabinet as Option 01 when you order the waveform monitor.
- WFM7F03 Plain Cabinet. Plain cabinet without any feet or carrying handle.
- WFM7F05 Rack Adapter. Dual side-by-side adapter for installing your half-rack monitors in a rack. This adapter uses two types of sleeves, one for the waveform monitor and one for other half-rack instruments. You can configure the adapter with any combination of two half-rack-width monitors. You can also order the rack adapter as Option 02 when you order the waveform monitor.

CAUTION. *WFM700 waveform monitors cannot be installed in 1700F00, 1700F02, or 1700F05 cabinets.*

Service Manual

The optional service manual includes procedures for qualified service personnel to verify that the instrument is operating within specifications and to trouble-shoot the instrument to the module level.

- *WFM700 Service Manual*, Tektronix part number 071-0915-XX.

Installation and Power On

This section contains information about installing and powering on the waveform monitor.

Instructions for performing firmware upgrades are located in *Appendix E*.

Instructions for installing or removing the waveform monitor from the WFM7F02 portable cabinet, the WFM7F03 plain cabinet, or the WFM7F05 rack adapter are located in *Appendix F*.

Instructions for adding or removing a module are located in *Appendix G*.

Hardware Installation

When you unpack the waveform monitor, save the shipping carton and packing materials in case you need to ship the instrument. Packing instructions are on page 1–12.

The waveform monitor is shipped in a wrap-around chassis (see Figure 1–1) that covers the instrument bottom and two sides. A cover is installed on the chassis, and the rear panel is made up of the module rear panels.

You can operate the waveform monitor in the instrument chassis (be sure the cover is on) or installed in an approved portable cabinet (WFM7F02) or rack adapter (WFM7F05). You can also install the waveform monitor in a custom installation, such as a console.

CAUTION. *Do not install the waveform monitor in any cabinet except those that are listed in* Optional Accessories *on page 1–6.*

Allowing Airflow

If you install the waveform monitor in a custom application, such as a console, be sure to provide adequate airflow. Follow these guidelines:

- Do not block the ventilating holes shown in Figure 1–1.
- Adhere to the clearance requirements listed in Table A–23 on page A–13.

CAUTION. *Failure to provide adequate airflow to the waveform monitor could cause the instrument to shut down (refer to Appendix C for LED fault codes). If the airflow is blocked and the instrument does not shut down, it could result in serious instrument damage.*

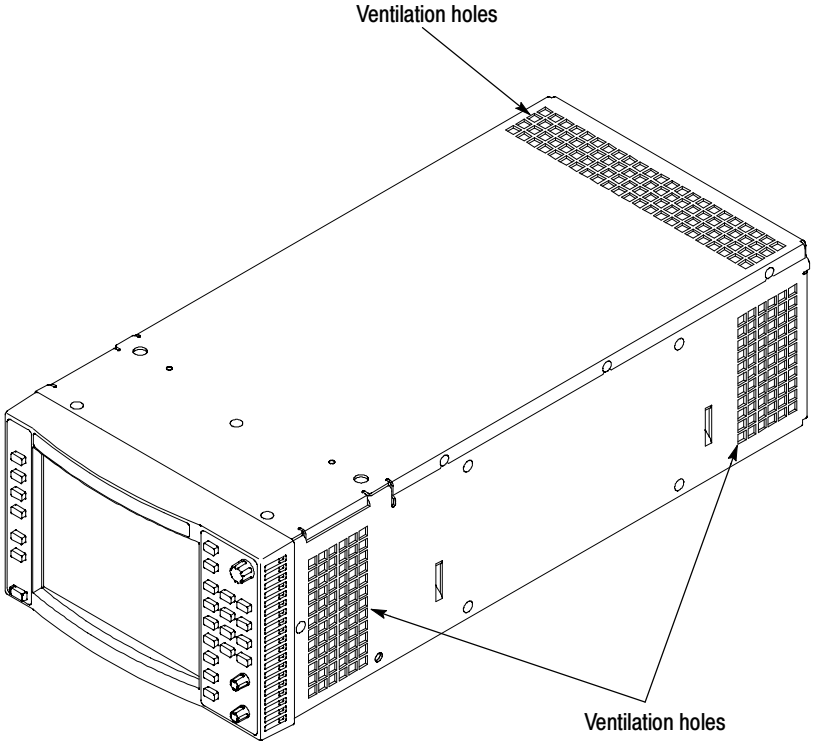


Figure 1-1: Waveform monitor chassis

WFM7F02 Portable Cabinet

You can install your waveform monitor into a WFM7F02 Portable Cabinet, shown in Figure 1–2. The WFM7F02 has a handle and four feet. The two rear feet are stationary and the two front feet flip down to provide a stand. A protective front cover is also provided. Instructions for installing the portable cabinet are located in *Appendix F*.

CAUTION. *Do not install the waveform monitor into the traditional 1700F02 Portable Cabinet, because it does not provide the correct ventilation. Additionally, there are keying pins to exclude this application.*

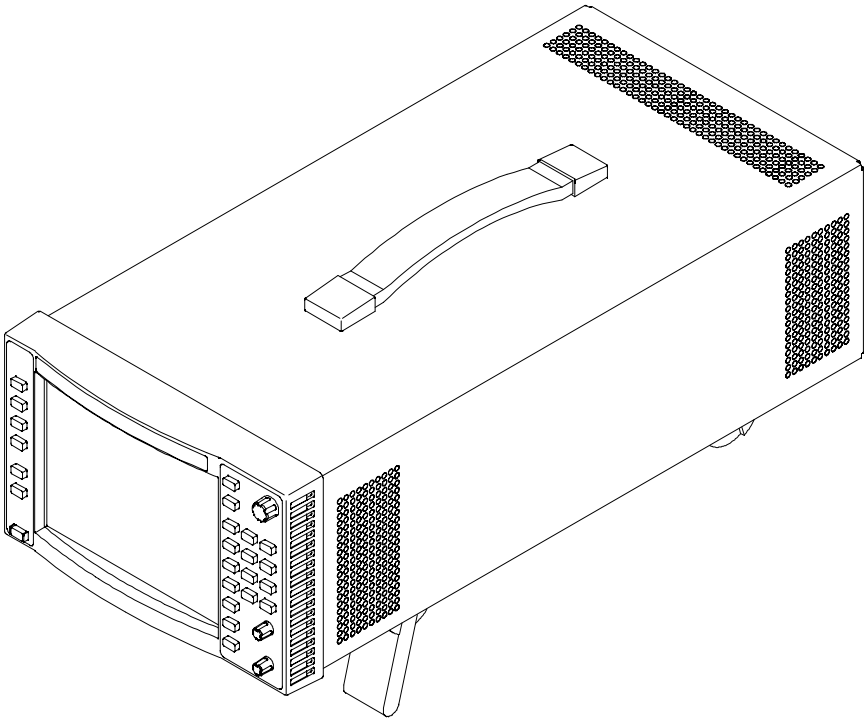


Figure 1-2: WFM7F02 Portable Cabinet

WFM7F03 Plain Cabinet

The WFM7F03 Plain Cabinet is designed to house any of the 1/2 rack-width, WFM700 waveform monitors. The cabinet does not have any feet, carrying handle, or protective front cover. Instructions for installing the cabinet are located in *Appendix F*.

WFM7F05 Rack Adapter

You can use the WFM7F05 side-by-side rack adapter, shown in Figure 1–3, to install the waveform monitor and another half-rack width instrument into a rack. You can also install a drawer or blank panel in the unused side of the rack adapter. Instructions for installing the rack adapter are in *Appendix F*.

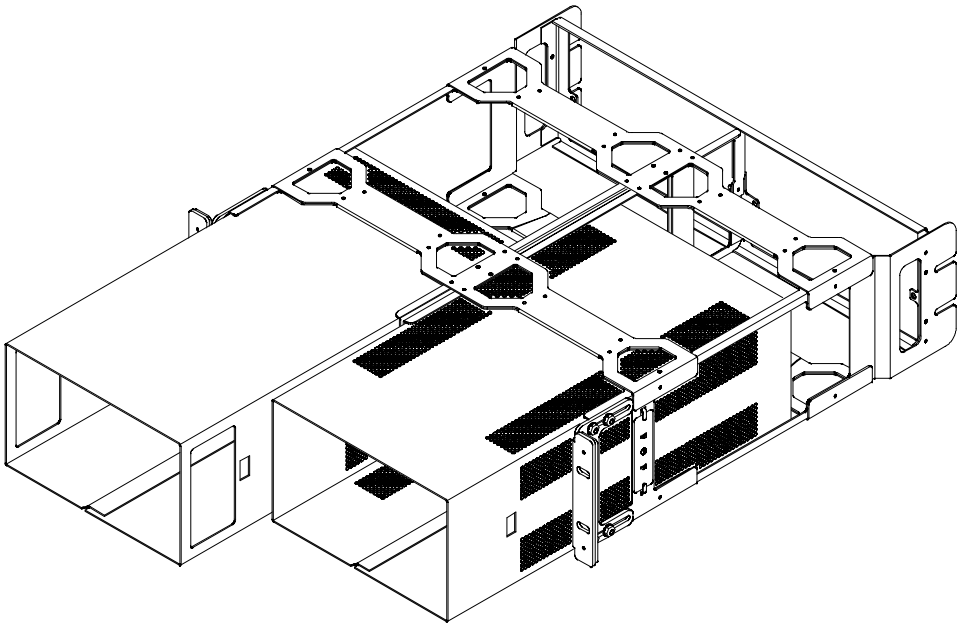


Figure 1- 3: WFM7F05 Rack Adapter

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.

WARNING. *When power is supplied via the power cord, line voltage will be present inside the waveform monitor, even if the unit is in standby mode.*

AC Power Requirements

The waveform monitor operates from an AC line frequency of 50 or 60 Hz, over the range of 100–240 Volts, without the need for configuration, except the power cord. Refer to page 1–5 for the power cord options.

The typical power consumption is 100 W with one video input card installed and 125 W with two video input cards installed. Refer to *Appendix A* for additional information on power and environmental requirements.

CAUTION. *Use only power cords that are approved for the country of use. Using non-approved power cords could result in fire or shock hazard.*

Powering On the Instrument

Follow these steps to power on the waveform monitor:

1. Plug the supplied power cord (IEC 320) into the back of the instrument. Refer to page 1–5 for a list of power cord options.
2. Plug the other end of the power cord into a standard wall outlet.
3. Press the ON/STBY button to bring the waveform monitor out of standby mode.

Packaging for Shipment

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

1. Contact Tektronix (see page xv) to get an RMA and other instructions.
2. Attach a tag to the waveform monitor showing the name of the owner, the complete address, the phone number, the instrument serial number and a description of the required service.
3. Repackage the instrument 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.
4. Seal the carton with shipping tape or industrial staples.

Functional Check

The following procedure is a basic operational check of the waveform monitor. The last step checks the LCD display. Measurement quantities or specifications are not checked in this procedure. This procedure does not require you to remove the cover from the instrument.

If you need to check a second input module, refer to the procedure on page 1–28.

WARNING. *To avoid personal injury, do not operate the waveform monitor with the chassis cover removed.*

If the Functional Check procedure reveals improper operation or an instrument malfunction, check the connections and the operation of the test equipment. If test equipment is operating normally and the failure is repeatable, contact qualified service personnel or Tektronix for repair or adjustment.

For a complete check of instrument performance to specifications, refer qualified service personnel to the Performance Verification procedure in the *WFM700 Service Manual*.

Required Equipment

The following equipment is required to perform this procedure:

- Television Signal Generator with analog, digital SD, and digital HD capabilities.
  For example: Tektronix TG2000 Signal Generation Platform with AVG1, DVG1, and HDVG1 modules installed.
- VGA monitor
- Test signals: SD and HD color bar signal, HD and SD 10 bit shallow ramp matrix, HD or SD 0% flat field and 100% flat field signals.
- 75 Ω terminator
- High quality 75 Ω BNC cables (3)

The following equipment can be used to test all outputs of the instrument while performing this procedure:

- HD CAV picture monitor
- SD serial digital picture monitor
- SD CAV picture monitor

Functional Check Procedure

1. For WFM700A and WFM700M only: Use the SD module of the test signal generator (for the TG2000 generator, use the DVG1 module). Connect an output signal to the rear-panel INPUT A on the waveform monitor module you will be checking (you can have up to two modules installed in the waveform monitor). Set the generator for a 525 format, 100% color bar signal with embedded audio and EDH enabled.

2. For WFM700HD, WFM700A, and WFM700M: Use the HD module of the test signal generator (for the TG2000 generator, use the HDVG1 module). Connect an output signal to INPUT B on the waveform monitor. Set the generator for a 1080i format, 100% color bar signal with embedded audio and CRC enabled.

3. Power on, check fans and installed modules:

   a. Press the ON/STBY button to power on the waveform monitor.

   b. Check that the fans spin up. All front-panel lights except the Fault light should come on momentarily.

   c. After about 20 seconds, the splash screen appears. This screen reports the status of the boot process and lists the installed modules. Check that the reported modules match the actual installed modules. Check that there are no fatal errors.

4. Check touch panel calibration:

   a. Press the CONFIG button to open the configuration menu. You can change configuration settings in this step because you will return to default menu settings in step 5.

   b. Touch the soft keys down the left side of the screen. Check that you are able to select each soft key and that the appropriate submenu appears on the right side of the screen.

   c. Touch the General Alarms soft key on the left side of the screen.

   d. Touch RGB Gamut in the submenu on the right side of the screen.

   e. Touch the buttons in the displayed table and check that you can select and deselect the buttons.

5. Restore factory presets:

   a. Press the PRESET button. The Preset menu appears across the bottom of the screen.

   b. Touch the soft key labeled **-more- 1 of 2**.

   c. Touch the soft key labeled **Restore Factory.** This returns the instrument state to the factory settings.

6. For WFM700HD only: Change to active input:

   a. Press the INPUT button.

   b. Touch the soft key to select the B input of the module you are checking (either 1B or 2B).

   c. Check that the HD color bar signal is displayed.

7. Check waveform signal and format:

   a. Press the WFM button.

   b. Check for the appropriate waveform display.

   c. Check that the format readout for the input is:
   270Mb/s 525i 59.94 for WFM700A and WFM700M
   1.4835Gb/s 1080i 59.94 for WFM700HD

8. Verify VGA output:

   a. Connect the waveform monitor EXT VGA output to the VGA monitor.

   b. Verify that the signal on the waveform monitor is the same as the signal on the VGA monitor.

9. Check vector mode:

   a. Press the VECTOR button to enter the vector mode.

   b. Check for the appropriate vector display.

10. Check picture mode:

a. Press the PICTURE button to enter the picture mode.

b. Check for the appropriate picture display.

11. Check gamut mode:

a. Press the GAMUT button to enter the gamut mode.

b. Check for the appropriate gamut display.

12. Check audio mode:

a. Press the AUDIO button to enter the audio mode.

b. Check the status of the audio channels. Verify that the correct channels are being detected.

13. Check audio de-embedding for HD:

a. Select the HD color bar signal from the generator.

b. Turn on the Embedded Audio. (For the TG2000 generator, from the signal select window, select Module Parameters and then select Embedded Audio folder.)

c. Set the Number of Groups Enabled to 2.

d. Set the Starting Group to 1.

e. Press the STATUS button on the waveform monitor.

f. Touch the EDH Status soft key.

g. Check that the Embedded Audio status reads as follows:
Embedded Audio: PPPP PPPP - - - - - - - -

14. For WFM700M and WFM700A only: Check audio de-embedding for SD:

a. Select the HD color bar signal from the generator.

b. Turn on the Embedded Audio. (For the TG2000 generator, from the signal select window, select Module Parameters and then select Embedded Audio folder.)

c. Set the Number of Groups Enabled to 2.

d. Set the Starting Group to 1.

e. Press the STATUS button on the waveform monitor.

f. Touch the EDH Status soft key.

g. Check that the Embedded Audio status reads as follows:
Embedded Audio: PPPP PPPP - - - - - - - -

15. Check to see that there are no errors on EDH status.

16. For WFM700M only: Check eye and jitter modes:

a. Press the EYE button. It may take a few seconds before a stable eye display appears.

b. Check for a clean, stable eye signal.

c. Touch the Jitter soft key.

d. Check for a nominal trace. This will typically be a flat line unless you have jitter added to the generator signal.

e. Press the WFM button to clear the EYE mode.

17. Check knob operation:

- **a.** Press the WFM button.
- **b.** Turn the VERT POS and HORIZ POS knobs.
- **c.** Check that the controls move the waveform horizontally and vertically.
- **d.** Press the CONFIG button.
- **e.** Turn the general purpose knob and check that it scrolls through the displayed menu options.
- **f.** Check that all three front-panel knobs have about the same drag and feel; one knob should not be stiff if another knob is loose.
- **g.** Press the CONFIG button again to exit the configuration menu.

18. Check vertical gain operation:

- **a.** Press the GAIN button.
- **b.** Touch the X5 soft key and check that the signal magnifies properly.
- **c.** Touch the X10 soft key and check that the signal magnifies properly.
- **d.** Touch the Var. Gain soft key. Turn the general-purpose knob and check for smooth control of the variable gain.
- **e.** Touch the X1 soft key. Check that the signal is unmagnified.

19. Check freeze mode:

- **a.** Press the FREEZE button.
- **b.** Touch the Capture Screen soft key.
- **c.** Touch the Display Both soft key.
- **d.** Use the horizontal and vertical position controls to reposition the live signal.
- **e.** Check for two waveforms, the live signal and the captured signal.
- **f.** Touch the Delete Capture soft key.

20. Check line select mode:

a. Press the LINE SELECT button to enter line select mode.

b. Use the general-purpose knob to set the active line to F1:50.

c. Check that you can see the waveform.

d. Press the LINE SELECT button again to turn the function off.

21. Check external reference operation:

a. Press the INPUT button.

b. Touch the Reference soft key to select External.

c. Check for a readout that the reference is not present (unlocked). You will not see a stable display.

d. Connect the NTSC analog reference from the generator to the REF IN loop-through connector on the monitor.

e. Terminate the second REF IN connector in 75 Ω.

f. Check for a stable (locked) waveform display on the monitor and a readout indicating the reference type.

22. For WFM700A and WFM700M only: Check for missing bits in the SD signal path:

a. Adjust the generator to supply a 525 format 10 bit shallow ramp matrix signal.

b. Press the Input button and touch the Input A soft key. Verify that the correct signal is displayed on the waveform monitor.

c. Press the WFM button.

d. Touch the Pr and Pb soft keys to turn them off.

e. Check the trace carefully; verify that the steps in the ramps are monotonic (all steps are in the same direction) and approximately one pixel high.

f. Press the GAIN button.

g. Touch the X10 Gain soft key.

h. Check the trace carefully. Check that the steps in the ramps are 0.7 mV to 0.9 mV high, which indicates that all 10 bits are working correctly. (You can use the voltage cursors for this check.) If the steps are 4 pixels high, it may be that the input signal has only 8 bits of resolution.

i. Press the WFM button.

j. Touch the Pb and Pr soft keys to turn those components back on.

k. Press the GAIN button.

l. Touch the X1 Gain soft key.

23. Select and verify the B input:

a. Press the INPUT button.

b. Touch the soft key to select the B input of the module you are checking (either 1B or 2B).

c. Check that the HD color bar signal is displayed. (It may take a second or so to appear.)

d. Press the WFM button.

e. Check that the 100% color bars are displayed correctly.

f. Check that the format readout for the input (1B or 2B) is: **1.4835Gb/s, 1080i 59.94**

24. Check external reference operation:

a. Press the INPUT button.

b. Disconnect the reference signal and check that the waveform display is unlocked.

c. Touch the Reference soft key to select Internal.

d. Check that the waveform display is stable (locked).

25. For WFM700M only: Check jitter and eye modes:

a. Press the EYE button. The jitter display will come up because it was selected last in eye mode.

b. Check for a nominal trace. This will typically be a flat line unless you have jitter added to the generator signal.

c. Touch the Eye soft key.

d. Check for a clean, stable eye signal.

26. Check for missing bits in the HD signal path:

a. Adjust the generator to supply a 1080i, 10 bit shallow ramp matrix signal.

b. Press the WFM button.

c. Touch the Pr and Pb soft keys to turn them off.

d. Check the trace carefully; verify that the steps in the ramps are monotonic (all steps are in the same direction) and approximately one pixel high.

e. Press the GAIN button.

f. Touch the X5 Gain soft key.

g. Check the trace carefully. Check that the steps in the ramps are 0.7 mV to 0.9 mV high, which indicates that all 10 bits are working correctly. (You can use the voltage cursors for this check.) If the steps are 4 pixels high, it may be that the input signal has only 8 bits of resolution.

h. Press the WFM button.

i. Touch the Pb soft key to turn on the Pb component.

j. Touch the Y soft key to turn off the Y component.

k. Press the GAIN button.

l. Touch the X1 Gain soft key.

m. Check the trace carefully; verify that the steps in the ramps are monotonic (all steps are in the same direction) and approximately one pixel high.

n. Touch the X5 Gain soft key.

o. Check the trace carefully. Check that the steps in the ramps are 0.7 mV to 0.9 mV high, which indicates that all 10 bits are working correctly. (You can use the voltage cursors for this check.) If the steps are 4 pixels high, it may be that the input signal has only 8 bits of resolution.

p. Touch the X1 Gain soft key.

q. Press the WFM button.

r. Touch the Y and Pr soft keys to turn those components back on (make sure that Y, Pb, and Pr are turned on).

27. Check the display screen pixels using black and white screens:

- **a.** Set the generator output signal to 0% flat field. Use HD for the WFM700HD. Use SD for the WFM700A and WFM700M.
- **b.** Press the PICTURE button on the waveform monitor.
- **c.** Press the INPUT button and touch the soft key as required to display the 0% signal that you just set up on the generator. (This varies depending on which instrument you are checking.)
- **d.** Press the CLR MENU button.
- **e.** Count any bad pixels on the black screen.
- **f.** Change the generator signal to 100% white field.
- **g.** Count any bad pixels on the white screen.
- **h.** Total all of the bad pixels. If there are more than 6 bad pixels, recount the bad pixels; this time if a pixel fails for both black and white signals, count it only once. If there are still more than 6 bad pixels, the LCD is faulty. Contact your Tektronix representative.

28. For WFM700A and WFM700M only: Check that both inputs accept SD and HD signals:

- **a.** Set the SD generator for a 525 format, 100% color bar signal with embedded audio and EDH enabled.
- **b.** Set the HD generator for a 1080i format, 100% color bar signal with embedded audio and CRC enabled.
- **c.** Swap the inputs: connect the SD signal to INPUT B and the HD signal to INPUT A.
- **d.** Check that the signal displays properly on INPUT B.
- **e.** Press the INPUT button.
- **f.** Touch the soft key to select the A input of the module you are checking.
- **g.** Check that the signal displays properly on INPUT A.

29. For WFM700HD only: Check that both inputs function properly:

a. Set the HD generator for a 1080i format, 100% color bar signal with embedded audio and CRC enabled.

b. Move the HD generator connection to INPUT A.

c. Press the INPUT button.

d. Touch the soft key to select the A input of the module you are checking.

e. Check that the signal displays properly on INPUT A.

30. For WFM700A and WFM700M only: Check the SD picture monitor out connections:

a. Press the INPUT button.

b. Touch the soft key to select the B input of the module you are checking.

c. Connect the waveform monitor PIX G/Y, B/Pb, and R/Pr outputs to the SD RGB monitor.

d. Check that the proper color bar signal is displayed on the monitor. If it is not correct, press the CONFIG button, touch Output Config on the touch screen, and then touch Output Active for SD. In the Output Active for SD submenu, change from the default Y Pb Pr mode to RGB mode.

e. Connect the waveform monitor SD PIX MON output to the SD serial monitor.

f. Check that the proper signal is displayed on the monitor.

31. Check the HD picture monitor out connections:

a. Connect the waveform monitor PIX G/Y, PIX B/Pb, and PIX R/Pr outputs to the HD RGB or VGA monitor.

b. Press the Input button.

c. Touch the Input #1A soft key to select the HD input.

d. Check that the proper color bar signal is displayed on the monitor. If the colors look wrong, press the CONFIG button, touch Output Config on the touch screen, and then touch Output Active for HD. In the Output Active for HD submenu, change from the default Y Pb Pr mode to RGB mode.

32. Run diagnostics and Check the display screen bits:

a. Press the Config button.

b. Select Diagnostics from the first level menu.

c. Touch the Next Menu soft key to get to the second level.

d. Select Diagnostics. This will display three choices: Run full power up diagnostics, Run internal digital path diagnostics, and View diagnostics log.

e. Select View Diagnostic Log and then touch Erase NVRAM Log to clear the log file.

f. Touch the Back to Diags Menu soft key.

g. Select Run Full Powerup Diagnostics on the touch screen.

h. Verify that there are no red fail messages.

i. Touch the Back to Diags Menu soft key.

j. Select Run Internal Digital Path Diagnostics on the touch screen.

k. Read the screen text, and then touch the Continue soft key to acknowledge that a reboot will be required. The diagnostic test will run.

l. At the end of the diagnostic test, four ramp patterns will appear on the LCD to check the bits on the waveform monitor display. Verify that there are steps about 1/16 inch wide on the left side of the ramps.

m. Verify that there are no color bands in the gray ramp.

n. If the steps in the ramp are wider than about 1/16 inch or if there are bands in the picture, it may indicate a bad bit in the LCD drive path. The width of the steps and bands indicates which bit is bad.

o. Press the flashing SELECT button to return to the Diagnostic Menu.

p. Touch the View Diagnostics Log soft key.

q. Page through the log to verify that there are no red FAIL messages.

r. Cycle the power to reboot the waveform monitor.

This completes the Functional Check procedure. If you need to check a second module, use the *Functional Check for a Second Input Module* procedure on page 1–28.

Functional Check for a Second Input Module

When you perform a functional check on a second input module, it is not necessary to repeat steps that verify general instrument operation, such as knob function.

To perform a functional check on a second input module, repeat the following steps from the *Functional Check Procedure*, which begins on page 1–15:

Step 1. Connect an SD test signal (WFM700A and WFM700M only)

Step 2. Connect an HD test signal (WFM700HD, WFM700A, and WFM700M)

Step 5. Recall the factory presets

Step 6. Change to input B (WFM700HD only)

Step 7. Check waveform signal and format

Step 15. Check EDH status

Step 16. Check eye and jitter modes (WFM700M only)

Step 22. Check for missing bits in the SD signal path (WFM700A and WFM700M only)

Step 23. Select and verify the B input

Step 25. Check jitter and eye modes

Step 26. Check for missing bits in the HD signal path

Step 28. Check that both inputs accept SD and HD signals (WFM700A and WFM700M only)

Step 29. Check that both inputs function properly (WFM700HD only)

Step 30. Check the SD picture monitor out connections (WFM700A and WFM700M only)

Step 31. Check the HD picture monitor out connections

Operating Basics

Functional Overview

The instrument is controlled through a combination of front-panel controls (buttons and knobs) and touch-screen controls (soft keys), as described on the following pages.

Front Panel Interface

The waveform monitor front panel is shown in Figure 2–1.

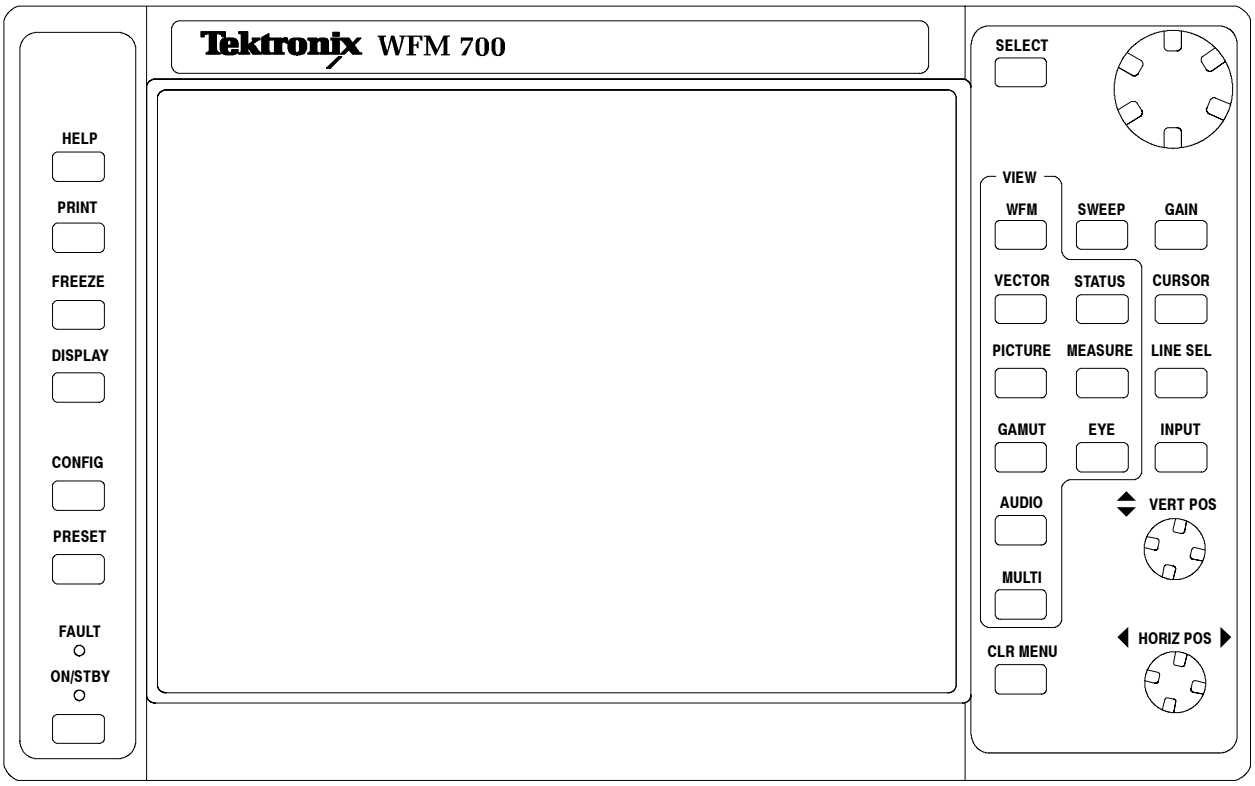


Figure 2-1: Waveform monitor front panel

Front Panel Controls and Indicators

The waveform monitor has the following controls and indicators:

General Purpose Knob

The general purpose knob is located in the upper right corner of the front panel. You can use the general purpose knob to navigate among choices or to change values, depending on the feature you are currently using. In general, the knob continues to perform the assigned function until you select a different feature.

In the Config menu, a knob icon appears in the upper left corner when it can be used to scroll through the menu or to change values. In most other menus, the item being modified by the knob is highlighted.

A clockwise turn:

- Increases a value
- Moves a graphical selection, such as a cursor, to the right or up
- Scrolls down through text

A counterclockwise turn:

- Decreases a value
- Moves a graphical selection, such as a cursor, to the left or down
- Scrolls up through text

You can use this knob with the following functions:

- Select button. You can use the Select button with the general purpose knob. For example, in the Config menu, use the knob to scroll through the list of submenus and then press the Select button to open the highlighted submenu.

  During some modes of operation the Select button LED will stay illuminated. This is an indicator that you can press the Select button to toggle the general purpose knob between controlling two items. An example is toggling between selecting a line or selecting a sample in Line Select mode.

- Line Select. The general purpose knob is used to select the line in Line Select mode. In some cases, the knob will automatically return to Line Select mode after being assigned to another function.
- Sample Select. Used in data view mode.
- Cursor Position
- Intensity control for waveform, graticule, readouts, and backlight
- Selecting items in the Config menu

Vertical Position Knob Moves the waveform vertically on the screen.

Horizontal Position Knob Moves the waveform horizontally on the screen.

ON / STBY LED This green LED is illuminated whenever the instrument is powered on.

FAULT LED This red LED is illuminated when a hardware fault is detected within the instrument, such as under/over voltage of a power supply. The Fault conditions are shown in *Appendix C*.

Front-Panel Buttons

For more information about these functions, refer to the *Menus* section beginning on page 2–13.

Major Mode Buttons

These buttons change the entire context and content of the LCD display, and generally function as follows:

- Pressing a button selects a mode and opens a menu (for example, pressing WFM selects the Waveform display mode and opens the Waveform menu).
- The button illuminates to show that the mode is activated.

The major mode front-panel buttons consist of the following:

- WFM (Waveform)
- VECTOR
- PICTURE
- GAMUT
- AUDIO
- MULTI (future capability)
- STATUS
- MEASURE
- EYE (functional on the WFM700M only)
- HELP
- CONFIG (Configuration)

Minor Mode Buttons

The minor mode front-panel buttons activate a function that works with one or more major modes. The minor mode front-panel buttons generally function as follows:

- Pressing a button activates a function (if that function is supported in the currently selected major mode) and displays the menu for that function.
- The front-panel button illuminates to show that the mode is activated.
- Pressing the CLR menu button (or selecting another mode that uses a menu) clears the function menu from the screen, leaving the function active. The major mode button LED will be on, and the minor one will be off.
- Some minor modes like Line Select, Sweep, and Cursor remain active and modify the display when their menu is not displayed. In this case, press the front panel button once to bring the menu back and then again to exit the mode.
- Settings selected in Sweep can only be turned off by pressing the SWEEP button and using the menu to change modes.

The minor mode front-panel buttons consist of the following:

- SWEEP
- GAIN
- CURSOR
- LINE SEL (Line Select)
- FREEZE
- DISPLAY

Additional buttons

Additional buttons are:

- SELECT
- INPUT
- PRINT (future capability)
- PRESET
- CLR MENU (Clear Menu)

Touch Screen (Soft Keys)

Use the touch screen to select choices from a menu and to access additional instrument menus. “Buttons” that appear on screen are referred to as soft keys. Soft keys vary depending on the instrument mode. The soft keys function as follows:

- Toggle soft keys toggle between two settings or between enable and disable.
- Some soft keys are presented as a linked group in which only one button can be selected at a time (mutually exclusive).

Readouts

Various on-screen readouts and icons inform you of instrument settings and conditions. For more information about the readouts, refer to the section about the mode in which you are operating. For example, information about the Cursor readouts would appear in the section on Cursors on page 2–28.

There are a number of readouts that may appear on the the screen, depending on the current state of the instrument. When a menu is displayed, the readouts on the lower part of the screen move up above the menu. When CLR MENU is pressed, these readouts move down to the bottom of the screen.

Readouts that may appear on the waveform monitor:
(listed in the order that they appear on screen, top to bottom, left to right)

1. Current reference (Ref). (Location = Lower left) Text indicates the current source of the video reference. May include INT(active input signal) or EXT (signal applied on the external reference connector). Also displays the type and status of the reference. See also *Input Menu* on page 2–42.
2. Vector graticule type (Bars:). (Location = Lower Left) Text indicates the current setting of the Vector Graticule, 75% or 100%.
3. Horizontal Gain (HGain). (Location = Lower Left) Text displays the variable horizontal gain value in yellow to indicate that it is not standard. See also *Gain Menu* on page 2–37.
4. Vertical Gain (VGain). (Location = Lower left) Text displays which calibrated vertical gain you have selected, such as X1 or X5. If you select variable gain, the readout displays the gain value in yellow to indicate that it is not standard. See also *Gain Menu* on page 2–37.

5. Selected input / input format. (Location = Lower left) Text indicates the currently selected input (1A, 1B, 2A, or 2B), followed by the input format. For example, 2A: 1.4835 Gb/s 1080sf:29.97 would indicate that the A input of the module in slot 2 is selected, it is receiving an HD signal, and that the format of the signal is 1080sf at a frame rate of 29.97 Hz. See also *Input Menu* on page 2-42.

6. Color standard. (Location = Lower Center) Text indicates the current colorimetry standard. Not present in all modes.

7. Audio channels. (Location = Lower center) When enabled, 16 characters indicate embedded audio channel status; one character for each channel. The codes are as follows:
   P = Present
   - = Not Present
   See also *Audio Mode* on page 2-16.

8. Waveform components. (Location = Lower center) The currently displayed waveform color components are listed. Non-displayed components are indicated by dashes. For example, an RGB display with G deselected would appear as R-B. See also *Waveform Menu* on page 2-58.

9. Magnification (Mag). (Location = Lower center) Text indicates the mag setting. If mag is on, the text appears in yellow to indicate that the signal is not being displayed in the normal time scale. See also *Sweep Menu* on page 2-54.

10. Sweep rate. (Location = Lower center) A readout indicates the selected sweep rate. See also *Sweep Menu* on page 2-54.

11. Field and line. (Location = Upper right) When Line Select is active and Line is selected, on-screen text shows the displayed field and line number. It also indicates in which portion of the video signal the selected line occurs. See also *Line Select Menu* on page 2-43.

12. Sample. (Location = Upper right) When Line Select is active and Sample is selected, text displays the selected sample number, followed by the portion of the video signal that the sample is in, such as Y, Cb, Cr, EAV, HB, or SAV. See also *Line Select Menu* on page 2-43.

13. Cursor. (Location = Upper right) When cursors are active, the text displays the time or voltage (depending upon mode) at their location and the difference in time or voltage between them (delta). See also *Cursor Menu* on page 2-28.

14. Gamut error. (Location = Middle right) When gamut errors occur, the readout (if enabled) will display either “RGB Err” or “Cmpst Err” for RGB and composite gamut errors, respectively. See also *Gamut Menu* on page 2-38.

Icons

On-screen icons inform you that an error condition exists or an instrument operation is in progress. The icons are:

Icon	Name	Description
	Alarm / Error Indicator (Red)	Appears when alarms have triggered and remains until just after the last alarm or error condition is resolved (cleared).
	Hardware Fault Indicator (Yellow)	Appears when there are hardware issues, such as high temperature or a blocked fan, and remains until the condition is resolved.
	Freeze Indicator (Green)	Appears when a capture is available, whether or not it is currently displayed. Refer to *Freeze Mode* on page 3–11.

Context-Sensitive Help

When the instrument is in a major mode, such as Waveform or Vector, pressing the HELP button displays help about that mode.

Rear Panel Connectors

The rear-panel connectors are shown in Figure 2–2 and are described in the following text.

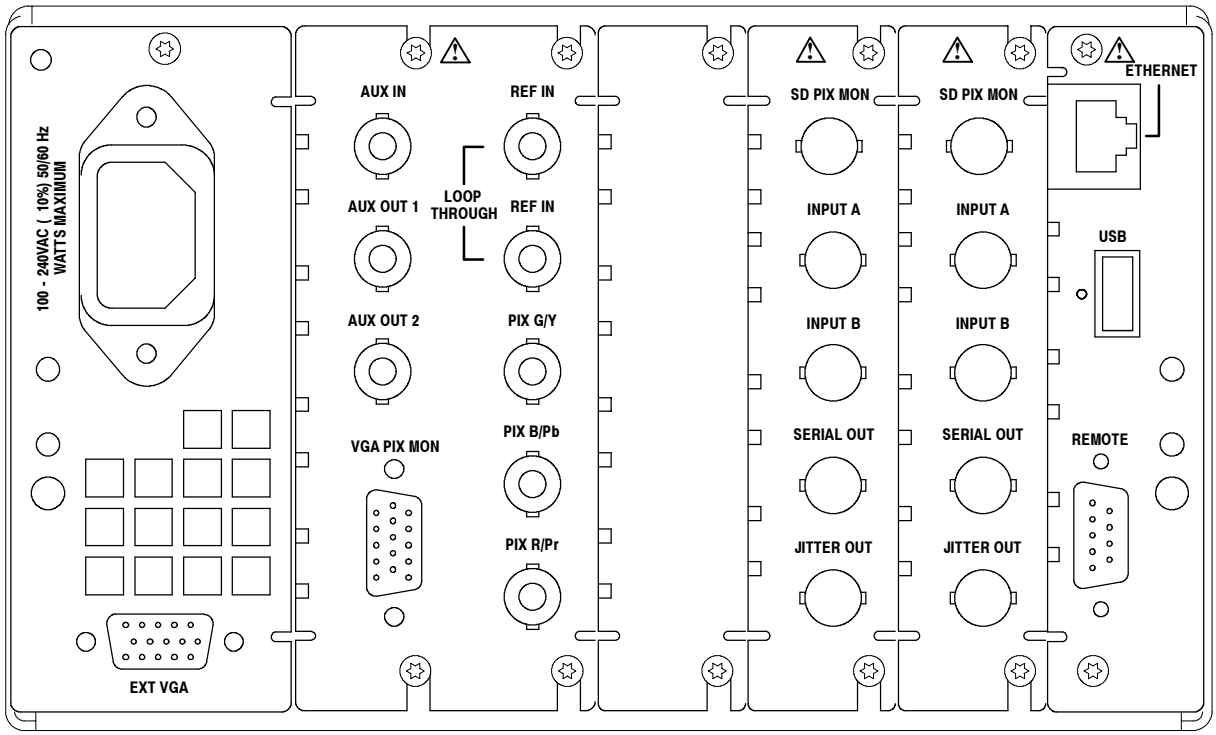


Figure 2-2: Waveform monitor rear panel with two WFM7M input modules installed

Power Connector

This instrument is intended to operate from a single-phase power source with one current-carrying conductor at or near earth ground (the neutral conductor). Only the Line conductor is fused for over-current protection. The fuse is internal, on the Power circuit board. Systems that have both current-carrying conductors live with respect to ground (such as phase-to-phase in multiphase systems) are not recommended as power sources. Mains frequency is 50 or 60 Hz. Operating voltage range is continuous from 100 to 240 VAC, ±10%.

Inputs

The waveform monitor provides the following inputs:

- INPUT A. Digital input for signal to be monitored. For WFM700HD, this can only accept 1.485 Gb/s High Definition serial video. For the WFM700A and WFM700M, this input can accept HD and 270 Mb/s Standard Definition video. This is a 75 Ω terminating input.
- INPUT B. Digital input for signal to be monitored. For WFM700HD, this can only accept 1.485 Gb/s High Definition serial video. For the WFM700A and WFM700M, this input can accept HD and 270 Mb/s Standard Definition video. This is a 75 Ω terminating input**.**
- REF IN LOOP-THROUGH. Compensated for 75 Ω impedance; requires proper termination at one end of the loop-through connector or at the receiver in a monitored system. Provides for connection of an external synchronization signal such as black burst or composite video.
- AUX IN. Future capability.

Multi-Pin Connectors

The waveform monitor provides the following multi-pin connectors:

- VGA PIX MON. A copy of the PIX G/Y, B/Pb, R/Pr pix mon outputs. This allows using an inexpensive VGA monitor for non-critical HD applications. Most computer monitors will not lock to 50 Hz vertical rates or to Standard Definition line rates, so this may not work in all applications.
- EXT VGA. Provides an exact copy of the LCD screen to drive an external monitor.
- REMOTE. 9 pin subminiature D-type connector. Future capability.
- USB. Intended for interfacing with USB printers. Future capability.
- ETHERNET. (10/100 Base T). 10/100 Mbit/sec Ethernet interface. Used for downloading firmware upgrades. The firmware upgrade procedure is located in *Appendix E*.

Coaxial Outputs

The waveform monitor provides the following coaxial outputs:

- PIX G/Y, B/Pb, R/Pr. Provides three 75 Ω component signal outputs to drive a component picture monitor. You can set the output format to YPbPr or RGB. Out of gamut input signals cause the affected areas to be highlighted on the monitor display. This gamut error highlight or "bright-up" signal is controlled in the CONFIG menu.
- SD PIX MON. This output is a copy of the PIX G/Y, B/Pb, R/Pr pix mon output, but in SD serial digital format. It is operational only for SD input formats.
- SERIAL OUT. Provides a reclocked version of the selected signal input (Video Input A or B).
- JITTER OUT. (WFM700M only) Provides a 75 Ω output signal from the jitter demodulator. This signal is only valid when the instrument is in Jitter mode. Any signal present on this output at other times is not a calibrated jitter signal. The jitter filter selection does not affect this signal.

  This signal is useful for driving an oscilloscope or spectrum analyzer to do additional analysis on the jitter. You can view the same jitter waveform on the waveform monitor using the Jitter display mode.
- AUX OUT 1 / AUX OUT 2. Future capability.

Menus

This section contains a diagram for each instrument menu, starting with the major instrument modes. Refer to Table 2–1 for diagram page numbers. This table also lists page numbers of related information in the *Reference* section, beginning on page 3–1.

Table 2-1: Menu diagram and reference information locator

Button name	Menu	Diagram / info.	Reference info.
AUDIO	Audio menu	page 2-16	page 3-4
CLR MENU	- - - - - -	page 2-16	
CONFIG	Configuration menu	page 2-17	
CURSOR	Cursor menu	page 2-28	
DISPLAY	Display menu	page 2-31	
EYE	Eye menu	page 2-34	page 3-9
FREEZE	Freeze menu	page 2-35	page 3-11
GAIN	Gain menu	page 2-37	
GAMUT	Gamut menu	page 2-38	page 3-12
HELP	Help menu	page 2-41	
INPUT	Input menu	page 2-42	
LINE SEL	Line Select menu	page 2-43	page 3-15
MEASURE	Measure menu	page 2-45	page 3-16
MULTI	future capability	- - - - - -	
PICTURE	- - - - - -	page 2-47	
PRESET	Preset menu	page 2-48	
PRINT	future capability	- - - - - -	
STATUS	EDH Status menu	page 2-53	page 3-16
SWEEP	Sweep menu	page 2-54	page 3-19
VECTOR	Vector menu	page 2-56	page 3-21
WFM	Waveform menu	page 2-58	page 3-23

Using the Menu Diagrams

The menu diagrams contain the following components (see Figure 2–3):

1. A partial illustration of the instrument front panel, highlighting the front-panel button you select to enter the displayed menu.
2. Menu names, shown in bold text.
3. Unique submenus, connected with a dashed line. These soft keys only appear when a certain mode, such as Arrowhead, is selected.
4. A list of menu soft keys that are displayed on the touch screen. Touching one of these soft keys either activates a feature or enters a submenu.
5. Submenu names, shown in bold text.
6. Submenu soft keys.
7. A vertical line (|) separates two options on a toggle soft key. A slash (/) may also be used to separate multiple options from which you can select.
8. Variables, usually controlled by the general purpose knob, are shown as ellipses or generic names inside angle brackets <...> .

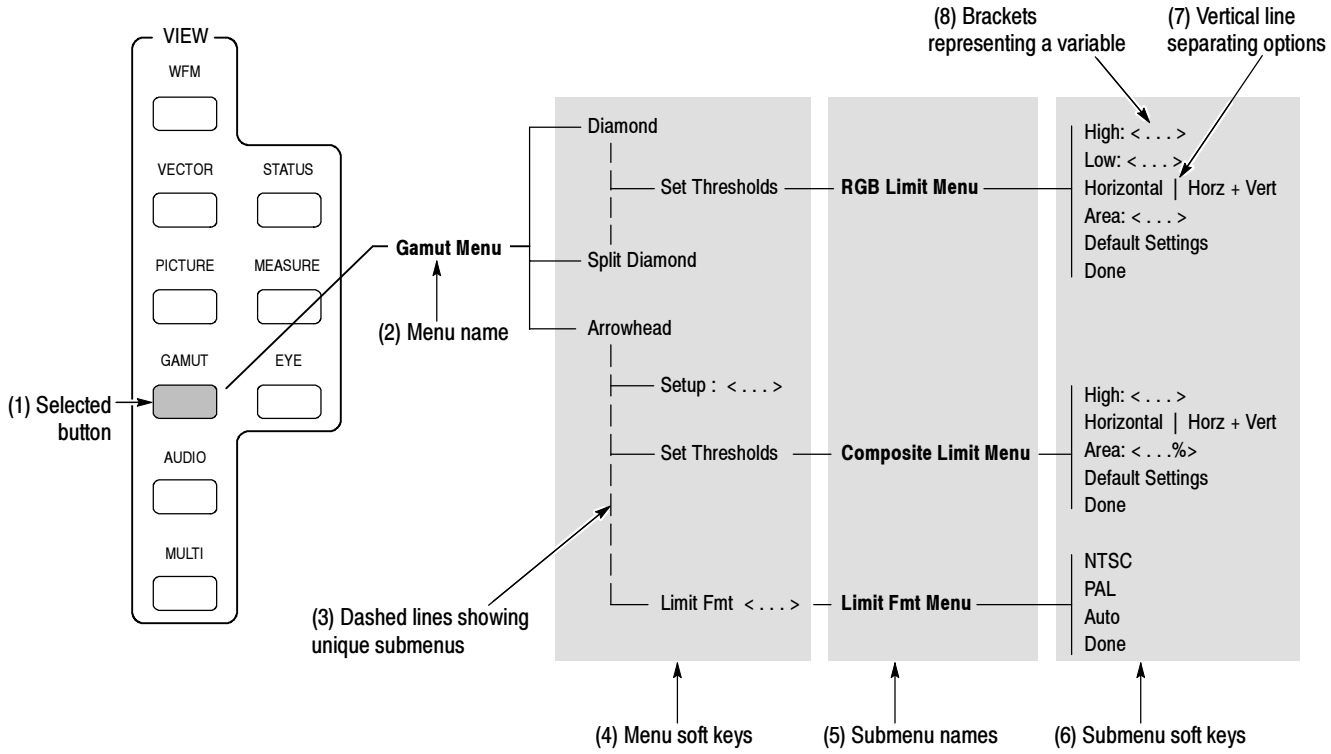


Figure 2-3: Example menu diagram showing components of the diagram

Audio Mode

Pressing the AUDIO button displays the Audio Status screen. Audio mode has no menu; to enable the Audio Presence readout, use the Configuration menu (refer to page 2–17). For more information about Audio Status display, refer to page 3–4.

Clear Menu

The CLR MENU button (clear menu) does not have its own menu display. Pressing this button removes the menu from the screen, without affecting the signal display and knob assignment. Readouts and Thumbnail picture, if enabled, move down into the space that was vacated by the menu.

Configuration Menu

Pressing the CONFIG button opens the Configuration menu. In this menu, you can adjust most instrument parameters. (To adjust display parameters, see the *Display Menu* on page 2–31.)

The configuration parameters are grouped into functional areas (submenus). The current value is shown in yellow next to the parameter name.

While the Configuration menu is open, the on-screen alarm notifier option is disabled so you will not be interrupted while you are changing a setting.

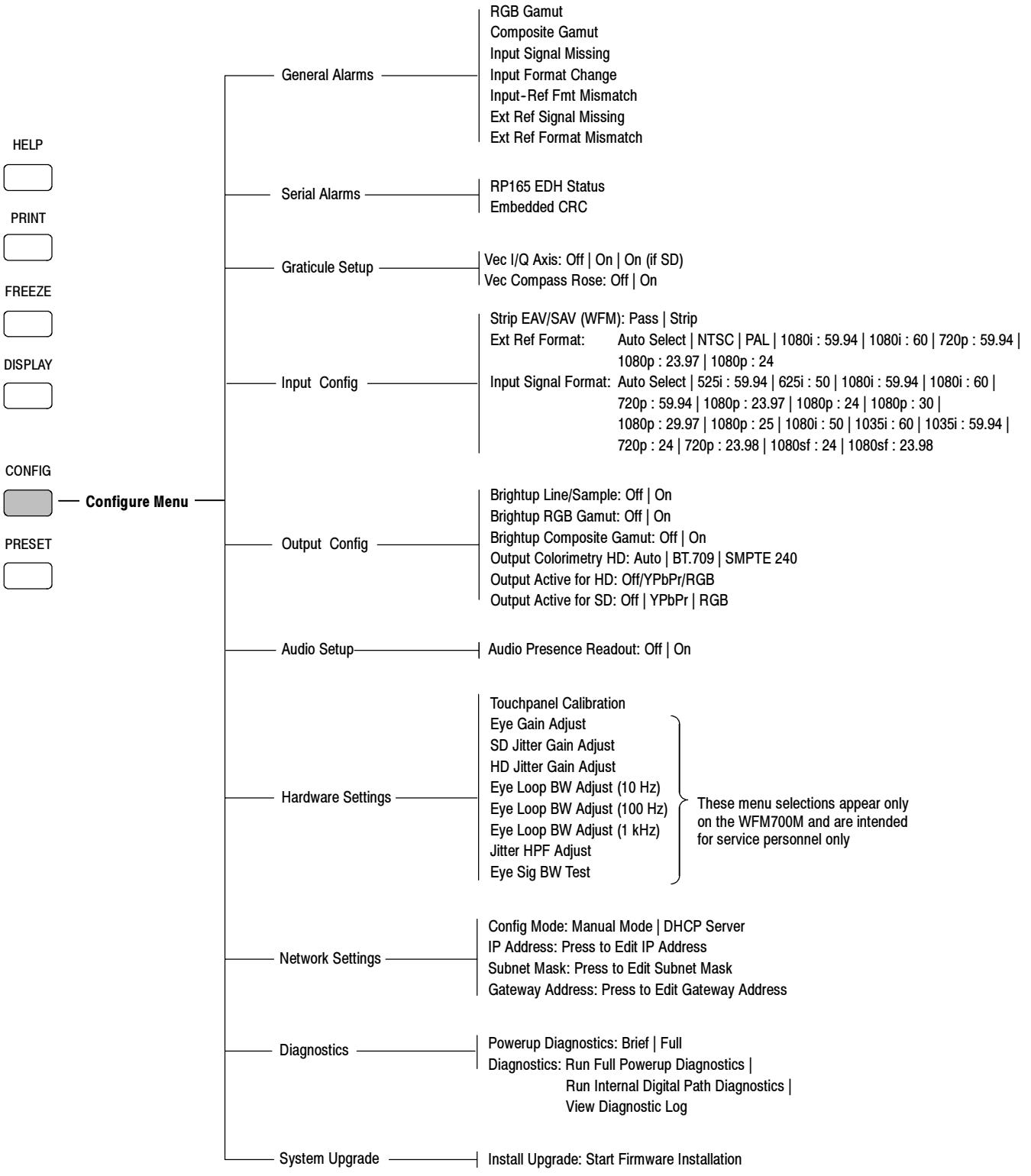


Figure 2-4: Configuration menu diagram

Configuring a Parameter

The top level Configuration menu contains submenus, shown in Figure 2–4. To adjust a parameter, use the submenu:

1. In the top level Configuration menu, highlight a submenu label by scrolling to the label with the general purpose knob or touching the label on the screen. For example, scroll to Graticule Setup and note that the label is highlighted.
2. Select the submenu by touching the Next Menu soft key or pressing the SELECT button.
3. In the submenu, modify the desired parameter setting. You can use mutually exclusive soft keys, numeric value menus, checkbox tables, or a command button, depending on which parameter you are modifying. Descriptions of these methods begin on page 2–18.

Mutually Exclusive Buttons

Some configuration parameters use a set of boxes containing all of the possible values or states (settings).

- The currently selected setting is highlighted.
- To change to another setting, touch the box containing that setting or press the SELECT button to cycle through all of the settings to the desired one.
- The readout updates when you change a setting.
- The submenu buttons remain displayed until you select another parameter name or exit the menu.

Numeric Value Menus

Some configuration parameters use a numeric value box.

- When you select such a parameter, the knob icon appears in the value box and the current parameter value is outlined.
- The part of the menu controlled by the general purpose knob and the knob icon are shown in bright blue.
- Use the general purpose knob to change the numeric value.

Checkbox Tables

The General Alarms and Serial Data Alarms configuration parameters use check box tables.

- You can check any alarm notification that you want to be active.
- You can select more than one alarm notification preference. The default is none selected.
- To select or deselect a preference, touch the box on the screen or press the SELECT button.

Command Buttons

If the configuration parameter that you select is a command button, it will open a command menu with instructions for you to follow. For example, System Upgrade displays a new screen with instructions on how to upgrade your firmware.

List Box

Some configuration parameters show a list of items that you can scroll through using the general purpose and select using the SELECT button. Depending on the length of the list, you may also be able to touch the desired item on the screen.

Exit

To exit the Configuration menu, press the CONFIG button again or press any major mode button.

Configure Menu Settings

This section describes the various instrument settings you can change using the Configure menu.

General Alarms

In the General Alarms menu, you can select which general error conditions you will monitor and how you will be notified in the event of an error. The top-level of the menu displays the current settings for each general alarm.

An “X” indicates that a condition is selected while an “O” indicates that the condition is not selected. An “X” in the left column indicates that the alarm condition will be displayed on-screen. An “X” in the right column indicates that a beep will sound when an alarm condition occurs. Touch the list of general alarms to change the settings of the alarms indicators.

Table 2–2 describes the available general alarms.

Table 2-2: General alarm descriptions

Alarm	Description
RGB gamut	Indicates whether RGB gamut violations have occurred. Refer to *Gamut Menu* on page 2-38 for information about setting RGB threshold limits.
Composite gamut	Indicates whether Composite gamut violations have occurred. Refer to *Gamut Menu* on page 2-38 for information about setting Composite threshold limits.
Input signal missing	Indicates whether the input signal is present or missing.
Input format change	Indicates whether a change in the format of the video signal has occurred.
Input-reference format mismatch	Indicates whether there is a format mismatch between the video input signal and the external reference signal. Refer to Table B-2 on page B-2 for a listing of the allowed references for the various video input formats.
External reference signal missing	Indicates whether the external reference signal is present or missing.
External reference format mismatch	Indicates whether the format of the external reference signal matches the Ext Ref Format setting in the Input Config submenu of the Configure menu. Refer to *Input Config* on page 2-23. *NOTE: Ensure that the video signal source and the WFM700 waveform monitor are locked to the same external reference signal.*

Possible Alarm Actions. For each monitored General Alarm or Serial Alarm condition, you can select one or more notification methods:

- On-screen. An icon appears at the top of the current display. This alarm preference is disabled when the Configuration menu is active.
- Beep. The instrument makes an audible alarm.

***NOTE**. If you do not select a notification method for an error, you will not be notified if that error occurs. However, you can view any current error conditions using the Alarm Status display. Refer to* Alarm Status *on page 3–17 for more information.*

Serial Alarms

In the Serial Alarms menu, you can select which serial error conditions you will monitor and how you will be notified in the event of an error (refer to *Possible Alarm Actions* above for more information).

An "X" indicates that a condition is selected while an "O" indicates that the condition is not selected. An "X" in the left column indicates that the alarm condition will be displayed on-screen. An "X" in the right column indicates that a beep will sound when an alarm condition occurs. Touch the list of general alarms to change the settings of the alarms indicators.

Table 2–3 describes the available serial alarms.

Table 2-3: Serial alarm descriptions

Alarm	Description
RP165 EDH Status	Indicates whether the EDH is present or missing in the SD video signal. *NOTE: EDH is always present in HD video signals, so this alarm is not active for HD signals.*
Embedded CRC	Indicates whether the embedded CRC is valid or invalid.

Graticule Setup

In the Graticule Setup menu, you can define the following parameters:

Vec I/Q Axis. Adds graticule lines in Vector mode to show the I axis and the Q axis.
Choices = Off, On, On (if SD)
Default = Off

Vec Compass Rose. Adds the compass rose graticule for component signals in the Vector mode display. (The compass rose graticule is always displayed for composite signals.)
Choices = Off, On
Default = Off

***NOTE**. The component vector graticule is provided to allow comparison with other equipment with similar displays. For a more accurate representation of hue shift, use the composite vector representation.*

Input Config

You can set the following input characteristics:

Strip EAV / SAV (WFM). This determines whether the EAV, SAV, and ancillary data such as audio are visible in the YPbPr Waveform display. Since these data values are not bandlimited, they usually ring when displayed through the video waveform filters. The EAV, SAV, and Anc portions of the signal are always stripped in other waveform color spaces, vector, and gamut modes. The EAV, SAV, and Anc portions of the signal are always displayed in the data modes.
Choices = Pass, Strip
Default = Strip

External Reference Format. Specifies the expected format of the video signal on the EXT REF IN connector. If you set the external reference signal format to Auto Select, the instrument will automatically select the external reference signal format based on the video input signal. When you select a specific signal format from the choices listed below, the instrument will expect the external reference signal format to match your selection.

You can set the Ext Ref Format Mismatch alarm to detect a mismatch between the expected signal format and the actual signal format. Refer to *General Alarms* on page 2–20.

Choices = Auto Select, NTSC, PAL, 1080i : 59.94, 1080i : 60, 720p : 59.94, 1080p : 23.97, 1080p : 24
Default = Auto Select

Input Signal Format. Specifies the expected format of the video signal on the INPUT A or INPUT B connector. If you set the input signal format to Auto Select, the instrument will automatically select the input signal format based on the video input signal. When you select a specific signal format from the choices listed below, the instrument will expect the input signal format to match your selection.

You can set the Input Format Mismatch alarm to detect a mismatch between the expected signal format and the actual signal format. Refer to *General Alarms* on page 2–20.

Choices = Auto Select, 525i : 59.94, 625i : 50, 1080i : 59.94, 1080i : 60, 720p : 59.94, 1080p : 23.97, 1080p : 24, 1080p : 30, 1080p : 29.97, 1080p : 25, 1080i : 50, 1035i : 60, 1035i : 59.94, 720p : 24, 720p : 23.98, 1080sf : 24, 1080sf : 23.98
Default = Auto Select

Output Config

You can set the following output characteristics:

Brightup Line / Sample. Enables or disables the bright-up on the pix monitor outputs at the selected line and sample. These bright-ups are always enabled on the thumbnail display and in Picture mode.
Choices = On, Off
Default = On

Brightup RGB Gamut. Enables or disables a bright-up on the thumbnail display, in Picture mode, and on the pix monitor outputs in areas that are out of gamut as defined by the RGB thresholds. To set these thresholds, press the GAMUT button and touch the Diamond soft key.
Choices = On, Off
Default = On

Brightup Composite Gamut. Enables or disables a bright-up on the thumbnail display, in Picture mode, and on the pix monitor outputs in the pix monitor outputs on areas that are out of gamut as defined by the composite thresholds. To set these thresholds, press the GAMUT button and touch the Arrowhead soft key.
Choices = On, Off
Default = On

Output Colorimetry HD. Sets the matrix used to convert from YPbPr to RGB on the Pix monitor outputs while in HD mode.
Choices = Auto, BT.709, SMPTE240
Default = Auto (automatically selects the colorimetry of the output signal based on the input format)

Output Active for HD. Sets the mode for the analog pix monitor outputs while in HD mode.
Choices = Off, YPbPr, RGB
Default = YPbPr

Output Active for SD. Sets the mode for the analog pix monitor outputs while in SD mode.
Choices = Off, YPbPr, RGB
Default = YPbPr

Audio Setup

You can set the following audio setup characteristic:

Audio Presence Readout. Turns on or off the audio readout at the bottom of the screen.
Choices = Off, On

Hardware Settings

You can select the following hardware settings:

Touchpanel Calibration. Select the Touchpanel Calibration submenu, and then touch Start Touchpanel Calibration. Follow the on-screen instructions to adjust the alignment between the place that a touch occurs and the place that the waveform monitor registers that touch.

Adjustments and Test (WFM700M Only). There are seven hardware adjustments and one performance test that can be enabled using this menu. These menu selections enable special instrument setups, which allow service personnel using specific test equipment to adjust internally stored calibration constants affecting WFM700M measurement accuracy. See Figure 2–4 on page 2–17.

CAUTION. *To prevent a misadjustment of the instrument, do not use the adjustment menu selections in the Hardware Settings submenu without referring to the* WFM700HD, WFM700A, & WFM700M Waveform Monitors Service Manual *(Tektronix, Inc. part number 071-0915-XX).*

Network Settings

Select Network Settings to enter the Network Setup menu. In this menu, the current settings for the network parameters are displayed in yellow text. These settings determine how the waveform monitor interacts with your network via the Ethernet interface. The values you enter will be specific to your network. If you have any questions, contact your Network Administrator for assistance.

You can select any of the following submenus to change the various network parameters:

Config Mode. Set the Config Mode to Manual if you want to assign an IP address to the waveform monitor.
Choices = Manual Mode, DHCP Server

IP Address. You must set the Config. Mode setting to Manual Mode before you can set the IP address. You cannot set the IP address if the Config. Mode is set to DHCP Server.

To set the IP address of the waveform monitor, touch the Press to Edit IP Address soft key. This displays a screen where you can set the IP address using the following steps:

1. Touch the soft key that displays the IP address and reads: Select+Knob or Softkeys. The first digit of the IP address is selected (highlighted).
   - To select a different digit, press the SELECT button, touch the Move Right soft key, or touch the Move Left soft key.
   - To change the value of the selected digit, turn the general purpose knob, touch the Increase Value soft key, or touch the Decrease Value soft key.
2. To save your changes, touch the Save IP Address soft key. The changes you made will not be saved unless you touch this key.

Subnet Mask. You must set the Config. Mode setting to Manual Mode before you can set the subnet mask. You cannot set the subnet mask if the Config. Mode is set to DHCP Server.

To set the subnet mask of the waveform monitor, touch the Press to Edit Subnet Mask soft key. This displays a screen where you can set the subnet mask using the following steps:

1. Touch the soft key that displays the subnet mask and reads: Select+Knob or Softkeys.
2. To change the subnet mask, press the SELECT button, turn the general purpose knob, touch the Increase Mask soft key, or touch the Decrease Mask soft key.
3. To save your changes, touch the Save Subnet Mask soft key. The changes you made will not be saved unless you touch this key.

Gateway Address. To change the gateway address, touch the Press to Edit Gateway Address soft key. This displays a screen where you can set the IP address using the following steps:

1. Touch the soft key that displays the gateway address and reads: Select+Knob or Softkeys. The first digit of the gateway address is selected (highlighted).
   - To select a different digit, press the SELECT button, touch the Move Right soft key, or touch the Move Left soft key.
   - To change the value of the selected digit, turn the general purpose knob, touch the Increase Value soft key, or touch the Decrease Value soft key.
2. To save your changes, touch the Save Gateway Address soft key. The changes you made will not be saved unless you touch this key.

Diagnostics

You can set the following diagnostics settings:

Powerup Diagnostics. In this menu, you can designate which diagnostics run at power on.
Choices = Full, Brief

Diagnostics. In this menu, you can run diagnostics or display a log of the last diagnostics that were run. For more details, refer to *Diagnostics* on page 3–8.
Choices = Run Full Powerup Diagnostics, Run Internal Digital Path Diagnostics, View Diagnostic Log

CAUTION. *Running the Internal Digital Path Diagnostics sets the instrument into a special diagnostics configuration mode. After running this diagnostic, you must reboot the instrument to return to normal operation.*

System Upgrade

In this menu, you can choose to install a firmware upgrade or a software option. Follow the instructions in the new window. Firmware upgrade instructions are located in *Appendix E*.

New software options and updated firmware can become available periodically. These may be found at the Tektronix, Inc. website: www.tektronix.com.

Cursor Menu

Pressing the CURSOR button enables the cursors (if the instrument is in a mode that supports cursors) and displays the Cursor menu, shown in Figure 2–5.

For Waveform, Eye, or Jitter, you can use voltage cursors, time cursors, or both voltage and time cursors. The cursor 1 and 2 settings, and the difference between the two, are shown in the readout in the upper right part of the screen. Time cursor settings are displayed below the voltage cursor settings. The absolute measurement of each cursor is shown on the soft key.

***NOTE**. The V+T Control soft key toggles the general purpose knob between controlling the voltage cursors and the time cursors when both cursor types are enabled.*

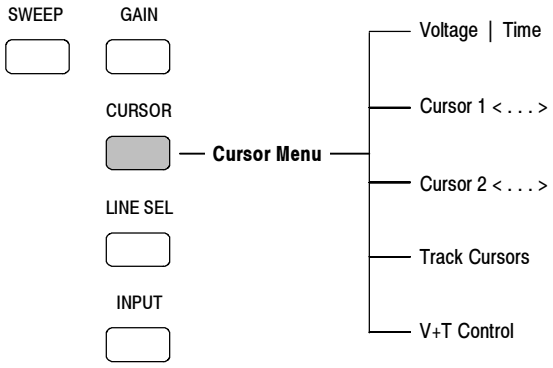


Figure 2- 5: Cursor menu diagram

Waveform Cursors

The cursors appear as dashed lines, oriented vertically for time measurements and horizontally for amplitude measurements. Both cursor 1 and cursor 2 use dashed lines; cursor 1 has big line segments and cursor 2 has smaller line segments.

***NOTE**. When switching between normal sweep and MAG mode, the time cursors may change their horizontal position slightly. This is due to the increased horizontal resolution provided in MAG mode.*

Do not use the time cursors to measure time between components in a paraded waveform display. Parade mode is a special display format that represents all displayed components in a single screen, irrespective of the time relationship between components.

Moving the Cursors

Selected (active) cursors are red and inactive cursors are blue.

To move the active cursor:

1. Touch the Voltage/Time soft key to select the cursor type: voltage, time, or both voltage and time. If you select both, use the V+T Control soft key to toggle between adjusting voltage cursors and adjusting time cursors.
2. Touch the corresponding soft key to select the active cursor: Cursor 1, Cursor 2, or Track Cursors. (Use Track Cursors if you want to adjust the position of either the voltage or the time cursors as a pair.) If Track Cursors is not selected, you can use the SELECT button to toggle between Cursor 1 and Cursor 2 as the active cursor.
3. Turn the general purpose knob to move the active cursor(s). The corresponding readouts and soft key displays update as you move the cursors.
4. Press the SELECT button to toggle between active cursors.

***NOTE**. Mag or Gain settings other than X1 may cause the cursors to be off screen.*

Readouts

The cursor readouts appear on the right side of the screen. Two sets of readouts show the cursor 1 value, the cursor 2 value, and the difference between the two, for both voltage cursors (in mV or IRE) and time cursors (in μs). Voltage cursor readouts appear in IRE only when in composite mode.

Cursor readouts are updated as you move the cursors.

Gain and Sweep with Cursors

At times the cursors may be off the screen when you select Mag or Gain settings other than X1. The readout of delta between the cursors is accurate even though one or both are off screen. You can make much more accurate measurements by using cursors in high gain or magnification modes. The all-digital design of the waveform monitor enables this accuracy because the ‘value’ of each pixel on the screen is smaller in higher Gain and Mag settings.

Cursor Menu Selections

You can select the following parameters:

Cursor Type. Selects the desired cursor function.
Choices = Voltage, Time, Voltage + Time

Cursor 1 or Cursor 2. Assigns the general purpose knob to move Cursor 1 or Cursor 2.

Track Cursors. Assigns the general purpose knob to move both cursors as a unit.

Exit

To remove the Cursor menu but leave the cursors enabled, press the CLR MENU button or another major mode button.

To turn off the cursors, press the CURSOR button once when the Cursor menu is displayed or twice when the Cursor menu is not displayed.

Display Menu

Pressing the DISPLAY button opens the Display menu, shown in Figure 2-6. In the Display menu, you can adjust display parameters through the Trace, Graticule, and Readout & Backlight submenus. You can enable the thumbnail picture or Sleep mode.

Touch the soft key (menu item) corresponding to the parameter that you want to adjust.

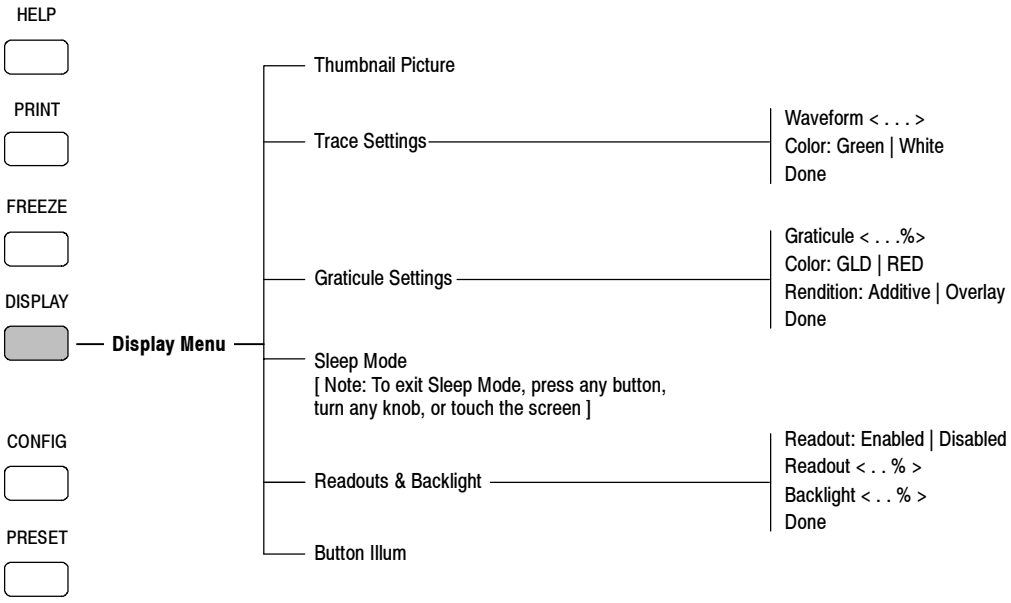


Figure 2-6: Display menu diagram

Thumbnail Picture

Enables a small video display in the lower right corner of the screen. Available in Waveform, Vector, Data, and Gamut display modes. If Line Select is enabled and the selected line is in an active picture region, that line appears as a yellow horizontal line in the thumbnail picture.

If Sample Select is also enabled, the position of the selected sample will be shown by the intersection of horizontal and vertical yellow lines.

***NOTE**. Due to the number of pixels used to represent the thumbnail picture, not all of the video content can be accurately reproduced by this display. The thumbnail picture offers a means of visually identifying the content present at the active input and is not designed to replace the rear-panel PIX MON outputs, which contain all of the video content.*

Trace Settings

You can make the following trace settings:

Waveform. Assigns the general purpose knob to adjust waveform intensity.
Range = -99 to +40
Default = nominal (0)

Color. Toggles the waveform color. White is preferred in some applications. However, green has greater dynamic range because the trace goes to white for the highest intensity signals.
Choices = Green, White
Default = White

Done. Returns to the Display menu.

Graticule Settings

You can make the following graticule settings:

Graticule. Assigns the general purpose knob to adjust graticule intensity.
Range = 0% to 100%
Default = 50%

Graticule Color. Toggles the graticule color.
Choices = GLD (gold), RED
Default = GLD

Rendition. Toggles the graticule rendition. Additive adds the waveform and graticule points together, causing the points of intersection to appear brighter (unless the intensity is already at maximum). Overlay causes the graticule to be drawn on top of the waveform.
Choices = Additive, Overlay
Default = Additive

Done. Returns to the Display menu.

Sleep Mode

Turns the LCD backlight off or nearly off. The Display button LED blinks while Sleep mode is active, so you know that the instrument is still functional. To return the backlight to the previous state, press any front-panel button, turn any front-panel knob, or touch the touch screen.

Readouts & Backlight

You can make the following readout settings:

Readout Enabled. Enables or disables the readout.
Default = enabled

Readout. Assigns the general purpose knob to adjust readout intensity.
Range = 0% to 100%
Default = 50%

Backlight. Assigns the general purpose knob to adjust LCD backlight intensity.
Range = 5% to 100%
Default = 100%

Done. Returns to the Display menu.

Button Illumination

Enables or disables a constant 10% illumination of the front-panel button LEDs. This selection is useful when the instrument is being used in a darkened room.

Under normal operation, front-panel LEDs are fully illuminated only when the associated button is selected. Use this menu selection to illuminate all of the LEDs at a 10% level. The LEDs will still illuminate fully when the associated button is selected.
Default = disabled

Eye Menu

To access the Eye menu and measurements, you must have a WFM700M or a unit with a WFM7M installed.

Pressing the EYE button enters the Eye mode and displays the Eye menu as shown in Figure 2–7. You can select Eye or Jitter display. When returning to Eye mode, the last selected display (Eye or Jitter) is active. For more information about the Eye mode, refer to *Eye Mode* on page 3–9.

***NOTE**. Gamut error detection is disabled in Eye and Jitter display modes.*

Eye Measurements

For HD signals, you can set the Eye display mode to 3 Eye or 20 Eye.
For SD signals, you can set it to 3 Eye or 10 Eye.
Default = 3 Eye

You can set the clock recovery bandwidth to 10 Hz, 100 Hz, or 1 kHz. When returning to Eye mode, the last selected value is restored.
Default = 10 Hz

Jitter Measurements

You can set the high-pass filter bandwidth to 10 Hz, 1 kHz, 10 kHz, or 100 kHz. When returning to Jitter mode, the last selected value is restored.

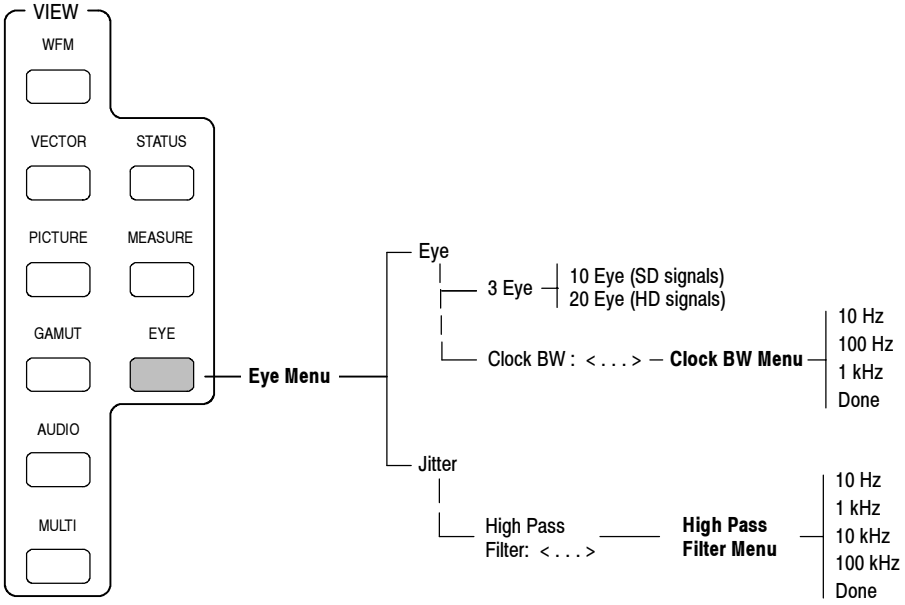


Figure 2-7: Eye menu diagram

Freeze Menu

Pressing the FREEZE button opens the Freeze menu, shown in Figure 2–8. Freeze mode lets you capture a signal.

***NOTE**. The Freeze function in Measure mode only freezes the data waveform (left side of screen). The data list (right side of screen) continues to update in response to the incoming serial stream.*

If you have frozen a waveform (even if it is not displayed), the live waveform will have its pixel density reduced. This is because the frozen waveform is using a portion of the display memory. Delete the captured waveform to regain full waveform density.

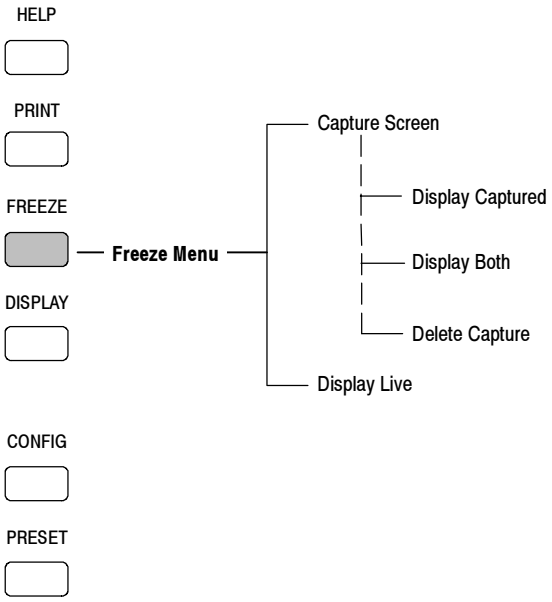


Figure 2-8: Freeze menu diagram

Capture Screen

Captures the active waveform as a “frozen” signal. When a capture is in the buffer, a freeze icon appears on the display and additional menu soft keys appear. The signal is held in the capture buffer until you delete it or touch the Capture Screen soft key to replace it with a new waveform.

Display Captured, Display Live, and Display Both

These three soft keys are mutually exclusive; only one can be selected at a time. If the capture buffer is empty, Display Live is automatically selected. The other two soft keys are displayed only if there is a capture in the buffer.

Display Captured. This soft key displays the contents of the capture buffer instead of the active signal. The contents cannot be rescaled or repositioned.

Display Live. This soft key displays the active waveform. You can reposition the live signal using the horizontal and vertical position controls or apply various Gain or Sweep settings.

Display Both. This soft key displays both the contents of the capture buffer and the live waveform. The captured waveform appears in a contrasting color for ease of comparison with the live waveform.

Delete Capture

When you touch this soft key, the contents of the capture buffer are deleted. The Freeze icon no longer appears on the display.

Exit

To exit the Freeze mode, press any major mode button or press the CLR MENU button. If the selection is Display Captured, the instrument will automatically change to Display Both mode upon exiting Freeze mode.

Gain Menu

Pressing the GAIN button displays the Gain menu, shown in Figure 2–9.

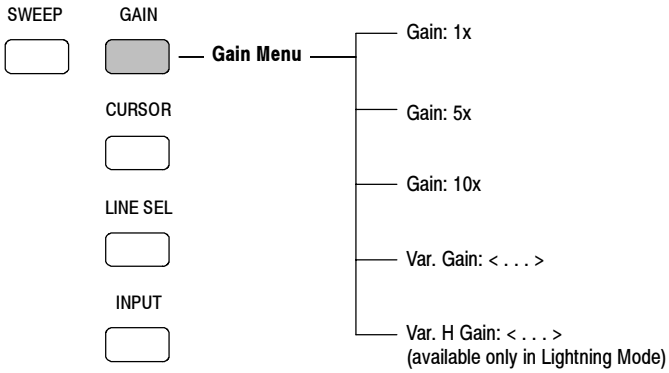


Figure 2-9: Gain menu diagram

To change the vertical gain, touch one of the soft keys (1x, 5x, or 10x). You can also select Variable Gain or Variable Horizontal Gain (in Lightning mode only). In variable gain modes, you can use the general purpose knob to set the gain. Turn left to decrease and right to increase the gain. The current gain setting is displayed on the soft key and in the readout.

The variable gain modes work together with the fixed settings. In this sense, the variable gain is a factor that applies to the fixed gain setting. For example, touch the 1x soft key, touch the Variable Gain soft key, and then turn the general purpose knob to select a setting of 1.50x. The vertical gain is 1.5. Now touch the 5x soft key. The gain is 7.50x (the product of 1.50 and 5).

***NOTE**. The variable gain range is from 0.25x to 14x. You cannot select values outside this range.*

Gain is only active in Waveform, Vector, Lightning, Eye, and Jitter modes.

In fixed gain settings, the vertical graticule appears with a calibrated scale. In Waveform mode, Jitter mode, and Eye mode variable gain, the graticule appears without a scale. In Vector and Lightning modes, the targets move when fixed gain settings are changed, but do not move as variable gain is adjusted.

The current gain setting is displayed in the lower left corner of the screen. The gain setting is displayed in yellow if variable gain is active.

Gamut Menu

Press the GAMUT button to enter the Gamut mode and display the Gamut menu shown in Figure 2–10.

Displays

In the Gamut menu, you can select Diamond, Split Diamond, or Arrowhead displays. For information about using these displays, refer to *Gamut Measurements* on page 3–12.

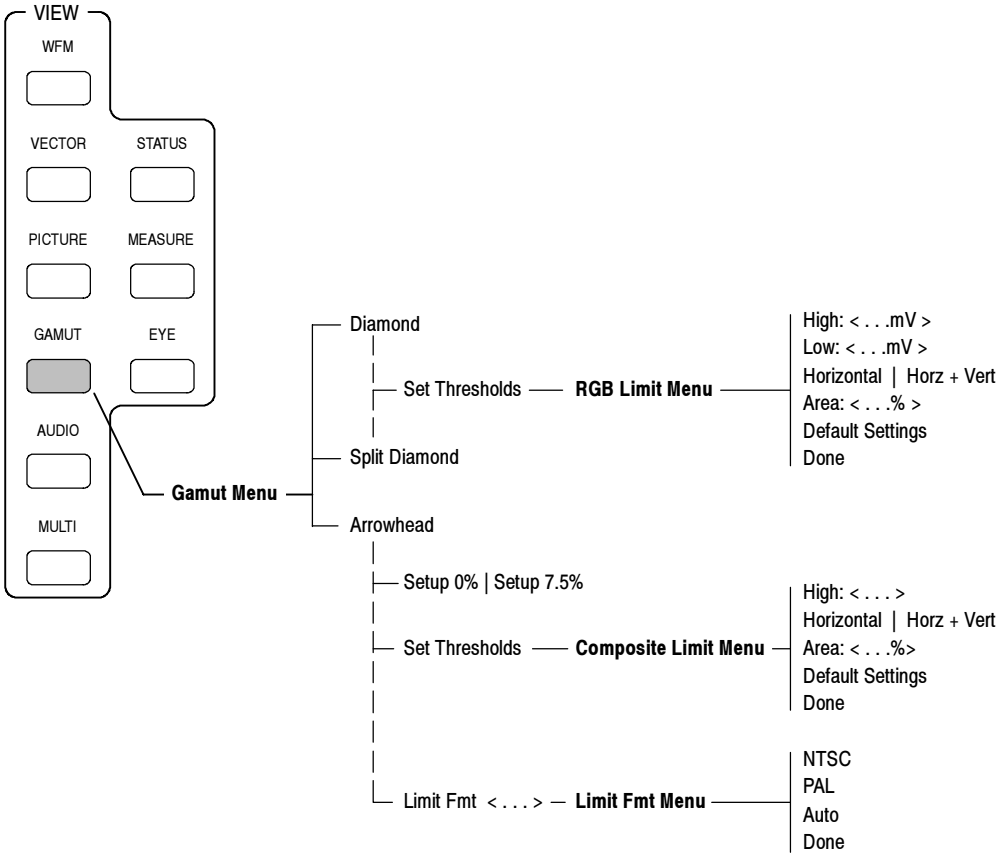


Figure 2-10: Gamut menu diagram

Set Thresholds

Touch the Set Thresholds soft key, and then touch a soft key to choose the parameter you want to set. Touching the High, Low (if available), and Area soft keys assigns the general purpose knob to control the variable value. Variable ranges are shown in Table 2–4.

***NOTE**. When the Arrowhead display is selected, changing the thresholds in the NTSC limit format also changes the thresholds in the PAL limit format.*

High. Defines the threshold above which signals will be considered gamut errors.

Low. Defines the threshold below which signals will be considered gamut errors.

Horizontal | Horizontal + Vert. Touching the Horizontal | Horizontal + Vert soft key toggles between filtering in the horizontal dimension and filtering in both the horizontal and the vertical dimensions. This filtering reduces the overshoot from the conversion between color spaces before comparison with the selected gamut thresholds.

Area. Defines the percentage of total pixels in the image that you will allow to be out of gamut without reporting that the signal has a gamut error. The Area settings do not affect bright-up in the picture display.

Table 2-4: Variable ranges for High, Low, and Area thresholds

Mode	Minimum	Maximum	Default
NTSC	90 IRE	135 IRE	120 IRE
PAL	630 mV	930 mV	917 mV
Area	0%	10%	0%
High	+630 mV	+756 mV	+721 mV
Low	-50 mV	+35 mV	-21 mV

Default Settings. Touching the Default Settings soft key restores the default gamut limits for the current monitoring mode.

Setup (Arrowhead Only)

When you select Arrowhead, the Setup soft key is displayed. Touch this soft key to toggle between setup levels of 0% or 7.5%. When set to 7.5%, the composite waveform representation has 7.5 IRE of setup. When you change the setup setting between 0% and 7.5% in any menu, the setup setting in all other display-mode menus changes to match the current setting.
Default = 7.5%.

Limit Format (Arrowhead Only)

When you select Arrowhead, the Limit Format soft key is displayed. Touch this soft key to enter the submenu and select which format (NTSC, PAL, or Auto) you want to use as the limiting format for gamut errors. For example, you may be working with an HD video signal, but if one of the target viewing formats is NTSC, select NTSC to limit the color space to the NTSC format.

If you select Auto, the instrument assigns gamut limits that are appropriate for the current input video format.

Help Menu

Press the HELP button to enter the Help menu, with access to the following:

Context-Sensitive Help

When the instrument is in a major mode, such as Waveform or Vector, pressing the HELP button displays help about that mode.

Button Finder

Touch the Button Finder soft key to illuminate all of the front-panel buttons for viewing in low-light conditions. To turn the button finder off, touch the Button Finder soft key again or press any button.

System Information

Touch the System Info soft key to view the following system information:

Software Version. Displays the instrument software version, which is automatically updated if you upgrade the instrument software.

Installed Options. Displays the modules you have installed in the waveform monitor. This information updates automatically when you install a new module.

Network Parameters. Displays the network parameters such as the Ethernet and IP addresses. To change these settings, use the Configuration menu (shown on page 2-17).

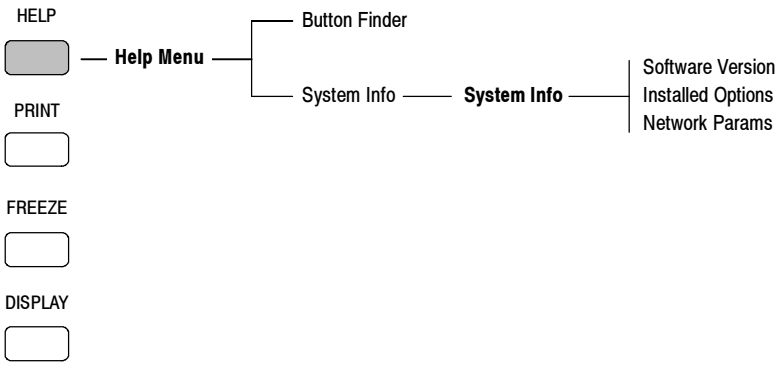


Figure 2-11: Help menu diagram

Input Menu

Press the INPUT button to enter the Input mode and display the Input menu shown in Figure 2–12. For a list of supported input signal formats, refer to Table B–1 on page B–1. For a list of supported reference signal formats, refer to Table B–2 on page B–2.

Selecting the Active Input

In the Input menu, you can select the active input from four possible inputs: input A and B for each installed input module, with up to two modules installed. Soft keys appear only for modules that are installed.

The inputs are labeled #1A, #1B, #2A, and #2B on the soft keys. The soft key labels for each input module also identify the type of module installed in that slot (WFM7A, WFM7HD, or WFM7M).

Selecting the Reference Mode

You can select which reference the instrument will use: Internal or External.

Internal. Selects the active signal as the reference.

External. Selects the signal on the external reference input as the reference.

***NOTE**. The waveform monitor does not utilize the SMPTE 318M 10 Field Sequence flag. This causes inconsistent operation for combinations of input and reference format whose frame rates are not related by an integer multiplier. The inconsistent operation causes multiple possible timing orientations to be shown on the Waveform. The display is similar to that shown when a timing offset is present. The number of possible waveform orientations is related to the ratio of the input and reference frame rates.*

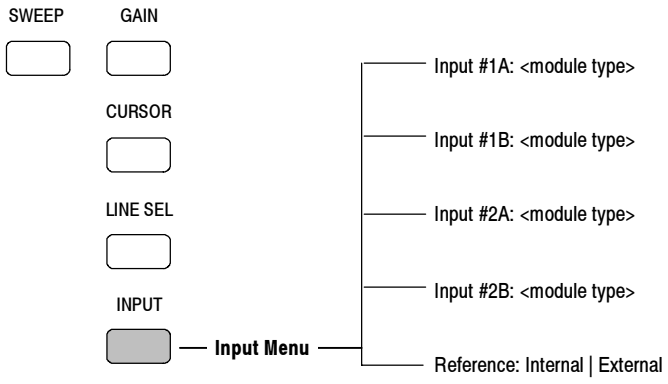


Figure 2- 12: Input menu diagram

Line Select Menu

Pressing the LINE SEL button enables line select (if the instrument is in an operating mode that supports line select) and sample select (useful in Data mode only). Operating modes that support line select are: Waveform, Vector, Gamut, Jitter, Eye, and Data. The Line Select menu is shown in Figure 2–13.

You can also enable line select by pressing the MEASURE button and touching the Data Display soft key. The selected line is highlighted in Picture mode and in the thumbnail picture. The external picture monitor signals also contain a bright-up, which is enabled in the Config menu.

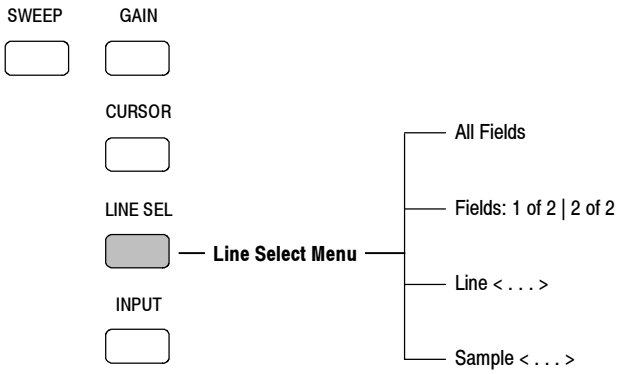


Figure 2-13: Line Select menu diagram

Selecting the Line or Sample

Touch either the Line or the Sample soft key to select which item you can change with the general purpose knob.

All Fields. Toggles the display between All Fields and Field: 1 of 2 / 2 of 2.

Field. Toggles the Field display between the first and second video fields. This selection is not available for progressive input formats or when All Fields is selected.
Choices = 1 of 2, or 2 of 2
Default = 1 of 2

Line. Assigns the general purpose knob to select the line. Press the SELECT button to toggle the general purpose knob assignment between Line and Sample.
Range = from line 1 to the maximum line number for the selected format.
Default = Line 1

Sample. (The sample select function is useful in Data mode only.) Assigns the general purpose knob to select the sample. Press the SELECT button to toggle the general purpose knob assignment between Sample and Line.
Range = from sample 1 to the maximum sample number for the selected format.

Exiting Line Select

To exit the Line Select menu and leave Line Select mode enabled, press the CLR MENU button or any major mode button. The line select indicator remains in the upper right corner of the screen, showing you which line or sample is selected. If you use the CLR MENU button, readouts, if present, will move down to the bottom of the screen.

To disable and exit the Line Select mode, press the LINE SELECT button again.

Measure Menu

To access the Measure menu and Data Display mode, you must have a WFM700M or a unit with a WFM7M installed.

Pressing the MEASURE button enters the Measure mode and displays the Measure menu, shown in Figure 2-14. In this menu, you can access the Data Display mode. For more information about using the Data Display mode, refer to *Data Display* on page 3-6.

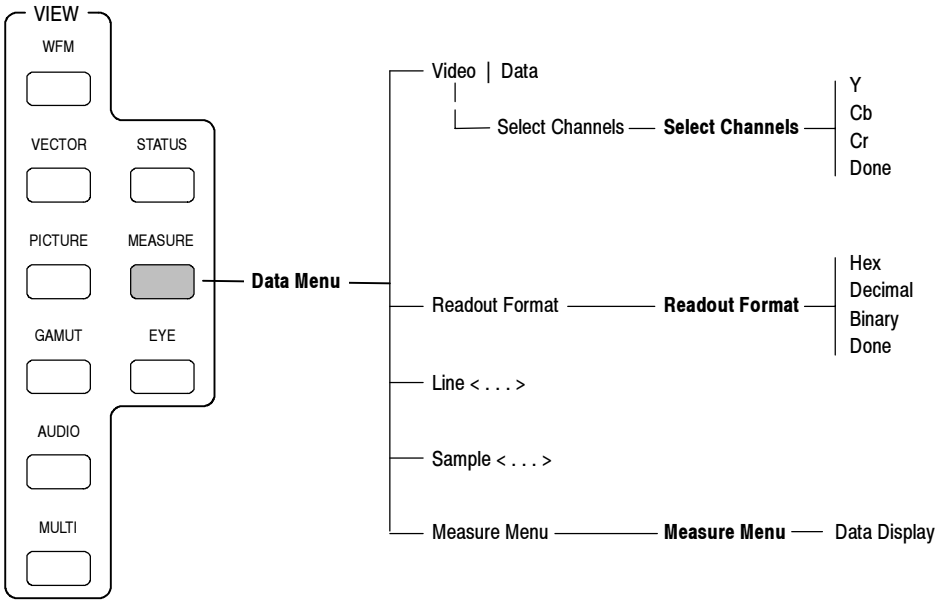


Figure 2-14: Measure menu diagram

Data Display

You can select the following parameters in the Data menu:

Video / Data. Touch the Video / Data soft key to toggle between video display and a data display.
Default = Video

- Video mode shows the data like the video YPbPr display in waveform mode, but without interpolation. The Y, Cb, and Cr traces are offset vertically to separate them, but are aligned temporally.
- Data mode for SD shows the data in the same sequence as it occurs in the serial domain. You see a sample of Y, then of Cb, then of Y' (Y prime), and then of Cr. Then the sequence repeats. The Y sample is the co-sited sample, and the Y' sample is the isolated luma sample.
- Data mode for HD splits the serial into a Y channel and a multiplexed Cb/Cr channel. The intent is to show the data in the same orientation as it occurs in the serial domain, even though it is displayed as 8 or 10 bit values.

***NOTE**. Selecting Freeze in Data Display mode freezes only the waveform portion (left side of screen) of the data display. The data list continues to update in response to input signal changes, if any.*

Select Channels (Video Only). This soft key appears only when Video is selected (highlighted in the Video / Data soft key). Pressing this key displays a set of soft keys that lets you turn off individual components of the display. At least one component must be displayed at all times.

Readout Format. Opens the Readout Format menu; touch a soft key to choose the base in which to view the data display.
Choices = Hex, Decimal, Binary
Default = Hex

Line. Assigns the general purpose knob to control the line and field number.
Range = from field 1, line 1 to the maximum field and line in the current input signal format.

Sample. Assigns the general purpose knob to control the sample number.
Range = as appropriate for the selected input signal format.

Measure Menu. Exits the Data Display mode and returns to the main Measure menu display. This function is not yet implemented. Press the Data Display soft key to return to the Data Display mode.

Picture Mode

Pressing the PICTURE button displays a full screen representation of the video present at the selected input. The Picture mode has no menu. To enable a thumbnail picture that appears in other modes, go to the Display menu (see page 2–31).

***NOTE**. Due to the number of pixels in the LCD display of the waveform monitor, not all of the video content (particularly in HD formats) can be reproduced with 100% accuracy by this display module. The picture display offers a means of visually identifying the content present at the active input and is not designed to replace the rear-panel PIX MON outputs, which contain all of the video content.*

Preset Menu

The Preset menu allows you to store and recall instrument configuration settings. There are 42 user-programmable presets available in addition to the Factory preset. You can designate up to four presets as shortcuts. To help you remember the presets you have created, you can assign names to the presets using up to eight characters.

Pressing the PRESET button displays page 1 of the Preset menu. Page 1 of the Preset menu allows you to load one of four presets you have previously setup as shortcuts. You can also restore the instrument to its configuration state prior to your loading of a preset.

Use page 2 of the Preset menu to save, remove, and rename presets and to restore the instrument to the factory-default configuration. To display page 2 of the Preset menu, touch the More soft key. The Preset menu is shown in Figure 2–15.

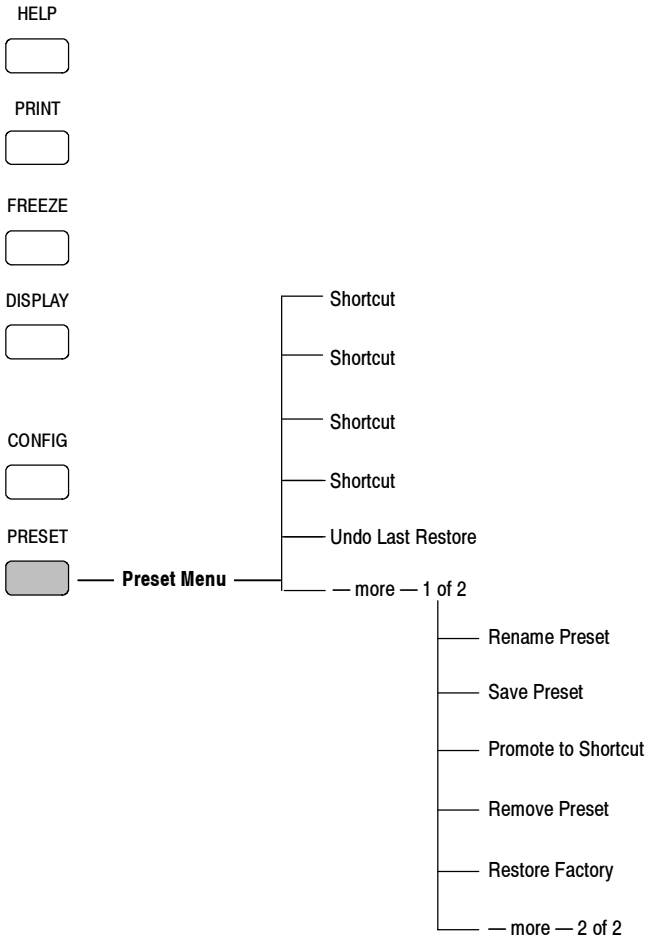


Figure 2- 15: Preset menu diagram

Shortcut Touch one of the Shortcut soft keys on page 1 of the Preset menu to load one of the four presets that you have previously setup as a shortcut. If the shortcut is empty, the instrument displays a message and will not load the shortcut. To store a preset as a shortcut, use the Promote to Shortcut soft key on page 2 of the Preset menu.

Undo Last Preset After you load a preset, the Undo Last Preset soft key appears on page 1 of the Preset menu. Touch this soft key to return the instrument configuration to the state it was in prior to loading the last preset.

More <x> of 2 This soft key appears on both pages of the Preset menu. Touch this soft key to toggle between the two menu pages. 1 of 2 or 2 of 2 appears on the soft key to indicate which menu page you are viewing.

Load State The Load State prompt appears in a box in the upper right corner of the screen when you first open page 2 of the Preset menu. When this prompt is displayed, you can touch any preset to load the instrument settings stored in that preset.

The user-prompts displayed in the box change depending on the menu command you select on page 2 of the Preset menu. These prompts are displayed to help you use the Preset menu commands.

Rename Preset To rename a preset, first touch the Rename Preset soft key on page 2 of the Preset menu. Next, touch a preset to rename, as prompted by yellow text in the upper right corner of the screen. An alphanumeric entry screen is provided to rename the selected preset. Enter the name (up to eight characters), and then touch the Done soft key to accept or the Cancel soft key to cancel the rename operation.

***NOTE**. You cannot rename an empty preset. You must first save the preset.*

Save Preset To save the current instrument configuration in a preset, first set up the instrument configuration as you want it saved. Next, touch the Save Preset soft key on page 2 of the Preset menu. Touch the desired preset on the screen, as prompted by yellow text in the upper right corner of the screen. The instrument settings are then stored in the preset you selected.

After you have saved a preset, you can then use the Rename Preset soft key to attach a name to the preset to help you remember the instrument configuration saved in that preset.

Promote to Shortcut

You can save up to four presets as a shortcut. The presets you save as shortcuts appear on the first page of the preset menu, providing you a quicker method of recalling commonly used presets.

To store an instrument setup in a shortcut key, first save it as a preset. Then touch the Promote to Shortcut soft key on page 2 of the Preset menu. Touch the desired preset on the screen, as prompted by yellow text in the upper right corner of the screen, and then touch the shortcut number to which the preset will be assigned.

After you have promoted a preset to a shortcut, the associated shortcut soft key on page 1 of the Preset menu will display the preset number (1-42) assigned to that shortcut and will display the custom name of the preset if you had assigned one to the preset.

Remove Preset

To delete the contents of a preset, first touch the Remove Preset soft key on page 2 of the Preset menu. Then touch the preset that you want to empty, as prompted by yellow text in the upper right corner of the screen. The contents of the preset are deleted. If the preset had been given a custom name, it will revert to (EMPTY).

Restore Factory

To restore all instrument settings to the factory presets, touch the Restore Factory soft key on page 2 of the Preset menu. Table 2–5 lists the factory default instrument settings restored by this soft key.

Table 2-5: Factory default instrument settings

Parameter	Setting	Comments
Display mode	Waveform	
Waveform Parade/Overlay mode	Parade	
Waveform Color Space	YPbPr	
Waveform Filter	Flat	
Gain	1x, Variable OFF	All display modes
Sweep	1H, Mag OFF	
Display V & H Position	No offset	All display modes
Line Select	Off (current line = 1)	
Sample Select	Off (current sample = 0)	
Cursors	Off	
Input	Slot 1, Input A	

Table 2-5: Factory default instrument settings (Cont.)

Parameter	Setting	Comments
Alarm Configuration		Beep is OFF for all alarms
RGB Gamut	On-screen: On	
Composite Gamut	On-screen: On	
Input Signal Missing	On-screen: On	
Input Format Change	On-screen: On	
Input-Ref Fmt Mismatch	On-screen: On	
Ext Ref Signal Missing	On-screen: Off	
Ext Ref Format Mismatch	On-screen: On	
RP165 EDH Status (SD-only)	On-screen: On	
Embedded CRC (HD-only)	On-screen: On	
Alarms Enable/Disable	Enabled	
Reference Signal	Internal	Changed text from Self
Thumbnail Display	Enabled	
Display Intensity (Waveform)	0	
Trace Color	White	
Graticule Intensity	50%	
Graticule Color	Gold	
Graticule Rendition	Additive	
Vec I/Q Axis Graticule (Component)	On	Both HD and SD
Compass Rose Graticule (Component)	Off	
Readouts	Enabled	
Readout Intensity	50%	
Backlight Intensity	100%	
Button Illumination (10% constant intensity)	Disabled	
Strip EAV/SAV	Strip	
Ext Ref Format	Auto Select	
Input Signal Format	Auto Select	
Output Brightup Line/Sample	On	
Output Brightup RGB Gamut	Off	Setting affects Int, Ext, and Thumbnail
Output Brightup Composite Gamut	Off	Setting affects Int, Ext, and Thumbnail
Output Colorimetry (HD)	Auto	
Output Active for HD	YPbPr	
Output Active for SD	YPbPr	

Table 2-5: Factory default instrument settings (Cont.)

Parameter	Setting	Comments
Audio Presence Readout	Off	
Vec/Ltng Color Bar Targets	75%	
Vector Graticule	Component	
Vector Composite Graticule Format	Auto	
Composite Setup	7.5% (IRE)	All modes
Gamut Display	Diamond	
Gamut Thresholds:		
• SD Diamond: High	721 mV (3%)	
• SD Diamond: Low	-21 mV	
• SD:Diamond: Area	Horizontal only; 0%	
• HD Diamond: High	721 mV (3%)	
• HD Diamond: Low	-21 mV	
• HD Diamond: Area	Horizontal only; 0%	
• SD Arrowhead: PAL	930 mV	PAL and NTSC
• SD Arrowhead: NTSC	120 IRE (840 mV)	Limits are not stored separately. Factory default will use 840 mV (NTSC) value.
• SD Arrowhead: Area	Horizontal only; 0%	
• HD Arrowhead: PAL	930 mV	
• HD Arrowhead: NTSC	120 IRE (840 mV)	
• HD Arrowhead: Area	Horizontal-only; 0%	
Arrowhead Limit Format	Auto	
Data Display	Video	
Data Display Readout Format	Hexadecimal	
Eye Display	Eye	
Eye Pattern Mode	3 Eye	
Eye Clock Bandwidth	10 Hz	
Jitter High-Pass Filter	10 Hz	

Status Menu

Pressing the STATUS button enters the Status mode and displays the Status menu, shown in Figure 2–16. In this menu, you can view the Display Format and EDH Status display or view the Alarm Status display. To change instrument settings, go to the Config menu or the Input menu.

For more information about the two status displays, refer to *Status Display* on page 3–16.

Format and EDH

The Display Format and EDH Status display shows status information about the input format, audio, colorimetry, reference format, and EDH.

Alarm Status

Displays the current status of every alarm in the instrument.

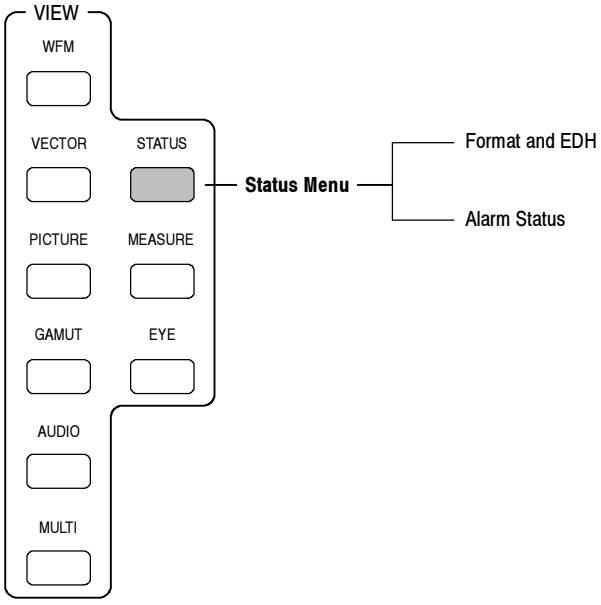


Figure 2- 16: Status menu diagram

Sweep Menu

Pressing the SWEEP button while in Waveform mode displays the Sweep menu, as shown in Figure 2–17. You can choose the horizontal display mode by touching the desired soft key. The Sweep menu is also functional in Vector and Eye Modes, although not all selections are available.

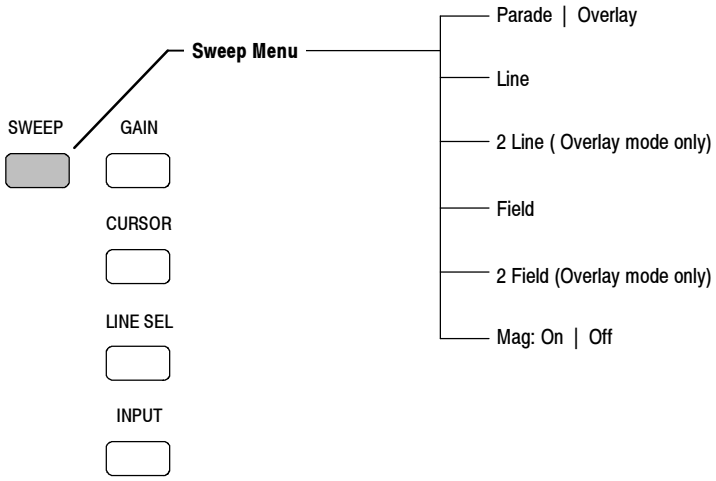


Figure 2- 17: Sweep menu diagram

Parade / Overlay

This soft key toggles between the Parade and Overlay modes. The default mode is Parade.

Line / Field Sweeps

Touch a soft key to select from the following line or field sweeps:

- Line. One line sweep
- 2 Line. Two line sweep (available in Overlay mode only)
- Field. One field sweep
- 2 Field. Two field sweep (available in Overlay mode only)

NOTE*. You must press either the Line or Field soft key to make the Parade / Overlay soft key appear once you have selected 2 Line or 2 Field displays.*

Mag Touch the Mag soft key to turn the horizontal magnification on or off. You can also use the Mag to expand the horizontal scale in Lightning mode.

When operating in two line sweep mode, MAG factors are chosen that optimize the evaluation of the horizontal blanking interval. To utilize this feature, perform the following steps:

1. Ensure that the waveform display is in OVERLAY mode.
2. Select 2LINE sweep.
3. Use the horizontal position control to adjust the waveform so that the blanking interval is aligned with the horizontal graticule indicating the center of the screen.
4. Select MAG sweep.

Vector Menu

Press the VECTOR button to enter the Vector mode and display the Vector menu shown in Figure 2–18. In this menu you can select the display type (Lightning or Vector) and the graticule target positions.

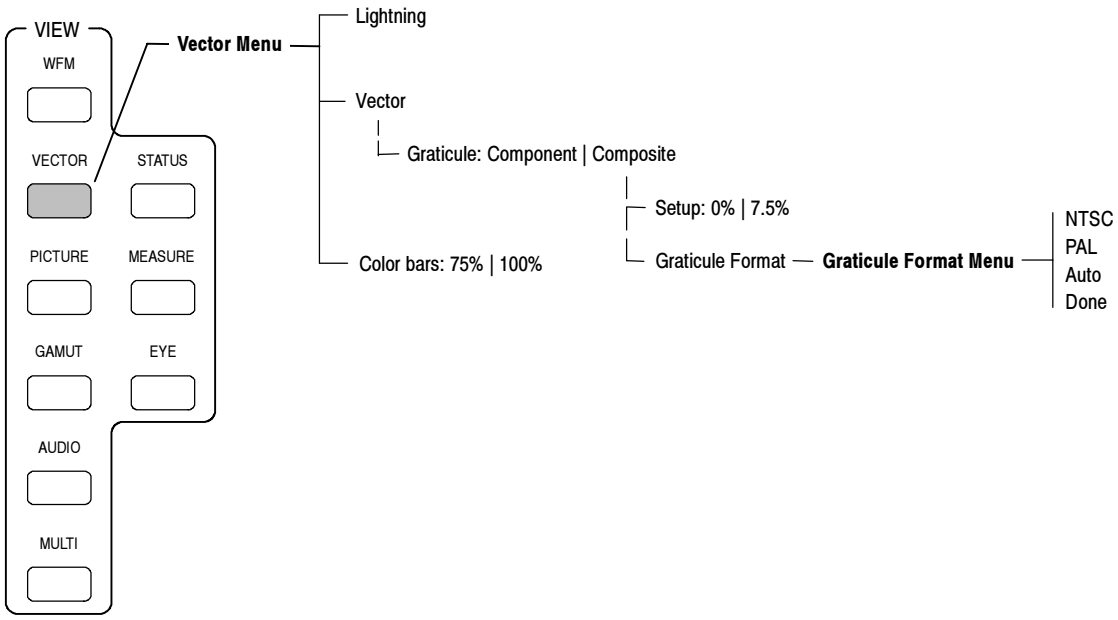


Figure 2-18: Vector menu diagram

Vector and Lightning Displays

Touch either soft key to select the desired display type.
Default = Vector

Vector. This display allows you to visualize the signal as a complex vector of color components, with no luminance information included. The radial magnitude represents saturation and the phase angle represents hue.

Lightning. This display uses an array of horizontally dispersed points to show chrominance components, and uses the vertical axis to show luminance components.

For more information about the Lightning and Vector displays, refer to *Vector Mode* on page 3–21.

75% / 100% Color Bars

This soft key toggles the vector target position to correspond to 75% and 100% Color Bar signals. Select the setting that corresponds to the type of signal you are monitoring.
Default = 75%

Component / Composite Graticules

This soft key toggles the compass rose display (available in Vector mode only) between the component and composite graticules and signal representations. Select the display type that corresponds to the vector representation you wish to view. The composite representation is independent from the Colorimetry in the signal source, and provides a uniform representation of the hue shift.
Choices = Component, Composite
Default = Component

To display the compass rose graticule when you select the component vector graticule, you must enable the compass rose display in the Graticule Setup section of the CONFIG menu. The compass rose graticule is always displayed when you select the composite vector graticule.

Setup 0% / 7.5%

This soft key appears only when you select the Composite vector graticule. Touch this soft key to toggle between setup levels of 0% or 7.5%. When set to 7.5%, the composite waveform representation has 7.5 IRE of setup. When you change the setup setting between 0% and 7.5% in any menu, the setup setting in all other display-mode menus changes to match the current setting.
Default = 7.5%

Graticule Format

This soft key appears only when you select the composite vector graticule. Touch this soft key to enter the Graticule Format menu where you can select the graticule format that matches the signal you are monitoring. The Auto setting allows the instrument to select the graticule based on the type of signal you are monitoring.
Choices = NTSC, PAL, or Auto
Default = Auto

Waveform Menu

Pressing the WAVEFORM button brings up a waveform display of the selected signal input and displays the Waveform menu, shown in Figure 2–19 and described in the following text. For more information about Waveform mode, refer to page 3–23.

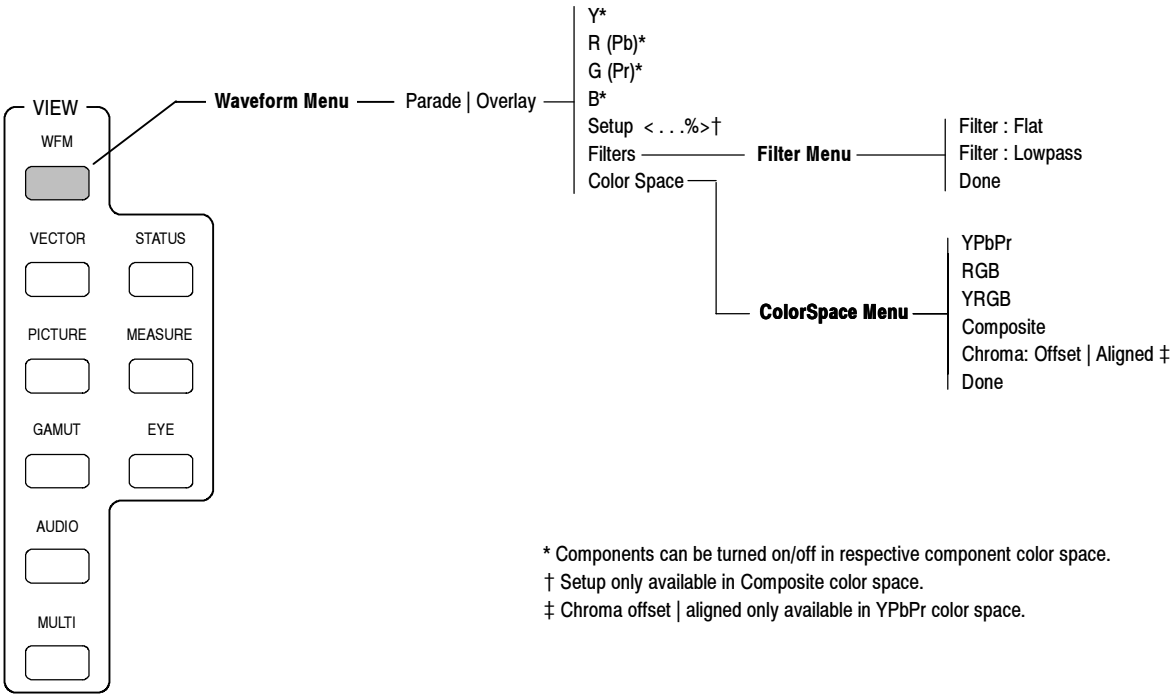


Figure 2-19: Waveform menu diagram

In the Waveform menu, you can make the following selections:

Parade / Overlay Choices = Parade, Overlay
Default = Parade

Parade. In this mode, each selected component is displayed in a portion of the screen. For example, if R, G, and B are selected, each will be displayed from left to right across the screen. If any component(s) is/are not selected, the remaining component(s) will be expanded to take up the screen width.

***NOTE**. Do not use the time cursors to measure time between components in a paraded waveform display. Parade mode is a special display format that represents all displayed components in a single screen, irrespective of the time relationship between components.*

Overlay. In this mode, all selected components of the signal are simultaneously displayed in full screen width.

Y Enables or disables the display of the Y component when YPbPr or YRGB is selected using the Color Space soft key.

R (Pb) Enables or disables the display of the R component when RGB or YRGB is selected using the Color Space soft key. Enables or disables the display of the Pb component when YPbPr is selected.

G (Pr) Enables or disables the display of the G component when RGB or YRGB is selected using the Color Space soft key. Enables or disables the display of the Pr component when YPbPr is selected.

B Enables or disables the display of the B component when RGB or YRGB is selected using the Color Space soft key.

Setup (Composite Only) When you set the Color Space setting to Composite, the Setup soft key is displayed. Touch this soft key to toggle between setup levels of 0% or 7.5%. When set to 7.5%, the composite waveform representation has 7.5 IRE of setup. When you change the setup setting between 0% and 7.5% in any menu, the setup setting in all other display-mode menus changes to match the current setting.
Default = 7.5%

Filter Choices = Flat, Low Pass
Default = Flat

Flat. This setting displays all frequency components of the waveform in creation of the image.

Low Pass. This setting activates a filter that removes high frequency components.

Color Space Choices = YPbPr, RGB, YRGB, Composite, Chroma Offset | Aligned
Default = YPbPr

Selects the representation of the video that will be used to create the waveform display.

Composite. The WFM700 provides a composite representation of both SD and HD component signals. For more information about composite mode, refer to page 3–4.

Chroma Offset | Aligned. (YPbPr color space only) Determines the vertical position of the color difference signals.

- When you select Offset, the chroma is offset by 350 mV from the luminance zero level. The color difference signals will occupy the same vertical range as the luma.
- When you select Aligned, the chroma zero levels are aligned with the luminance zero level. The color difference signals will extend below luma, but Gain will expand around the zero levels.

Reference

Reference

The following topics in this section are organized alphabetically, as in an encyclopedia:

- Alarms
- Audio mode
- Composite display
- Cursors
- Data display
- Diagnostics
- Eye mode
- Freeze mode
- Gamut measurements
- Line Select mode
- Measure mode
- Readouts
- Status display
- Sweep mode
- Vector mode
- Waveform mode

Alarms

The waveform monitor can be configured to report alarms on a variety of conditions. Different user situations will find different alarms and reporting conditions useful.

In the Config menu, you can specify one or more notification methods for each type of alarm. There are three basic reporting means: Audible beep, on-screen icon or message, and listing on the status page.

***NOTE**. If you do not select a notification method for an error, you will not be notified if that error occurs.*

General Alarms

You can monitor for the following general alarm conditions:

RGB Gamut. The input signal contains colors that violate the currently set limits for RGB gamut.

Composite Gamut. The input signal contains colors that violate the currently set limits for composite gamut.

***NOTE**. Gamut error detection is disabled in Eye and Jitter display modes.*

Input Signal Missing. The instrument detects no signal at the currently selected input.

Input Format Change. The instrument detects a change in the format of the input signal.

Input / Ref Format Mismatch. The instrument detects a combination of input and external reference formats that is not supported. This alarm is only valid if the reference is set to External (in the Input menu).

Ext Ref Signal Missing. The instrument detects no signal at the external reference input. This alarm is only valid when the reference source is set to External.

Serial Alarms

You can monitor for the following serial alarm conditions:

RP165 EDH Status. A specialized form of CRC dedicated to SD. See the following description of Embedded CRC for further details.

Embedded CRC. Selects monitoring for CRC (Cyclical Redundancy Check) errors. The CRC data is generated from the serial data content by the source. The CRC word is then embedded into the data. In the WFM700, the CRC is generated again, based on the data, and compared to the embedded value. Differences detected in the comparison serve as an indicator of single or multiple bit errors in the SDI traffic.

EAV / SAV Missing. Selects monitoring for missing EAV (End of Active Video) and SAV (Start of Active Video) words.

Alarm Error Availability

Table 3–1 lists the alarms that are available in each of the operating modes:

Table 3-1: Alarm error availability

Operating mode	Alarm icon	Gamut error indicators
Waveform	Yes	Yes
Vector / Composite Vector	Yes	Yes
Lightning	Yes	Yes
Picture	Yes	Yes
Diamond / Split Diamond	Yes	Yes
Arrowhead	Yes	Yes
Audio	Yes	No
EDH Status	Yes	No
Alarm Status	Yes	No[1]
Data List	Yes	No
Eye / Jitter	Yes[2]	No[3]
Configuration	No	No
Help	No	No
Preset (page 2)	No	No

[1] The RGB Error / Composite Error messages do not appear. However, the RGB status is part of the readout.

[2] The alarm icon appears but has limited functionality in Eye / Jitter modes. For example, CRC errors are not detected.

[3] Gamut measurements are not possible in Eye / Jitter modes. In other modes where gamut error indicators are not displayed, current error information is available in the Alarm Status display.

Audio Mode

This mode provides a protocol-level check for the AES stream. The Audio status screen reports whether the header indicates that audio is present on each pair of channels (Status = Present or Not Present).

An audio presence readout also appears near the bottom center of the waveform monitor screen, if enabled in the Config menu. This readout groups the 16 audio channels into four sets of 4. If audio is present on a channel, the readout displays a “P” (present) for that channel. If no audio is present, a dash is displayed.

Composite Display

The waveform monitor provides a composite representation of both SD and HD component signals. To access this display, set the color space to composite in Waveform mode.

The SD composite mimics NTSC or PAL, depending on the input standard. For HD, a scaled version of subcarrier was chosen to provide a similar number of subcarrier cycles per horizontal line.

The composite representation of the component waveform is useful to people who are skilled in composite signal manipulation, especially when facilities are converting to digital. Viewing the waveform in a familiar form provides confidence that you are delivering a correct signal. You can then compare the familiar composite display to more exact and powerful displays such as Diamond, Arrowhead and YPbPr waveform. Over time, you can become more comfortable using component displays to more completely evaluate the signal.

You might also find it easier to perform certain operations, such as live camera balancing, in composite waveform mode. By looking at the nulling of the subcarrier, an experienced operator can dynamically adjust the white, black, and knee settings on a camera control unit during a live shoot. This is possible using other displays, but you might prefer composite mode.

NOTE. *The composite signal is not available as an output; it is strictly a processed version of the input for viewing in waveform mode. The sync and burst are synthetic and do not relate to any aspect of the input signal. The vertical interval does not conform to normal conventions.*

Cursors

For Waveform, Eye, or Jitter, you can use voltage cursors, time cursors, or both voltage and time cursors. The cursor 1 and 2 settings, and the difference between the two are shown in the readout in the upper right part of the screen. Time cursor settings are displayed below the voltage cursor settings. The absolute measurement of each cursor is shown on the soft key.

Both cursor 1 and cursor 2 use dashed lines; cursor 1 has big line segments and cursor 2 has smaller line segments. The currently selected cursor is shown in red and other cursors are shown in blue.

***NOTE**. When switching between normal sweep and MAG mode, the time cursors may change their horizontal position slightly. This is due to the increased horizontal resolution provided in MAG mode.*

Do not use the time cursors to measure time between components in a paraded waveform display. Parade mode is a special display format that represents all displayed components in a single screen, irrespective of the time relationship between components.

Waveform Cursors

The cursors appear as dashed lines, oriented vertically for time measurements and horizontally for amplitude measurements.

Gain and Sweep with Cursors

At times the cursors may be off the screen when you select Mag or Gain settings other than X1. Cursor readings are accurate even though one or both are off screen. You can make much more accurate measurements by using cursors with high gain or magnification modes. The all-digital design of the waveform monitor enables this accuracy because the “value” of each pixel on the screen is smaller in higher Gain and Mag settings.

Data Display

This display shows the actual SD or HD input data without any interpolation. It is useful for examining streams for protocol errors, or for looking at auxiliary data. Refer also to *Measure Menu* on page 2–45 and *Line Select Menu* on page 2–43.

The different fields of the data stream are shown in different colors, as shown in Table 3–2. You can choose to display data in Hex, Decimal, or Binary units.

Table 3-2: Data Display colors

Color	Use
Green	Active video
Gray	Horizontal or vertical blanking regions
White	EAV and SAV packets
Yellow	Data outside the nominal allowed range
Red	Data with an illegal value

In Data Display mode, the general purpose knob is automatically assigned to control sample select. Touch the Line Select soft key or the SELECT button to assign the general purpose knob to control line select.

***NOTE**. Use of Freeze in Data Display mode freezes only the waveform portion (left side of screen) of the data display. The data list continues to update in response to input signal changes, if any.*

Video / Data Selection

There are two ways of representing the data:

Video Mode. Shows the data like the video YPbPr display in waveform mode, but without interpolation. The Y, Cb, and Cr traces are offset vertically to separate them, but are aligned temporally. Since Cb and Cr have half the data rate of Y, the samples appear twice as long. In Video mode, you can touch the Select Channels soft key to turn off individual components of the display.

Data Mode (SD). Shows the data in the same sequence as it occurs in the serial domain. You see a sample of Y, then of Cb, then of Y' (Y prime), and then of Cr. Then the sequence repeats. The Y sample is the co-sited sample, and the Y' sample is the isolated luma sample.

Data Mode (HD). Splits the serial into a Y channel and a multiplexed Cb/Cr channel. The intent is to show the data in the same orientation as it occurs in the serial domain, even though it is displayed as 8 or 10 bit values.

Line Select / Sample Select

In the Data Display mode, Line Select is set to Sample by default. Use the general purpose knob to select samples within a line. The current line and sample number are displayed in the respective soft keys. The line number is also displayed in the upper right corner of the screen; the sample number is highlighted in the data list. Touch the Line Select soft key to select lines instead of samples. You can also toggle between line and sample by pressing the SELECT button.

Diagnostics

The waveform monitor provides the following diagnostics capabilities, accessed through the Config menu:

Powerup Diagnostics

The instrument runs either full or brief diagnostics at power up, depending on how you have it set in the Config menu.

Run Diagnostics

You should run diagnostics after installing a new module, software upgrade or firmware upgrade, or when troubleshooting. You have the following choices:

Run Full Powerup Diagnostics. The instrument goes through all of the diagnostics and displays the results for the various tests. Warning messages are displayed in yellow text; PASS and FAIL messages are labeled PASS (green text) or FAIL (red text).

Run Internal Digital Path Diagnostics. The instrument checks the main digital paths within the instrument and displays the results of the various tests. If there is only one input card installed, expect some yellow warnings. Refer to the *WFM700 Service Manual* for details.

CAUTION. *Running the Internal Digital Path Diagnostics sets the instrument into a special diagnostics configuration mode. After running this diagnostic, you must reboot the instrument to return to normal operation.*

View Log

You can display a log of the diagnostics results. Touch the View Next Log Page and View Previous Log Page soft keys to page through the log. You can also touch the **Erase** NVRAM Log soft key to clear the diagnostic messages.

Eye Mode

To access the Eye menu and measurements, you must have a WFM700M, a unit with option 2M or a WFM7M module installed.

Eye Measurements

The Eye pattern display presents a voltage-versus-time waveform composed of multiple sweeps of the serial bit stream. You can view and measure the amplitude, rise time, aberrations, and jitter of the serial signal using the Eye pattern display.

The eye-pattern display can measure both standard definition (270 Mb/s) and high-definition (1.485 Gb/s) data streams.

You can set the sampled eye pattern to display either a full word of correlated data or a three-data-bit overlay showing jitter uncorrelated to the parallel word. In the word-correlated mode, the sweep is also synchronized to the video, so that you can see any shift in the data stream timing correlated to horizontal or vertical video information. This mode is most useful for detecting jitter patterns or modulation related to parallel-to-serial conversions.

The scale at 1x vertical gain for the Eye mode is 100 mv/div. You can expand the vertical scale for better viewing by selecting X5, X10, or Variable gain from the Gain menu. You can also use the Mag setting in the Sweep menu to horizontally expand the signal for better viewing.

Jitter is seen in the eye diagram as a horizontal thickening of the trace. As jitter increases, the opening in the eye shrinks until the receiver can no longer reliably decode the serial stream.

The eye measurement is useful at short cable lengths. Even a short cable will slow the rise time and make evaluation of a source difficult. Slightly longer cables will make one eye run into the next. This is called intersymbol interference. It makes the eye appear to have multiple levels and closes the eye opening vertically long before the receiver fails to decode the signal. The only information the eye gives on longer cables is some idea of the cable length.

Different clock recovery bandwidths can be selected to help isolate the frequency of any jitter that is observed. When the 10 Hz setting is selected, all jitter above 10 Hz is displayed. When a higher setting is chosen, only frequencies above that cut-off are observed. For more information, read the following *Jitter Measurements*.

***NOTE**. Gamut error detection is disabled in Eye and Jitter display modes.*

Jitter Measurements

The Jitter display mode plots jitter versus time as a trace and measures peak-to-peak time jitter on the active input signal.

You can select one of four high-pass filters to separate the medium and high frequency jitter from low frequency jitter. When you select a filter, depending on the active input signal, you select the jitter measurement type (Timing, Alignment, or neither, as defined by the SMPTE standard). Use the lowest settings to measure timing jitter and the higher settings to measure alignment jitter.

Only jitter above the filter cut-off frequency will be displayed. For this reason, the jitter should always be greatest on the lowest filter setting because it will pass the widest range of jitter frequencies. Higher filter settings will cut off lower frequency jitter components.

Additional functions you can use to help visualize the jitter measurement are:

- Sweep Mode, including horizontal MAG
- Line Select to view an individual line
- Vertical Gain
- Cursors

Digital jitter readouts appear in a box labeled “Measured jitter (p-p)”. The type of measurement and the filter setting are displayed below the label. The jitter readout is displayed in nanoseconds (nsecs) or picoseconds (psecs) and unit intervals (UI).

NOTE. *Gamut error detection is disabled in Eye and Jitter display modes.*

Freeze Mode

Freeze mode is useful for capturing a trace while an error is present. It is also useful for checking matching between sources.

Freeze Mode lets you:

- Capture (freeze) the active signal and hold it in the Capture buffer.
- Display the frozen signal or the live signal.
- Compare the frozen signal and the live signal by selecting Display Both.

If there is nothing in the Capture buffer, Display Live is automatically selected.

If there is a capture in the buffer, a Freeze icon appears on the display. For optimum display performance, delete the capture when you are finished viewing the waveform.

For ease of comparison, Freeze displays the live signal and the frozen signal in contrasting colors, regardless of the selected trace color.

Freeze is not available in all modes. Refer also to *Freeze Menu* on page 2–35.

***NOTE**. Use of Freeze in Data Display Mode freezes only the waveform portion (left side of screen) of the data display. The data list continues to update in response to input signal changes, if any.*

If you have frozen a waveform (even if it is not displayed), the live waveform will have its pixel density reduced. This is because the frozen waveform is using a portion of the display memory. Delete the captured waveform to regain full waveform density.

Gamut Measurements

The waveform monitor features three types of gamut displays that are associated with two gamut measurements. Both measurements can trigger an alarm when the input signal exceeds a gamut limit.

NOTE. *Gamut error detection is disabled in Eye and Jitter display modes.*

Split Diamond and Diamond modes display the gamut space for component RGB signals, and are associated with the RGB gamut measurement. Arrowhead displays the composite gamut space and is associated with the composite gamut measurement.

- The Diamond display checks that signals conform to legal RGB gamut space.
- The Split Diamond display separates the upper and lower diamonds to show excursions below black, otherwise it is identical to the Diamond display.
- The Arrowhead display checks that signals conform to legal composite gamut space.

Diamond Display

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 component is excessive. Errors in green amplitude affect both diamonds equally, blue amplitude errors affect only the top diamond, and red errors affect only the bottom diamond. You can set the threshold(s) that the instrument uses to define gamut limits. See *Gamut Menu* on page 2–38.

The intensity of a vector indicates its duration. A momentary out-of-gamut condition appears as a faint trace. Long duration violations show as a bright trace.

On the Diamond display, monochrome signals appear as vertical lines. Nonlinear component processing, such as from a gamma corrector that alters white balance, can cause deviations along the vertical axis.

Bending of the transitions indicates timing delays. When a color bar signal is applied, the vertical axis becomes an indicator of delay errors.

Split Diamond Display

Excursions below black can sometimes be masked by the opposite diamond in a traditional Diamond display. Therefore, it is useful to split the diamond into two parts to see excursions below black in either of the G–B or G–R spaces. The Split Diamond display provides this capability.

Arrowhead Display

The Arrowhead display plots luminance on the vertical axis, with blanking at the lower left corner of the arrow. The magnitude of the chroma subcarrier at every luminance level is plotted on the horizontal axis, with zero subcarrier at the left edge of the arrow. The upper sloping line forms a graticule indicating 100% color bar total luma + subcarrier amplitudes. The lower sloping graticule indicates a luma–subcarrier extending towards sync tip (maximum transmitter power). The electronic graticule provides a reliable reference to measure what luminance plus color subcarrier will be when the signal is later encoded into NTSC or PAL.

Signals exceeding the luminance amplitude gamut extend above the top horizontal limit (top electronic graticule line). Signals exceeding the luminance plus or minus peak chrominance amplitude gamut extend beyond the upper and lower diagonal limits. The bottom horizontal line shows the minimum allowed luminance level.

Default Settings

Each of the Gamut modes offers the ability to set the high, and, in some cases, the low gamut thresholds. The waveform monitor also features a set of default thresholds that are based on the input video format. These are shown in Table 2–4 on page 2–39. Touch the Default Settings soft key to quickly restore gamut limits to the default values.

Area Masking

This feature lets you set the percentage of the total image pixels (up to 10%) that can be outside the current gamut limits, yet not be reported as a gamut error.

***NOTE**. The Area settings in the Gamut menu do not affect bright-up in the picture display.*

Filtering

Two filters in the WFM700 let you accept overshoot that would otherwise be reported as a gamut error. Overshoot occurs due to the unequal rise time of the chroma and luma inherent in the YPbPr signal. It is seen on many signals, including color bars. Most gamut detection systems filter in the horizontal dimension only (equivalent to the default Horizontal setting), allowing the instrument to accept a vertical line that is out of gamut. The addition of the Horz + Vert filter expands the filtering to accept horizontal artifacts, making the detection symmetrical in the picture domain.

Horizontal monitoring looks for out-of-gamut errors within a single horizontal line using a low-pass filter (SD: < 1 MHz, HD: < 1.2 MHz).

Horizontal + vertical monitoring looks for out-of-gamut errors on three consecutive horizontal lines with a weighting of 25% for the first and third lines and 50% for the second line.

Line Select Mode

In Line Select mode, you can select one line of the video signal to display and measure. You can use Line Select to isolate the characteristics of one portion of the image: for example, you can look at the color of an actor's face.

The selected line is highlighted in Picture mode and in the thumbnail picture. The external picture monitor signals also contain a bright-up, which is enabled in the Config menu.

Line Select modifies many of the displays in the WFM700. For example, in the Waveform display, instead of seeing a waveform that is representative of the entire video frame, the waveform displayed will be the video signal of a single line. The same is true of the Vector, Lightning, and Gamut displays.

Line Select stays active as you change between major modes. This enables you to select a line in Picture mode, and then go to Waveform, Vector, Diamond, or other modes and view the same line.

Field Selection

The Field and Next Field soft keys select the field from which the selected line/sample is taken. Selecting All Fields displays the same line number from all fields in a frame. The 1 of 2 selection lets you choose a line from only one field in a frame. Touch the Next Field soft key repeatedly to cycle through the fields in a frame.

Sample Selection

Sample Select determines what portion of the line is viewed in Data Display mode. The general purpose knob is automatically assigned to adjust the sample number. To adjust the line, touch the Line Select soft key or press the SELECT button. Sample Select is also active in Picture and thumbnail modes to allow correlation of events between modes.

Readout

The readout, in the upper right corner of the screen, shows both line select and sample select information, with the active selection highlighted.

- The readout for Line Select shows the selected field, the selected line, and the portion of the video signal in which the selected line occurs (such as active video or vertical blanking).
- The readout for Sample shows the selected sample number and the component of the video signal in which the sample occurs.

Measure Mode

In the Measure mode, you can access the Data Display. See page 3-6.

Readouts

There are a number of readouts that may appear on the the screen, depending on the current state of the instrument. Refer to page 2-6 for information about specific readouts.

When a menu is displayed, the readouts on the lower part of the screen move up above the menu. When CLR MENU is pressed, these readouts move down.

Status Display

You can select two different status displays: Display Format and EDH (Error Detection and Handling) Status, and Alarm Status. Refer also to the *Status Menu* on page 2-53.

Display Format and EDH Status

This display provides the following information about instrument status:

Input. Displays the number of the active input (selected in the Input menu).

Format. Displays the video format of the active input.

Selected Ref. Displays the selected reference: internal or external.

Embedded Audio. Reports the presence or absence of embedded audio in the data stream.

Embedded CRC. Reports CRC (Cyclical Redundancy Check) errors.

Signal. Indicates whether the signal is present or missing.

Colorimetry. Displays the current colorimetry setting.

Ref Std. Displays the format of the current input signal on the external reference connector.

Alarm Status

This display indicates the status of all alarms selected in the Config menu. Possible status indications are:

Disabled. No alarm is set for this condition.

OK. No alarm is detected.

Alarm. An alarm is detected and information about the error is displayed.

N/A. The alarm condition does not apply to the current configuration. An example would be the RP165 EDH status alarm. This alarm is set to N/A when an HD signal is present because RP165 is only valid in SD signals.

Missing An optional feature is not present in the input signal. An example would be the RP165 EDH status alarm. This alarm is set to Missing when the input is SD but there are no RP165 packets present in the signal, since EDH is an optional feature.

***NOTE**. Some of the lines in the Alarm Status display may contain text such as Status: 0X0000. These are status bits from the serial receiver and are not intended for user interpretation.*

When RGB errors and/or Composite Gamut errors are detected, the associated lines in the Alarm Status display have characters on the right side that indicate which gamut threshold(s) are exceeded for each component.

If the high threshold is exceeded, a capital letter is displayed. If the low threshold is exceeded, a lower case letter is displayed. The letter displayed corresponds to the first letter of the video component with the error. For example, if the Red signal is too large, an “R” is displayed. If the Green signal goes below the low threshold, a “g” is displayed. For composite signals, if the chroma signal is too large, a “C” is displayed.

Table 3–3 lists the various error codes that may be displayed.

Table 3-3: Alarm Status display error indicators

Indicator	Description
R	Signal exceeds the high gamut limit for the red component (RGB gamut)
r	Signal exceeds the low gamut limit for the red component (RGB gamut)
G	Signal exceeds the high gamut limit for the green component (RGB gamut)
g	Signal exceeds the low gamut limit for the green component (RGB gamut)
B	Signal exceeds the high gamut limit for the blue component (RGB gamut)
b	Signal exceeds the low gamut limit for the blue component (RGB gamut)
C	Signal exceeds the high gamut limit for the chroma component (composite gamut)

Sweep Mode

Use the Sweep mode to select horizontal timing optimized to display one full line (line), two lines consecutively (2 Line), all of the lines in one video field (Field), or all of the lines in two video fields consecutively (2 Field).

***NOTE**. The SWEEP button is operational only in modes which support the Sweep and Mag function: Waveform, Eye, Jitter, and Lightning (Mag only).*

Parade / Overlay

In Parade mode, all selected components of the signal are displayed from left to right, in the same order as they appear on the soft key (for example, in the RGB display, "R" is on the left, followed by "G" and then "R"). In Overlay mode, all selected components of the signal are overlaid.

***NOTE**. Do not use the time cursors to measure time between components in a paraded waveform display. Parade mode is a special display format that represents all displayed components in a single screen, irrespective of the time relationship between components.*

Line / Field Sweeps

Press the corresponding soft key in the Sweep menu to select the following sweep modes:

Line. One horizontal line is displayed. Use the Line Select function to choose one line out of a field or frame.

2 Line. (Overlay mode only) Two consecutive horizontal lines are displayed.

Field. All lines for one video field are displayed.

2 Field. (Overlay mode only) All lines for two video fields are displayed.

Time/div varies with format and sweep type to keep the displayed waveform a reasonable size.

Mag When Mag is on, the horizontal scale is magnified about the center of the screen. In the magnified mode, the waveform extends off both sides of the CRT. Use the horizontal position knob to pan left and right on the waveform.

NOTE*. Timing cursors operate correctly in the magnified mode, although one or both may be off screen during measurements.*

When operating in two line sweep mode, MAG factors are chosen that optimize the evaluation of the horizontal blanking interval. To utilize this feature, perform the following steps:

1. Ensure that the waveform display is in OVERLAY mode.
2. Select 2LINE sweep.
3. Use the horizontal position control to adjust the waveform so that the blanking interval is aligned with the horizontal graticule indicating the center of the screen.
4. Select MAG sweep.

Vector Mode

In the Vector menu, you can select two related displays: the Vector display, which is a traditional vector plot of color difference signals, and the Lightning display, which is a Tektronix proprietary display combining a vertical luma axis with horizontal chroma information. Both displays have targets suitable for determining conformance using 75% or 100% color bar patterns.

Several alpha-numeric text messages may appear on the screen in Vector mode, for example, Bars, Gain, and color standard. For information about individual readouts, refer to page 2–6.

For information about the Vector menu options, refer to *Vector Menu* on page 2–56.

Vector Display

The Vector display allows you to visualize the signal as a complex vector of color components, with no luminance information included. The radial magnitude represents saturation and the phase angle represents hue.

You can use the Vector menu to select either a component or composite vector graticule. When the component graticule is selected, you can turn the compass rose graticule on or off (default setting) and you can turn the I/Q axis on (default setting) or off using the Graticule Setup settings in the Configuration menu. When the composite graticule is selected, the compass rose graticule is always displayed.

***NOTE**. The component vector graticule is provided to allow comparison with other equipment with similar displays. For a more accurate representation of hue shift, use the composite vector representation.*

Lightning Display

The Lightning display uses an array of horizontally dispersed points to show chrominance components, and uses the vertical axis to show luminance components.

The Lightning graticule has two sets of small cross-hairs that bisect the green-magenta transitions on a color bar signal. The calibration of the marks is shown in Table 3–4.

Table 3-4: Lightning graticule marks

SD cross-hair timing error calibration[1]		HD cross-hair timing error calibration[1]	
Graticule mark	**Description**	**Graticule mark**	**Description**
Center	Aligned	Center	Aligned
1st mark	20 ns	1st mark	2 ns
2nd mark	40 ns	2nd mark	5 ns
3rd mark	74 ns (one luma sample time)	3rd mark	13.5 ns (one luma sample time)
4th mark	148 ns (one chroma sample time)	4th mark	27 ns (one chroma sample time)

1 The graticule calibration is only correct if the color bar signal lands in the targets.

The graticule marks help you quantify any chroma-to-luma timing errors. Since luma is plotted relative to the blue color difference signal on the top half of the display, the cross-hairs on the upper transition indicate timing errors between Y and Pb. Similarly, timing errors between Y and Pr are evident on the cross-hairs on the lower green-magenta transition.

If chroma-to-luma timing is correct, the traces for the green-magenta transition on the color bar signal pass through the center cross-hair as it crosses the vertical luma axis. If errors are present, the traces for the transition bow upward or downward. If chroma is ahead of luma, it shows as an upward bowing on the upper transition and a downward bowing on the lower transition. If luma is ahead of chroma, the direction of bowing is reversed.

You can adjust the vertical and horizontal gain to normalize signal amplitude (in the Gain menu). You can also use the fixed gain and the mag function (in the Sweep menu) to expand the scale of the display to better view the small timing graticule cross-hairs.

Waveform Mode

In Waveform mode, the selected components are displayed in a voltage versus time plot. You can display the signal in Parade or Overlay mode, apply flat or low pass filters, and choose the color space (such as RGB or composite). In component color space modes, you can turn the individual components on or off. For information about these menu options, refer to *Waveform Menu* on page 2–58.

***NOTE**. Do not use the time cursors to measure time between components in a paraded waveform display. Parade mode is a special display format that represents all displayed components in a single screen, irrespective of the time relationship between components.*

Composite Color Space

The waveform monitor provides a composite representation of both SD and HD component signals.

The SD composite mimics NTSC or PAL, depending on the input standard. For HD, a scaled version of subcarrier was chosen to provide a similar number of subcarrier cycles per horizontal line.

The composite representation of the component waveform is useful to people who are skilled in composite signal manipulation, especially when facilities are converting to digital. Viewing the waveform in a familiar form provides confidence that you are delivering a correct signal. You can then compare the familiar composite display to more exact and powerful displays such as Diamond, Arrowhead and YPbPr waveform. Over time, you can become more comfortable using component displays to more completely evaluate the signal.

You might also find it easier to perform certain operations, such as live camera balancing, in composite waveform mode. By looking at the nulling of the subcarrier, an experienced operator can dynamically adjust the white, black, and knee settings on a camera control unit during a live shoot. This is possible using other displays, but you might prefer composite mode.

***NOTE**. The composite signal is not available as an output; it is strictly a processed version of the input for viewing in waveform mode. The sync and burst are synthetic and do not relate to any aspect of the input signal. The vertical interval does not conform to normal conventions.*

Chroma Offset

Chroma Offset | Aligned (YPbPr only) determines the vertical position of the color difference signals.

When you select Offset, the chroma is offset by 350 mV from the luminance zero level. The color difference signals will occupy the same vertical range as the luma.

When you select Aligned, the chroma zero levels are aligned with the luminance zero level. The Color Difference signals will extend below luma, but Gain will expand around the zero levels.

Secondary Modes

You can apply several secondary modes while in Waveform mode. The secondary menu will overlay the Waveform menu. To remove the Line Select menu or the Cursor menu from the screen without affecting the signal display and knob assignment, press the CLR MENU button.

Cursors. You can use cursors to measure time and amplitude. Refer to the *Cursor Menu* on page 2–28.

Line Select. You can use Line Select to select part of the video signal to display and measure. For information on the Line Select menu choices, refer to the *Line Select Menu* on page 2–43. For additional information about using Line Select, refer to *Line Select Mode* on page 3–15.

Gain. Vertical gain is available through the Gain menu and is valid during cursor measurements.

Sweep. You can choose the horizontal display mode and turn Mag on or off.

Freeze. You can use the Freeze feature to capture (freeze) the active signal and compare the frozen signal to the live signal.

Configuration

You can modify the waveform by turning the EAV/SAV stripping on and off. Refer to *Input Config* on page 2–23.

Readouts

Several alpha-numeric text messages may appear on the screen in Waveform mode; for example, cursor readouts, the format of the External Reference signal, Gain setting and Line Select. For information about individual readouts, refer to page 2–6.

Appendices

Appendix A: Specifications

The tables in this appendix list the specifications for the Tektronix WFM700 Standard Definition/High Definition Multiformat Video Waveform Monitor. Items listed in the Performance Requirement column are generally quantitative, and can be tested by the *Performance Verification* procedure in the service manual. Items listed in the Reference Information column are useful operating parameters that have typical values; information in this column is not guaranteed.

The specifications listed in the Electrical Specifications portion of these tables apply over an ambient temperature range of +0 °C to +40 °C. The rated accuracies are valid when the instrument is calibrated in an ambient temperature range of +20 °C to +30 °C.

Electrical Specifications

Table A- 1: Waveform vertical deflection

Characteristic	Performance requirement	Reference information
Vertical Measurement Accuracy, YPbPr		Limited by the screen resolution and internal processing. Fully digital system.
1X	± 0.5% of 700 mV full scale mode	
5X	± 0.2% of 700 mV full scale mode	
10X	± 0.1% of 700 mV full scale mode	
Gain	X1, X5, and X10	
Variable Gain Range, Typical		0.25X to 14X
Frequency Response - HD		
Luminance Channel (Y)	50 kHz to 30 MHz, ± 0.5%	
Chrominance Channels (Pb, Pr)	50 kHz to 15 MHz, ± 0.5%	
Frequency Response - SD		
Luminance Channel (Y)	50 kHz to 5.75 MHz, ± 0.5%	
Chrominance Channels (Pb, Pr)	50 kHz to 2.75 MHz, ± 0.5%	
YPbPr to RGB Conversion Accuracy		0.35%, nominal

Table A- 1: Waveform vertical deflection (Cont.)

Characteristic	Performance requirement	Reference information
Step Response, Typical		Sine-squared bars
Preshoot		
SD		≤ 0.3% peak (2T5 bar)
HD		≤ 0.5% peak (2T30 bar)
Overshoot		
SD		≤ 0.3% peak (2T5 bar)
HD		≤ 0.5% peak (2T30 bar)
Ringing		
SD		≤ 0.4% peak-peak (2T5 bar)
HD		≤ 0.8% peak-peak (2T30 bar)
		Most of the error seen on the display comes from the inherent ringing in the digital data. The response of the WFM700 is close to the theoretical limit of a perfect sinx/x reconstruction filter.
Pulse Response, Typical		Blackman pulse
Baseline Ringing		
SD		≤0.6% peak-peak (2T5)
HD		≤0.7% peak-peak (2T30)
		Pulse-to-bar ratio 0.995:1 to 1.005:1 on appropriate Sine Squared or Blackman 2T pulse.
		A sine-squared pulse near Nyquist is not band-limited and so inherently has ringing much larger than the WFM700 filter. A three term Blackman pulse with the same HAD has much less inherent ringing, so it is a better choice for most testing. See Digital to Analog Conversion, Data and Filter Requirements, SMPTE Journal Mar 1995, Vol. 104, Fibush, Baker, Penny.
Interpolation Filter Group Delay, Typical		
HD		1 ns
SD		1 ns

Table A-1: Waveform vertical deflection (Cont.)

Characteristic	Performance requirement	Reference information
Tilt, Typical		
Field Rate		0.1%
Line Rate		0.1%
Off Screen Recovery, Typical		0.1% variation in baseline of a 5 MHz modulated pulse when positioned anywhere on screen
Offset, Typical		Pr and Pb can be displayed aligned to Y or offset by 350 mV.

Table A-2: Serial digital video interface

Characteristic	Performance requirement	Reference information
Video Inputs		Two per card; only one input active at a time.
Format		Each input compatible with SMPTE 292M/BTA-S004B and 270 Mbs/s SMPTE 259M
Input Type		75 Ω BNC, internally terminated
Cable Loss Accommodation	With 1/SQRT(f) characteristic at ½ of serial rate.	
SD	0 to 30 dB attenuation	Equivalent to approximately 300 m of Belden 8281 at 270 Mb/s, typically 400 m.
HD	0 to 20 dB attenuation	Equivalent to approximately 80 m of Belden 8281 at 1.485 Gb/s, typically 120 m.
Allowed Serial Source Amplitude		
With Max Specified Cable Loss		800 mV ± 10%
Up to 20 dB Cable Loss		800 mV ± 30%
Jitter Tolerance, Typical		0.4 UI p-p above 2 MHz. Increases proportional to 1/f below 2 MHz.
Return Loss	> 15 dB to 1.5 GHz	
Isolation Between Inputs	> 45 dB to 1 GHz	

Table A-3: Switched serial video output (serial out)

Characteristic	Performance requirement	Reference information
Format		1.485 Gb/s or 270 Mb/s repeat of selected input. Functionally follows active input if on this input card.
Output Level	800 mV, ± 5% into 75 Ω load	
Return Loss	15 dB to 1.5 GHz	

Table A-4: Eye pattern display

Characteristic	Performance requirement	Reference information
Type		Equivalent Time Sampler
Signal Bandwidth	50 KHz to 2.5 GHz at -3 dB point	
Time Base Jitter		
SD		150 ps p-p in 1 kHz high-pass filter mode
HD		70 ps p-p in 1 kHz high-pass filter mode
Eye Clock Recovery Bandwidth Settings		Clock recovery bandwidth can be set to 10 Hz, 100 Hz, or 1000 Hz high pass filter
Eye Clock Recovery Bandwidth Accuracy	Actual -3 dB frequency within 10 % of nominal	
Jitter Attenuation Error		
10 Hz or 100 Hz Bandwidth	< 10% for frequencies greater than 2 times the Clock BW setting	
1 kHz Bandwidth	<-10%, +20 % for frequencies from 2 KHz to 10 kHz; <10% for frequencies above 10 kHz	
Display Modes		
SD		
Overlay		Overlays all bits to form each eye opening. Useful for observing peak jitter.
10 Eye		Displays eye relative to the parallel clock and line sync. Useful for observing jitter correlated to line rate and word clock.
HD		
Overlay		Overlays all bits to form each eye opening. Useful for observing peak jitter.

Table A-4: Eye pattern display (Cont.)

Characteristic	Performance requirement	Reference information
20 Eye		Displays eye relative to the parallel clock and line sync. Useful for observing jitter correlated to line rate and word clock.
Deflection Factor		
Vertical	800 mV ±5% with an 800 mVp-p input signal	
Horizontal		±1%, fully digital system

Table A-5: Jitter display

Characteristic	Performance requirement	Reference information
Type		Demodulated recovered clock, per SMPTE RP184 specifications.
High-Pass Filter Settings		Can be set to 10 Hz, 1 kHz, 10 kHz, or 100 kHz. Applies to digital readout, jitter waveform, and jitter output.
High-Pass Filter Attenuation	-2 dB to -4 dB at specified frequency.	Applies to digital readout, jitter waveform, and jitter output.
High-End Frequency Response, Typical		-3 dB at > 5 MHz. Applies to digital readout, jitter waveform, and jitter output.
Dynamic Range, Typical		Applies to digital readout, jitter waveform, and jitter output.
Maximum is a function of jitter frequency and standard:		
10 Hz to 50 kHz, HD		9 UI_{p-p}
10 Hz to 50 kHz, SD		7 UI_{p-p}
100 kHz to 5 MHz		Decreasing linearly to 0.2 UI_{p-p} at 5 MHz
Minimum (noise floor) is a function of bandwidth selection:		
10 Hz, HD		60 ps typical
1 kHz, 10 kHz, HD		60 ps typical
100 kHz, HD		30 ps typical
All HPF settings, SD		200 ps typical
Digital Readout Type		Indicates timing jitter or alignment jitter, depending on high-pass filter selection.

Table A- 5: Jitter display (Cont.)

Characteristic	Performance requirement	Reference information
Digital Readout		
Error, Typical		< 0.1 UI, +10% of reading for jitter frequences from 3 times bandwidth selection to 1 MHz.
Resolution		0.01 UI
Jitter Waveform		
Gain Error, Typical		< 0.1 UI +10% for jitter frequencies from 3 times bandwidth selection to 1 MHz
Scale		
Horizontal Modes		1 Line, 2 Line, 1 Field, 2 Field
Vertical Modes		1 UI / div, 0.2 UI / div, 0.1 UI / div
Jitter Output		100 mV / UI, ± 10%, into 75 Ω load. In Jitter Mode only

Table A- 6: Data error detection (EDH / Status)

Characteristic	Performance requirement	Reference information
Data Integrity		
SD	Active picture and full field. Field rate resolution. Complies with SMPTE RP165.	Uses CRC check-word system. System is known as EDH (Error Detection and Handling) in industry literature.
HD	Field Rate Resolution. Separate reporting for errors in Y or Color Difference data streams.	
Reporting Means		Data errors shown on screen when STATUS button is pressed. On screen notification and audible beep can also be enabled through the CONFIG mode.
Line Rate		Indicates the signal format and serial data rate of the input signal
Signal Lost		Reports absence of serial video signal
Signal Unlocked		Reports when signal present but unable to lock

Table A-7: Data display mode

Characteristic	Performance requirement	Reference information
Digital Waveform		Non-interpolated waveform display. Cursor identifies selected sample value (hex, decimal, binary). Cross-hair cursor inserted on picture monitor output shows selected line and sample.
Digital List		Sequential list of sample values in table format. Cursor identifies selected sample.
Display Format		HEX, DEC, BIN

Table A-8: External reference

Characteristic	Performance requirement	Reference information
Operational		Locks to analog bi-level and tri-level signals of formats listed in *Appendix B*. Reference must have a frame rate compatible with input. WFM mode and Line Select derive timing from the external sync information. Picture mode does not use timing from the external reference.
Analog Sync Format	PAL 1080i 60 Hz 720p 59.94 Hz NTSC 1080i 59.94 Hz 1080p 23.98 Hz 1080p 24 Hz	External reference is tested with PAL 1080i 60 Hz and 720p 59.94 Hz signals. This guarantees operation with all specified formats.
Input Signal Level, Typical		- 6 dB to + 6 dB
Maximum Operating Input Voltage, Typical		± 15 V DC
Absolute Maximum Input Voltage, Typical		± 15 V DC
Inband Input Impedance, Typical		≥ 15 KΩ
Return Loss	40 dB to 30 MHz	
Hum Tolerance, Typical		Operates with 500 mV_{p-p}
Signal/Noise Tolerance, Typical		Operates to 25 dB

Table A-9: Waveform horizontal deflection

Characteristic	Performance requirement	Reference information
Sweep		
Accuracy	± 0.5%, all rates	Fully digital system
Linearity	0.2% of time displayed on screen	Fully digital system
Timing Cursor Registration and Readout Accuracy, Typical		± 0.5% of sweep time displayed on screen
Rates		1, 2, 3, or 4 line or field depending on mode.
Line Select		Selected Line in 1 Line Selected first line in 2 Line or Parade

Table A-10: Component Vector Mode

Characteristic	Performance requirement	Reference information
Vertical Bandwidth, Typical		
SD		1.2 MHz
HD		4.5 MHz
Vertical Gain Accuracy	± 0.5%	Fully digital system
Horizontal Gain Accuracy	± 0.5%	
Display to Graticule Registration	0.5%	Fully digital system limited by sample resolution
Vector Display		P_B is displayed on horizontal axis and P_R is displayed on vertical axis

Table A-11: Save and display waveform - overlay

Characteristic	Performance requirement	Reference information
Delay Time from Button Push		< 3 frames at input frame rate
Number of Reference Memory		1 frame at VGA display rate

Table A-12: Lightning and Diamond modes

Characteristic	Performance requirement	Reference information
Vertical Gain Accuracy	±0.5%	Fully digital system
Electronic Graticule Display		
Diamond		RGB Deflection axis indicated
Split Diamond		Offsets the top and bottom diamonds horizontally for better viewing of black gamut space.
Lightning		Displays signal components as follows: Y vertically Pb horizontally on top half of display P_r horizontally on bottom half of display

Table A-13: RGB GAMUT error detection

Characteristic	Performance requirement	Reference information
Detection Level		
High Limit	+630 mV to +756 mV in 1 mV steps	
Low Limit	-50 mV to +35 mV in 1 mV steps	
Detection Level Accuracy	±3.5 mV	

Table A-14: Arrowhead mode (NTSC/PAL composite limit display)

Characteristic	Performance requirement	Reference information
Signal to Graticule Accuracy	±1%, 100 IRE (700 mV), and 131 IRE	(PAL values in parenthesis)
Composite Limit Cursor Accuracy	±0.5% at 100 IRE, 110 IRE, 120 IRE, and 131 IRE (700 and 950 mV)	(PAL values in parenthesis)
Composite Limit Detection Level Accuracy	Detection level ±7 mV 90% to 135% in 1% steps	

Table A-15: Audio mode

Characteristic	Performance requirement	Reference information
Embedded Audio		Identifies the presence of up to 16 channels of AES/EBU digital audio. Presence is detected by looking at AES protocol.

Table A-16: Picture mode

Characteristic	Performance requirement	Reference information
Format		Picture can be viewed in all formats: In SD, picture is cropped from 720 to 640 pixels wide. In HD, picture is downsampled to fit into 640 X 480 size. In low frame rate formats, frames are repeated as needed to achieve VGA speed; this is similar to 3:2 pulldown on some frame rates.
Synchronization		Picture mode always uses internal timing. It is not affected by external sync.

Table A-17: Serial SD only monitor outputs (SD PIX MON)

Characteristic	Performance requirement	Reference information
Content - Follows active input with brightups (SD Only)		Gamut bright ups appear one line below error. Digital version of RGB/YPbPr analog pix monitor output on Ref board.
Rate		270 Mbit/s
Signal Level	800 mV ±5% into 75 Ω	Internal adjustment
Return Loss	20 dB, 5 MHz to 270 MHz	

Table A-18: Picture monitor outputs

Characteristic	Performance requirement	Reference information
Signal Format		
BNC outputs SD and HD		Y, Pb, Pr with sync on Y RGB with sync on all. HD sync is tri-level.
VGA DSUB outputs		Same signals as on BNC outputs, also have TTL H and V drive.
DAC Resolution		10 bit
Impedance, Typical		75 Ω unbalanced
Active Video Accuracy, Y-Pb-Pr mode	700mV ±5% peak-to-peak	
Black (Blanking) Output Level SD and HD	0 mV ±25 mV	
Frequency Response, Typical		Response changes between systems with 1 video input card and systems with 2 video input cards installed. Response degrades if driving both BNC and VGA outputs.
SD		Y, G, B, and R ±5% to 5.5 MHz
HD		Y, G, B, and R ±8% to 30 MHz
Non-Linearity	≤0.5%	
Group Delay Error, Typical		
SD		±10 ns to 5.5 MHz
HD		±6 ns to 27 MHz
Interchannel Timing Match, Typical		
SD		Y-to-Pb and Y-to-Pr ±3.0 ns
HD		Y-to-Pb and Y-to-Pr ±4.0 ns
Sync Amplitude Accuracy, Typical		
SD		-300 mV ±5 %
HD		300 mV on positive transition 400 mV on negative transition
S/N inband, Typical		
SD		60 dB to 5.5 MHz on quiet line RMS relative to 700 mV
HD		50 dB to 30 MHz on quiet line RMS relative to 700 mV
Return Loss on BNCs	>40 dB to 30 MHz	
Transcoder Accuracy		9 bit

Table A-19: Power source

Characteristic	Performance requirement	Reference information
Electrical Rating	100 - 240 VAC, 50/60 Hz, 150 Watts max.	Tested to 90 - 264 VAC, 50/60 Hz. 2.6 A max.
Supply Connection		Detachable cord set
Power Consumption, Typical		< 150 VA (100 Watts) with 1 video input card and 125 Watts with 2 video input cards
Standby Power Consumption, Typical		1 Watt at 110 or 240 VAC
Surge, Typical		5 amps at 90 V 2.5 amps at 240 V
Fuse Rating	T3.5, 250 V	Not operator replaceable. Refer servicing to qualified service personnel.

Table A-20: LCD display

Characteristic	Performance requirement	Reference information
Display Area		
Horizontal		13 cm
Vertical		10 cm
Resolution		640 (H) x 480 (V) pixels
Color Palette		6 bit per component. LSB is dithered to improve picture.
Pixel Defects	≤ 6 bad pixels	

Table A-21: External VGA output (EXT VGA)

Characteristic	Performance requirement	Reference information
Content		Identical to front-panel LCD display
Output Levels		1 V for RGB signals, 3.3 V for H and V sync signals
Resolution		640 (H) x 480 (V) pixels
Color Palette		6 bit per component. LSB is dithered to improve picture.
Connector Pin Assignments		Pin 1: R Pin 6: GND Pin 11: NC Pin 2: G Pin 7: GND Pin 12: NC Pin 3: B Pin 8: GND Pin 13: HSync Pin 4: NC Pin 9: NC Pin 14: VSync Pin 5: GND Pin 10: NC Pin 15: NC

Physical Specifications

Table A- 22: Physical characteristics

Characteristic	Standard
Dimensions	
Height	5 1/4 inches (133.4 millimeters)
Width	8 1/2 inches (215.9 millimeters)
Depth	18 1/8 inches (460.4 millimeters)
Weight	
Net	12 pounds (5.5 kilograms)
Shipping	21 pounds (9.6 kilograms) approximate

Table A- 23: Environmental performance

Category	Standards or description
Temperature	
Operating	0 °C to +40 °C
Non Operating	-20 °C to +60 °C
Humidity	
Operating	20% to 80% relative humidity (% RH) at up to +40 °C, non-condensing
Non Operating	5% to 90% RH (relative humidity) at up to +60 °C, non-condensing
Altitude	
Operating	Up to 9,842 feet (3,000 meters)
Non Operating	Up to 40,000 feet (12,192 meters)
Cooling	Variable Fan. Forced air circulation with no air filter.
Required Clearances	Top None Bottom None Left side 2 in (51 mm) Right side 2 in (51 mm) Front None Rear 2 in (51 mm)

Table A-24: Certifications and compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets the 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 Communities:	
	EN 55103	Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use.[2]
	Environment	E2 - commercial and light industrial
	Part 1 Emission	
	EN 55022	Class B radiated and conducted emissions
	EN 55103-1, Annex A	Radiated magnetic field emissions
	EN 55103-1, Annex B	Inrush current; I peak = 2.19 amps
	EN-55103-1, Annex E	Conducted emissions, signal/control ports
	Part 2 Immunity	
	IEC 61000-4-2	Electrostatic discharge immunity
	IEC 61000-4-3	RF electromagnetic field immunity
	IEC 61000-4-4	Electrical fast transient / burst immunity
	IEC 61000-4-5	Power line surge immunity
	IEC 61000-4-6	Conducted RF Immunity
	IEC 61000-4-11	Voltage dips and interruptions immunity
	EN 55103-2, Annex A	Radiated magnetic field immunity
	EN 55103-2, Annex B	Balanced ports common mode immunity
	EN 61000-3-2	AC power line harmonic emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s):	
	AS/NZS 2064.1/2	Industrial, Scientific, and Medical Equipment: 1992
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.	
EC Declaration of Conformity - Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:	
	Low Voltage Directive 73/23/EEC, amended by 93/68/EEC	
	EN 61010-1:1993/A2:1995	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.

[2] **Use only high-quality shielded cables.**

Table A- 24: Certifications and compliances (cont.)

Category	Standards or description	
Additional Compliance	IEC61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use.
	ISA S82.02.01:1999	Safety standard for electrical and electronic test, measuring, controlling, and related equipment.
Installation (Overvoltage) Category Descriptions	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 Descriptions	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 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
	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.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.
Equipment type	Test and Measurement	
Safety Class	Class I	
Overvoltage Category	CAT II	
Pollution Degree	Pollution Degree 2	

Appendix B: Supported Video Standards

Table B–1 lists the video standards supported by the WFM700 instruments. Table B–2 lists the supported input/reference format combinations.

Table B-1: Supported video standards

Standard	Image Format	Field/Frame Rate							
		60 Hz	59.94 Hz	50 Hz	30 Hz	29.97 Hz	25 Hz	24 Hz	23.98 Hz
274M	1920x 1080i	x (D-292)[1]	x (E-292)[1]	x (F-292)[1]					
	1920x 1080p				x (G-292)[1]	x (H-292)[1]	x (I-292)[1]	x (J-292)[1]	x (K-292)[1]
	1920x 1080sF				x	x	x	x	x
240M/260M	1920x 1035i	x (A-292)[1]	x (B-292)[1]						
296M	1280x 720p		x (M-292)[1]					x	x
ITU-R BT.601	720x 576i (625)			x (C-259)[2]					
	720x 483i (525)		x (C-259)[2]						

[1] **SMPTE 292M format support.**

[2] **SMPTE 259M support level C - 270 Mbyte/s, 525/625 component.**

Table B- 2: Allowed references for input formats

Input format, digital	Allowed reference, analog						
	Bi-level sync		Tri-level sync				
	NTSC	PAL	1080i 59.94 Hz	1080i 60 Hz	720p 59.94 Hz	1080p 23.98 Hz	1080p 24 Hz
274M, 1080i, 60 Hz				x			
274M, 1080i, 59.94 Hz	x		x		x[1]		
274M, 1080i, 50 Hz		x					
274M, 1080p, 30 Hz				x			
274M, 1080p, 29.97 Hz	x		x		x[1]		
274M, 1080p, 25 Hz		x					
274M, 1080p, 24 Hz				x[2]			x
274M, 1080p, 23.98 Hz	x[2]		x[2]		x[2]	x	
RP211, 1080sf, 30 Hz				x			
RP211, 1080sf, 29.97 Hz	x		x		x[1]		
RP211, 1080sf, 25 Hz		x					
RP211, 1080sf, 24 Hz				x[2]			x
RP211, 1080sf, 23.98 Hz	x[2]		x[2]		x[2]	x	
240M 1035i, 59.94 Hz	x		x				
240M 1035i, 60 Hz				x			
296M 720p, 59.94 Hz	x[3]		x[3]		x		
296M 720p, 24 Hz				x[2]			x
296M 720p, 23.98 Hz	x[2]		x[2]		x[2]	x	
BT601 576i, 50 Hz (625)		x					
BT601 483i, 59.94 Hz (525)	x		x		x		

1 Digital input frame rate is divided by a factor of two.

2 Every fifth frame of reference matches the fourth frame of digital input.

3 Reference frame rate is divided by a factor of two.

NOTE*. The WFM700 does not utilize the SMPTE 318M 10 Field Sequence flag. This causes inconsistent operation for combinations of input and reference format whose frame rates are not related by an integer multiplier. The inconsistent operation causes multiple possible timing orientations to be shown on the Waveform. The display is similar to that shown when a timing offset is present. The number of possible waveform orientations is related to the ratio of the input and reference frame rates.*

Appendix C: LED Fault Codes

The green ON/STBY LED and the red FAULT LED indicate instrument status. The ON/STBY LED LED is illuminated whenever the instrument is on. The FAULT LED is illuminated when the environment controller detects a fault within the instrument, such as under/over voltage of a power supply. The LEDs indicate instrument status and do not report input signal problems.

Table C–1 shows the LED conditions and what they indicate.

Table C-1: LED Fault Codes

State	ON/STBY LED	Fault LED	Main power relay	Description / suggested action
Standby	Off	Off	Off	
On	On	Off	On	
Cold	Flashing	Off	On	The LCD may be damaged if operated at low temperatures. If the internal temperature sensors detect a low temperature, this fault code will be asserted. Let the unit warm up and cycle the power or press the ON/STBY switch for normal operation to occur.
Momentary fault	On	On	On	This is a transient state. It should never last more than one second. It occurs when the internal sensors detect that one of the internal supplies is out of the allowable range. In this state, the instrument will be reset. This state can occur due to an intermittent problem that requires service or from a drop-out on the AC line. If the fault persists for more than one second, then the instrument will go to the Power Fault state. It is normal for the momentary fault state to be asserted when the AC line is removed while the instrument is running.
Power supply fault	Off	On	Off	If the internal monitors detect that one of the internal power supplies is out of its allowed range, the instrument will shut down and the Power Fault LED code will be asserted. This can be triggered by multiple drop-outs on the AC power supply to the instrument. If this Fault Code is present, press the ON/STBY switch to reset the instrument. If the fault code reoccurs, refer the instrument to qualified service personnel. If the waveform monitor seems to be operating properly, monitor the AC power supply to be sure there are no problems in the power source.

Table C- 1: LED Fault Codes (Cont.)

State	ON/STBY LED	Fault LED	Main power relay	Description / suggested action
Overtemp fault	Off	Flashing	Off	The internal temperature sensors will shut down the instrument at 75 °C to prevent damage to the components if the ambient temperature is too high or if the airflow is blocked. If this occurs, the Overtemp fault code will be asserted. Let the instrument cool down and cycle the power or press the ON/STBY switch to resume normal operation.
EC self test failed	Flashing	Flashing	Off	This is asserted if the Environmental Controller is not able to test the temperature sensors and fan circuits. If this occurs, refer the instrument to qualified service personnel.

Appendix D: User Service

This appendix contains procedures for cleaning the instrument and performing preventive maintenance on the waveform monitor.

Cleaning

General Care

Protect the instrument from adverse weather conditions. The instrument is not waterproof.

CAUTION. *To avoid damage to the instrument, do not expose it to sprays, liquids, or solvents.*

Do not use chemical cleaning agents; they may damage the instrument. Avoid chemicals that contain acetone, benzene, toluene, xylene, or similar solvents, because they may damage the plastic.

WARNING. *Remove the power cord before cleaning the instrument.*

Cleaning the Exterior

Remove the power cord before cleaning the instrument. Clean the exterior surfaces of the instrument with a dry, lint-free cloth or a soft-bristle brush. If dirt remains, use a cloth or swab dampened with a 75% isopropyl alcohol solution. A swab is useful for cleaning in narrow spaces around the controls and connectors. Do not use abrasive compounds on any part of the instrument.

CAUTION. *Do not allow moisture inside the instrument. During exterior cleaning, use only enough solution to dampen the cloth or swab.*

The touch panel on the LCD is a soft plastic surface. Observe the following precautions when cleaning:

- *Do not use abrasive cleaners or commercial glass cleaners.*
- *Do not spray liquids directly on the surface.*
- *Do not scrub the surface with excessive force.*

Preventive Maintenance

Preventive maintenance mainly consists of periodic cleaning. Periodic cleaning reduces instrument breakdown and increases reliability. Clean the instrument as needed, based on the operating environment. Dirty conditions may require more frequent cleaning than computer-room conditions.

Check the waveform monitor once a year to verify that the instrument still meets its functional requirements. Refer to the *Functional Check* on page 1–13.

Yearly performance verification is recommended. Refer to the *WFM700 Service Manual* for the Performance Verification procedure.

Appendix E: Firmware Upgrade

Firmware upgrades for the waveform monitor will become available periodically. Check with your Tektronix representative for more information.

Required Equipment

***NOTE**. The firmware upgrade utility and the updated firmware image are available at the www.tektronix.com website.*

To upgrade your waveform monitor firmware, you need the following:

- Firmware Upgrade Utility (transfer.exe)
- Image file of new firmware version (*.fmw)
- A networked PC with the following minimum configuration:

  Processor: Pentium, 167 MHz
  RAM: 64 MB
  OS: Windows 95 or Windows NT
  Free space on hard drive: 8 MB

- One of the following Ethernet cables:
  - Standard RJ45 Ethernet cable. Use this type of cable if you are connecting the waveform monitor to a PC through a local network or through an Ethernet hub.
  - Ethernet crossover cable. Use this type of cable if you are connecting the waveform monitor directly to the Ethernet card on a PC.

Instrument Setup

To prepare the waveform monitor for a firmware upgrade, perform the following steps:

1. Connect the waveform monitor to your PC using one of the following three methods:
   - Connect the waveform monitor to your local network using a standard RJ45 Ethernet cable.
   - Connect the waveform monitor to the PC through an Ethernet hub using a standard RJ45 Ethernet cable.
   - Connect the waveform monitor directly to the Ethernet card on the PC using an Ethernet crossover cable.

NOTE. *You must use an Ethernet crossover cable if you are connecting the waveform monitor directly to the Ethernet card on the PC.*

2. Turn on the waveform monitor.
3. Assign the waveform monitor an IP address using one of the two following methods:
   - Perform the procedure *Manually Assigning an IP Address* on page E–3 if your local network requires fixed IP addresses or if you are connecting the waveform monitor directly to the Ethernet card on the PC.
   - Perform the procedure *Using DHCP Service to Assign an Ethernet Address* on page E–5 if your local network supports DHCP service, which dynamically assigns an IP address to connected equipment.

NOTE. *In order to use the DHCP Server option on the waveform monitor, your local network must support DHCP service. If necessary, refer to your local network administrator for assistance in determining which method to use when assigning your waveform monitor an IP address.*

Manually Assigning an IP Address

To manually assign to the waveform monitor the IP address provided by your local network administrator, perform the following procedure:

***NOTE**. If the waveform monitor is already connected and operating on your local network, you will not need to reassign the instrument a new IP address. In this case, proceed to* Firmware Upgrade Procedure *on page E–6.*

Depending on the operating system and how your PC is configured, you may need to have Administrator privileges on the PC before you can view or edit the IP address on the PC. Contact your local network administrator if you are unable to view or change the IP address on the PC.

1. Press the CONFIG button on the waveform monitor.
2. Touch the Network Settings soft key, and then touch the Next Menu soft key.
3. Touch the Config Mode soft key, and then touch the Manual Mode soft key.
4. Touch the IP Address soft key, and then touch the Press to Edit IP Address soft key.

***CAUTION.** Entering an incorrect IP address, gateway address, or subnet mask address into the WFM700 waveform monitor can create problems with other networked devices and prevent network communication with the instrument.*

Be sure to consult with your local network administrator before you enter these addresses into the waveform monitor.

5. Use the general purpose knob and the Select button or use the soft keys (Increase/Decrease Value and Move Left/Right) to enter one of the following IP addresses:
   - If you connected the waveform monitor to your local network, enter the IP address, gateway address, and subnet mask assigned to your waveform monitor by your local network administrator.
   - If you connected the waveform monitor directly to the Ethernet card on your PC, enter the following IP address (you will not need to enter a gateway address or subnet mask):

     192.168.1.2
6. Touch the Save IP Address soft key to save the changed address. The new IP address is displayed in the top soft key.

7. If you connected the waveform monitor to your local network, proceed to *Firmware Upgrade Procedure* on page E–6.

8. If you connected the waveform monitor directly to the Ethernet card on your PC, perform the following steps to assign your PC an IP address:

***NOTE**. If you connected the waveform monitor directly to the Ethernet card on your PC, you must assign the PC an IP address to allow the firmware upgrade process to operate properly.*

The following steps are for Windows 95 and Windows 98 operating systems. The steps are similar for Windows NT and Windows 2000 operating systems.

---

   a. Open the Control Panel on your PC.

   b. Open the Network and Dial-up Connections folder.

   c. Right-click the Local Area Connection icon.

   d. Click Properties.

   e. Highlight Internet Protocol (TCP/IP).

   f. Click Properties.

***CAUTION.** If your PC already has a valid fixed IP address for your local network and you disconnected the PC from the network so that you could perform the firmware upgrade procedure, make a note of your IP address before you perform the following steps.*

Be sure to reset the PC's IP address back to the proper address before you reconnect the PC to your network (you will be reminded to do this at the end of the upgrade procedure).

---

   g. Click the manual button for setting the IP address.

   h. Enter the following IP address (you will not need to enter a gateway address or subnet mask):

      192.168.1.1

   i. Save your changes and exit the Local Area Connection dialog box.

   j. Close or minimize the Control Panel.

   k. Proceed to *Firmware Upgrade Procedure* on page E–6.

Using DHCP Service to Assign an Ethernet Address

To use DHCP service to assign the waveform monitor an IP address, perform the following procedure:

1. Press the CONFIG button on the waveform monitor.
2. Touch the Network Settings soft key, and then touch the Next Menu soft key.
3. Touch the Config Mode soft key, and then touch the DHCP Server soft key.
4. Touch the IP Address soft key.
5. The top soft key will display the message “Waiting for DHCP Server” while the waveform monitor waits for an IP address to be assigned by the DHCP server.

***NOTE**. It will usually take only several seconds for the DHCP server to assign an IP address. The waveform monitor will time out from waiting for an address after approximately 45 seconds.*

If the waveform monitor times out while waiting for an IP address to be assigned, contact your local network administrator for assistance. Either there is a problem with your local network or your network does not support DHCP service.

---

6. After an IP address has been assigned to the waveform monitor by the DHCP server, the top soft key will display the assigned address.

Firmware Upgrade Procedure

After you have prepared the waveform monitor for the firmware upgrade as described in *Instrument Setup* on page E–2, perform the following procedure to upgrade the instrument firmware:

On your PC:

1. Access the Tektronix, Inc. website at www.tektronix.com and download the following two files:
   - Firmware upgrade utility (transfer.exe)
   - Image file of new firmware version (*.fmw)
2. Save the upgrade files to a convenient location on your local hard drive.

On your waveform monitor:

3. Power on the waveform monitor.
4. Push the CONFIG button.
5. Touch the System Upgrade soft key.
6. Touch either the Next Menu soft key, the Install Upgrade: Available soft key, or the Select button.
7. Touch the Start Firmware Installation softkey.
8. Read the instructions displayed on the screen and touch the Continue soft key if you want to proceed with the firmware upgrade. Touch the Cancel soft key to exit without updating the instrument firmware.

***NOTE**. Upgrading the waveform monitor firmware will not delete any instrument configuration presets you have saved.*

On your PC:

9. Locate the Upgrade Utility file (transfer.exe) you previously downloaded from the Tektronix website.
10. Double-click the transfer.exe file to start the Upgrade Utility program.
11. Click “Browse for Firmware Pathname” and browse to the *.fmw file you previously downloaded from the Tektronix website.
12. Enter the IP address of the waveform monitor into the appropriate boxes on the PC screen. (The IP address is displayed on the waveform monitor screen.)

13. Click Upgrade in the Firmware Upgrade Utility window.

14. After the upgraded firmware has been downloaded to the waveform monitor, the "Firmware File Transfer Complete" message will be displayed.

15. If you get a message on your PC that says "Instrument is not reachable!" do the following (otherwise proceed to step 16):

    a. Click OK on the PC.

    b. Touch the Cancel soft key on the waveform monitor.

    c. If you manually assigned the IP address to your waveform monitor, verify the IP address you used with your local network administrator, and then repeat the procedure in *Manually Assigning an IP Address* on page E–3.

    d. Exit the Upgrade Utility on your PC, and then restart this procedure from step 1 on page E–6.

    e. If you still get a message on your PC that says "Instrument is not reachable!," after performing these steps, contact your local network administrator.

On your waveform monitor:

16. The waveform monitor screen presents two soft key choices: Continue and Cancel. If you do not want to proceed with the firmware upgrade, touch the Cancel soft key. This is your last opportunity to cancel the upgrade.

CAUTION. *Once you touch the Continue soft key, the instrument will erase the existing flash memory and will reprogram the instrument firmware. You cannot stop the upgrade process once you touch the Continue soft key.*

To prevent the corruption of the instrument firmware, do not turn off or interrupt the power to the instrument and do not touch any instrument soft keys or controls during the firmware upgrade process. If you interrupt the firmware upgrade process after you touch the Continue soft key, you will have to return the waveform monitor to a Tektronix Customer Service Center to have the instrument firmware reinstalled.

17. To start the firmware upgrade, touch the Continue soft key (the upgrade process takes about 5 minutes). Refer to the *Caution* note above.

18. When a message appears on the waveform monitor saying "Upgrade Complete," touch the Reboot soft key.

19. Verify the instrument firmware version as follows:

- **a.** Press the HELP button.
- **b.** Touch the System Info soft key.
- **c.** Make sure the new firmware version number appears correctly.
- **d.** Exit the Help Menu.

On your PC:

20. Click Exit on the firmware upgrade screen.

21. Click Yes.

CAUTION. *If you changed the valid fixed IP address of your PC when you performed the Manually Assigning an IP Address starting on page E–3, be sure to reset the PC's IP address back to the proper address before you reconnect the PC to your network. If you misplaced your previous valid IP address, contact you local network administrator for assistance.*

This completes the upgrade procedure. If you want to verify proper instrument operation, perform the *Functional Check Procedure* on page 1–15.

NOTE*. There is no instrument calibration required after performing the firmware upgrade and there is no requirement that you verify instrument operation. If the firmware upgrade completes without any error messages, the instrument will operate properly.*

Updated versions of the WFM700 User Manual *and* WFM700 Release Notes *corresponding to your new firmware version are available from the Tektronix, Inc. website: www.tektronix.com.*

WARNING

The following servicing instructions are for use only by qualified personnel. To avoid injury, do not perform any servicing other than that stated in the operating instructions unless you are qualified to do so. Refer to all safety summaries before performing any service.

Appendix F: Cabinet and Rack Adapter Installation

This section provides instructions for mounting the WFM700 waveform monitor into the following available cabinets and rack adapter:

- WFM7F02 portable cabinet page F–2
- WFM7F03 plain cabinet page F–7
- WFM7F05 rack adapter page F–11

The information included in this section duplicates portions of the instructions that are sent with each of the installation kits. Included are installation instructions, cabinet dimension drawings, and replacement parts lists.

Preparation

These instructions are for personnel who are familiar with servicing the product. If you need further details for disassembling or reassembling the product, refer to the appropriate product manual. Contact your nearest Tektronix, Inc., Service Center or Tektronix Factory Service for installation assistance.

CAUTION. *To prevent static discharge damage, service the product only in a static-free environment. Observe standard handling precautions for static-sensitive devices while installing these kits. Always wear a grounded wrist strap, grounded foot strap, and static resistant apparel while installing these kits.*

WFM7F02 Portable Cabinet Installation

The WFM7F02 Portable Cabinet, shown in Figure F–1, is designed to house any of the 1/2 rack-width, WFM700 waveform monitors for desktop or portable applications. The cabinet has a carrying handle, two stationary rear feet, and two front feet that flip down to provide a stand.

If your WFM7F02 cabinet is missing any of the feet or if the handle is damaged, refer to Table F–2 on page F–5 for a list of replaceable parts.

CAUTION. *The ventilation holes and EMI shielding on the WFM7F02 cabinet are designed to meet the requirements of the WFM700 waveform monitor only. Do NOT attempt to install other instruments into the WFM7F02 cabinet.*

Conversely, do not install the WFM700 waveform monitor into the 1700F02 Portable Cabinet, because it does not provide the correct ventilation. Additionally, there are keying pins to exclude this application.

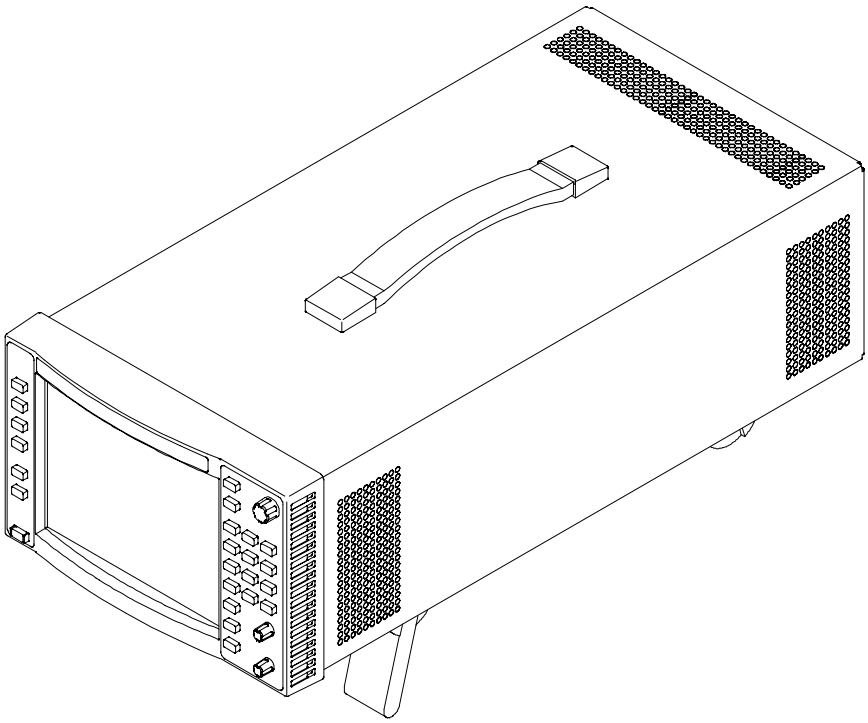


Figure F-1: WFM7F02 portable cabinet

WFM7F02 Cabinet Dimensions

The WFM7F02 cabinet dimensions, shown in Figure F–2, are provided for installation information only.

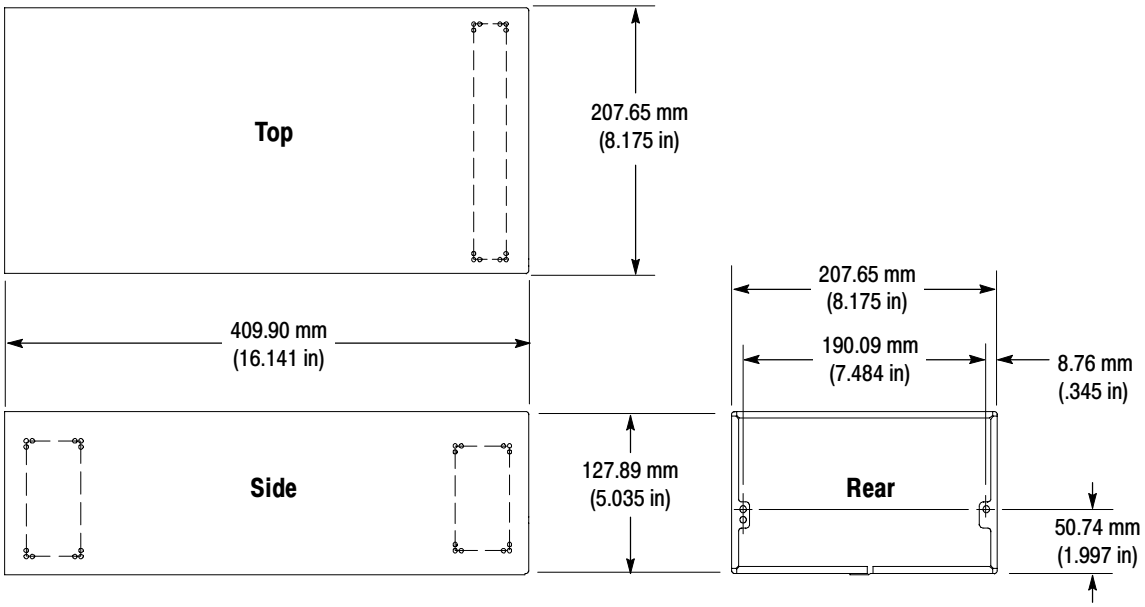


Figure F-2: WFM7F02 cabinet dimensions

WFM7F02 Minimum Tool and Equipment List

Table F–1 lists the tools and equipment you will need to install the WFM7F02 portable cabinet.

Table F-1: WFM7F02 required tools

Required tools and equipment	Part number
TORX driver (T–15)	NA

WFM7F02 Installation Instructions

Follow these instructions to install a WFM700 instrument into a WFM7F02 portable cabinet:

CAUTION. *The WFM7F02 cabinet is designed to accommodate the WFM700 waveform monitors only. Do NOT attempt to install any other products in the WFM7F02 cabinet. To do so may cause serious instrument damage and cause overheating problems.*

Do not force the instrument into the cabinet. Key pins on the WFM7F02 cabinet tabs (shown in Figure F–3)are designed work only with a WFM700 instrument. Attempting to force an instrument into the cabinet may damage the tabs.

1. Position the instrument with the front panel down on a work surface, protecting the front panel with a pad or cover to prevent damage.
2. Slide the WFM7F02 cabinet over the instrument chassis and down to rest on the front panel frame.
3. At the rear of the cabinet, install the two attaching screws through the left and right tabs and into the instrument chassis. See Figure F–3.

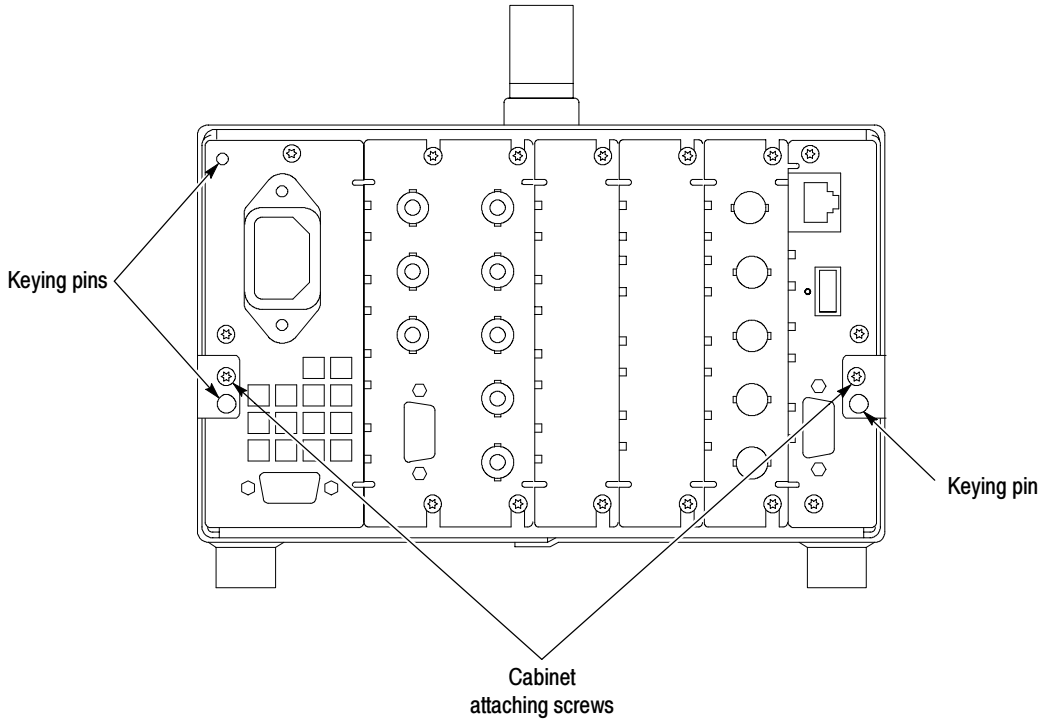


Figure F- 3: WFM7F02 rear-panel attaching screws

WFM7F02 Replaceable Parts List

Table F–2 lists the replaceable parts for the WFM7F02 portable cabinet. The numbers in the Index Number column of the table refer to the index numbers in Figure F–4.

Table F–2: WFM7F02 replaceable parts

Index Number	Quantity	Part number	Description
1	2 EA	344-0098-00	CLIP, DECORATIVE: CARRYING HANDLE
2	2 EA	213-0155-01	SCREW, SHOULDER: 10-32 X 0.355, 0.5 OD HD, STL CD PL, POZ
3	1 SET	348-1515-00	FEET, CABINET: SET OF 4
4	1 EA	200-4716-XX	COVER, FRONT: PROTECTIVE, PC/ABS, GRAY
5	1 EA	390-1212-XX	CABINET ASSY: WFM7F02, SILVER GRAY, W/FEET & HANDLE
6	1 EA	367-0037-03	HANDLE, CARRYING: 6.0 L, VINYL, GRAY
- - - - - - -	2 EA	211-0722-XX	SCREW, MACHINE; 6-32 X 0.250, PNH, STL, T-15 TORX (REAR PANEL ATTACHING SCREWS)
- - - - - - -	1 EA	071-1106-XX	MANUAL, TECH: KIT INSTRUCTIONS, PORTABLE CABINET, WFM7F02

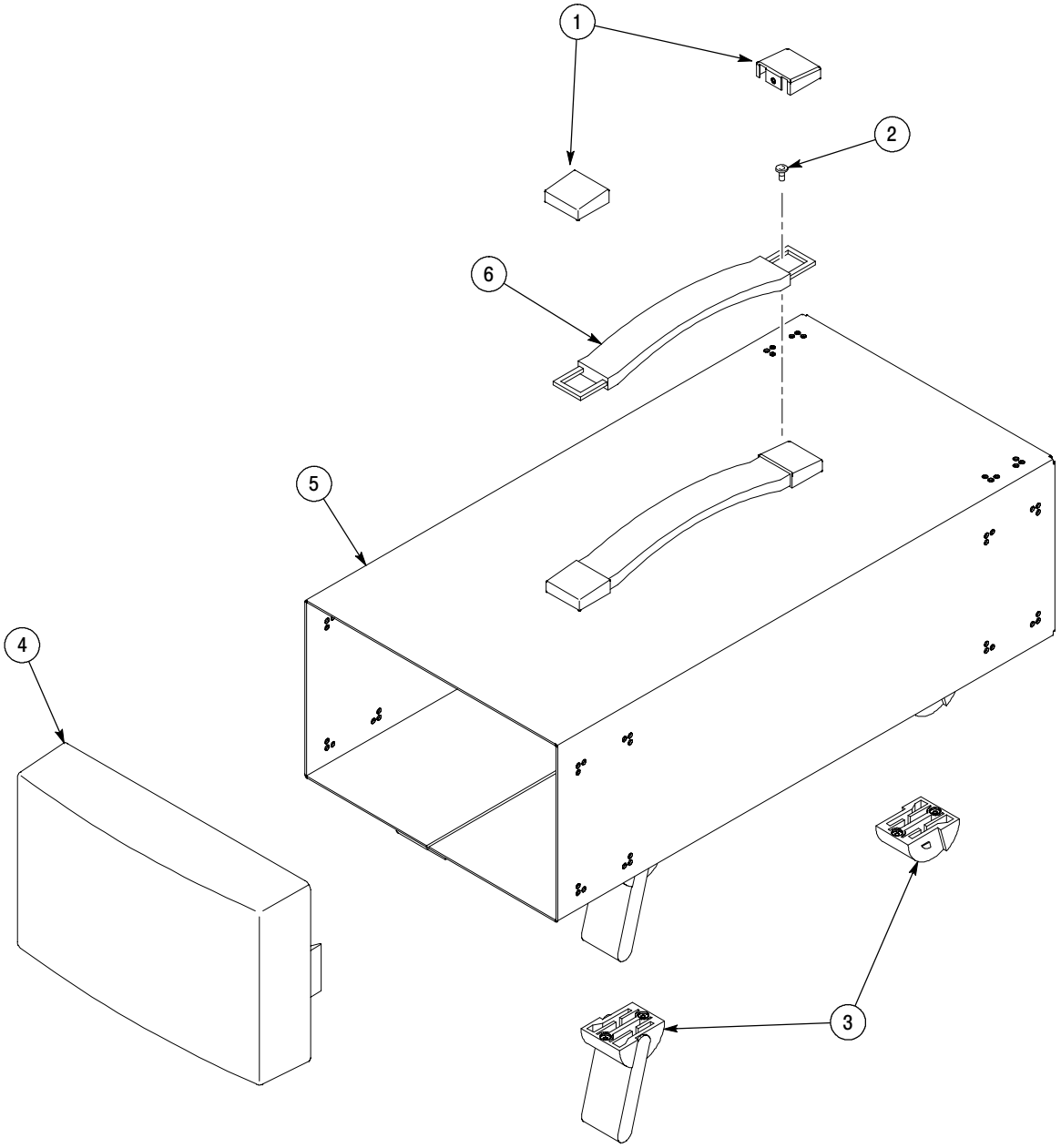


Figure F- 4: WFM7F02 replaceable parts

WFM7F03 Plain Cabinet Installation

The WFM7F03 Plain Cabinet, shown in Figure F–5, is designed to house any of the 1/2 rack-width, WFM700 waveform monitors. The cabinet does not have any feet or carrying handle.

***NOTE**. The ventilation holes and EMI shielding on the WFM7F03 cabinet are designed to meet the requirements of the WFM700 waveform monitor only. Do NOT attempt to install other instruments into the WFM7F03 cabinet.*

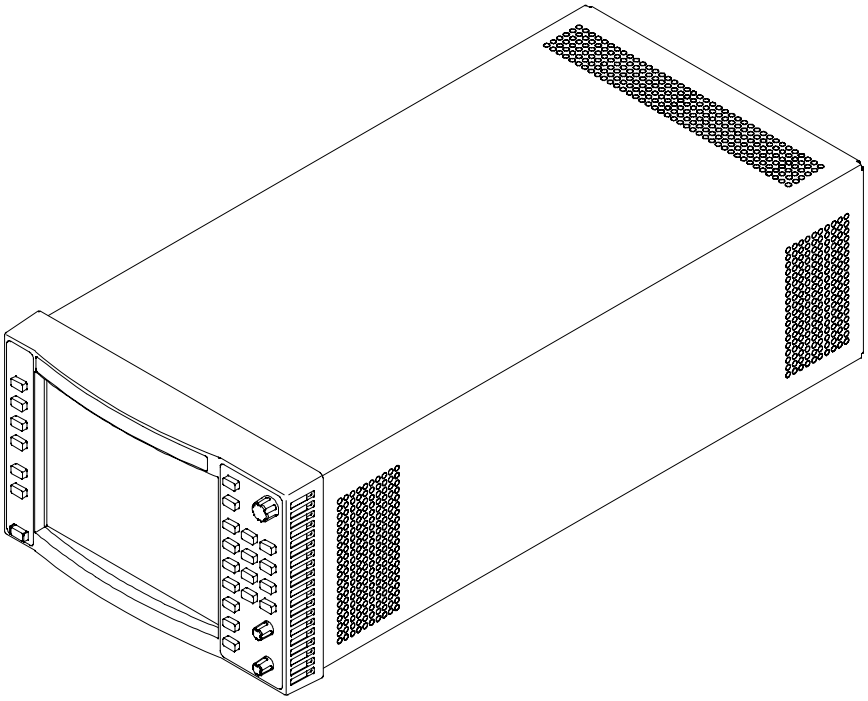


Figure F- 5: WFM7F03 plain cabinet

WFM7F03 Minimum Tool and Equipment List

Table F–3 lists the tools and equipment you will need to install the WFM7F03 plain cabinet.

Table F- 3: WFM7F03 required tools

Required tools and equipment	Part number
TORX driver (T–15)	NA

WFM7F03 Cabinet Dimensions

The WFM7F03 cabinet dimensions, shown in Figure F-6, are provided for installation information only.

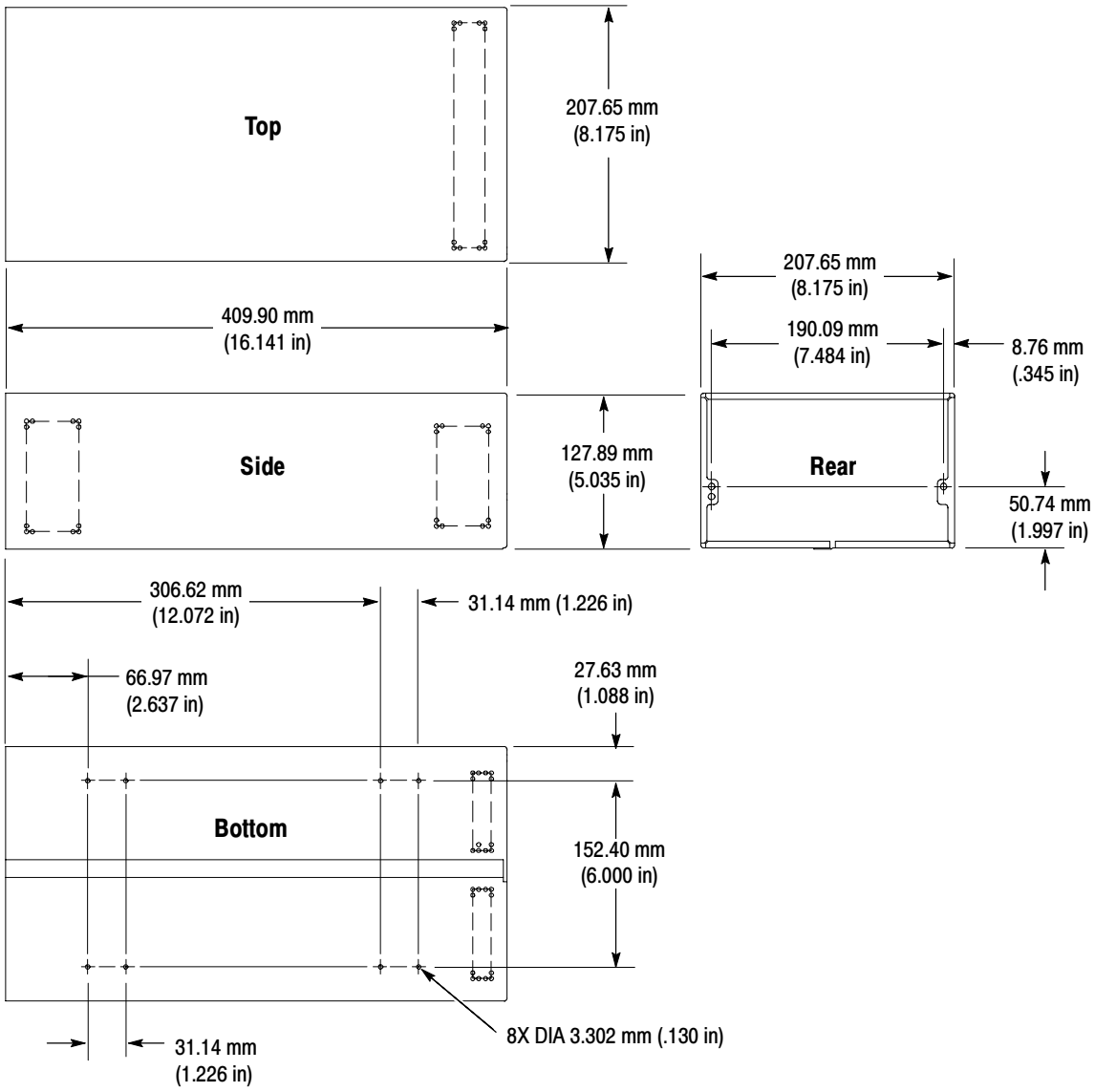


Figure F-6: WFM7F03 cabinet dimensions

WFM7F03 Installation Instructions

Follow these instructions to install a WFM700 instrument into a WFM7F03 plain cabinet:

CAUTION. *The ventilation holes and EMI shielding on the WFM7F03 cabinet are designed to meet the requirements of the WFM700 waveform monitor only. Do NOT attempt to install any other products in the WFM7F03 cabinet. To do so may cause serious instrument damage and cause overheating problems.*

Do not force the instrument into the cabinet. Key pins on the WFM7F03 cabinet tabs (shown in Figure F–7) are designed work only with a WFM700 instrument. Attempting to force an instrument into the cabinet may damage the tabs.

1. Position the instrument with the front panel down on a work surface, protecting the front panel with a pad or cover to prevent damage.
2. Slide the WFM7F03 cabinet over the instrument chassis and down to rest on the front panel frame.
3. At the rear of the cabinet, install the two attaching screws, provided in this kit, through the left and right tabs and into the instrument chassis. See Figure F–7.

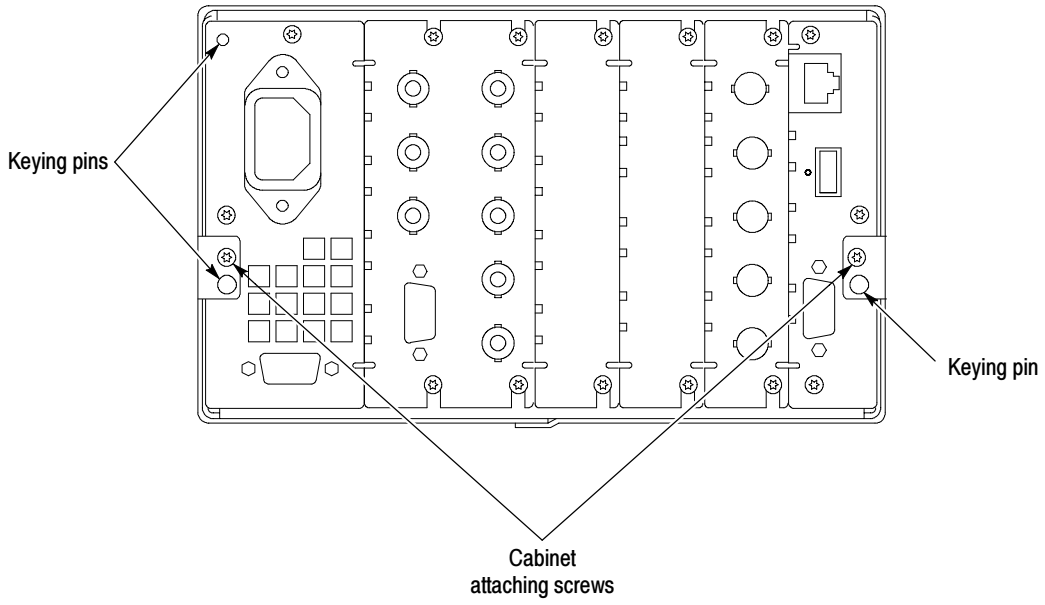


Figure F-7: WFM7F03 rear-panel attaching screws

WFM7F03 Replaceable Parts List

Table F–4 lists the replaceable parts for the WFM7F03 plain cabinet.

Table F- 4: WFM7F03 replaceable parts

Quantity	Part number	Description
1 EA	390-1215-XX	CABINET, PLAIN WRAP AROUND HOUSING, 0.05 AL, SILVER GRAY
2 EA	211-0722-XX	SCREW, MACHINE; 6-32 X 0.250, PNH, STL, T-15 TORX (REAR PANEL ATTACHING SCREWS)
1 EA	075-0748-XX	MANUAL, TECH: KIT INSTRUCTIONS, PLAIN CABINET, WFM7F03

WFM7F05 Rack Adapter Installation

The WFM7F05 rack adapter, shown in Figure F–8, is designed to house two, 1/2 rack-width instruments side-by-side in a rack. The WFM7F05 accommodates various Tektronix products by using two types of sleeves (either sleeve can be mounted in either side of the adapter):

- The WFM7F00 sleeve is designed to properly fit only the WFM700 waveform monitors.
- The 1700F00A sleeve is designed to properly fit any of the following Tektronix instruments:
  - 1700 Series
  - WFM601 Series
  - WFM300 Series
  - 760 Series
  - 1420 Series
  - 528A
  - 764

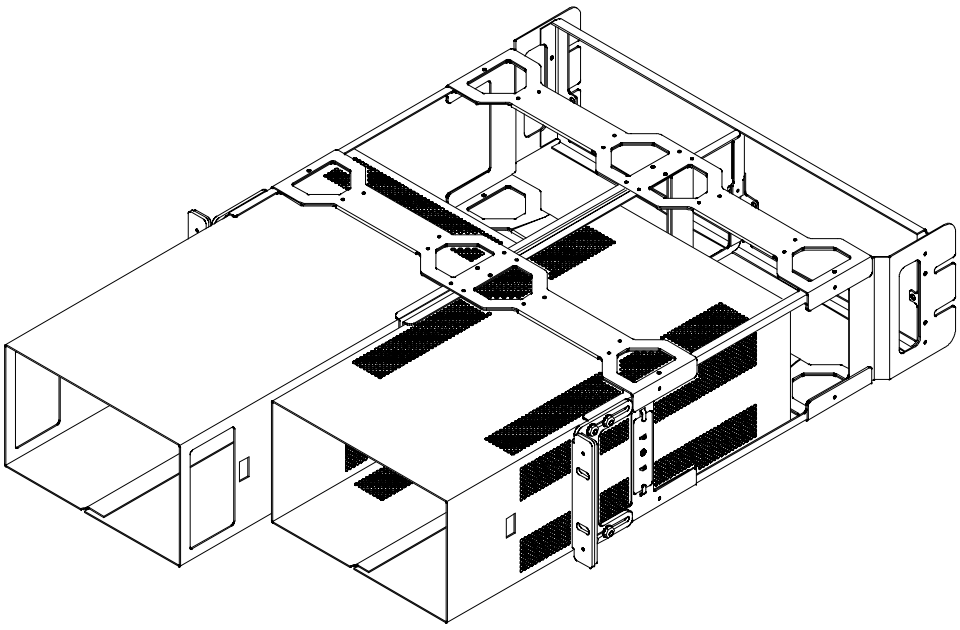


Figure F- 8: WFM7F05 rack adapter

WFM7F05 Ordering Information

When ordered, the rack adapter is configured by which of the following sleeve configurations you order:

WFM7F05 Option OO. Includes two 1700F00A sleeves.

WFM7F05 Option NN. Includes two WFM7F00 sleeves.

WFM7F05 Option ON. Includes one 1700F00A sleeve and one WFM7F00 sleeve. You can install either sleeve in either side of the WFM7F05 rack adapter.

Other Options. You can also install a sleeve in one side of the WFM7F05 rack adapter and a blank panel (1700F06) or an accessory drawer (1700F07) in the other side to improve airflow and appearance.

WFM7F05 Cabinet Dimensions

The WFM7F05 cabinet dimensions, shown in Figure F-9 through Figure F-11, are provided for installation information only.

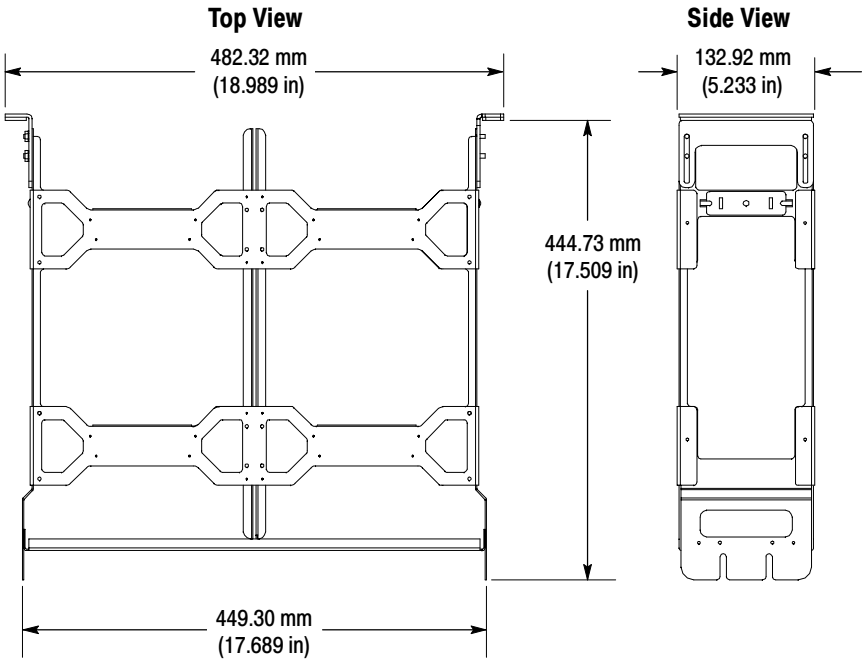


Figure F-9: WFM7F05 rack adapter dimensions

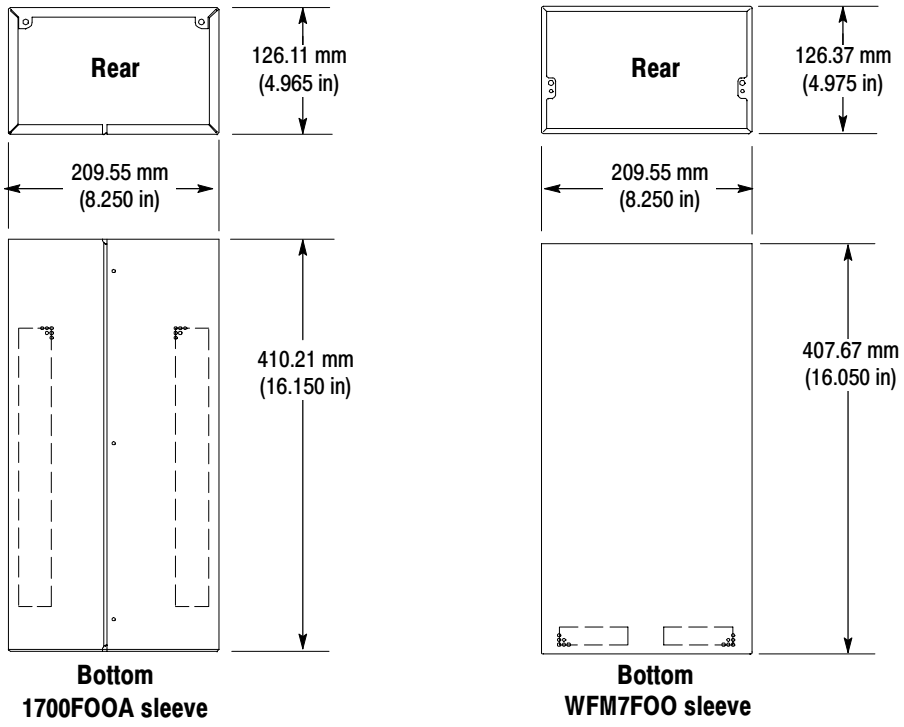


Figure F- 10: WFM7F05 sleeve dimensions

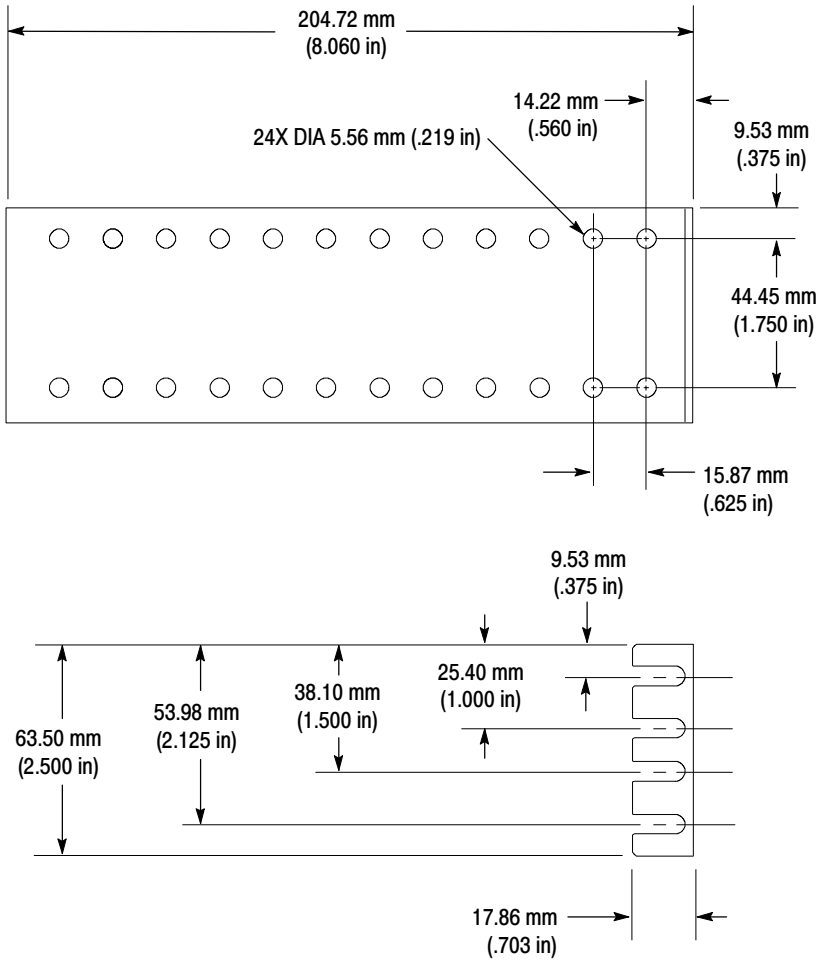


Figure F- 11: Rear bracket guide dimensions

Installing the WFM7F05 into the Equipment Rack

Before you install an instrument into the rack adapter, install the adapter into the rack as follows:

***NOTE**. The numbers in brackets in the following procedure refer to the circled numbers in Figure F–15 and in the WFM7F05 adapter parts list.*

1. If there are any sleeves installed in the rack adapter, remove them as follows: Locate the button on the inside front of the rack adapter (see Figure F–12) and hold it in while pulling the sleeve forward and out of the adapter.
2. If desired, you can adjust the position of the handle brackets to mount the adapter flush with other equipment in the rack (see Figure F–12). To do this, loosen the nuts that attach the handle brackets to the rack adapter, adjust the position of the handle brackets as desired, and then tighten the nuts securely.
3. Secure the rack adapter assembly to the front frame of the rack using four screws and four shoulder washers.
4. Install one guide bracket to one side of the rear frame of the rack using the screws and nut bar provided in the kit.
5. Secure the guide bracket to the rack adapter, using the nut bar and attaching hardware. Use the holes in the bracket that will accommodate the depth of the instrument rack frame being used. Leave the screws loose.
6. Install the other guide bracket to the other side of the rear frame of the rack, using the screws and nut bar.
7. Secure the guide bracket to the rack adapter, using the nut bar and attaching hardware.
8. Tighten all attaching screws that were left loose in the previous steps.

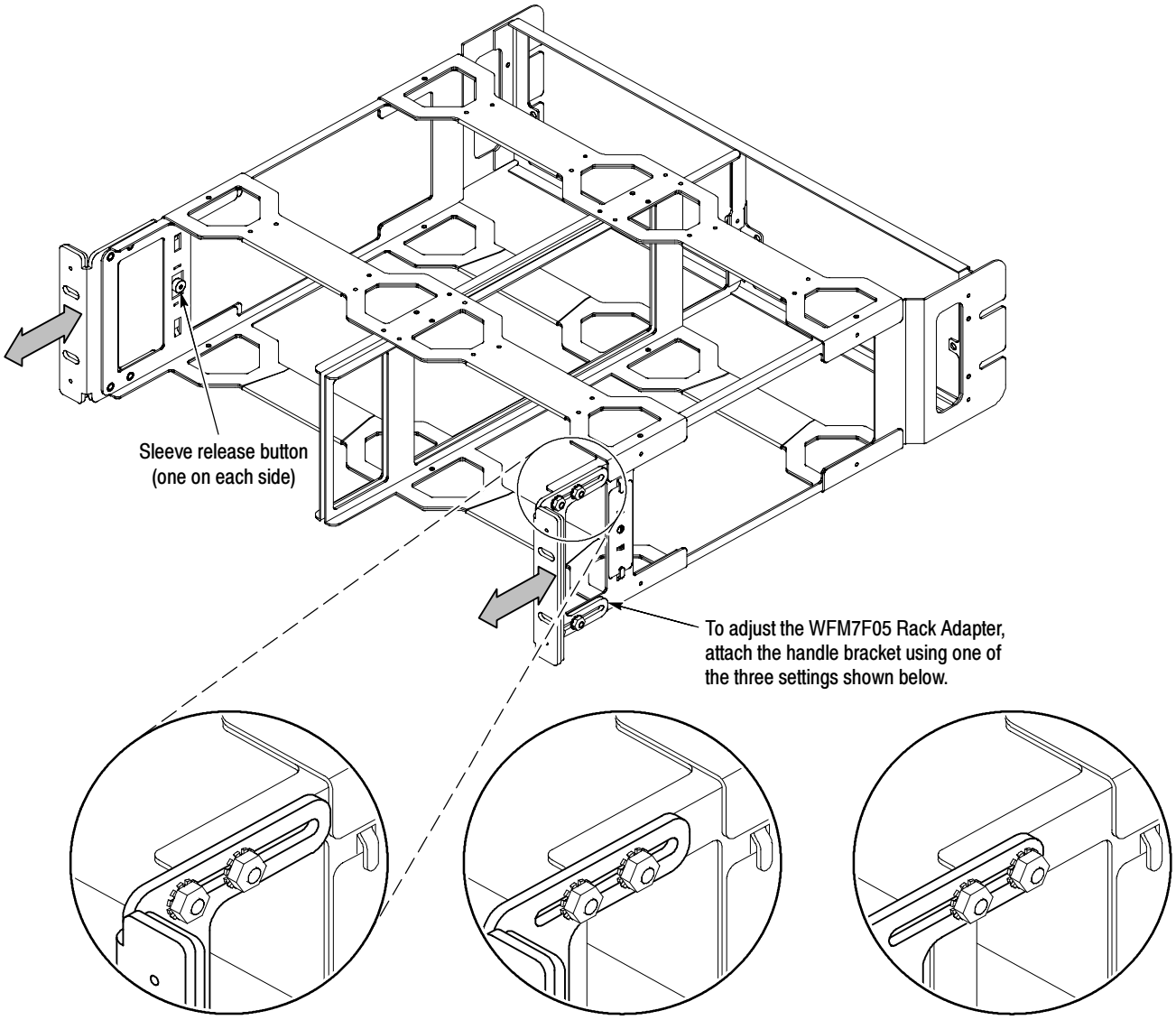


Figure F- 12: Adjusting the position of the WFM7F05 rack adapter handles

Installing an Instrument into the WFM7F05 Rack Adapter

With the rack adapter already installed in the rack, install the instrument into the rack adapter as follows:

CAUTION. *When working with instruments that are not enclosed in a chassis, you must observe static precautions. You must also be careful not to damage circuit board mounted components or interconnection wiring when sliding a sleeve over these products.*

Be sure to use the correct sleeve for your product. If you use the wrong sleeve, it could damage the instrument and cause overheating problems.

The ventilation holes and EMI shielding on the sleeves are specially designed to meet the requirements of the instruments for which they were intended.

1. Referring to Figure F–13, choose the appropriate sleeve in which to install your instrument:
   - The WFM7F00 sleeve is designed for WFM700 instruments only. The rear-panel attaching tabs are near the vertical center of the rear frame.
   - The 1700F00A sleeve is designed for 1700 Series, WFM300 Series, WFM600 Series, 760 Series, 1420 Series, and 528A instruments. The rear-panel attaching tabs are close to the top of the rear frame.

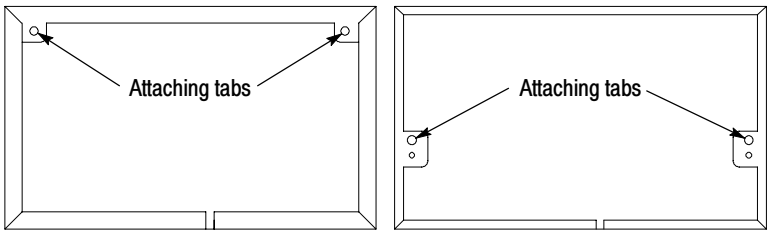


Figure F- 13: Rear view of the WFM7F05 sleeves, showing the locations of the attaching tabs and screws

2. Slide the sleeve into the desired half of the rack adapter, depressing the button on the inside front of the rack adapter as needed to insert the sleeve. See Figure F–14.

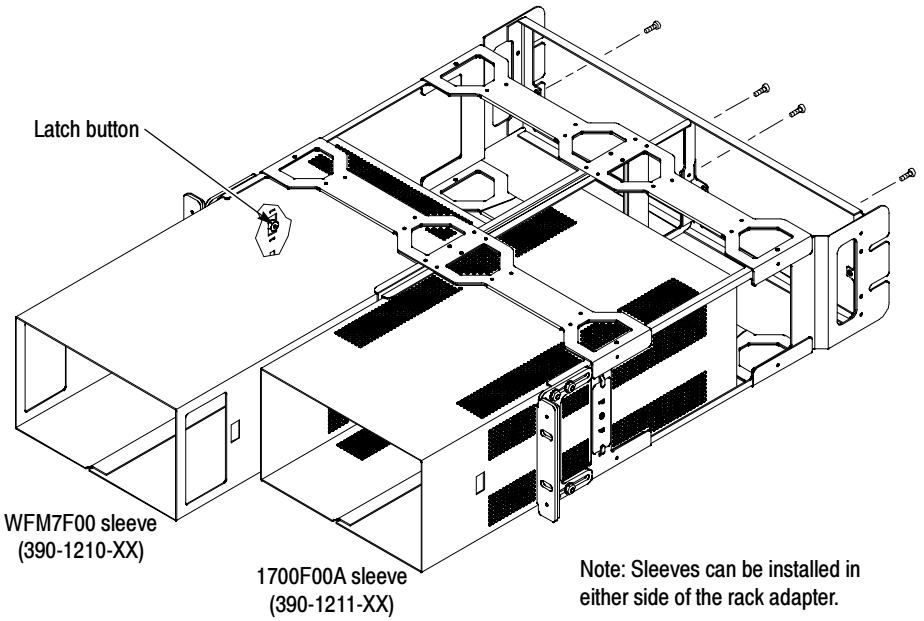


Figure F- 14: Installing the sleeves into the WFM7F05 rack adapter

WARNING. *During installation, the instrument could slide out of the sleeve and cause instrument damage or injury. To prevent the instrument from sliding out of the sleeve, be careful to hold the instrument until it is secured.*

3. Make sure that the button pops back out and that it securely locks the sleeve in the rack adapter.

CAUTION. *Do not force the instrument into the cabinet. Keying pins on the tabs at the rear of the sleeves are designed to work only with the correct instrument. Attempting to force an instrument into the sleeve may damage the tabs.*

4. Slide the instrument into the sleeve. Be careful not to let the instrument slide out of the sleeve until the two screws are attached on the rear.

5. On the rear panel, install and tighten the two attaching screws as follows:

   - For the WFM7F00, insert the screws through the rack adapter, through the tabs on the sleeve (Figure F–13), and then into the instrument rear panel.
   - For the 1700F00A, insert the screws through the holes on the top right and left of the sleeve (Figure F–13) and into the instrument rear panel. The screws do not attach to the rack adapter; this sleeve is held in place by the button on the inside front of the rack adapter.

WFM7F05 Replaceable Parts List

Table F–4 lists the replaceable parts for the WFM7F05 rack adapter (item numbers refer to the circled numbers in Figure F–15).

Number	Quantity	Part number	Description
1	1 EA	407-4892-XX	BRACKET: RACKMOUNT, DUAL SIDE-BY-SIDE, FOR WRAP-AROUND CABINETS
	1 EA	016-1908-XX	HDW KIT, RACK MOUNT, CONSISTING OF:
2	4 EA	211-0540-XX	SCREW, MACHINE: 6-32 x 0.5, TRH.STL
2	4 EA	212-0008-XX	SCREW, MACHINE: 8-32 x 0.5, PNH.STL
3	4 EA	213-0090-XX	SCREW, MACHINE: 10-32 X 0.5, HEX HD, STL
4	4 EA	210-1061-XX	WASHER, FLAT: 0.203 ID X 0.625 OD X 0.062
5	2 EA	407-3752-XX	BRACKET, GUIDE: LEFT & RIGHT REAR
6	4 EA	212-0509-XX	SCREW, MACHINE: 10-32 X 0.625, PNH, STL CDP
7	4 EA	381-0251-01	NUT BAR: 10-32 X 3.0 X 0.375 X 0.125
8	1 PR	407-4906-XX	BRACKET, HANDLE: ALUMINUM
9	8 EA	210-0458-00	NUT, PL, ASSEM WA: 8-32 X 0.344, HEX, STL, CD PL, W/EXT TOOTH LOCKWASHER
10	4 EA	210-1298-01	WSHR, SHLDR & REC: 0.195 ID X 0.195 THK
11	4 EA	212-0591-XX	SCREW, MACHINE: 10-32 x 0.75, OVH.STL
11	4 EA	213-0199-XX	SCREW, MACHINE: 12-24 x 0.75, OVH.STL
12	----	390-1211-XX	CABINET: WRAP-AROUND, FOR 1700 SERIES (QUANTITY DETERMINED BY OPTION)
13	----	390-1210-XX	CABINET: WRAP-AROUND, FOR WFM700 (QUANTITY DETERMINED BY OPTION)
----	1 EA	071-1107-XX	MANUAL, TECH: INSTRUCTIONS, WFM7F05

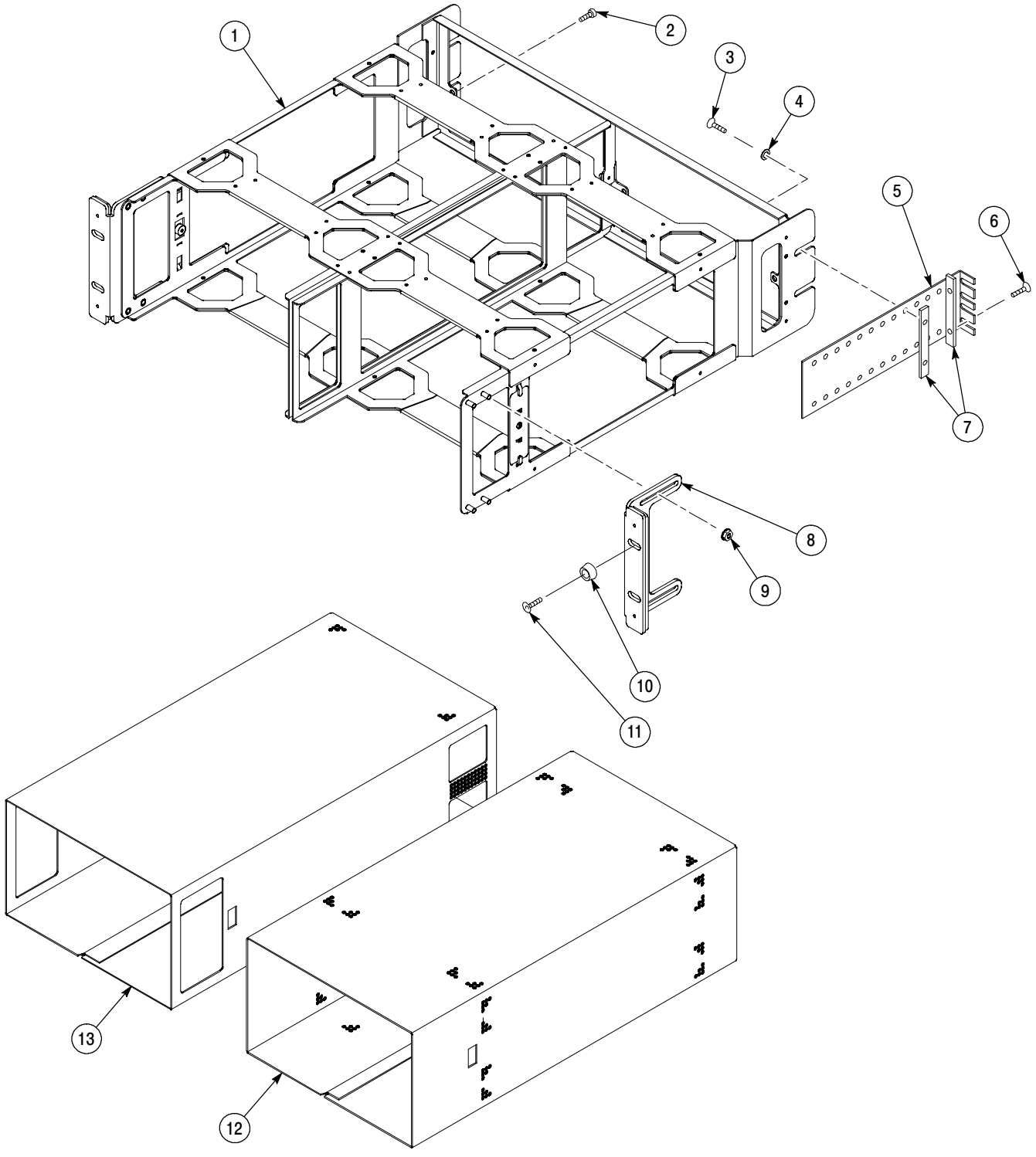


Figure F- 15: WFM7F05 rack adapter replaceable parts

Appendix G: Module Installation

This section provides precautions and instructions for adding or replacing a module.

Preventing Electrostatic Discharge

When performing any service that requires internal access to the instrument, adhere to the following precautions to avoid damage due to electrostatic discharge (ESD):

- Minimize handling of static-sensitive circuit boards and components.
- Transport and store static-sensitive modules in static protected containers.
- Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules.
- Service static-sensitive modules only at a static-free work station.
- Do not allow anything capable of generating or holding a static charge on the work surface.
- Handle circuit boards by the edges or hold onto grounded shields when possible.
- Do not slide circuit boards over any surface.

Module Slot Assignments

Different modules can be installed in different slots. It is important to use the correct slot(s) for your module type. To determine in which slot(s) you can install the particular module, refer to the instructions that were shipped with your module. Slot assignments are shown in Figure G–1.

CAUTION. *Install the module only in an appropriate slot, according to the instructions that were shipped with your module. If you use a different slot, the module will not operate properly and will fail boot up diagnostics.*

NOTE*. Before you can install a WFM7HD, WFM7A, or WFM7M, in slot 3, you must have one of these modules installed in slot 2.*

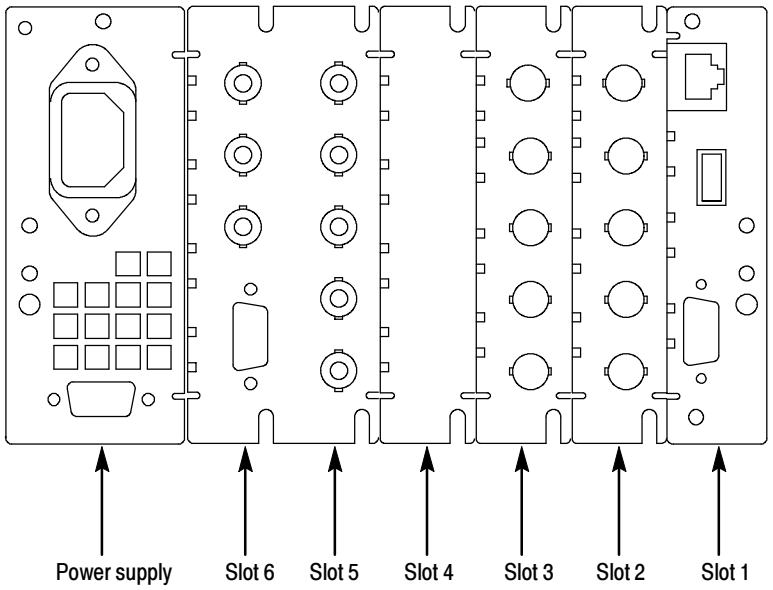


Figure G-1: WFM700 rear panel slot numbers (two input cards installed)

Adding or Replacing a Module

Table G-1: Tools required

Name	Description
Torx screwdriver handle	Accepts Torx-driver bits
T-10 and T-15 Torx tips	Torx-driver bit for T-10 and T-15 screw heads

Use the following procedure to add a new module or replace a module.

WARNING. *Disconnect the power source from the WFM700 before beginning this or any procedure requiring you to remove the cover from the instrument chassis. Fan blades and other components inside the instrument could cause serious injury if power is on while the instrument chassis is open.*

1. Remove the instrument from the portable cabinet or rack adapter sleeve. If necessary, you can refer to *Hardware Installation* in the *WFM700 User Manual.*
2. Place the instrument on a static-safe work surface. Be sure to follow safe handling procedures to avoid electrostatic damage to the instrument or module (refer to *Preventing Electrostatic Discharge* on page G–1).
3. Remove the chassis cover as follows:
   a. Loosen three attaching screws (T-10) along the left side and three screws along the right side of the chassis cover (see Figure G–2). Loosen the screws sufficiently to free the cutouts in the cover (about 3 turns) or remove the screws if desired.
   b. Remove two screws (T-10) from the front of the chassis cover (see Figure G–2). Save the screws for reinstallation.

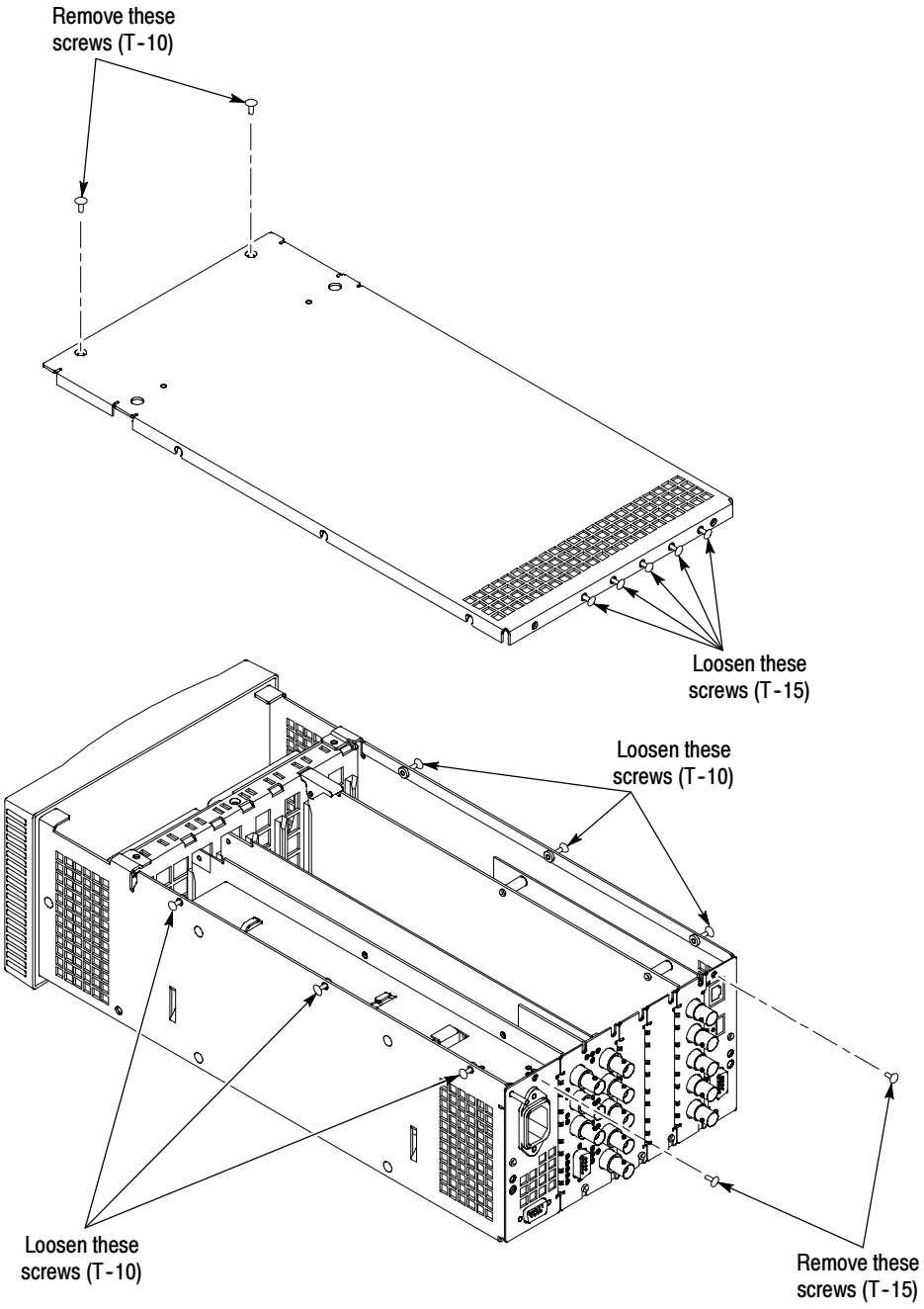


Figure G-2: WFM700 chassis, showing screws to loosen and remove

c. Loosen the attaching rear-panel screws (T-15) at the top of the module rear panels in slots 2 through 6 (see Figure G–2 for screw locations and Figure G–1 for slot numbering). Loosen the screws sufficiently to free the cutouts in the cover (about 3 turns) or remove the screws if desired.

d. Remove a screw (T-15) from slot 1 and from the power supply (see Figure G–2 for screw locations and Figure G–1 for slot numbers).

e. Lift the cover off the instrument. The rear-panel screws that you loosened will remain in the cover.

4. To add a module: Read this entire step before proceeding.

a. Referring to the instructions that were shipped with your module, identify an appropriate slot in which to install the module.

b. Loosen the screw from the bottom of the unneeded rear panel spacer and pull it up and out of the instrument chassis.

CAUTION. *When inserting a module, slide the module straight down to avoid damaging the EMI flaps on the rear panels.*

Be sure that the white ejector lever is level with the module, so that it will not be jammed in the fan housing as you install the module.

c. Prepare to insert the module by lining it up with the plastic guide toward the front of the instrument and by placing the white ejector lever in the down position, level with the module. See Figure G–3.

d. Slide the module straight down, into the plastic guide, and line up the connectors on the module with the pins on the Main board below.

e. Applying firm pressure to both ends of the module, press it all the way down and into place.

f. Install and tighten the screw (T15) that attaches the bottom of the module rear panel to the instrument chassis.

g. If you are installing a second input module, install the grounding clip that was shipped with the module (see Figure G–4).

h. Proceed to Step 6 on page G–8.

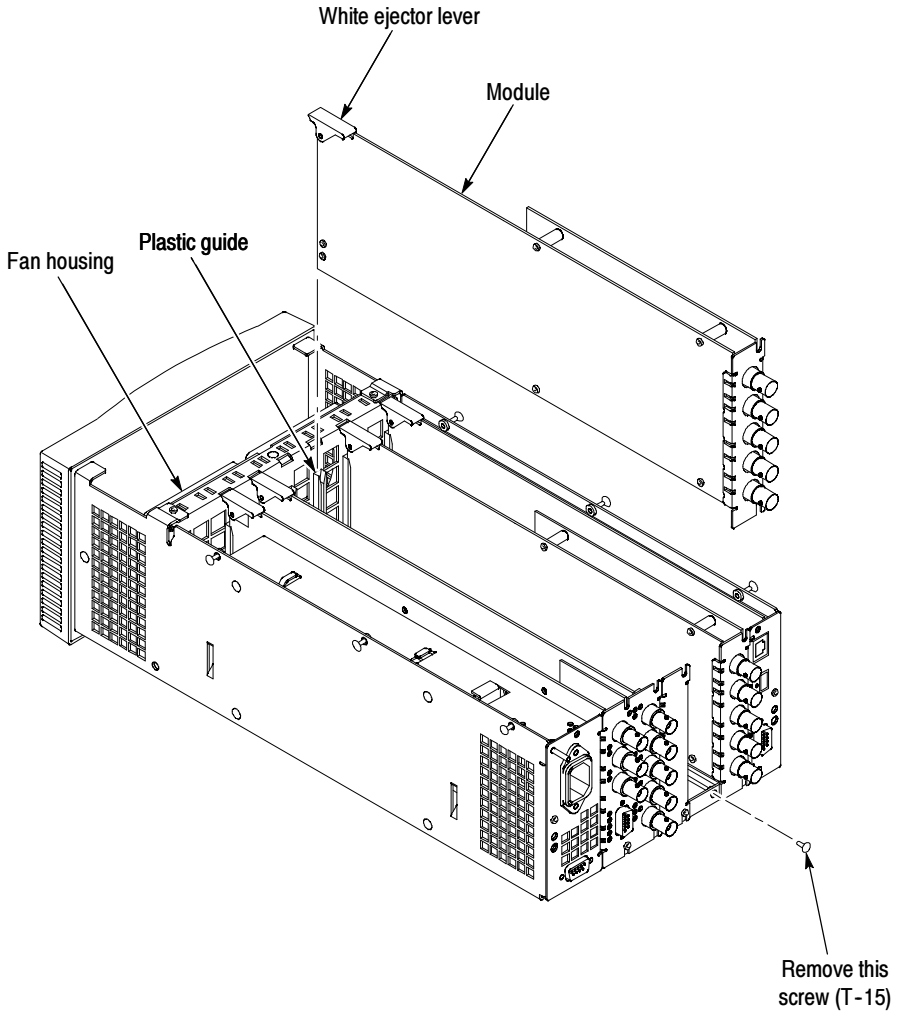


Figure G-3: Inserting the module into the chassis

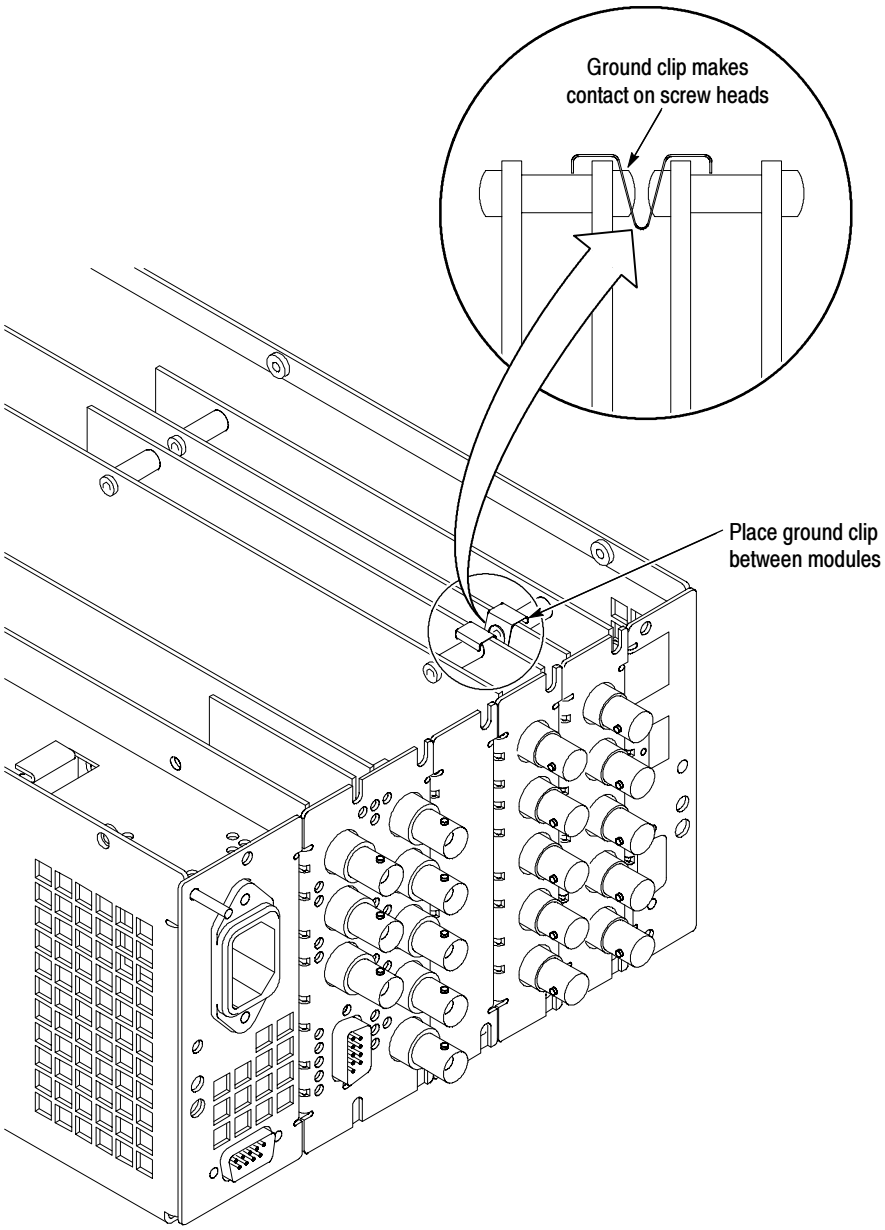


Figure G-4: Installing the grounding clip between two input modules

5. To remove a module: Read this entire step before proceeding.

   a. Loosen the bottom screw on the rear panel of the module you are going to remove.

   b. If you have two input cards with a grounding clip installed, remove the grounding clip (see Figure G–4).

CAUTION. *When removing a module, be careful to avoid damaging the EMI flaps on the rear panels.*

   c. Lift the white ejector lever located near the front of the module.

   d. Holding onto the lever and the rear panel BNC, carefully pull the module straight up and out of the instrument. Be careful not to damage the EMI flaps on the rear of the modules.

   e. If you are replacing the module with a new module, follow the instructions for adding a module in step 4.

6. Replace the chassis cover as follows:

   a. Insert the lip on the rear of the cover inside the rear panel, lining up the screws in the cover with the rear panel cutouts.

   b. Line up the screws along the left and right sides of the cover with the cutouts on the sides of the chassis.

   c. Install the two screws that you removed across the front edge of the chassis cover and the two screws that you removed from the slot 1 and power supply rear panels.

   d. Hold the cover on the chassis tightly, applying pressure to compress the foam underneath. Tighten the screws along the right and left sides of the chassis. (If it is easier for you, turn the instrument chassis on its side while tightening these screws.)

7. Reinstall the instrument into either a portable cabinet (WFM7F02) or a rack adapter (WFM7F05).

8. Install the power cord and power on the instrument.

9. Run the diagnostics (press the CONFIG button and select the Run Diagnostics soft key) to be sure there is no problem with the new module.

10. You can select the following menu sequence to see a list of all installed modules, including any new modules:

    [HELP button > System Info > Installed Modules]

11. This completes the module installation. To verify proper instrument operation, perform the *Functional Check Procedure* on page 1–15.

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