

Service Manual



WFM700 Series Waveform Monitors

071-0915-04

This document applies to firmware version 1.3.0 and above.

Warning

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

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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 is the service manual for the WFM700HD, WFM700A, and WFM700M multi-format, multi-standard waveform monitors.

Read this preface to learn how this manual is structured, what conventions it uses, and where you can find other information related to servicing this product.

Manual Content

This manual contains only information related to servicing the WFM700 instrument. For information related to installing and operating the instrument or for a list of instrument specifications, refer to the appropriate user document as described in *Related User Documents* on the following page.

Be sure to read the introductions to all procedures. These introductions provide important information needed to do the service correctly, safely, and efficiently.

Manual Conventions

This manual uses certain conventions that you should become familiar with before attempting service.

Module The term module refers to a collection of items that are replaceable as a unit. A module may contain electrical and mechanical assemblies, circuit boards, and interconnecting cables.

Plug-in Module The term Plug-in Module refers to the units that plug into the Main board.

Replaceable Parts This manual refers to any field-replaceable assembly or mechanical part by its name or generically as a replaceable part. In general, a replaceable part is any circuit board or assembly that is listed in the *Replaceable Parts* section.

Safety Symbols and terms related to safety appear in the *General Safety Summary* found at the beginning of this manual.

Be sure to read both the General Safety Summary and Service Safety Summary before performing any service to this instrument.

Related User Documents

The following related English user documents are available if you need more information about operating the instrument. These documents are located on the WFM700 User Documentation CD-ROM or can be downloaded from the Tektronix, Inc. Web site (www.tektronix.com).

- *WFM700 User Manual*. This document provides the basic information you need to install and operate the instrument. Included is a listing of the options and accessories available for the instrument.
- *WFM700 Series Technical Reference* (English). Contains the following technical information about the instrument:
 - Electrical and physical specifications, including a list of certifications and compliances
 - Descriptions of each menu selection, the status displays, and the Option DG audio displays
 - Instructions for operating the instrument using remote control, including the ground closure, Web server, and SNMP interfaces
 - Procedures for checking the basic functions of the instrument, for upgrading the instrument firmware, and for performing the user-service tasks such as cleaning and maintenance, cabinet and rack adapter installation, and module installation or replacement
- *WFM700 Release Notes*. 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.
- *WFM700 Series SNMP MIB Reference* (English). Describes the syntax of the variables and traps for remotely controlling the instrument over a network using SNMP.

Non-English Language Documents

The following non-English language documents are available:

- *WFM700 Series User Documentation Package* (Japanese). Contains a printed Japanese language user manual and the CD-ROM described on the previous page.
- *WFM700 Series User Documentation Package* (Korean). Contains a printed Korean language user manual and the CD-ROM described on the previous page.

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.
- *Audio Monitoring*. This application note describes balanced and unbalanced audio signals, and explains the physical and electrical characteristics and the specific strength and weaknesses of the different digital audio signal formats.
- *Monitoring Surround Sound Audio*. This application note describes the basics of 5.1-channel surround sound audio and how to use the Surround Sound display to visualize key audio-level and phase relationships in this audio format.

Contacting Tektronix

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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	www.tektronix.com/support 1-800-833-9200, select option 3* 6:00 a.m. - 5:00 p.m. Pacific Standard 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.



Theory of Operation

Theory of Operation

This chapter contains a module-level description of the WFM700 instrument. Two block diagrams are provided to aid the descriptions. Figure 1-1 on page 1-8 shows the signal flow of the instrument and Figure 1-2 on page 1-9 shows the control flow.

Operating Conditions

The electrical specifications of the instrument are listed in the *WFM700 Series Technical Reference* document and 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.

Overview

The WFM700 accepts either SD (Standard Definition) or HD (High Definition) serial video data at the input connectors of an installed Input Module (in either slots 1 or 2 of the WFM700 mainframe). The applied video signal is sent to SD and HD equalizers (to compensate for signal degradation due to cable loss) and to the eye sampler. The compensated serial video signal is converted to parallel video and a clock signal is recovered. The parallel signal is further processed to extract the embedded audio signal, detect the video format, and generate an RGB Analog video signal. The embedded audio is encoded into AES signals that are sent to the optional Audio module by way of the audio bus.

The parallel video signal is sent to the Real-time Display module on a digital bus, 10 bits for SD video and 20 bits for HD video. The RGB video is sent to the Reference module on the analog bus for component video output at the PIX G/Y, PIX B/Pb, and PIX R/Pr connectors and the VGA PIX MON connector.

The Real-Time Display module accepts the parallel video signal from the selected Input Module. The video signal is processed to display the information in various forms on the raster display. The output from the Real-Time Display module is sent to the Main Interface board via LVDS pairs. There the video signal is added with text and graticule information from the VGA controller. The combined video signal is sent to the LCD and the EXT VGA output connector.

Timing is accomplished by using the clock and TRS (timing reference signal) from the video input signal. A clock and TRS (from an analog video signal) can be input via the External Reference module using the AUX IN connector.

Communication between modules and the CPU is accomplished via the Main Interface board using two main control busses (PCI and Serial) and two RS232 connections. The Input Modules and Real-Time Display module use the PCI bus. The Reference Module uses the Serial bus. The Front Panel uses RS232 to communicate with the CPU which interprets the information and sends the commands to the appropriate modules. The CPU also communicates with the Environmental Controller (on the Main Interface board) via an RS232 connection.

Power for the WFM700 is provided by the power supply module. The power supply module accepts line input voltages within the range of 100 VAC to 240 VAC. Anytime line input voltage is supplied to the power supply module, a +5 V housekeeping supply is activated, providing power to the front panel ON/STBY switch and to the Environmental Controller (EC) on the Main Interface board. Pressing the ON/STBY button activates the main power supply (within the Power Supply module), providing power to the entire instrument and modules.

Once the power supply stabilizes, the CPU module polls all slots (via the PCI bus and Serial Control bus) to determine the installed modules.

Individual Module Descriptions

The following descriptions provide more detail about the individual functions of each instrument board or module.

Front Panel Processor

The Front Panel Processor board sends all front panel actions (including the touch screen) to the CPU board via the RS232 Bus.

LCD and Backlight

The LCD panel displays the video output from the Main Interface board via the VGA Mux. The Backlight board supplies the high voltage necessary to drive the backlight for the LCD panel.

Input Module

The Input module is comprised of two circuit boards, a Mezzanine board and an Input board.

The Mezzanine board provides two terminating serial inputs, each supporting either SD (SMPTE 259M) or HD (SMPTE 292M) SDI signals. A mux selects between the two inputs and sends the signal to an eye pattern sampler block and a serial receiver block (equalizing the signal). The eye pattern sampler block implements a 3 GHz equivalent-time sampler to allow viewing the input eye pattern. The equalized SD or HD signal and the eye pattern data samples are sent to the Input board.

On the Input board, an SD or HD serial-to-parallel block provides clock recovery and serial-to-parallel conversion of the selected input. An FPGA block multiplexes between the eye sampler output and serial receiver block output (depending on instrument mode), implements any needed waveform conditioning (such as ancillary data extraction), and outputs the parallel signal (20 bits for HD mode, 10 bits for SD mode) to the Real-Time Display (RTD) board. The FPGA block also extracts up to eight channels of audio signal which is put on the audio bus for future use.

A DAC block creates a picture monitor signal which is output through the VGA PIX MON connector and the component video connectors (PIX G/Y, PIX B/Pb, PIX R/Pr) on the Reference Module.

External Connectors

- **INPUT A.** Digital input for signal to be monitored. For WFM700HD, this can only accept 1.485 Gb/s and 1.4835 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 and 1.4835 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.
- **SD PIX MON.** This output is a copy of the PIX G/Y, B/Pb, R/Pr pix mon output, but in reclocked SD serial digital format. It is operational only for SD input formats.
- **SERIAL OUT.** Provides an equalized and buffered 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.

Reference Module

The External Reference module provides synchronization for the WFM700 instrument, allowing you to sync the display to an analog video input. The Reference Module accepts PAL and NTSC signals with bi-level sync (SD) or tri-level sync (HD) input, so that timing of the SDI input signals can be compared to the analog sync reference. The External Reference module automatically detects the input standard. The Reference Board timing signals are available to both the Input Module and Real-Time-Display Module.

The sync signal from the External Reference module is embedded in a data stream of 27 MHz (for SD video), and 74.25 MHz or 74.1758 MHz (for HD video). This data stream is called the TRS signal, and contains H, V, and F information. The External Reference module acts as a data hub or router for TRS (timing reference signal) signals to and from the input modules (slots 0 or 1) and the Real-Time Display module.

External Connectors

- 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.
- 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.
- 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.
- AUX OUT 1 / AUX OUT 2. Future capability.

Main Interface Board

The Main Interface board provides signal paths and communication paths between all modules.

- PCI Bus and Serial Control Bus are used for control and data transfer. Both go to all slots. The PCI Bus is typically used for modules requiring high-speed performance and communication between modules without the use of the CPU board. The Serial Control Bus is used for modules requiring less control and speed.
- The Timing Bus is used to distribute the TRS signal to the Input Modules and the RTD board.
- The Audio Bus routes the digital audio signal (extracted from the video serial input) to the module slots for use by future modules.
- The Video Bus routes the parallel video signal (with clock and sync signals) to the RTD slot from the two Input slots.

The Main Interface board provides power distribution, contains thermal sensors, and contains the Environmental Controller (EC). The EC monitors the front panel ON/STBY switch to control the main power supply (in the Power Supply module) and monitors all low voltage power sensors for inaccurate voltage levels.

The VGA Controller routes the video signal to both the LCD and the EXT VGA output. This output can be used to drive an external monitor to produce the same display as seen on the LCD.

External Connectors

- EXT VGA. Provides an exact copy of the LCD screen to drive an external monitor.

CPU Board

The CPU board receives commands from the Front Panel (buttons, knobs, and touch screen) via RS232 connections, then transmits instructions to the other modules via the PCI bus and Serial bus. The CPU also defines the operation of the video channels (but is not in the video signal path). All text and graticule information for the LCD panel is generated by the CPU board and sent to the LCD via the VGA Mux on the Main Interface board.

External Connectors

- **REMOTE.** 9 pin subminiature D-type connector used as a Ground Closure interface for remote control.
- **USB.** This connector is not used and was removed for CPU board versions 671-4528-04 (SN B019999 and below) and 671-5751-03 (SN B024089 and above).
- **ETHERNET.** (10/100 Base T). 10/100 Mbit/sec Ethernet interface. Used for downloading firmware upgrades.

Real Time Display (RTD) Board

Real Time Display board receives the parallel digital video signal from the Input module and processes the video data to display the information in various forms on the raster display. The different forms of display consist of sweeps (overlay or parade), x y (vectors, lighting, diamond, ect.), and picture monitor. The RTD board handles either standard definition (SD) or high definition (HD) data. Only one channel is processed at a time.

The RTD is divided into two logical sections. The first section, the DSP engine, performs signal processing and routing operations to create standard waveform monitor displays. The second section, the rasterizer engine, performs attack and decay operations to simulate an analog CRT phosphor screen. The rasterizer also has the ability to partition multiple displays into separate windows.

The RTD accepts a 10 or 20-bit data stream (SD or HD) from either of two input slots. A polyphase interpolator increases the data rate and fills gaps in the data. The higher data rate allows the rasterizer to plot more pixels per second to improve the display quality. The Measurement Processing block produces various waveform displays such as Parade, Vector, and Diamond and also performs gain, offsetting, and filtering operations. It outputs pairs of numbers used by the Rasterizer and its companion memory to build a display map. Memory values are incremented or decremented depending on these number pairs, varying pixel display brightness according to frequency of occurrence, similar to a phosphor screen. A Picture Mode Processing block allows a raster picture display of the input signal, suitably adjusted to the 640x480 VGA display format. The Rasterizer output is applied to the color LCD display after it is combined with any text and graticules from the VGA controller.

Audio Module (Option DG)

The Audio board receives serial audio data in AES/EBU format from the selected Input module, or from the AES I/O connectors if they are configured as inputs. When configured as outputs, the AES I/O connectors supply AES/EBU serial audio de-embedded from the selected video input. The selection of extracted embedded audio groups takes place within the Input module.

AES/EBU signals from the selected source are processed to extract channel status, validity, and parity bits. The audio data is examined for clip and mute conditions, and word length (active bits) and peak values are determined. Audio data is up-sampled to 192 kb/sec for further processing.

DSP processors compute audio level according to the configured level meter ballistic. The CPU periodically polls the Audio Module to get the current audio levels, and then draws the corresponding bars via the VGA controller. Other data concerning audio (clip, mute, channel status etc) is communicated in a similar fashion from the Audio Module to the CPU for display, data logging, or alarm activation.

A DSP processor creates a Lissajous image that is periodically transferred directly to the VGA controller via the PCI bus.

External Connectors

- AES 1-2 I/O / AES 3-4 I/O / AES 5-6 I/O / AES 7-8 I/O. Four AES/EBU format, AES-3id compatible inputs or outputs. As outputs, they supply serial audio de-embedded from the selected video input. As inputs, they can be selected for complete processing and display in place of embedded audio.

Power Supply Module

The power supply module accepts line input voltages within the range of 100 VAC to 240 VAC. Anytime line input voltage is supplied to the power supply module, a +5 V housekeeping supply is activated, providing power to the front panel ON/STBY switch and to the Environmental Controller (EC) on the Main Interface board. The EC continuously polls the front panel ON/STBY switch. Pressing the front panel ON/STBY button instructs the EC to activate a relay in the power supply module, activating the Main Power supply. The Main Power supply provides +5 V, +3.3 V, +12 V and -12 V to the circuits and other modules via the Main Interface board. The EC monitors all power supply voltages and shuts down the Main Power supply if a problem is detected.

Diagrams

Figure 1-1 on page 1-8 is a block diagram of the signal flow of the instrument. Figure 1-2 on page 1-9 is a block diagram of the control flow.

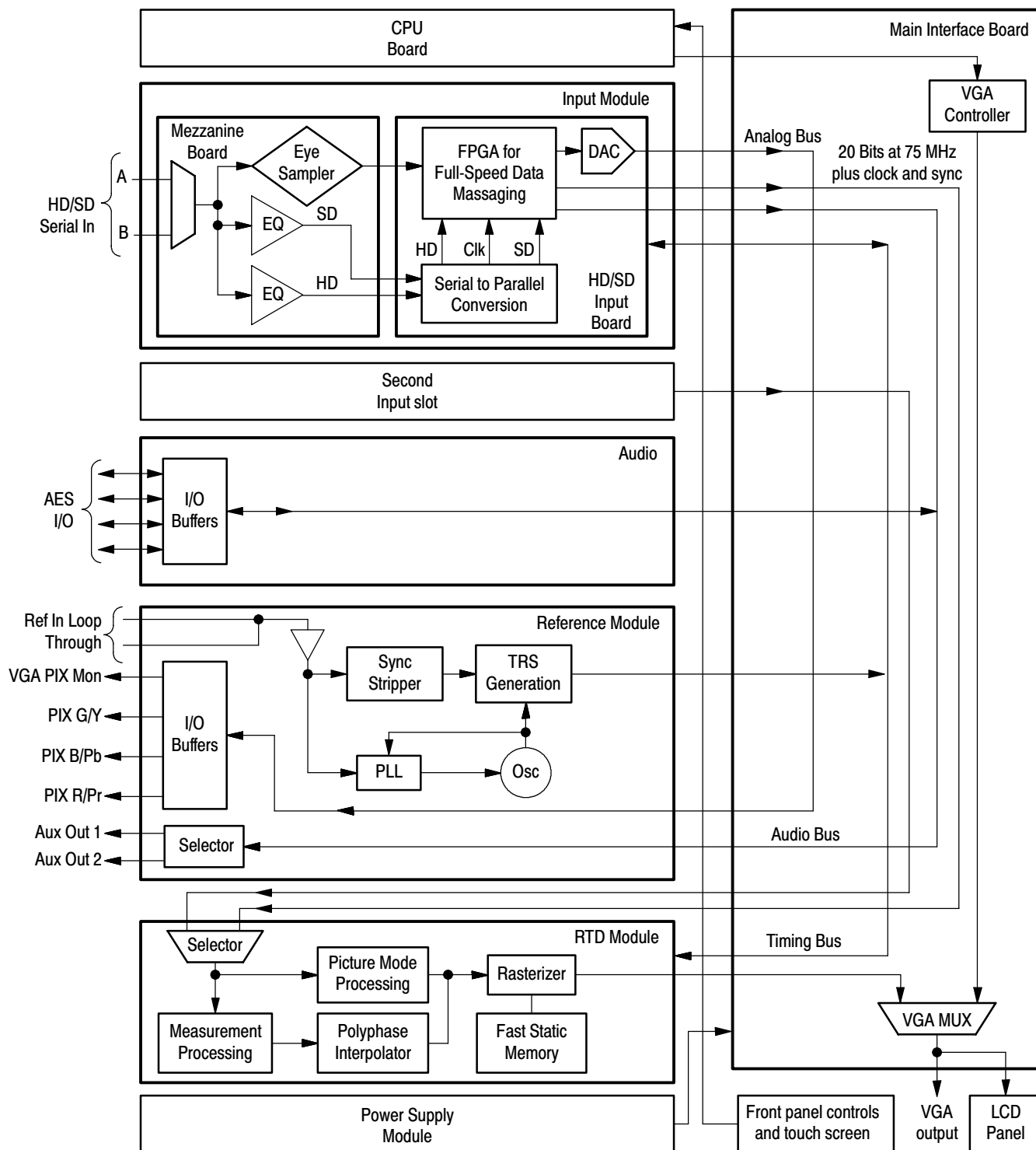


Figure 1-1: WFM700 signal flow block diagram

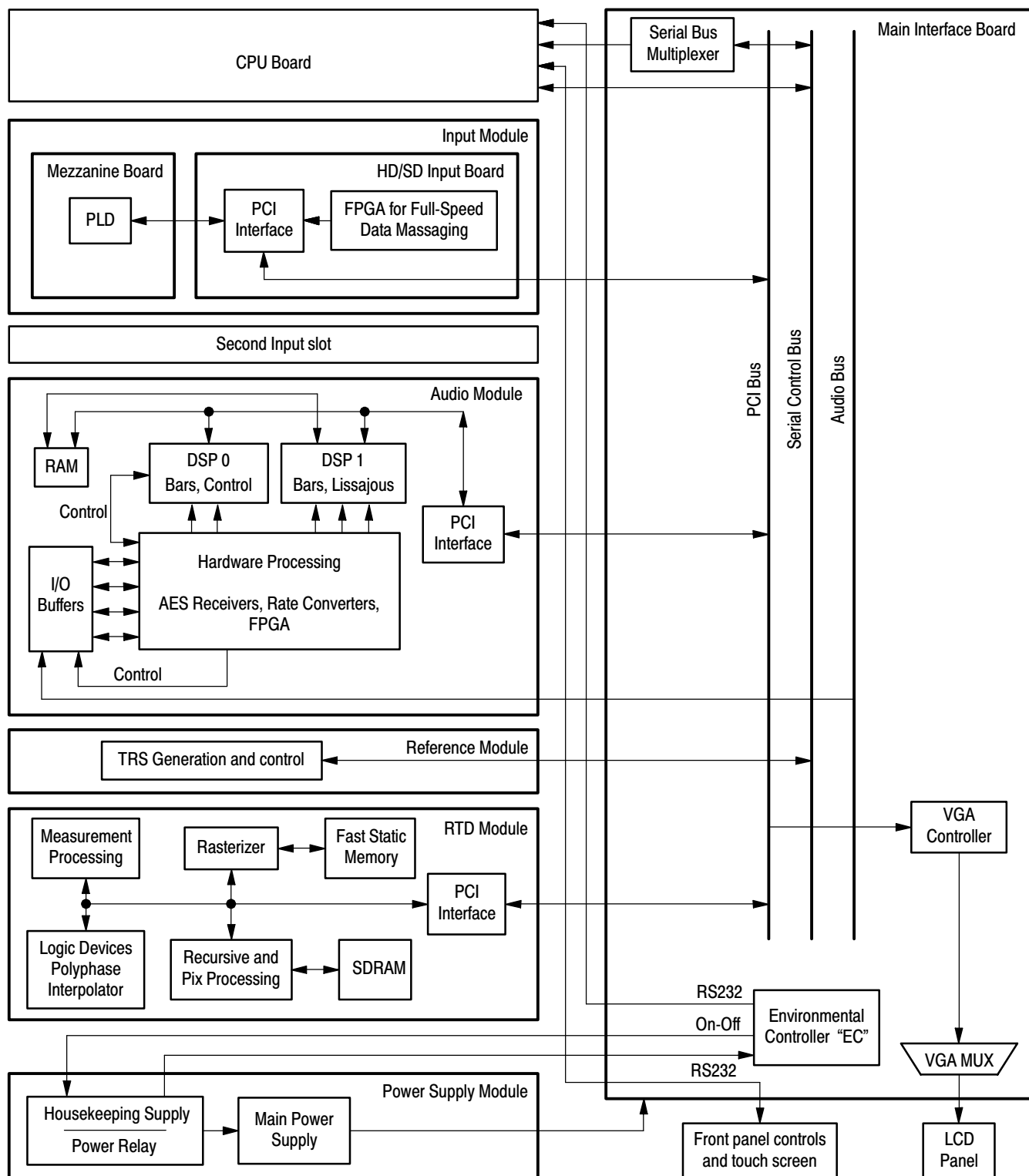


Figure 1-2: Control flow block diagram



Performance Verification

Performance Verification

This section contains three procedures to verify the operation of all models of the WFM700 waveform monitor. This includes the Video modules (WFM7HD, WFM7A, and WFM7M) and the Audio module (WFM7DG). Please disregard checks that do not apply to the module type you are testing.

- **Self Tests** use the internal diagnostic routines to verify proper power-up, modules recognized and operating, and signal paths. No external equipment is required for these tests.
- **Functional Tests** verify that the waveform monitor and its installed modules are operating correctly.
- **Performance Tests** verify that the waveform monitor and all its installed modules meet the performance requirements listed in the *Specifications* section of the *WFM700 Series Technical Reference* document. This section also includes checks for operating parameters that are specified as typical but are not guaranteed. Firmware version 1.3 or above is required to perform all performance tests.
- **Test Records** are provided at the end of this chapter to record the results of each performance test that checks a warranted characteristic.

Prerequisites

Before doing the performance verification procedures, note the following prerequisites:

- **Personnel** — Users should be familiar with the operation of all test equipment and the WFM700.
- **Two Video Modules** — The verification procedures must be performed on both video modules if two are installed in the WFM700. Complete the entire performance procedures on one video module at a time.
- **Audio Module** — The verification procedure for the Option DG Audio module must be performed if the module is installed in the WFM700.
- **Warm-up Period** — Turn on the WFM700 and allow a 20-minute warm-up period in an environment that meets the operating range specifications for temperature and humidity. Verification of warranted characteristics done before the operating temperature has stabilized might cause errors.

Also turn on other required test equipment and allow them to warm up for their recommended time periods.

Test Equipment Required

Table 2-1 lists the test equipment required to perform all of the performance verification procedures. Some equipment may not be necessary for your waveform monitor. The procedures describe the input signal characteristics necessary to perform the test. Where external test equipment is required, refer to your test equipment's user manual for instructions to obtain the correct signal.

Table 2-1: Test equipment for performance verification

Test equipment	Requirements	Example ¹	WFM700			Opt. DG
			A	HD	M	
HD serial digital video test signal generator	1080i 59.94 100% color bars 1080i 59.94 10-bit shallow ramp matrix 1080i 59.94 0% flat field 1080i 59.94 75% SMPTE color bars 1080i 59.94 100/0/100/0 color bars 1080i 59.94 100/0/75/0 color bars 1080i 50 100% color bars 1080i 60 100% color bars 720p 59.94 100% color bars 1080i 59.94 100% sweep 1 - 30 MHz 1080i 59.94 100% flat field 1080i 59.94 20 - 30 MHz multiburst	Tektronix TG2000 with HDVG1 module	•	•	•	•
SD serial digital video test signal generator	525-format 100% color bars 525-format 10-bit shallow ramp matrix 525-format 0% flat field 525-format 75% color bars 525-format 100% flat field 525 line 60% multiburst	Tektronix TG2000 with DVG1 module	•		•	•
Analog video test signal generator	PAL black 1080i 50 black 1080i 60 black 720p 59.94 black	Tektronix TG2000 with AVG1 module	•	•	•	
RF generator	20 MHz to 2.5 GHz <1 dB level flatness 10 Hz to 100 kHz phase modulation with < 3% setting error	Rohde & Schwarz SMT03 Opt SM-B2 50 Ω N-to-BNC adapter	•	•	•	
Sinewave generator	Capable of 0.8 V _{p-p} at 6 MHz into a 50 Ω load	Rohde & Schwarz SMT03 Opt SM-B2				•
Digital audio generator/analyzer	35 kHz to 96 kHz sample rate range, jitter measurement per AES-3 (1997)	Rohde & Schwarz UPL06 Opt B22, B29				•
Test oscilloscope	2 GHz vertical bandwidth	Tektronix TDS794	•	•	•	•

Table 2-1: Test equipment for performance verification (cont.)

Test equipment	Requirements	Example ¹	WFM700			Opt. DG
			A	HD	M	
VGA monitor with cable			•	•	•	
Autotransformer	Output range 90 V to 264 V		•	•	•	
75 Ω coaxial cables (2 required)	General purpose digital video Male-to-male BNC connectors 36 inches long	Belden 8281	•	•	•	•
75 Ω coaxial cable (1 required)	Low loss digital video Male-to-male BNC connectors 18 inches long	Belden 1695A	•	•	•	
50 Ω coaxial cables (2 required)	Male-to-male BNC connectors 36 inches long	Tektronix part number 012-0482-00	•	•	•	•
Precision 75 Ω -to-50 Ω adapter (for test oscilloscope input)	1.5% impedance and attenuation accuracy	Tektronix AMT75	•	•	•	
Wideband 50 Ω -to-75 Ω matching pad	0 to 2.5 GHz, N connectors, 75 Ω N-to-BNC adapter	Rohde & Schwarz RAM			•	
90 meters and 325 meters of 75 Ω cable	Low loss cable. Cable simulators can be used as substitutes as follows:	Belden 8281	•	•	•	
	SD Cable Simulator	Faraday SC75A800 B-G Cable Clone	•		•	
	HD Cable Simulator	Faraday FFC Kit	•	•	•	
Return loss bridge	75 Ω test port 50 Ω input and output ports	Wide Band Engineering A57TUC with male 75 Ω BNC test port	•	•	•	•
Calculator	Logarithmic function		•	•	•	•

¹ You may need additional cables and adapters, depending on the actual test equipment you use.

Performance Verification Conditions

NOTE. Menu selections in the WFM700 Waveform Monitor differ between firmware versions. The Performance Verification procedures assume you have the latest firmware version installed in your instrument.

The following conditions must be met prior to doing these procedures:

1. The WFM700 Waveform Monitor must have been operating continuously for twenty (20) minutes in an environment that meets the operating range specifications for temperature and humidity.
2. Connect the WFM700 Waveform Monitor and the test equipment to the same AC power circuit or to a common power strip if you are unsure of the AC power circuit distribution.

Self Tests

This procedure uses internal routines to verify that the waveform monitor functions and passes its internal self tests. No test equipment or hookups are required.

1. Press the **PRESET** button.
2. Touch the **-more-** soft key, then touch the **Restore Factory** soft key.

NOTE. Restoring factory settings overrides the current instrument state but does not alter calibration or presets.

3. Press the **CONFIG** front panel button.
4. Touch **System** and then **Diagnostics**.
5. Touch **Diagnostics**, then **View Diagnostic Log**.
6. Touch ****Erase** NVRAM Log** to clear the log file.
7. Touch **Back to Diags Menu**.
8. Touch **Run Full Powerup Diagnostics**.
9. Touch **Back to Diags Menu**.
10. Touch **View Diagnostics Log**.
11. **CHECK** the diagnostics log pages to verify that there are no red **FAIL** messages.

12. Touch ****Erase** NVRAM Log** to clear the log file.
13. Touch **Back to Diags Menu**.
14. Touch **Run Internal Digital Path Diagnostics**.
15. Read the screen text, and then touch **Continue** to acknowledge that a reboot will be required. The diagnostic test will run.
16. *CHECK* for the following display properties:
 - a. Verify that four ramp patterns (bars) appear on the display as gray, blue, green, and red.
 - b. Verify that each ramp pattern has brightness steps approximately every 1/16 inch.
 - c. Verify there are no color bands in the gray ramp display.
17. Press the flashing **SELECT** button to return to the diagnostics menu.
18. Touch **View Diagnostics Log**.
19. *CHECK* the diagnostics log pages to verify that there are no red FAIL messages.
20. Touch ****Erase** NVRAM Log** to clear the log file.

STOP. *Unless the WFM700 has the optional Audio module (Option DG), skip down to step 28 to complete this procedure.*

21. Touch **Back to Diags Menu**.
22. Touch **Run Audio Path Diagnostics**.
23. Read the screen text, and then touch **Continue** to acknowledge that a reboot will be required. The diagnostic test will run.
24. Touch the **Back to Diags Menu**.
25. Touch **View Diagnostics Log**.
26. *CHECK* the diagnostics log pages to verify that there are no red FAIL messages.
27. Touch ****Erase** NVRAM Log** to clear the log file.
28. Cycle the power to reboot the WFM700.
29. Press the **PRESET** button and touch the **–more–** soft key.
30. Touch the **Restore Factory** soft key.

Functional Tests

These functional tests provide tests to check basic functionality of the inputs and general operation prior to starting the Performance Tests. A more exhaustive check of all functions and buttons is provided in the Technical Reference.

Preliminary Setup and Test

The Preliminary Setup performs the following tasks:

- Sets the waveform monitor to a known state
 - Provides instructions for test equipment setup used throughout the Functional Tests
 - Provides a preliminary check of the video input path and display
1. Press the **PRESET** button.
 2. Touch the **-more-** soft key, then touch the **Restore Factory** soft key. Restoring factory settings overrides the current instrument state but does not alter calibration or presets.
 3. Connect a serial digital output from the HD video generator to **INPUT A** using a 75 Ω cable.
 4. Set the HD video generator for a 1080i 59.94 100% color bars signal.
 5. Connect a serial digital output from the SD video generator to **INPUT B** using a 75 Ω cable.
 6. Set the SD video generator for a 525-format 100% color bars signal.
 7. Press the **INPUT** button and touch the **Input A** soft key.
 8. *CHECK* that an HD color bar signal is displayed.
 9. Press the **DISPLAY** button. Adjust the **Trace Settings**, **Graticule Settings**, and **Readouts & Backlight** settings for best viewing.

HD Input and Embedded Audio Detection

This procedure checks the input detection and audio disembedding data paths for high definition video.

1. Press the **WFM** button.
2. Press the **INPUT** button and touch the **Input A** soft key.
3. Disable or disconnect the HD video generator signal to **INPUT A**.
4. *CHECK* that the red **"Input Unlocked"** message is displayed.

5. Enable or reconnect the HD video generator signal to **INPUT A**.
6. *CHECK* that the red "**Input Unlocked**" message is gone.
7. Set the HD video generator for 2 groups of embedded audio, starting with group 1.
8. Press the **STATUS** button.
9. Touch the **Display** soft key.
10. Touch the **Session** soft key and then touch the **Done** soft key.
11. Option DG only: Touch the **Video Session** soft key if necessary to select Video Session.
12. *CHECK* that the embedded audio status reads as follows:

Embedded Audio: PPPP PPPP ---- ----

SD Input and Embedded Audio Detection (WFM7A, WFM7M only)

This procedure checks the input detection and audio disembedding data paths for standard definition video.

1. Press the **WFM** button.
2. Press the **INPUT** button and touch the **Input B** soft key.
3. Disable or disconnect the SD video generator signal to **INPUT B**.
4. *CHECK* that the red "**Input Unlocked**" message is displayed.
5. Enable or reconnect the SD video generator signal to **INPUT B**.
6. *CHECK* that the red "**Input Unlocked**" message is gone.
7. Set the SD video generator for 2 groups of embedded audio, starting with group 1.
8. Press the **STATUS** button.
9. Touch the **Display** soft key.
10. Touch the **Session** soft key and then touch the **Done** soft key.
11. Option DG only: Touch the **Video Session** soft key if necessary to select Video Session.
12. *CHECK* that the embedded audio status reads as follows:

Embedded Audio: PPPP PPPP ---- ----

VGA Outputs

This procedure checks VGA PIX MON and EXT VGA outputs.

1. Connect a VGA monitor to the **VGA PIX MON** output.
2. Press the **INPUT** button and touch the **Input A** soft key.
3. Press the **CONFIG** button.
4. Touch the **Video Inputs/Outputs** soft key, then **Next Menu**.
5. Touch the **Output Active for HD** soft key.
6. Touch the **RGB** soft key.
7. *CHECK* that color bars are correctly displayed on the VGA monitor.

NOTE. *Some VGA monitors do not synchronize correctly to color bars with tri-level sync. If the picture is not locked, select a flat field signal from the generator, then switch back to color bars.*

8. Move the VGA monitor cable from the **VGA PIX MON** output to the **EXT VGA** output.
9. *CHECK* that the external VGA display matches the display on the LCD.
10. Disconnect the test setup.

Performance Tests

The Performance Tests verify that the WFM700 waveform monitor (all models) meets the warranted characteristics listed in the *Specifications* section of the *WFM700 Series Technical Reference* document. Characteristics with typical specifications (not warranted) are also checked.

NOTE. *WFM700 firmware version 1.3 or above is required to perform all tests in this section. Verify the firmware version and update if needed.*

Power Source Range

This test checks for stable operation over a varied AC input range.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the AC power cord from the WFM700 to the variable autotransformer.
2. Power on both the autotransformer and the WFM700.
3. Connect the HD video generator to **INPUT A** using a 75 Ω cable.
4. Set the HD video generator for a 1080i 59.94 100% Sweep 1 – 30 MHz signal.
5. Press the **INPUT** button and select **Input A**.
6. Vary the autotransformer from 90 V to 264 V.
7. *CHECK* for a stable display and no error indications over the entire voltage range.
8. Set autotransformer to 90 V.
9. Press the **ON/STBY** button to power off the WFM700.
10. Press the **ON/STBY** button to power on the WFM700.
11. *CHECK* that the WFM700 re-starts and after boot-up the HD color bar signal is displayed.
12. Return the autotransformer setting to local nominal mains voltage.

Signal Data Paths

This test checks the digital data paths.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

The following characteristics are directly checked:

- Vertical Measurement Accuracy, YPbPr
- Vector Vertical Gain Accuracy

The following characteristics are indirectly checked:

- Frequency Response
- Sweep Accuracy and Linearity
- Vector Horizontal Gain Accuracy
- Vector Display to Graticule Registration
- Lightning and Diamond Vertical Gain Accuracy
- Arrowhead Signal to Graticule Registration
- Arrowhead Composite Limit Cursor Accuracy and Detection Level Accuracy

1. Ensure that the *Self Tests* on page 2-4 have been performed and passed.
2. Connect the HD video generator to **INPUT A** using a 75 Ω cable.
3. Press the **INPUT** button and select **Input A**.
4. Set the HD video generator for a 1080i 59.94 10-bit Shallow Ramp Matrix signal.
5. Press the **WFM** button.
6. Touch **Pr** and **Pb** to turn off the color difference signals.

NOTE. The *Y* component must be on to allow both the *Pr* and *Pb* components to be turned off.

7. *CHECK* that the steps in the displayed ramps are monotonic (all steps are in the same direction) and approximately one pixel high. See Figure 2-1.

NOTE. *If the steps are 4 pixels high, it may be that the input signal has only 8 bits of resolution.*

8. Press the **GAIN** button.
9. Touch **Gain: 10x**.
10. *CHECK* that the steps in the ramps are 0.7 mV to 0.9 mV. (Use the voltage cursors for this measurement.) See Figure 2-2.
11. Press the **WFM** button.
12. Touch **Pb** to turn on the Pb component.
13. Touch **Y** to turn off the Y component.
14. Press the **GAIN** button.
15. Touch **Gain: 1x**.
16. *CHECK* for step direction and height by repeating steps 7 through 10 above.
17. Press the **WFM** button.
18. Touch **Y** and **Pr** to turn these components back on. All components should be on (Y, Pb, and Pr).

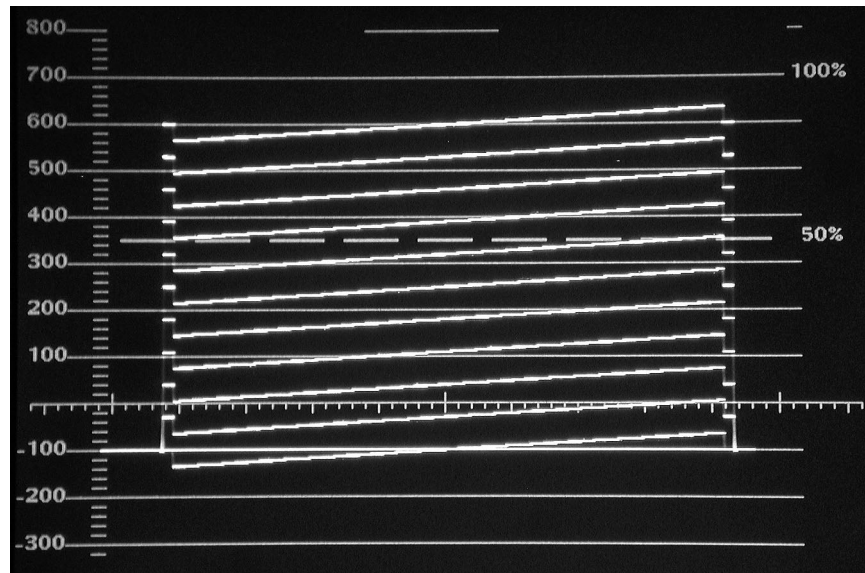


Figure 2-1: Signal data paths performance verification screen one

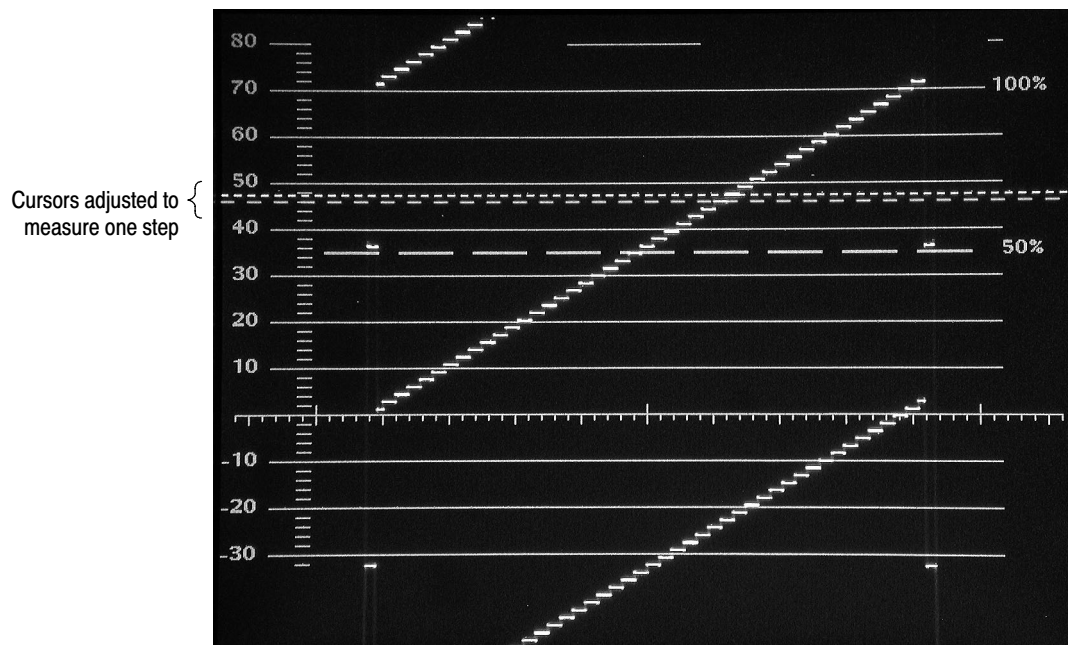


Figure 2-2: Signal data paths performance verification screen two

Stop here for WFM7HD. The Signal Data Path procedure is now finished for the WFM7HD Input Module. Continue with this check if testing a WFM7A or WFM7M Input Module.

19. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
20. Set the SD video generator for a 525-format 10-bit shallow ramp matrix signal.
21. Press the **INPUT** button and select **Input B**.
22. Press the **WFM** button.
23. Touch **Pr** and **Pb** to turn off the color difference signals.

NOTE. *The Y component must be on to allow both the Pr and Pb components to be turned off.*

24. **CHECK** that the steps in the displayed ramps are monotonic (all steps are in the same direction) and approximately one pixel high. See Figure 2-1.

NOTE. *If the steps are 4 pixels high, it may be that the input signal has only 8 bits of resolution.*

25. Press the **GAIN** button.
26. Touch **Gain: 10x**.
27. Press the **CLR MENU** button.
28. **CHECK** that the steps in the ramps are 0.7 mV to 0.9 mV. (Use the voltage cursors for this measurement.)
29. Press the **WFM** button.
30. Touch **Pr** and **Pb** to turn these components back on. All components should be on (Y, Pb, and Pr).
31. Press the **GAIN** button.
32. Touch **Gain: 1x**.

HD LCD Pixel Defects (WFM7HD only)

This step checks for defective display pixels with a HD video signal.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the HD video generator to **INPUT A** using a 75 Ω cable.
2. Set the HD video generator for a 1080i 59.94 100% flat field signal.
3. Press the **INPUT** button and select **Input A**.
4. Press the **PICTURE** button.
5. Count any pixels stuck low (not white).
6. Change the HD video generator signal to 0% flat field.
7. Count any pixels stuck high (not black).
8. *CHECK* the total number of pixels counted in steps 5 and 7 is less than six.

NOTE. *If the bad pixel count exceeds six, perform the procedure again. If a pixel fails for both black and white signals, count it only once.*

SD LCD Pixel Defects (WFM7A and WFM7M only)

This step checks for defective display pixels with a SD video signal.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
2. Set the SD video generator for a 525-format 100% flat field signal.
3. Press the **INPUT** button and select **Input B**.
4. Press the **PICTURE** button.
5. Count any pixels stuck low (not white).
6. Change the SD video generator signal to 0% flat field.
7. Count any pixels stuck high (not black).
8. *CHECK* the total number of pixels counted in steps 5 and 7 is less than six.

NOTE. *If the bad pixel count exceeds six, perform the procedure again. If a pixel fails for both black and white signals, count it only once.*

Error Detection Data Paths

This test checks data paths and error detection.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

The following characteristics are directly and indirectly checked:

- Data Integrity
 - RGB Gamut error Detection Level Limits
 - RGB Gamut error Detection Level Accuracy
1. Connect the HD video generator to **INPUT A** using a 75 Ω cable.
 2. Set the HD video generator for a 1080i 59.94 0% flat field signal. Enable Error Detection and Handling (EDH) if necessary.
 3. Press the **INPUT** button and select **Input A**.
 4. Press the **STATUS** button.
 5. Touch the **Display** soft key.
 6. Touch the **Alarm Status** soft key and then touch the **Done** soft key.
 7. Touch the **Serial Alarms** soft key.
 8. *CHECK* that the Embedded CRC status reads:

292M Y CRC error	Status:OK
292M C CRC error	Status:OK
 9. Touch the **General Alarms** soft key.
 10. *CHECK* that gamut errors read as follows:

RGB Gamut Error	Status: OK
Composite Gamut Error	Status: OK
 11. Set the HD video generator for a 1080i 59.94 SMPTE color bars signal.
 12. *CHECK* that gamut errors read as follows:

RGB Gamut Error	Status: Alarm
Composite Gamut Error	Status: OK
 13. Set the HD video generator for a 1080i 59.94 100% color bars signal.
 14. *CHECK* that gamut errors read as follows:

RGB Gamut Error	Status: OK
Composite Gamut Error	Status: Alarm

Serial Video Output

This test checks the serial video output signal into a 75 Ω load.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
2. Set the SD video generator for a 525-format 100% color bars signal.
3. Connect the **SERIAL OUT** to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
4. Press the **INPUT** button and select **Input B**.

NOTE. *If testing a WFM7HD, a display message will report "unsupported standard". This will not affect the test.*

5. Measure the signal amplitude on the test oscilloscope and note this measurement. The following substeps will help obtain a measurable display on the test oscilloscope.
 - a. Ensure that the termination is correct on the test oscilloscope.
 - b. Set the vertical scale to 200 mV/div, horizontal scale to 5 ns/div, and the trigger position to 90%.
 - c. Set the display style to dots.
 - d. Set the trigger level to zero, and to neglect glitches of either polarity for widths to 30 ns.
 - e. The oscilloscope display should show a few random transitions followed by 30 ns with no transitions. This is followed by the triggering transition. See Figure 2-3.
 - f. When measuring, disregard signal noise. Measure the waveform amplitude from the centers of the high and low levels in the region from 5 ns to 10 ns before the triggering transition.
 - g. Note the signal amplitude.
6. Calculate the percent amplitude error with the formula below using the measured value from step 5.

$$\text{Amplitude Error} = \frac{(\text{Measured mV} - 800 \text{ mV})}{8}$$

7. **CHECK** that the calculated error is between $\pm 5\%$.

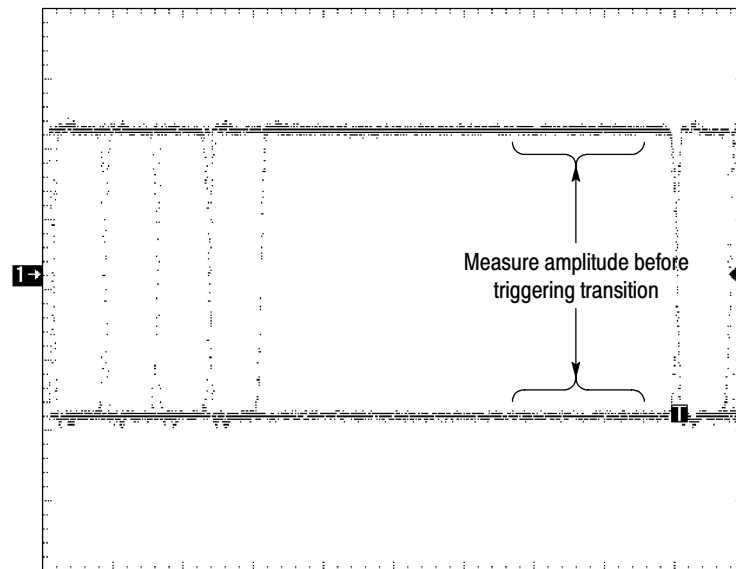


Figure 2-3: Serial video output level performance verification screen

SD PIX MON Output Level

This test checks the SD PIX MON output level into 75 Ω load.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
2. Set the SD video generator for a 525-format 100% color bars signal.
3. Connect the **SD PIX MON** output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
4. Press the **INPUT** button and select **Input B**.

NOTE. A WFM7HD will report "unsupported standard". This will not affect the results of this check.

5. Measure the signal amplitude on the test oscilloscope. The following substeps will help obtain a measurable display on the test oscilloscope. Note this measurement.
 - a. Ensure that the termination is correct on the test oscilloscope. Use a converter if necessary.

- b. Set the vertical scale to 200 mV/div, horizontal scale to 5 ns/div, and the trigger position to 90%.
 - c. Set the display style to dots.
 - d. Set the trigger level to zero, and to neglect glitches of either polarity for widths to 30 ns.
 - e. The oscilloscope display should show a few random transitions followed by 30 ns with no transitions. This is followed by the triggering transition. See Figure 2-4.
 - f. When measuring, disregard signal noise. Measure the waveform amplitude from the centers of the high and low levels in the region from 5 ns to 10 ns before the triggering transition.
 - g. Note the measurement.
6. Calculate the percent amplitude error using the formula:

$$\text{Percent Amplitude Error} = \frac{(\text{Measured mV} - 800 \text{ mV})}{8}$$

7. *CHECK* that the calculated error is within $\pm 5\%$.

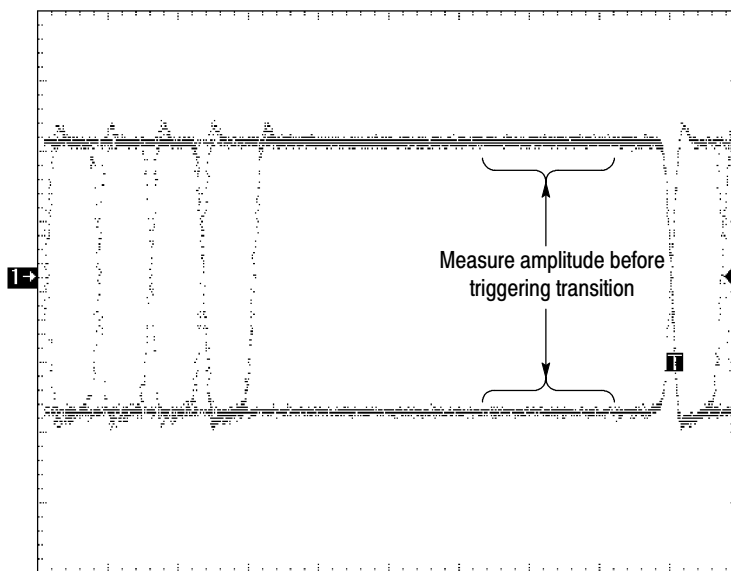


Figure 2-4: SD PIX MON output level performance screen

PIX Video Output Level

This step checks the active video and of black (blanking) levels.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the HD video generator to **INPUT A** using a 75 Ω cable.
2. Press the **INPUT** button and select **Input A**.
3. Set the HD video generator for a 1080i 59.94 100% color bars signal.
4. Connect the **PIX G/Y** output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
5. Press the **CONFIG** button.
6. Touch the **Video Inputs/Outputs** soft key, then **Next Menu**.
7. Touch the **Output Active for HD** soft key, then **YPbPr**.
8. Press the **CONFIG** button twice to exit menu.
9. Set the test oscilloscope to view the first color bar. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV/div
Vertical Position	-3.5 div
Horizontal Scale	1 us/div
Horizontal Trigger Position	50%
Trigger Slope	Rising edge
Trigger Level	500 mV

10. Measure the amplitude between the black level and the first color bar and note the measurement. See Figure 2-5.
11. Calculate the percent amplitude error using the formula:

$$\text{Amplitude Error} = \frac{(\text{Measured Amplitude mV} - 700 \text{ mV})}{7}$$

12. **CHECK** that the calculated error is between $\pm 5\%$.
13. Measure the amplitude of the black level (the level preceding the first color bar step) referenced to ground on the test oscilloscope. Note the measurement. See Figure 2-5.
14. **CHECK** that the black level is between ± 25 mV.

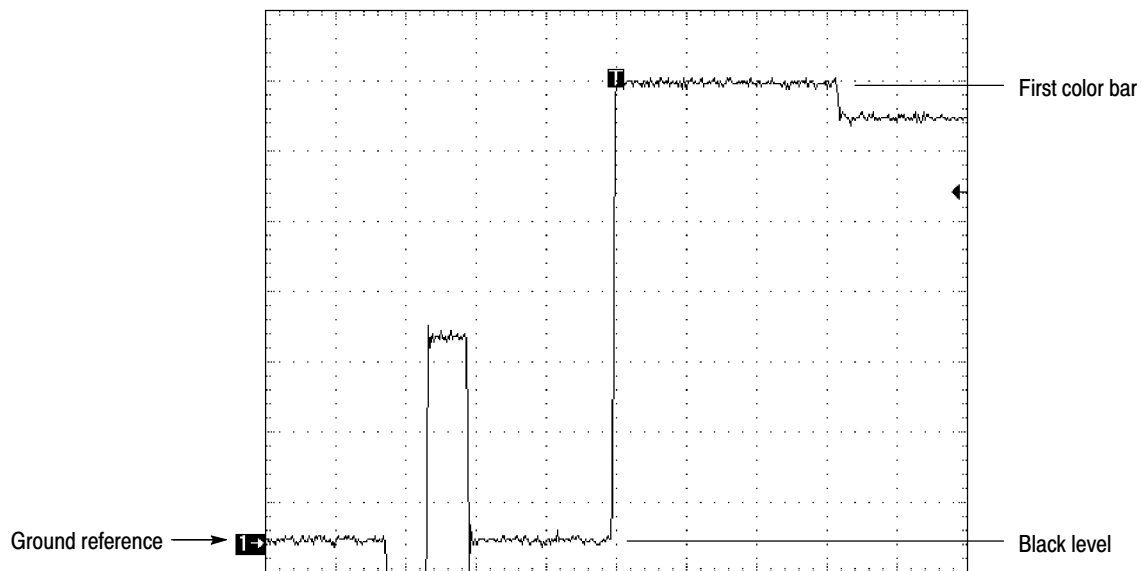


Figure 2-5: HD pix G/Y video output level performance screen

15. Move the cable from the **PIX G/Y** to the **PIX B/Pb** connector.
16. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV/div
Horizontal Scale	10 us/div
Horizontal Trigger Position	10%
Trigger Slope	Rising edge
Trigger Level	300 mV

17. Measure the peak-to-peak amplitude of the waveform displayed on the oscilloscope. See Figure 2-6.

18. Calculate the percent amplitude error using the formula:

$$\text{Amplitude Error} = \frac{(\text{Measured Amplitude mV} - 700 \text{ mV})}{7}$$

19. *CHECK* that the calculated error is between $\pm 5\%$.
20. Measure the black level (the widest horizontal step) referenced to ground on the test oscilloscope. Change test oscilloscope settings as needed to obtain the best display. See Figure 2-6.
21. *CHECK* that the black level is between $\pm 25 \text{ mV}$.

22. Move the cable from the **PIX B/Pb** to the **PIX R/Pr** connector.

23. Repeat steps 17 through 21.

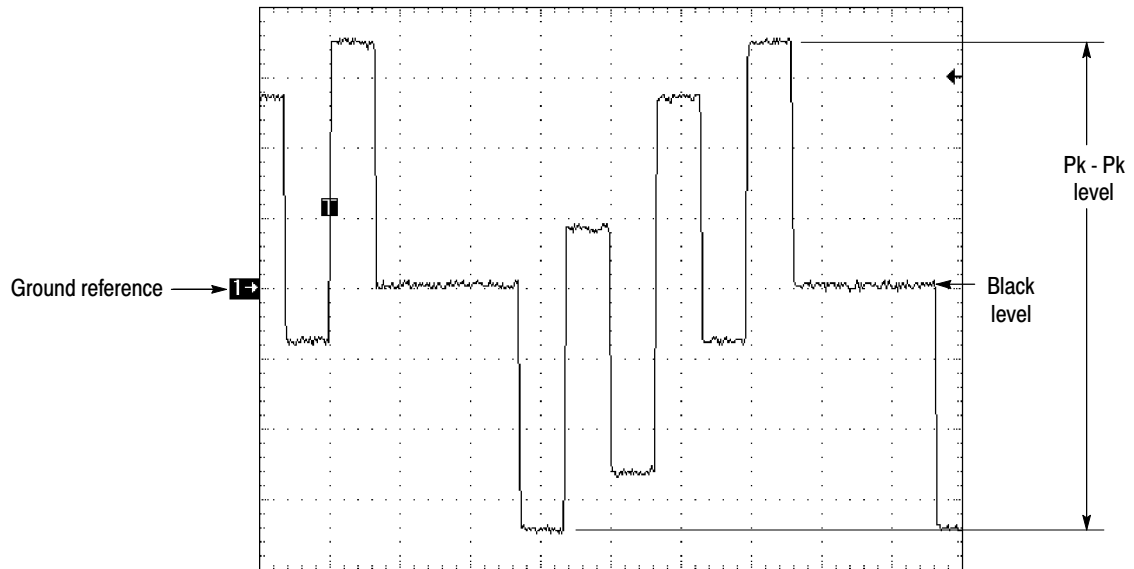


Figure 2-6: HD pix B/Pb and R/Pr video output level performance screen

Stop here for WFM7HD. The PIX Video Output Level procedure is now finished for the WFM7HD Input Module. Continue with this check if testing a WFM7A or WFM7M Input Module.

24. Connect the SD video generator to **INPUT B** using a 75 Ω cable.

25. Press the **INPUT** button and select **Input B**.

26. Set the SD video generator for a 525-format 100% color bars signal.

27. Connect the **PIX G/Y** output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.

28. Press the **CONFIG** button.

29. Touch the **Video Inputs/Outputs** soft key, then **Next Menu**.

30. Touch the **Output Active for SD** soft key, then **YPbPr**.

31. Press the **CONFIG** button twice to exit the menu.

32. Set the test oscilloscope to view the first color bar. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV/div
Vertical Position	−3.5 div
Horizontal Scale	5 us/div
Horizontal Trigger Position	50%
Trigger Slope	Rising edge
Trigger Level	500 mV

33. Measure the amplitude between the black level and the first color bar and note the measurement. See Figure 2-7.
34. Calculate the percent amplitude error using the formula:

$$\text{Amplitude Error} = \frac{(\text{Measured Amplitude mV} - 700 \text{ mV})}{7}$$

35. *CHECK* that the calculated error is between $\pm 5\%$.
36. Measure the black level (the level preceding the first color bar step) referenced to ground on the test oscilloscope. Change test oscilloscope settings if needed. Note the measurement. See Figure 2-7.
37. *CHECK* that the black level is between $\pm 25 \text{ mV}$.

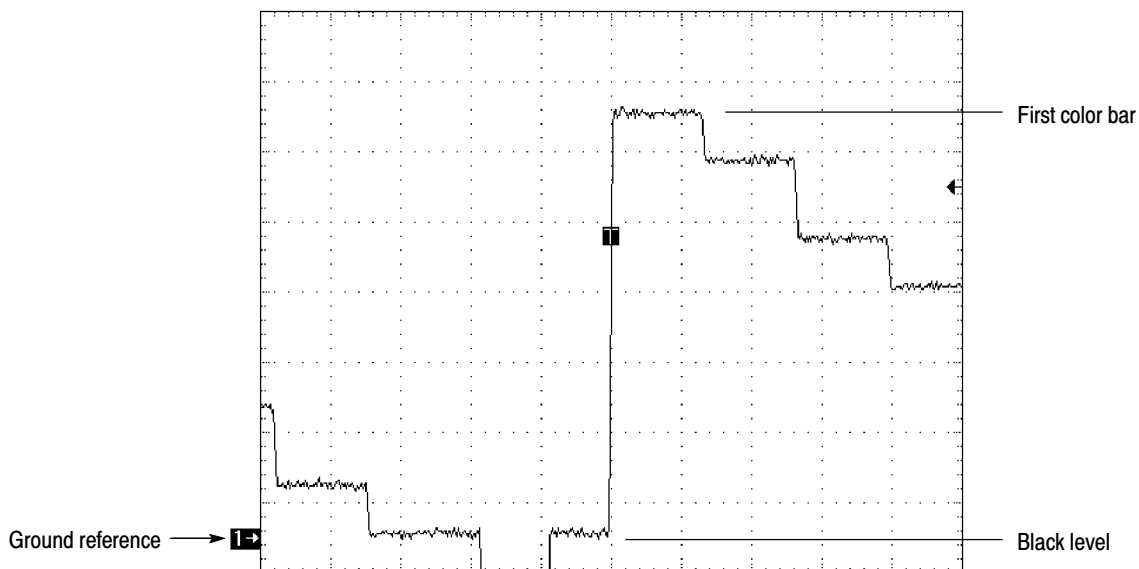


Figure 2-7: SD pix video output level performance screen

38. Move the cable from the **PIX G/Y** to the **PIX B/Pb** connector.
39. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV/div
Horizontal Scale	10 us/div
Horizontal Trigger Position	10%
Trigger Slope	Rising edge
Trigger Level	300 mV

40. Measure the peak-to-peak amplitude of the waveform displayed on the oscilloscope. See Figure 2-6 on page 2-21.

41. Calculate the percent amplitude error using the formula:

$$\text{Amplitude Error} = \frac{(\text{Measured Amplitude mV} - 700 \text{ mV})}{7}$$

42. *CHECK* that the calculated error is between $\pm 5\%$.
43. Measure the black level (the widest horizontal step) referenced to ground on the test oscilloscope. Change test oscilloscope settings as needed to obtain the best display. See Figure 2-6.
44. *CHECK* that the black level is between $\pm 25 \text{ mV}$.
45. Move the cable from the **PIX B/Pb** to the **PIX R/Pr** connector.
46. Repeat steps 40 through 44.
47. Disconnect the cable from the **PIX R/Pr** connector.

External Reference

This test checks for stable operation with external reference signals.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the output from the analog video generator to one of the **REF IN** connectors using a 75Ω cable.
2. Connect a 75Ω termination to the remaining **REF IN** connector.
3. Set the analog video generator for a PAL black signal.
4. Connect the output from the HD video generator to **INPUT A** using a 75Ω cable.
5. Set the HD video generator for a 1080i 50 100% color bars signal.

6. Press the **DISPLAY** button and touch the **Thumbnail Picture** soft key (to turn off the thumbnail picture).
7. Press the **WFM** button.
8. Press the **INPUT** button and select **Input A**.
9. Touch the **Reference:** soft key so that Reference is set to **External**.
10. *CHECK* that the displayed waveform remains locked to the external reference.

NOTE. *The waveform is considered locked if the color bar steps are distinct and the red "Unlocked" message is not present.*

The appearance of the displayed waveform depends on the phase or frequency difference between the HD video generator and the analog video generator. A phase difference causes a horizontal shift of the waveform, while a frequency difference causes the waveform to slowly roll horizontally.

11. Set the analog video generator for a 1080i 60 black signal.
12. Set the HD video generator for a 1080i 60 100% color bars signal.
13. *CHECK* that the displayed waveform remains locked to the external reference.
14. Set the analog video generator for a 720p 59.94 black signal.
15. Set the HD video generator for a 720p 59.94 100% color bars signal.
16. *CHECK* that the displayed waveform remains locked to the external reference.
17. Touch the **Reference:** soft key so that Reference is set to **Internal**.
18. Disconnect the analog video generator.

GBR Frequency Response

This test checks the typical performance of the PIX G/Y, PIX B/Pb, and PIX R/Pr outputs.

Typical Operation Check. This test checks for typical output levels. Typical values are not guaranteed characteristics and are not listed in the test record.

1. Connect the output from the HD video generator to **INPUT A** using a 75 Ω cable.
2. Set the HD video generator for a 1080i 59.94 20–30 MHz Multiburst signal.
3. Set the HD video generator Pb and Pr amplitudes to 0 (off).
4. Connect the **PIX G/Y** output to the 75 Ω input of the test oscilloscope. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
5. Press the **CONFIG** button.
6. Touch the **Video Inputs/Outputs** soft key, then **Next Menu**.
7. Touch the **Output Active for HD** soft key.
8. Touch the **RGB** soft key.
9. Press the **CONFIG** button twice to exit the menu.
10. Press the **INPUT** button and select **Input A**.
11. Set the test oscilloscope to view the signal packets. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV
Horizontal Scale	5 us/div
Horizontal Trigger Position	10%
Trigger Level	100 mV

NOTE. When making the following measurements, disregard the spiking on the packet waveforms.

12. Measure the signal amplitude of the reference level before the first packet. Note the Reference measurement. See Figure 2-8.
13. Measure the amplitude of the smallest packet. Note the Smallest Packet measurement. See Figure 2-8.

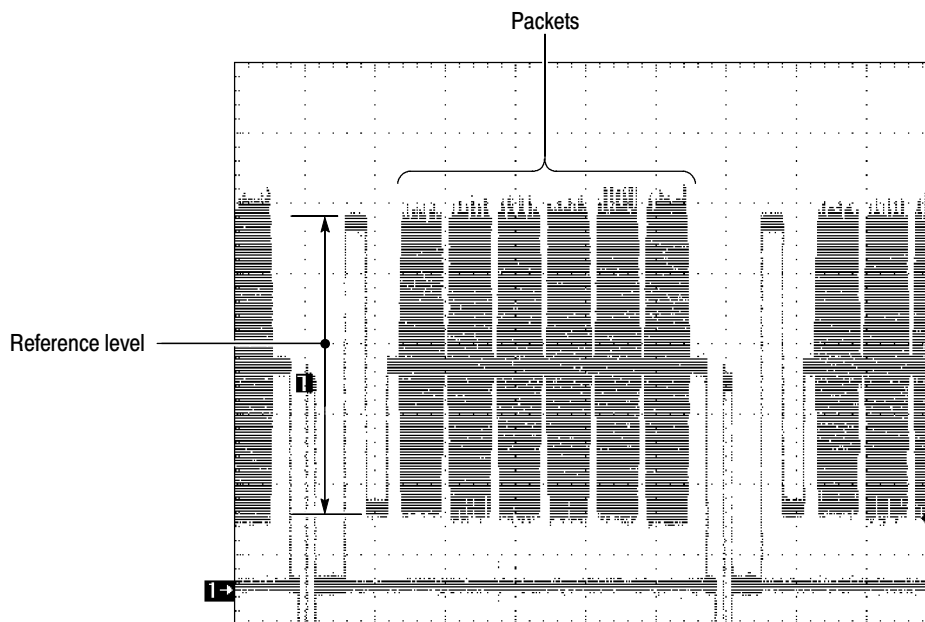


Figure 2-8: HD GBR frequency response performance screen

14. Calculate the percent amplitude variation using the formula:

$$\text{Amplitude Variation} = 100 \times \frac{(\text{Smallest Packet} - \text{Reference})}{\text{Reference}}$$

15. *CHECK* that the calculated measurement is between $\pm 10\%$ (typical).

16. Measure the amplitude of the largest packet. Note the Largest Packet measurement. See Figure 2-8.

17. Calculate the percent amplitude variation using the formula:

$$\text{Amplitude Variation} = 100 \times \frac{(\text{Largest Packet} - \text{Reference})}{\text{Reference}}$$

18. *CHECK* that the calculated measurement is between $\pm 10\%$ (typical).

19. Move the cable from the **PIX G/Y** to the **PIX B/Pb** connector.

20. Repeat steps 12 through 18.

21. Move the cable from the **PIX B/Pb** to the **PIX R/Pr** connector.

22. Repeat steps 12 through 18.

Stop here for WFM7HD. The GBR Frequency Response procedure is now finished for the WFM7HD Input Module. Continue with this check if testing a WFM7A or WFM7M Input Module.

23. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
24. Set the SD video generator for a 525 line 60% Multiburst signal.
25. Set the SD video generator Pb and Pr amplitudes to 0 (off).
26. Connect the **PIX G/Y** output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
27. Press the **CONFIG** button.
28. Touch the **Video Inputs/Outputs** soft key, then **Next Menu**.
29. Touch the **Output Active for SD** soft key.
30. Touch the **RGB** soft key.
31. Press the **CONFIG** button twice to exit the menu.
32. Press the **INPUT** button and select **Input B**.
33. Set the test oscilloscope to view the signal packets. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV
Horizontal Scale	5 us/div
Horizontal Trigger Position	0%
Trigger Level	100 mV

NOTE. When making the following measurements, disregard the spiking on the packet waveforms.

34. Measure the signal amplitude of the reference levels before the first packet. Note the Reference measurement. See Figure 2-9.
35. Measure the amplitude of the smallest packet. Note the Smallest Packet measurement. See Figure 2-9.

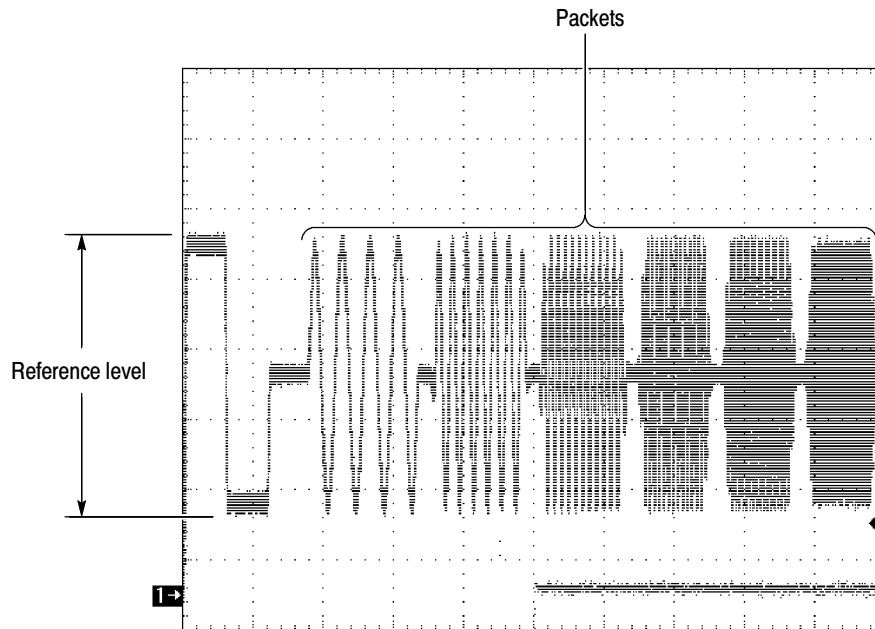


Figure 2-9: SD GBR frequency response performance screen

36. Calculate the percent amplitude variation using the formula:

$$\text{Amplitude Variation} = 100 \times \frac{(\text{Smallest Packet} - \text{Reference})}{\text{Reference}}$$

37. *CHECK* that the calculated measurement is between $\pm 10\%$ (typical)

38. Measure the amplitude of the largest packet. Note the Largest Packet measurement. See Figure 2-9.

39. Calculate the percent amplitude variation using the formula:

$$\text{Amplitude Variation} = 100 \times \frac{(\text{Largest Packet} - \text{Reference})}{\text{Reference}}$$

40. *CHECK* that the calculated measurement is between $\pm 10\%$ (typical)

41. Move the cable from the **PIX G/Y** to the **PIX B/Pb** connector.

42. Repeat steps 34 through 40.

43. Move the cable from the **PIX B/Pb** to the **PIX R/Pr** connector.

44. Repeat steps 34 through 40.

45. Disconnect the test setup.

**Cable Loss
Accommodation**

This test checks for error-free operation with 0 to 30 dB signal loss.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Set the HD video generator for a 1080i 59.94 100% color bars signal.
2. Connect 90 meters of 75 Ω cable from the HD video generator to **INPUT A**.

NOTE. You can substitute the 90 meters of cable with an HD cable simulator set for 90 meters.

3. Press the **INPUT** button and select **Input A**.
4. Press the **STATUS** button.
5. Touch the **Display** soft key.
6. Touch the **Session** soft key and then touch the **Done** soft key.
7. Touch the **Video Session** soft key.
8. **CHECK** that no Embedded CRC Y or C errors messages occur in an interval of 10 seconds.
9. Disconnect the test setup.

Stop here for WFM7HD. The Cable Loss procedure is now finished for the WFM7HD Input Module. Continue with this check if testing a WFM7A or WFM7M Input Module.

10. Set the SD video generator for a 525-format 75% color bars signal.
11. Connect 325 meters of 75 Ω cable from the SD video generator to **INPUT B**.

NOTE. You can substitute the 325 meters of cable with an SD cable simulator set for 325 meters.

12. Press the **INPUT** button and select **Input B**.
13. Press the **STATUS** button.
14. Touch the **Video Session** soft key.
15. **CHECK** that no Embedded CRC Y or C errors messages occur in an interval of 10 seconds.
16. Disconnect the test setup.

Eye Vertical Scale (WFM7M only)

This test checks the Eye vertical deflection factor. This procedure is only applicable for a WFM7M Input Module.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the SD video generator to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
2. Set the SD video generator for a 525-format 100% color bars signal.
3. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

Vertical Scale	200 mV
Horizontal Scale	2 ns/div
Horizontal Trigger Position	10%
Trigger Level	100 mV

4. Measure the amplitude of the signal on the test oscilloscope. Note this measurement as the Reference Amplitude. See Figure 2-10 for measurement points.

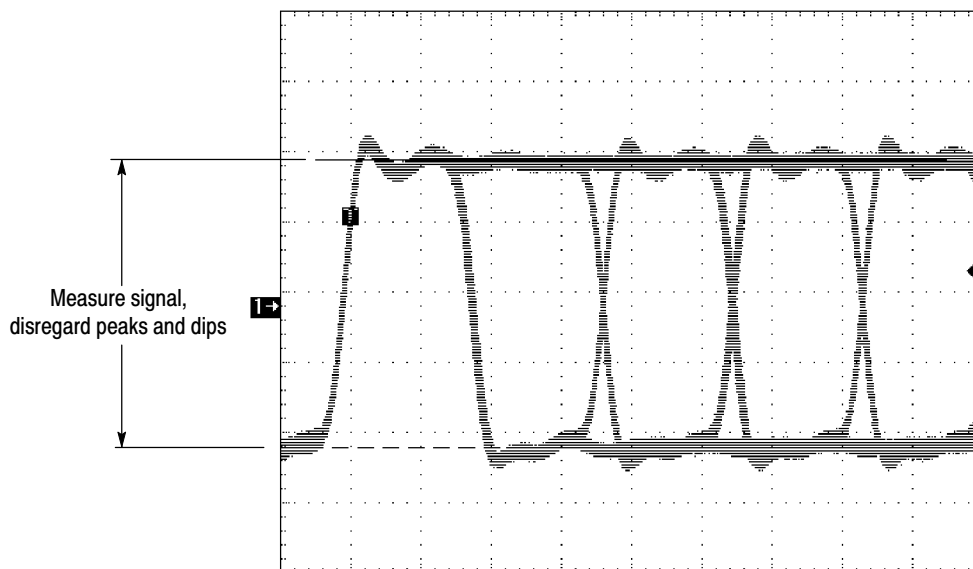


Figure 2- 10: Eye vertical scale reference level screen

5. Move the signal from the test oscilloscope to **INPUT B**.
6. Press the **INPUT** button and select **Input B**.
7. Press the **EYE** button and touch the **3 Eye** soft key (**3 Eye** selected).
8. Press the **CURSOR** button and touch the **Voltage** soft key (**Voltage** selected).
9. Measure the signal amplitude displayed on the WFM700 using the voltage cursors. Position the cursors where the waveform is unaffected by overshoot or ringing. See Figure 2-11.
10. Calculate scale error using the formula:
$$\text{Scale Error} = 100 \times \left(\frac{\text{Displayed Amplitude} - \text{Reference Amplitude}}{\text{Reference Amplitude}} \right)$$
11. **CHECK** that the calculated scale error is between $\pm 5\%$.
12. Disconnect the test setup.

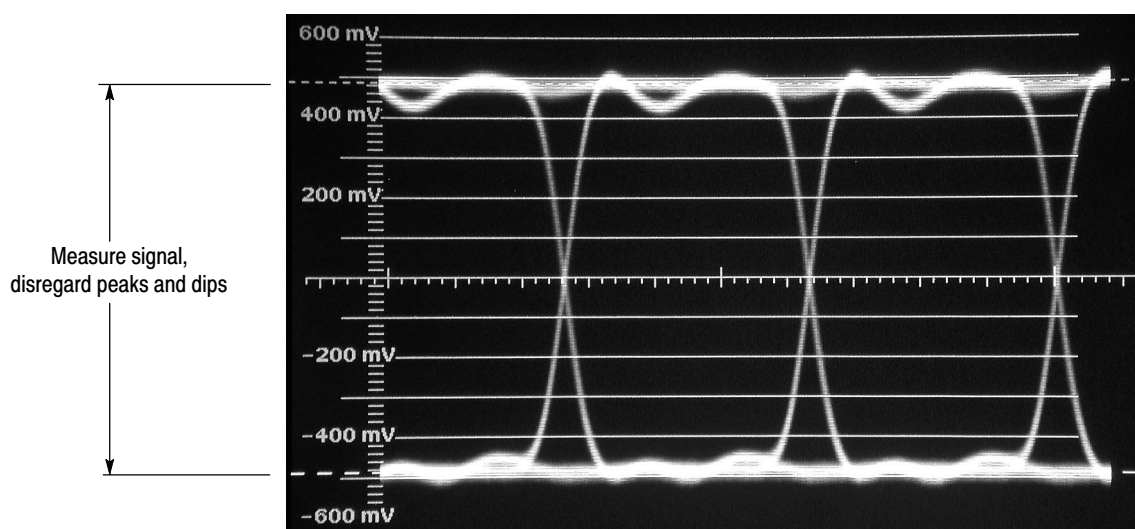


Figure 2-11: Eye vertical scale performance screen

Input Return Loss This test checks the signal return loss. Performance is checked indirectly.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to the input port of the Return Loss Bridge using a 50 Ω cable.
3. Connect the output of the Return Loss Bridge to the 50 Ω input of the test oscilloscope using a 50 Ω cable. Do not connect the test port of the Bridge at this time.
4. Set the RF generator as follows:

Frequency	900 MHz
Phase Modulation	OFF
Frequency Modulation	OFF
Output Power	+7.0 dBm
RF Output	ON
5. Adjust the test oscilloscope to obtain a stable display of the 900 MHz sine wave from the RF generator.
6. Measure the amplitude of the signal on the test oscilloscope. Note this measurement as the reference level.
7. Connect the test port of the Return Loss Bridge directly to **INPUT A**. Do not use any cables or adapters.
8. Press the **INPUT** button and select **Input A**.
9. Measure the amplitude of the signal on the test oscilloscope. Note this as the A Reflection level.
10. Calculate the return loss with the formula below using the measured values from steps 6 and 9.

$$\text{Input A Return Loss} = 20 \times \log_{10} \left(\frac{\text{Reference}}{\text{A Reflection}} \right)$$

11. *CHECK* that the calculated return loss is >25 dB for Input A.

12. Move the Return Loss Bridge test port from **Input A** to **Input B**.
 13. Select **Input B**.
 14. Measure the amplitude of the signal on the test oscilloscope. Note this as the B Reflection level.
 15. Calculate the return loss with the formula below using the measured values from steps 6 and 14.
- $$\text{Input B Return Loss} = 20 \times \log_{10} \left(\frac{\text{Reference}}{\text{B Reflection}} \right)$$
16. *CHECK* that the calculated return loss is >25 dB for Input B.
 17. Disconnect the test setup.

Jitter Noise Floor (WFM7M only)

This test checks the Jitter Noise Floor.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are not listed in the test record.

NOTE. *If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.*

- a. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
 - b. Set the SD video generator for a 525-format 100% color bar signal.
 - c. Press the **INPUT** button and select **Input B**.
 - d. Press the **EYE** button.
-

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this test.
3. Set the RF generator as follows:

Frequency	741.7582 MHz
Output Level	0 dB
Frequency Modulation	OFF
Phase Modulation	OFF
RF Output	ON

4. Press the **INPUT** button and select **Input A**.
5. Press the **EYE** button and then touch the **Display** soft key.
6. Touch the **Jitter** soft key and then touch the **Done** soft key.
7. Touch the **Hi Pass Filter:** soft key and set to **100 kHz**.
8. *CHECK* that the Measured Jitter is approximately 30 ps (typical).
9. Touch the **Hi Pass Filter:** soft key and set to **10 kHz**.
10. *CHECK* that the Measured Jitter is approximately 60 ps (typical).
11. Change the RF generator settings as follows:

Frequency	135.0 MHz
-----------	-----------
12. Touch the **Hi Pass Filter:** soft key and set to **10 Hz**.
13. *CHECK* that the Measured Jitter is approximately 200 ps (typical).

**Eye Time Base Jitter
(WFM7M only)**

This test checks the Eye Time Base Jitter.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are not listed in the test record.

NOTE. *If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.*

- a. *Connect the SD video generator to **INPUT B** using a 75 Ω cable.*
 - b. *Set the SD video generator for a 525-format 100% color bar signal.*
 - c. *Press the **INPUT** button and select **Input B**.*
 - d. *Press the **EYE** button.*
-

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this test.
3. Set the RF generator as follows:

Frequency	741.7582 MHz
Output Level	0 dB
Frequency Modulation	OFF
Phase Modulation	OFF
RF Output	ON

4. Press the **INPUT** button and select **Input A**.
5. Press the **EYE** button, touch the **Eye** soft key and select **3 Eye**.
6. Touch the **Clock BW:** soft key and set to **1 kHz**.
7. Press the **DISPLAY** button.
8. Touch the **Trace Settings** soft key, then select **Waveform** and adjust the waveform value to +20 using the General Purpose Knob.
9. Use the Time cursors to measure the width of the point where a rising edge crosses a falling edge. See Figure 2-12.
10. *CHECK* that the measured value is approximately 0.07 ns (typical).
11. Change the RF generator settings as follows:

Frequency	135.0 MHz
-----------	-----------
12. Use the Time cursors to measure the width of the point where a rising edge crosses a falling edge. See Figure 2-12.
13. *CHECK* that the measured value is approximately 0.15 ns (typical).

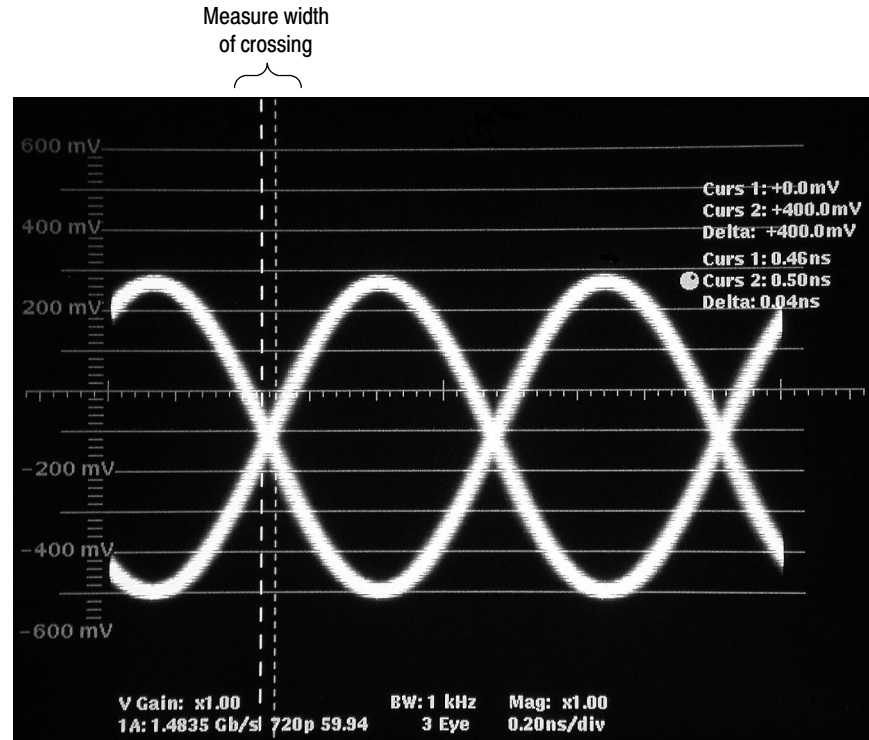


Figure 2-12: Eye time base jitter performance screen

**Eye Pattern Display Jitter
Attenuation Error (WFM7M
only)**

This test checks the jitter error (for frequencies greater than 2 times the Clock BW setting). This procedure is only applicable for a WFM7M Input Module.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

NOTE. *If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.*

- a. Connect the SD video generator to **INPUT B** using a 75 Ω cable.*
 - b. Set the SD video generator for a 525-format 100% color bar signal.*
 - c. Press the **INPUT** button and select **Input B**.*
 - d. Press the **EYE** button.*
 - e. Press the **INPUT** button and select **Input A**.*
-

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this test.
3. Set the RF generator as follows:

Frequency	741.7582 MHz
Output Level	0 dB
Frequency Modulation	OFF
LFGEN2 Frequency	40 Hz
LFGEN2 Waveshape	SINE
Phase Modulation Source	LF2
Phase Deviation	1.57 RADIANS
RF Output	ON
Phase Modulation	ON
4. Press the **EYE** button.
5. Touch the **Clock BW:** soft key. On the resulting screen, touch the **10 Hz** soft key and then the **Done** soft key.
6. Touch the **3 Eye** soft key (**3 Eye** selected).

7. Adjust the RF generator phase deviation in 0.01 radian steps until the displayed waveform shows exactly 1 UI phase modulation. Note the phase deviation. See Figure 2-13.

NOTE. 1 UI phase modulation is achieved when the peak positive phase modulation exactly overlaps the peak negative modulation. The result is that the sine wave is brighter where the peak positive and negative phase modulations overlap. Slowly adjust the RF generator phase deviation to become familiar with the appearance of 1 UI phase modulation.

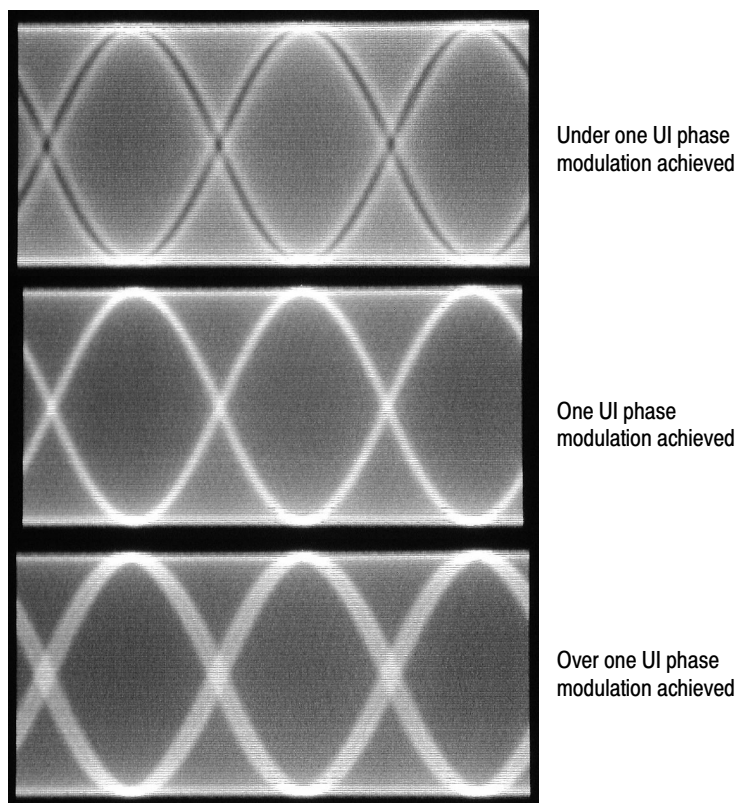


Figure 2-13: Eye clock recovery bandwidth performance screen

8. Calculate percent amplitude error using the formula:

$$\text{Amplitude Error} = 100 \times \left(\frac{1.57 - \text{Phase Deviation}}{1.57} \right)$$

9. *CHECK* that the calculated amplitude error is between –10% and +10%.

10. Set **Clock BW** to **100 Hz**.

11. Adjust the RF generator settings as follows:

LFGEN2 Frequency 400 Hz

12. Adjust the RF generator phase deviation in 0.01 radian steps until the displayed waveform shows exactly 1 UI phase modulation. Note the phase deviation. See Figure 2-13.

13. Calculate percent amplitude error using the formula:

$$\text{Amplitude Error} = 100 \times \left(\frac{1.57 - \text{Phase Deviation}}{1.57} \right)$$

14. *CHECK* that the calculated amplitude error is between –10% and +10%.

15. Set the **Clock BW** to **1 kHz**.

16. Change the RF generator settings as follows:

LFGEN2 Frequency 4000 Hz

17. Adjust the RF generator phase deviation in 0.01 radian steps until the displayed waveform shows exactly 1 UI phase modulation. Note the phase deviation. See Figure 2-13.

18. Calculate percent amplitude error using the formula:

$$\text{Amplitude Error} = 100 \times \left(\frac{1.57 - \text{Phase Deviation}}{1.57} \right)$$

19. *CHECK* that the calculated amplitude error is between –10% and +20%.

20. Press the **WFM** button to exit eye clock BW mode.

Jitter Display High Pass Filter (WFM7M only)

This test checks the jitter high pass filter attenuation at the selected frequency. This procedure is only applicable for a WFM7M Input Module.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

NOTE. *If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.*

- a. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
 - b. Set the SD video generator for a 525-format 100% color bar signal.
 - c. Press the **INPUT** button and select **Input B**.
 - d. Press the **EYE** button.
 - e. Press the **INPUT** button and select **Input A**.
-

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this test.
3. Set the RF generator as follows:

Frequency	741.7582 MHz
Output Level	0 dB
Frequency Modulation	OFF
LFGEN2 Frequency	10 Hz
LFGEN2 Waveshape	SINE
Phase Modulation Source	LF2
Phase Deviation	6.28 RADIANS
RF Output	ON
Phase Modulation	ON

4. Press the **EYE** button and then touch the **Display** soft key.
5. Touch the **Jitter** soft key and then touch the **Done** soft key.
6. Touch the **Hi Pass Filter:** soft key and set to **10 Hz**.
7. Read the Measured Jitter amplitude (in UI) displayed on screen.
8. Calculate the jitter response in db using the formula:

$$\text{Jitter Response} = 20 \times \log_{10} \left(\frac{\text{Measured Jitter}}{4 \text{ UI}} \right)$$

9. **CHECK** that the calculated response is between -2 dB and -4 dB.

- 10. Set Hi Pass Filter to 1 kHz.**
- 11. Change RF generator settings as follows:**

LFGEN2 Frequency	1 kHz
------------------	-------
- 12. Repeat steps 7 through 9.**
- 13. Set Hi Pass Filter to 10 kHz.**
- 14. Change RF generator settings as follows:**

LFGEN2 Frequency	10 kHz
------------------	--------
- 15. Repeat steps 7 through 9.**
- 16. Change RF generator settings as follows:**

LFGEN2 Frequency	100 kHz
------------------	---------
- 17. Set Hi Pass Filter to 1 kHz.**
- 18. Adjust the RF generator deviation for a Jitter reading of 4.0 UI.**
- 19. Set Hi Pass Filter to 100 kHz.**
- 20. Repeat steps 7 through 9.**

Eye Clock Recovery Bandwidth (WFM7M only)

This test checks the Eye Clock recovery Bandwidth. This procedure is only applicable for a WFM7M Input Module.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

NOTE. *If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.*

- a. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
 - b. Set the SD video generator for a 525-format 100% color bar signal.
 - c. Press the **INPUT** button and select **Input B**.
 - d. Press the **EYE** button.
 - e. Press the **INPUT** button and select **Input A**.
-

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this test.
3. Press the **EYE** button and then touch the **Display** soft key.
4. Touch the **Eye** soft key and then touch the **Done** soft key.

NOTE. *If an adapter is needed to obtain the correct cable connectors, they should be installed at the generator, not on the WFM700.*

5. Set the RF generator as follows:

Frequency	741.7582 MHz
Output Level	0 dBm
Phase Modulation	OFF
Frequency Modulation	OFF
RF Output	ON

6. Touch the **Clock BW:** soft key. On the resulting screen, touch the **100 Hz** soft key and then the **Done** soft key.
7. Touch the **3 Eye** soft key (**3 Eye** selected).
8. The displayed waveform should be two overlapping sine waves 180 degrees out of phase. See Figure 2-14.

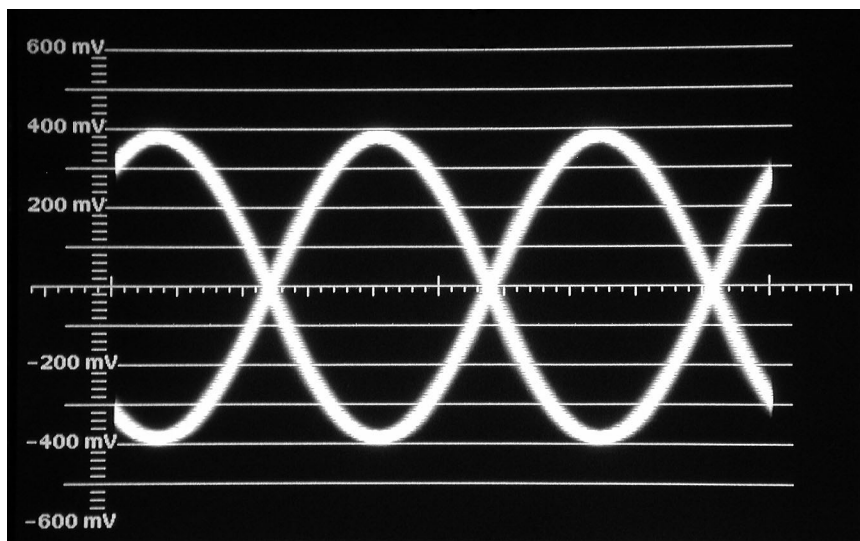


Figure 2-14: Eye clock recovery bandwidth performance screen

9. Adjust the RF generator to add phase modulation to the signal as follows:

LFGEN2 Frequency	10 kHz
LFGEN2 Waveshape	SINE
Phase Modulation Source	LFGEN2
Phase Deviation	1.57 RADIANS
Phase Modulation	ON

10. The displayed waveform should fill in with 1 unit interval (UI) of phase modulation. See Figure 2-13.

NOTE. 1 UI phase modulation is achieved when the peak positive phase modulation exactly overlaps the peak negative modulation. The result is that the sine wave is brighter where the peak positive and negative phase modulations overlaps. Slowly adjust the RF generator phase deviation to become familiar with the appearance of 1 UI phase modulation.

11. Adjust the RF generator settings as follows:

LFGEN2 Frequency	100 Hz
Phase Deviation	2.22 RADIANS

12. Adjust the RF generator LF2 frequency in 1 Hz steps until the displayed waveform shows exactly 1 UI phase modulation. Note the LF2 frequency setting. See Figure 2-13 on page 2-37.

13. Calculate the percentage of frequency error using the formula:

$$\text{Frequency Error} = \text{LF2 frequency} - 100$$

14. **CHECK** that the calculated frequency error is between –10% and +10%.

15. Set the **Clock BW** to **10 Hz**.

16. Adjust RF generator settings as follows:

LFGEN2 Frequency	10 Hz
------------------	-------

17. Adjust the RF generator LF2 frequency in 0.1 Hz steps until the displayed waveform shows exactly 1 UI phase modulation. See Figure 2-13 on page 2-37. Note the LFGEN2 frequency setting.

18. Calculate the percentage of frequency error using the formula:

$$\text{Frequency Error} = 10 \times (\text{LF2 frequency} - 10)$$

19. **CHECK** that the calculated frequency error is between –10% and +10%.

20. Set **Clock BW** to **1 kHz**.

21. Adjust the RF generator settings as follows:

LFGEN2 Frequency	1 kHz
------------------	-------

22. Adjust the RF generator LF2 frequency in 10 Hz steps until the displayed waveform shows exactly 1 UI phase modulation. See Figure 2-13 on page 2-37. Note the LFGEN2 frequency setting.

23. Calculate percent frequency error using the formula:

$$\text{Frequency Error} = 0.1 \times (\text{LF2 frequency} - 1000)$$

24. **CHECK** that the calculated frequency error is between –10% and +10%.

25. Press the **WFM** button to exit Eye mode.

Jitter Gain Check (WFM7M only)

This test checks the jitter display and JITTER OUT scale factors.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are not listed in the test record.

NOTE. *If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.*

- a. Connect the SD video generator to **INPUT B** using a 75 Ω cable.*
 - b. Set the SD video generator for a 525-format 100% color bar signal.*
 - c. Press the **INPUT** button and select **Input B**.*
 - d. Press the **EYE** button.*
-

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this connection.
3. Set the RF generator as follows:

Frequency	741.7582 MHz
Output Level	0 dB
Frequency Modulation	OFF
LFGEN2 Frequency	10 kHz
LFGEN2 Waveshape	SQUARE
Phase Modulation Source	LFGEN2
Phase Deviation	3.14 RADIANS
RF Output	ON
Phase Modulation	ON
4. Connect the **JITTER OUT** to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
5. Press the **INPUT** button and select **Input A**.
6. Press the **EYE** button and then touch the **Display** soft key.
7. Touch the **Jitter** soft key and then touch the **Done** soft key.
8. Touch the **Hi Pass Filter:** soft key and set to **10 Hz**.
9. Set the oscilloscope controls to produce a stable display. Limit the bandwidth setting to reduce displayed noise for better results. See Figure 2-15.

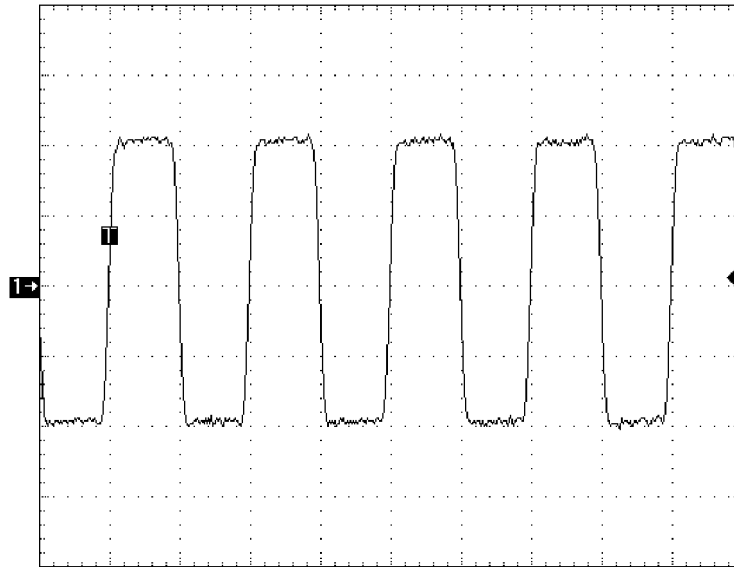


Figure 2-15: Jitter gain check performance screen

10. Measure the amplitude of the 10 kHz square wave on the test oscilloscope. Note the measurement.
11. Calculate the JITTER OUT scale factor error percentage using the formula:

$$\text{Jitter Out Scale Factor Error} = \frac{(\text{Measured Amplitude } mV - 200 \text{ } mV)}{2}$$

12. *CHECK* that the calculated error is $\pm 10\%$ (typical).
13. Read the Measured Jitter amplitude in UI on the WFM700 display.
14. Calculate the HD jitter gain error in percentage using the formula:

$$\text{HD Jitter Gain Error} = (\text{Measured Jitter UI} - 2 \text{ UI}) \times 50$$

15. *CHECK* that the calculated error is $\pm 10\%$ (typical).
16. Change RF generator settings as follows:

Frequency	135.0 MHz
-----------	-----------
17. Allow the display to settle for several seconds.
18. Read the Measured Jitter amplitude in UI on the WFM700 display.

19. Calculate the SD jitter gain error percentage using the formula:

$$SD \text{ Jitter Gain Error} = (\text{Measured Jitter UI} - 2 \text{ UI}) \times 50$$

20. *CHECK* that the calculated error is $\pm 10\%$ (typical).

21. Disconnect the test setup.

Eye Pattern Display Signal Bandwidth (WFM7M only)

This test checks the eye pattern signal bandwidth. This procedure is only applicable for a WFM7M Input Module.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Press the **CONFIG** button.
2. Touch the **Calibration** soft key and then **Next Menu**.
3. Touch the **Eye Sig BW Test** soft key and then the **Start Eye Sig BW Test** soft key. This puts the WFM700 in Eye Bandwidth mode and starts the test.
4. Touch the **Input#** softkey, select **Input A**, then touch **Done**.
5. Install the wide band 50 Ω -to-75 Ω matching pad and a 75 Ω N-to-BNC adapter on the RF generator output.
6. Connect the RF generator output to **INPUT A** using the 75 Ω 18 inch low loss cable.

NOTE. The WFM700 inputs are terminated into 75 Ω . Impedance matching is necessary for this test.



CAUTION. Avoid excess stress on the BNC connections. If adapters and/or terminations are installed on the inputs of the WFM700, provide support to the cable assembly.

7. Set the RF generator as follows:

FREQUENCY	20 MHz
PHASE MODULATION	OFF
FREQUENCY MODULATION	OFF
OUTPUT LEVEL	6 dBm
RF OUTPUT	ON

8. Press the **CURSOR** button and touch **Voltage** cursors (**Voltage** selected).
9. Using the **SELECT** button and the General Purpose Knob, set cursor 1 to -400 mV and cursor 2 to +400 mV.
10. Set the RF generator output level so that the displayed signal amplitude matches the cursors. It may be necessary to adjust the vertical position. The display is an unsynchronized waveform. See Figure 2-16.

NOTE. When setting and measuring unsynchronized signal amplitude, position the cursors halfway from the dark background to the bright central area of the waveform. It is important to position the cursor in the waveform noise consistently. Do not change display brightness or ambient lighting between measurements.

11. Set the RF generator frequency to 2.5 GHz.
12. Measure the waveform amplitude using the cursors and note the delta measurement.

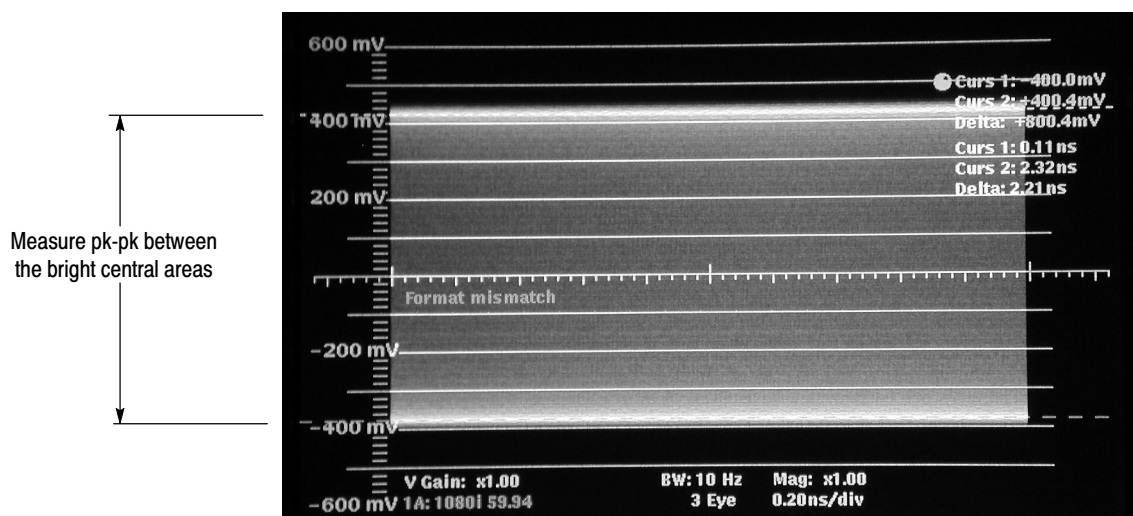


Figure 2-16: Eye pattern display signal bandwidth performance screen

13. While observing waveform amplitude, adjust the RF generator frequency down to 500 MHz (in 10 MHz steps). If the waveform amplitude falls below the cursors set in the previous step (step 12), re-adjust the cursors to the new minimum level.

14. Calculate the high frequency response using the formula:

$$\text{High Frequency Response} = 20 \times \log_{10} \left(\frac{\text{Measured Minimum}}{800 \text{ mV}} \right)$$

15. *CHECK* that the calculated high frequency response is between 0 and –3 dB.

16. Set the RF generator frequency to 50 kHz.

17. Measure the waveform amplitude using the cursors and note the measurement.

18. Calculate the low frequency response using the formula:

$$\text{Low Frequency Response} = 20 \times \log_{10} \left(\frac{\text{Measured Minimum}}{800 \text{ mV}} \right)$$

19. *CHECK* that the calculated low frequency response is between 0 and –3 dB.

20. Move the input cable assembly from **Input A** to **Input B**.

21. Press the **CURSOR** button to exit cursor mode.

22. Touch the **Input#** soft key, touch **Input B**, then touch **Done**.

23. Repeat steps 7 through 19 for **Input B**.

24. Press the **CURSOR** button to exit cursor mode.

25. Touch **Exit** to exit Eye Bandwidth mode.

NOTE. Most front panel buttons are disabled while in the Eye Sig BW Test mode. You must use the Exit soft key to return instrument functions.

26. Disconnect the test setup.

Restore to Factory Settings

Follow these steps to restore the WFM700 to the factory settings when finished with the Performance Verification procedures.

1. Press the **CONFIG** button.
2. Touch the **Audio Inputs/Outputs** soft key and then **Next Menu**.
3. Touch the **AES Connectors** soft key, then **Input**.
4. Touch the **Top Menu** soft key.
5. Press the **PRESET** button.
6. Touch the **-more-** soft key, then touch the **Restore Factory** soft key. Restoring factory settings overrides the current instrument state.

WFM700 Audio (Option DG) Performance Verification Procedure

The following tests verify that the Audio module (Option DG) for the WFM700 waveform monitor (all models) meets the warranted characteristics listed in the *Specifications* section of the *WFM700 Series Technical Reference* document. Characteristics with typical specifications (not warranted) are also checked.

Return Loss This test verifies that the return loss of the AES Inputs and Outputs.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Install the 50 Ω N-to-BNC adapter on the sinewave generator output.
2. Connect the RF generator output to the input port of the Return Loss Bridge using a 50 Ω cable.
3. Connect the output of the Return Loss Bridge to the 50 Ω input of the test oscilloscope using a 50 Ω cable. Do not connect the test port of the Bridge at this time.

4. Set the sinewave generator as follows:

Frequency	6 MHz
Phase Modulation	OFF
Frequency Modulation	OFF
Output Power	+2.0 dBm (0.8 V p-p)
RF Output	ON

5. Adjust the test oscilloscope to obtain a stable display of the 6 MHz sine wave from the RF generator. The following oscilloscope settings normally provide a usable display.

Vertical Scale	50 mV
Horizontal Scale	100 ns/div
Bandwidth Limit	On

6. Measure the amplitude of the signal on the test oscilloscope. Note this measurement as the reference level.

NOTE. The reference level should be between 150 mV and 200 mV. Adjust the output level of the RF generator if necessary to obtain the correct output level.

7. Press the **CONFIG** button.
 8. Touch the **Audio Inputs/Outputs** soft key and then **Next Menu**.
 9. Touch the **AES Connectors** soft key and then **Input**.
 10. Press the **AUDIO** button.
 11. Press the **INPUT** button, then touch **Audio In:** and select **External AES**.
 12. Connect the test port of the Return Loss Bridge directly to the **AES 1-2 I/O** connector. Do not use any cables or adapters.
 13. Measure the amplitude of the signal on the test oscilloscope. Note this as the Reflection level.
 14. Calculate the return loss with the formula below using the measured values from steps 6 and 13.
- $$\text{Input Return Loss} = 20 \times \log_{10} \left(\frac{\text{Reference}}{\text{Reflection}} \right)$$
15. *CHECK* that the calculated return loss is >25 dB.
 16. Move the return loss bridge to each of the remaining **AES I/O** connectors and repeat steps 12 through 15.
 17. Disconnect the test setup.

Input Amplitude and Sample Rate Range

This test verifies that each AES input locks to an input signal.

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the digital audio generator unbalanced (UNBAL) output to **AES 1-2 I/O** using a 75 Ω cable.
2. Set the digital audio generator as follows:

Frequency	1 kHz
Output Level	-20 dB FS Audio Tone
Sample Frequency	96 kHz
Unbalanced V_{p-p}	2.000 V (Carrier Level)

3. Press the **CONFIG** button.
4. Touch the **Audio Inputs/Outputs** soft key, then **Next Menu**.
5. Touch the **Audio Program Type** soft key, then **Stereo Pairs**.
6. Press the **AUDIO** button.
7. Touch the **Meter Scaling:** soft key and select **Default**.
8. *CHECK* for an indication of –20 dB FS and no error messages in the corresponding bars.
9. Move the audio generator output to each of the remaining **AES I/O** connectors and repeat step 8 for each connector.
10. Set the digital audio generator as follows:

Unbalanced V_{p-p}	0.2000 V (Carrier Level)
----------------------	--------------------------
11. *CHECK* for an indication of –20 dB FS and no error messages in the corresponding bars.
12. Move the audio generator output to each of the remaining **AES I/O** connectors and repeat step 11 for each connector.
13. Set the digital audio generator as follows:

Sample Frequency	35 kHz
------------------	--------
14. *CHECK* for an indication of –20 dB FS and no error messages in the corresponding bars.
15. Move the audio generator output to each of the remaining **AES I/O** connectors and repeat step 14 for each connector.
16. Set the digital audio generator as follows:

Unbalanced V_{p-p}	2.000 V (Carrier Level)
----------------------	-------------------------
17. *CHECK* for an indication of –20 dB FS and no error messages in the corresponding bars.
18. Move the audio generator output to each of the remaining **AES I/O** connectors and repeat step 17 for each **AES I/O** connector.
19. Disconnect the test setup.

Output Amplitude, Rise Time and Fall Time

This test verifies the amplitude and the rise and fall times of each AES output

Performance Requirement. This test verifies performance characteristics and is listed in the test record.

1. Connect the HD video generator to **INPUT A** using a 75 Ω cable.
2. Set the HD video generator for a 1080i 59.94 100% color bars signal.
3. Set the HD video generator for 2 groups of embedded audio, starting with group 1.
4. Connect the **AES 1-2 I/O** output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
5. Press the **CONFIG** button.
6. Touch the **Audio Inputs/Outputs** soft key, then **Next Menu**.
7. Touch the **AES Connectors** soft key, then **Output**.
8. Select **Input 1A**. (Select **Input 2A** if checking a second Input Module in slot 2.)
9. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

Vertical Scale	200 mV/div
Horizontal Scale	100 ns/div
Horizontal Trigger Position	30%
Trigger Slope	Rising edge
Trigger Level	0 mV
10. *CHECK* that the amplitude of the waveform displayed on the oscilloscope is between 0.9 V and 1.1 V.
11. Change the oscilloscope horizontal scale to 20 ns/div.
12. *CHECK* that the rise time of the waveform displayed on the oscilloscope is between 30 ns and 44 ns.
13. Change the oscilloscope to trigger on the falling edge.
14. *CHECK* that the fall time of the waveform displayed on the oscilloscope is between 30 ns and 44 ns.
15. Move the cable to each of the remaining **AES I/O** connectors and repeat steps 9 through 14 for each **AES I/O** connector.
16. Disconnect the test setup.

SD Output Jitter (WFM7A, WFM7M only)

This test measures jitter at each AES output.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are not listed in the test record.

1. Connect the SD video generator to **INPUT A** using a 75 Ω cable.
2. Set the SD video generator for a 525-format 100% color bars signal.
3. Set the SD video generator for 2 groups of embedded audio, starting with group 1.
4. Connect **AES 1-2 I/O** to the digital audio analyzer unbalanced (UNBAL) input using a 75 Ω cable.
5. Set the audio analyzer for measurement of jitter per AES3-1992 (or 1997).
6. Allow the jitter reading to settle for a few second.
7. *CHECK* for a typical Jitter Peak abs reading of less than 3.5 ns over an interval of at least 5 seconds.
8. Move the cable to each of the remaining **AES I/O** connectors and repeat step 7 for each **AES I/O** connector.
9. Disconnect the test setup.

HD Output Jitter (WFM7HD only)

This test measures jitter at each AES output.

Typical Operation Check. This test checks for typical operation. Typical values are not guaranteed characteristics and are not listed in the test record.

1. Connect the HD video generator to **INPUT A** using a 75 Ω cable.
2. Set the HD video generator for a 1080i 59.94 100% color bars signal.
3. Set the HD video generator for 2 groups of embedded audio, starting with group 1.
4. Connect **AES 1-2 I/O** to the digital audio analyzer unbalanced (UNBAL) input using a 75 Ω cable.
5. Set the audio analyzer for measurement of jitter per AES3-1992 (or 1997).
6. Allow the jitter reading to settle for a few second.
7. *CHECK* for a typical Jitter Peak abs reading of less than 3.5 ns over an interval of at least 5 seconds.

8. Move the cable to each of the remaining **AES I/O** connectors and repeat step 7 for each **AES I/O** connector.
9. Disconnect the test setup.

Restore to Factory Settings

Follow these steps to restore the WFM700 to the factory settings when finished with the Performance Verification procedures.

1. Press the **CONFIG** button.
2. Touch the **Audio Inputs/Outputs** soft key and then **Next Menu**.
3. Touch the **AES Connectors** soft key, then **Input**.
4. Touch the **Top Menu** soft key.
5. Press the **PRESET** button.
6. Touch the **-more-** soft key, then touch the **Restore Factory** soft key. Restoring factory settings overrides the current instrument state.

WFM700/WFM7M Input Module Test Record

Photocopy this form and use it to record the performance test results. If your instrument also contains the optional Audio module (Option DG), photocopy that test record to record the performance test results for the Audio module.

Test Record

Instrument Serial Number: _____ Certificate Number: _____
 Input Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

Power Source Range

Stable display from 90 V to 264 V	Pass			N/A
Re-start at 90 V	Pass			N/A

Signal Data Paths

High Definition				
Y component ramp is monotonic	Pass			N/A
Y component ramps step size	0.7 mV			0.9 mV
Pb component ramp is monotonic	Pass			N/A
Pb component ramps step size	0.7 mV			0.9 mV
Pr component ramp is monotonic	Pass			N/A
Pr component ramps step size	0.7 mV			0.9 mV
Standard Definition				
Y component ramp is monotonic	Pass			N/A
Y component ramps step size	0.7 mV			0.9 mV
Pb component ramp is monotonic	Pass			N/A
Pb component ramps step size	0.7 mV			0.9 mV
Pr component ramp is monotonic	Pass			N/A
Pr component ramps step size	0.7 mV			0.9 mV

SD LCD Pixel Defects (WFM7A and WFM7M only)

Number of bad pixels	N/A			6
----------------------	-----	--	--	---

WFM700/WFM7M Input Module Test Record

Test Record (cont.)

Instrument Serial Number: _____	Certificate Number: _____
Input Module Serial Number: _____	
Temperature: _____	Relative Humidity %: _____
Date of Calibration: _____	Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

Error Detection Data Paths

1080i 59.94 0% flat field				
Embedded CRC status reads: Embedded CRC: SMPTE 292 Y:OK C:OK	Pass			N/A
1080i 59.94 0% flat field				
Gamut errors read as follows: RGB Gamut Error X OK Composite Gamut Error X OK	Pass			N/A
1080i 59.94 SMPTE color bars				
Gamut errors read as follows: RGB Gamut Error X Alarm Composite Gamut Error X OK	Pass			N/A
1080i 59.94 100% color bars				
Gamut errors read as follows: RGB Gamut Error X OK Composite Gamut Error X Alarm	Pass			N/A

Serial Video Output

Calculated error	-5%			+5%
------------------	-----	--	--	-----

SD PIX MON Output Level

Calculated error	-5%			+5%
------------------	-----	--	--	-----

Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Input Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

PIX Video Output Level

High Definition				
PIX G/Y calculated amplitude error	-5%			+5%
PIX G/Y black level	-25 mV			+25 mV
PIX B/Pb calculated amplitude error	-5%			+5%
PIX B/Pb black level	-25 mV			+25 mV
PIX R/Pr calculated amplitude error	-5%			+5%
PIX R/Pr black level	-25 mV			+25 mV
Standard Definition				
PIX G/Y calculated amplitude error	-5%			+5%
PIX G/Y black level	-25 mV			+25 mV
PIX B/Pb calculated amplitude error	-5%			+5%
PIX B/Pb black level	-25 mV			+25 mV
PIX R/Pr calculated amplitude error	-5%			+5%
PIX R/Pr black level	-25 mV			+25 mV

External Reference

1080i 50 100% color bars				
Display remains locked to the external reference	Pass			N/A
1080i 60 100% color bars				
Display remains locked to the external reference	Pass			N/A
720p 59.94 100% color bars				
Display remains locked to the external reference	Pass			N/A

Cable Loss Accommodation

High Definition				
No embedded CRC Y or C errors messages	Pass			N/A
Standard Definition				
No embedded CRC Y or C errors messages	Pass			N/A

Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Input Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Eye Vertical Scale</i>				
Calculated scale error	-5%			+5%
<i>Input Return Loss</i>				
Input A				
Calculated return loss	>25 dB			N/A
Input B				
Calculated return loss	>25 dB			N/A
<i>Eye Pattern Display Jitter Attenuation Error</i>				
Calculated amplitude error				
10 Hz Clock BW	-10%			+10%
100 Hz Clock BW	-10%			+10%
1 kHz Clock BW	-10%			+20%
<i>Jitter Display High Pass Filter</i>				
Calculated jitter response				
Generator at 6.28 RADIANS Phase Deviation				
10 Hz Hi Pass Filter	-4 dB			-2 dB
1 kHz Hi Pass Filter	-4 dB			-2 dB
100 kHz Hi Pass Filter	-4 dB			-2 dB
Generator set to produce 4 UI jitter with Hi Pass Filter at 1 kHz				
100 kHz Hi Pass Filter	-4 dB			-2 dB
<i>Eye Clock Recovery Bandwidth</i>				
Calculated frequency error				
Clock BW at 100 Hz	-10%			+10%
Clock BW at 10 Hz	-10%			+10%
Clock BW at 1 kHz	-10%			+10%

Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Input Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Eye Pattern Display Signal Bandwidth</i>				
Calculated frequency response				
Input A				
2.5 GHz to 500 MHz	-3 dB			0 dB
50 kHz	-3 dB			0 dB
Input B				
2.5 GHz to 500 MHz	-3 dB			0 dB
50 kHz	-3 dB			0 dB

WFM700/WFM7A Input Module Test Record

Photocopy this form and use it to record the performance test results. If your instrument also contains the optional Audio module (Option DG), photocopy that test record to record the performance test results for the Audio module.

Test Record

Instrument Serial Number: _____ Certificate Number: _____
 Input Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

Power Source Range

Stable display from 90 V to 264 V	Pass			N/A
Re-start at 90 V	Pass			N/A

Signal Data Paths

High Definition				
Y component ramp is monotonic	Pass			N/A
Y component ramps step size	0.7 mV			0.9 mV
Pb component ramp is monotonic	Pass			N/A
Pb component ramps step size	0.7 mV			0.9 mV
Pr component ramp is monotonic	Pass			N/A
Pr component ramps step size	0.7 mV			0.9 mV
Standard Definition				
Y component ramp is monotonic	Pass			N/A
Y component ramps step size	0.7 mV			0.9 mV
Pb component ramp is monotonic	Pass			N/A
Pb component ramps step size	0.7 mV			0.9 mV
Pr component ramp is monotonic	Pass			N/A
Pr component ramps step size	0.7 mV			0.9 mV

SD LCD Pixel Defects

Number of bad pixels	N/A			6
----------------------	-----	--	--	---

WFM700/WFM7A Input Module Test Record

Test Record (cont.)

Instrument Serial Number: _____	Certificate Number: _____
Input Module Serial Number: _____	
Temperature: _____	Relative Humidity %: _____
Date of Calibration: _____	Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

Error Detection Data Paths

1080i 59.94 0% flat field				
Embedded CRC status reads: Embedded CRC: SMPTE 292 Y:OK C:OK	Pass			N/A
1080i 59.94 0% flat field				
Gamut errors read as follows: RGB Gamut Error X OK Composite Gamut Error X OK	Pass			N/A
1080i 59.94 SMPTE color bars				
Gamut errors read as follows: RGB Gamut Error X Alarm Composite Gamut Error X OK	Pass			N/A
1080i 59.94 100% color bars				
Gamut errors read as follows: RGB Gamut Error X OK Composite Gamut Error X Alarm	Pass			N/A

Serial Video Output

Calculated error	-5%			+5%
------------------	-----	--	--	-----

SD PIX MON Output Level

Calculated error	-5%			+5%
------------------	-----	--	--	-----

Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Input Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

PIX Video Output Level

High Definition				
PIX G/Y calculated amplitude error	-5%			+5%
PIX G/Y black level	-25 mV			+25 mV
PIX B/Pb calculated amplitude error	-5%			+5%
PIX B/Pb black level	-25 mV			+25 mV
PIX R/Pr calculated amplitude error	-5%			+5%
PIX R/Pr black level	-25 mV			+25 mV
Standard Definition				
PIX G/Y calculated amplitude error	-5%			+5%
PIX G/Y black level	-25 mV			+25 mV
PIX B/Pb calculated amplitude error	-5%			+5%
PIX B/Pb black level	-25 mV			+25 mV
PIX R/Pr calculated amplitude error	-5%			+5%
PIX R/Pr black level	-25 mV			+25 mV

External Reference

1080i 50 100% color bars				
Display remains locked to the external reference	Pass			N/A
1080i 60 100% color bars				
Display remains locked to the external reference	Pass			N/A
720p 59.94 100% color bars				
Display remains locked to the external reference	Pass			N/A

Cable Loss Accommodation

High Definition				
No embedded CRC Y or C errors messages	Pass			N/A
Standard Definition				
No embedded CRC Y or C errors messages	Pass			N/A

WFM700/WFM7A Input Module Test Record

Test Record (cont.)

Instrument Serial Number: _____	Certificate Number: _____
Input Module Serial Number: _____	
Temperature: _____	Relative Humidity %: _____
Date of Calibration: _____	Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Input Return Loss</i>				
Input A				
Calculated return loss	>25 dB			N/A
Input B				
Calculated return loss	>25 dB			N/A

WFM700/WFM7HD Input Module Test Record

Photocopy this form and use it to record the performance test results. If your instrument also contains the optional Audio module (Option DG), photocopy that test record to record the performance test results for the Audio module.

Test Record

Instrument Serial Number: _____	Certificate Number: _____
Input Module Serial Number: _____	
Temperature: _____	Relative Humidity %: _____
Date of Calibration: _____	Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Power Source Range</i>				
Stable display from 90 V to 264 V	Pass			N/A
Re-start at 90 V	Pass			N/A
<i>Signal Data Paths</i>				
High Definition				
Y component ramp is monotonic	Pass			N/A
Y component ramps step size	0.7 mV			0.9 mV
Pb component ramp is monotonic	Pass			N/A
Pb component ramps step size	0.7 mV			0.9 mV
Pr component ramp is monotonic	Pass			N/A
Pr component ramps step size	0.7 mV			0.9 mV
<i>HD LCD Pixel Defects</i>				
Number of bad pixels	N/A			6

Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Input Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

Error Detection Data Paths

1080i 59.94 0% flat field				
Embedded CRC status reads: Embedded CRC: SMPTE 292 Y:OK C:OK	Pass			N/A
1080i 59.94 0% flat field				
Gamut errors read as follows: RGB Gamut Error X OK Composite Gamut Error X OK	Pass			N/A
1080i 59.94 SMPTE color bars				
Gamut errors read as follows: RGB Gamut Error X Alarm Composite Gamut Error X OK	Pass			N/A
1080i 59.94 100% color bars				
Gamut errors read as follows: RGB Gamut Error X OK Composite Gamut Error X Alarm	Pass			N/A

Serial Video Output

Calculated error	-5%			+5%
------------------	-----	--	--	-----

SD PIX MON Output Level

Calculated error	-5%			+5%
------------------	-----	--	--	-----

PIX Video Output Level

High Definition				
PIX G/Y calculated amplitude error	-5%			+5%
PIX G/Y black level	-25 mV			+25 mV
PIX B/Pb calculated amplitude error	-5%			+5%
PIX B/Pb black level	-25 mV			+25 mV
PIX R/Pr calculated amplitude error	-5%			+5%
PIX R/Pr black level	-25 mV			+25 mV

Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Input Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
------------------	---------	----------	----------	---------

External Reference

1080i 50 100% color bars				
Display remains locked to the external reference	Pass			N/A
1080i 60 100% color bars				
Display remains locked to the external reference	Pass			N/A
720p 59.94 100% color bars				
Display remains locked to the external reference	Pass			N/A

Cable Loss Accommodation

High Definition				
No embedded CRC Y or C errors messages	Pass			N/A
Standard Definition				
No embedded CRC Y or C errors messages	Pass			N/A

Input Return Loss

Input A				
Calculated return loss	>25 dB			N/A
Input B				
Calculated return loss	>25 dB			N/A

WFM700 Audio Module (Option DG) Test Record

Photocopy this form and use it to record the performance test results for the Audio module (Option DG).

Audio (Option DG) Test Record

Instrument Serial Number: _____ Certificate Number: _____
Audio Module Serial Number: _____
Temperature: _____ Relative Humidity %: _____
Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Return Loss</i>				
AES 1-2 I/O				
Calculated return loss	>25 dB			N/A
AES 3-4 I/O				
Calculated return loss	>25 dB			N/A
AES 5-6 I/O				
Calculated return loss	>25 dB			N/A
AES 7-8 I/O				
Calculated return loss	>25 dB			N/A
<i>Input Amplitude and Sample Rate Range</i>				

Audio (Option DG) Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Audio Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
Sample Frequency at 96 kHz Unbalanced Output (Carrier Level) at 2.000 V				
AES 1-2 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 3-4 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 5-6 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 7-8 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
Sample Frequency at 96 kHz Unbalanced Output (Carrier Level) at 0.200 V				
AES 1-2 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 3-4 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 5-6 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 7-8 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A

Audio (Option DG) Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Audio Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
Sample Frequency at 35 kHz Unbalanced Output (Carrier Level) at 2.000 V				
AES 1-2 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 3-4 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 5-6 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 7-8 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
Sample Frequency at 35 kHz Unbalanced Output (Carrier Level) at 0.200 V				
AES 1-2 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 3-4 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 5-6 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A
AES 7-8 I/O				
–20 dB FS indication on display	Pass			N/A
No error messages	Pass			N/A

Audio (Option DG) Test Record (cont.)

Instrument Serial Number: _____ Certificate Number: _____
 Audio Module Serial Number: _____
 Temperature: _____ Relative Humidity %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Output Amplitude, Rise Time and Fall Time</i>				
AES 1-2 I/O				
Amplitude	0.9 V			1.1 V
Rise Time	30 ns			44 ns
Fall Time	30 ns			44 ns
AES 3-4 I/O				
Amplitude	0.9 V			1.1 V
Rise Time	30 ns			44 ns
Fall Time	30 ns			44 ns
AES 5-6 I/O				
Amplitude	0.9 V			1.1 V
Rise Time	30 ns			44 ns
Fall Time	30 ns			44 ns
AES 7-8 I/O				
Amplitude	0.9 V			1.1 V
Rise Time	30 ns			44 ns
Fall Time	30 ns			44 ns



Adjustment Procedures

Adjustments

This chapter contains information needed to manually adjust the WFM700 Waveform Monitor.

Use the *Adjustments* to return the WFM700 to conformance with the performance specified in the *Specifications* section of the *WFM700 Series Technical Reference* document. These procedures are not required to verify performance. For performance verification, refer to the *Performance Verification* section in this manual.

NOTE. *WFM700 firmware version 1.3 or above is required to perform the procedures in this section. Verify the firmware version and update if needed.*

Menu selections in the WFM700 Waveform Monitor differ between firmware versions. The Adjustments procedures assume you have the latest firmware version installed in your instrument.

There are no adjustment procedures required for the Option DG Audio module.

Adjustment Interval. You should perform these *Adjustment Procedures* once a year or if the instrument fails any of the *Performance Tests* starting on page 2-9.

Adjustment After Repair. After repairing the instrument, use the *Performance Verification* procedures to verify operation. If the instrument fails any of the procedures, perform the adjustment procedures in this chapter and then repeat the *Performance Verification* procedures.

Before Performing Adjustment Procedures

Before doing the adjustments, note the following prerequisites:

- **Personnel** — Only trained service technicians should perform these procedures. Technicians should be familiar with the operation of all test equipment and the WFM700.
- **Two Video Modules** — The adjustment procedures must be performed on both video modules if two are installed in the WFM700. Complete the entire performance procedures on one video module at a time.
- **Access to Adjustments** — The cabinet and cover must be removed to access the manual adjustments in this procedure.
- **Test Equipment** — Table 3-1 lists all test equipment required to perform the adjustment procedures. The adjustment procedures describe the input signal characteristics necessary to perform the adjustment. Where external

test equipment is required, refer to your test equipment's user manual for instructions to obtain the correct signal.

- **Warm-up Period** — Turn on the WFM700 and allow a 20-minute warm-up period in a 20 °C to 30 °C environment before adjusting it. Adjustments done before the operating temperature has stabilized may cause errors in performance. Also turn on other required test equipment and allow them to warm up for their recommended time periods.

Test Equipment Required Table 3-1 lists the equipment required to adjust the waveform monitor.

Table 3-1: Test equipment for adjustment procedures

Test Equipment	Requirements	Example ¹	WFM700		
			A	HD	M
HD serial digital video test signal generator	1080i 59.94 100% color bar	Tektronix TG2000 with HDVG1 module	●	●	●
SD serial digital video test signal generator	525-format 100% color bar	Tektronix TG2000 with DVG1 module	●		●
RF wave generator	20 MHz to 2.5 GHz <1 dB level flatness 10 Hz to 100 kHz phase modulation with < 3% setting error	Rohde & Schwarz SMT03 Opt SM-B2 50 Ω N-to-BNC adapter	●	●	●
Test oscilloscope	2 GHz vertical bandwidth	Tektronix TDS794	●	●	●
75 Ω coaxial cables (1 required)	Low loss digital video Male-to-male BNC connectors 36 inches long	Belden 8281	●	●	●
Adjustment Tool	0.075 inch slot screwdriver		●	●	●

¹ You may need additional cables and adapters, depending on the actual test equipment you use.

Manual Adjustment Procedures

This section describes how to do the manual adjustments of the WFM700 Waveform Monitors. Performing these procedures require the removal of the cabinet. Read the section *Before Performing Adjustment Procedures* on page 3-1.

It's recommended that this procedure be performed in its entirety and in the order presented.

All manual adjustment locations listed in this procedure are illustrated in Figure 3-1.

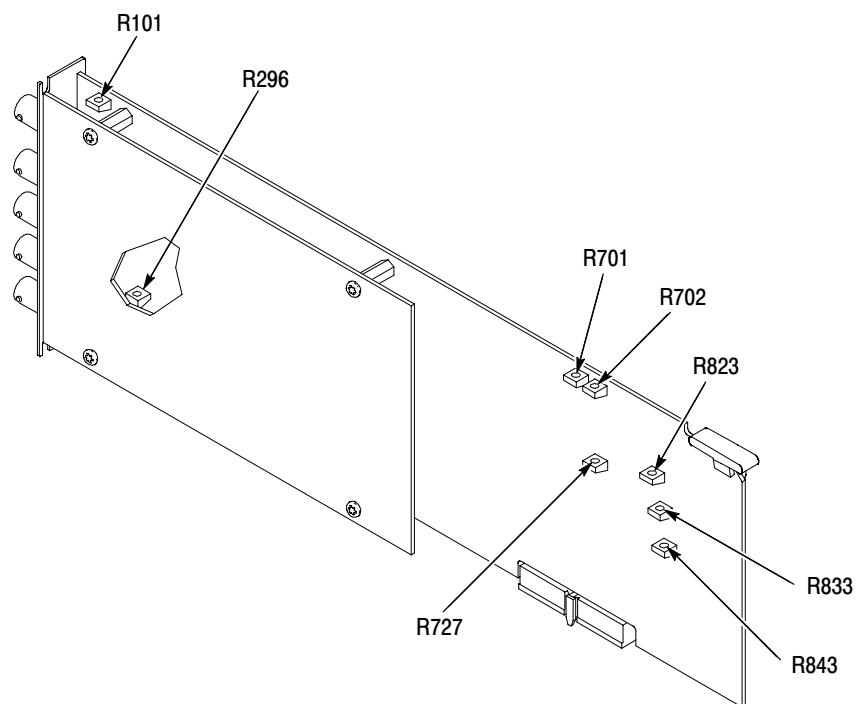


Figure 3-1: Adjustment locations on the video module

Serial Out Amplitude Adjustment

This adjustment calibrates the Serial Out amplitude from the Video Module.

Video Module Types. WFM700A, WFM700M, and WFM700HD

Requirements. HDVG, 1080-line color bar signal; test oscilloscope; 75 Ω coaxial cable

1. Connect the HD video generator to the Video Module under test using a 75 Ω cable.
2. Set the HD video generator for a 1080i 59.94 100% color bar signal.
3. Select the appropriate WFM700 Video Module (1 or 2) and input (A or B).
4. Press the **WFM** button.
5. Connect the **SERIAL OUT** to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
6. Adjust R296 for a display of 800 mV (± 10 mV) on the test oscilloscope. The following substeps will help obtain a measurable display on the test oscilloscope.
 - a. Ensure that the termination is correct on the test oscilloscope.
 - b. Set the vertical scale to 200 mV/div, horizontal scale to 5 ns/div, and the trigger position to 90%.
 - c. Set the display style to dots.
 - d. Set the trigger level to zero, and to neglect glitches of either polarity for widths to 30 ns.
 - e. The oscilloscope display should show a few random transitions followed by 30 ns with no transitions. This is followed by the triggering transition. See Figure 3-2.
 - f. When measuring, disregard signal noise. Measure the waveform amplitude from the centers of the high and low levels in the region from 5 ns to 10 ns before the triggering transition.

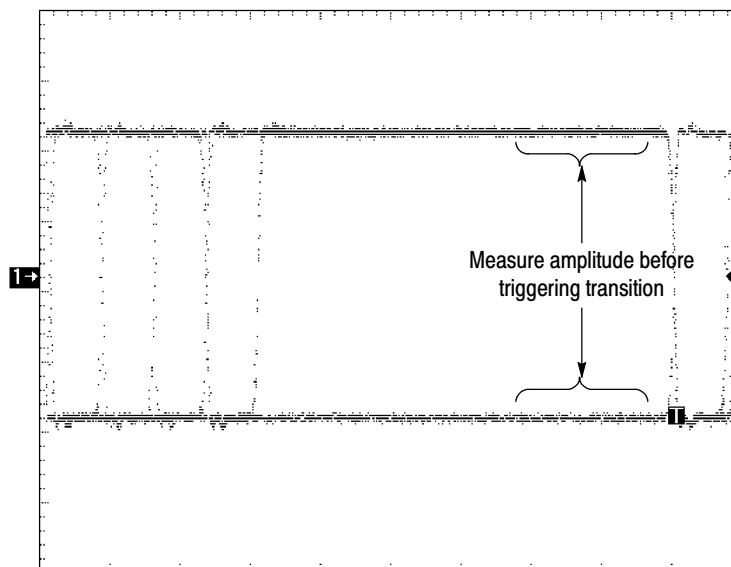


Figure 3-2: Serial out amplitude adjustment screen

SD PIX Monitor Adjustment

This adjustment calibrates the Standard Definition PIX output amplitude from the Video Module.

Video Module Types. WFM700A and WFM700M

Requirements. DVG, 525-line color bar signal; test oscilloscope; 75 Ω coaxial cable

1. Connect the SD video generator to the Video Module under test using a 75 Ω cable.
2. Set the SD video generator for a 525-format 100% color bar signal.
3. Select the appropriate WFM700 Video Module (1 or 2) and input (A or B).
4. Press the **WFM** button.
5. Connect the **SD PIX MON** output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.

6. Adjust R101 for a display of 800 mV on the test oscilloscope. The following substeps will help obtain a measurable display on the test oscilloscope.
 - a. Ensure that the termination is correct on the test oscilloscope. Use a converter if necessary.
 - b. Set the vertical scale to 200 mV/div, horizontal scale to 5 ns/div, and the trigger position to 90%.
 - c. Set the display style to dots.
 - d. Set the trigger level to zero, and to neglect glitches of either polarity for widths to 30 ns.
 - e. The oscilloscope display should show a few random transitions followed by 30 ns with no transitions. This is followed by the triggering transition. See Figure 3-3.
 - f. When measuring, disregard signal noise. Measure the waveform amplitude from the centers of the high and low levels in the region from 5 ns to 10 ns before the triggering transition.

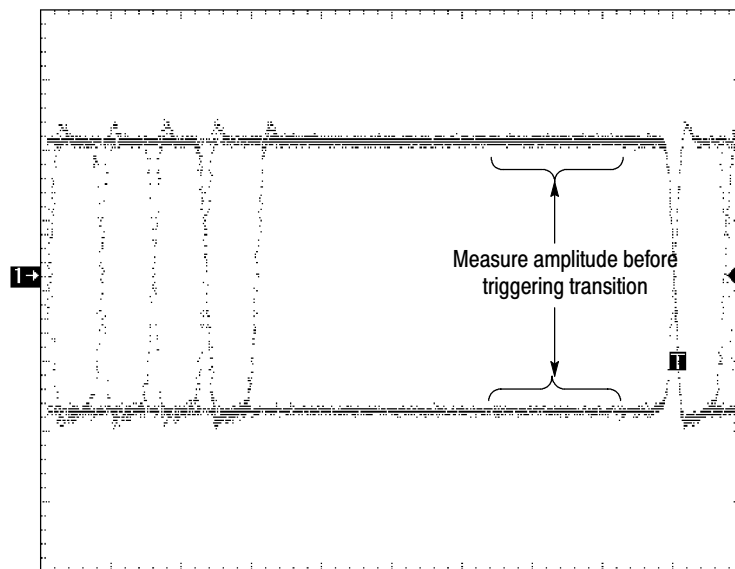


Figure 3-3: SD PIX monitor adjustment screen

SD GRB Output Adjustment

This adjustment calibrates the Standard Definition RGB output amplitude from the Reference Module.

1. Connect the SD video generator to the Video Module under test using a 75 Ω cable.
2. Set the SD video generator for a 525-format 100% color bar signal.
3. Connect the **PIX G/Y** output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
4. Select the appropriate WFM700 Video Module (1 or 2) and input (A or B).
5. Press the **CONFIG** button.
6. Touch the **Video Inputs/Outputs** soft key, then **Next Menu**.
7. Touch the **Output Active for SD** soft key, then **YPbPr**.
8. Press the **CONFIG** button twice to exit the menu.
9. Set the test oscilloscope to view the first color bar. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV/div
Vertical Position	-3.5 div
Horizontal Scale	5 us/div
Horizontal Trigger Position	50%
Trigger Slope	Rising edge
Trigger Level	500 mV

10. Adjust R701 for a display of 700 mV on the test oscilloscope. Measure the amplitude between the black level and the first color bar. See Figure 3-4.

11. Move the cable from the **PIX G/Y** to the **PIX B/Pb** connector.

12. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV/div
Horizontal Scale	10 us/div
Horizontal Trigger Position	10%
Trigger Slope	Rising edge
Trigger Level	300 mV

13. Adjust R702 for a display of 700 mV on the test oscilloscope. Measure the peak-to-peak amplitude of the waveform displayed on the oscilloscope. See Figure 3-5.

14. Move the cable from the **PIX B/Pb** to the **PIX R/Pr** connector.
15. Adjust R727 for a display of 700 mV on the test oscilloscope. Measure the peak-to-peak amplitude of the waveform displayed on the oscilloscope. See Figure 3-5.



Figure 3-4: SD PIX G/Y output adjustment screen

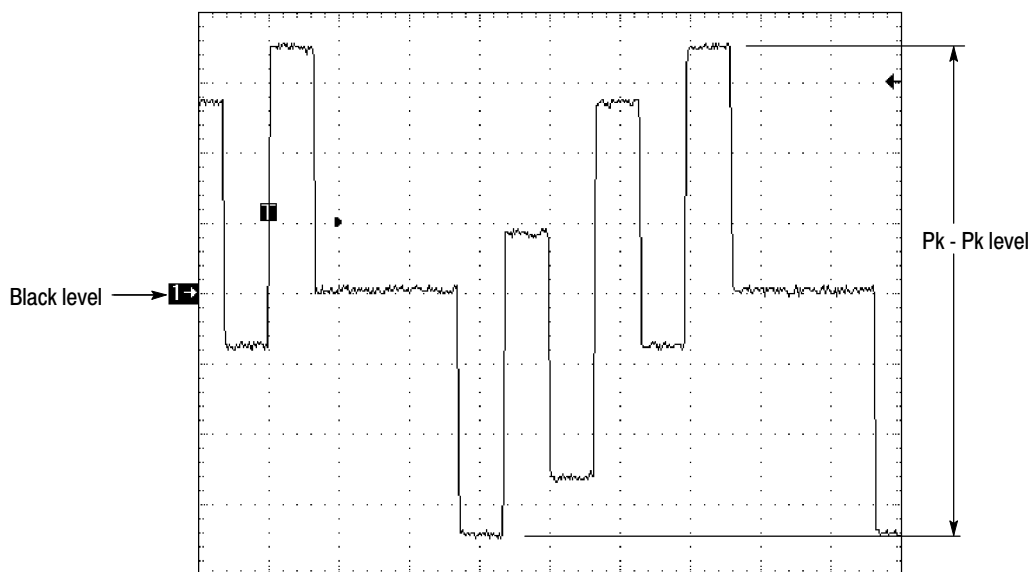


Figure 3-5: SD PIX B/Pb and R/Pr output adjustment screen

HD RGB Output Adjustment

This adjustment calibrates the High Definition RGB output amplitude from the Reference Module.

Video Module Types. WFM700A, WFM700M, and WFM700HD

Requirements. HDVG, 1080-line color bar signal; test oscilloscope

1. Connect the HD video generator to the Video Module under test using a 75 Ω cable.
2. Select the appropriate WFM700 Video Module (1 or 2) and input (A or B).
3. Connect the **PIX G/Y** output to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
4. Press the **CONFIG** button.
5. Touch the **Video Inputs/Outputs** soft key, then **Next Menu**.
6. Touch the **Output Active for HD** soft key, then **YPbPr**.
7. Press the **CONFIG** button twice to exit menu.
8. Set the test oscilloscope to view the first color bar. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV/div
Vertical Position	-3.5 div
Horizontal Scale	1 us/div
Horizontal Trigger Position	50%
Trigger Slope	Rising edge
Trigger Level	500 mV

9. Adjust R823 for a display of 700 mV on the test oscilloscope. Measure the amplitude between the black level and the first color bar. See Figure 3-6.
10. Move the cable from the **PIX G/Y** to the **PIX B/Pb** connector.
11. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

Vertical Scale	100 mV/div
Horizontal Scale	10 us/div
Horizontal Trigger Position	10%
Trigger Slope	Rising edge
Trigger Level	300 mV

12. Adjust R833 for a display of 700 mV on the test oscilloscope. Measure the peak-to-peak amplitude of the waveform displayed on the oscilloscope. See Figure 3-7.

13. Move the cable from the **PIX B/Pb** to the **PIX R/Pr** connector.
14. Adjust R843 for a display of 700 mV on the test oscilloscope. Measure the peak-to-peak amplitude of the waveform displayed on the oscilloscope. See Figure 3-7.



Figure 3-6: HD PIX G/Y output adjustment screen

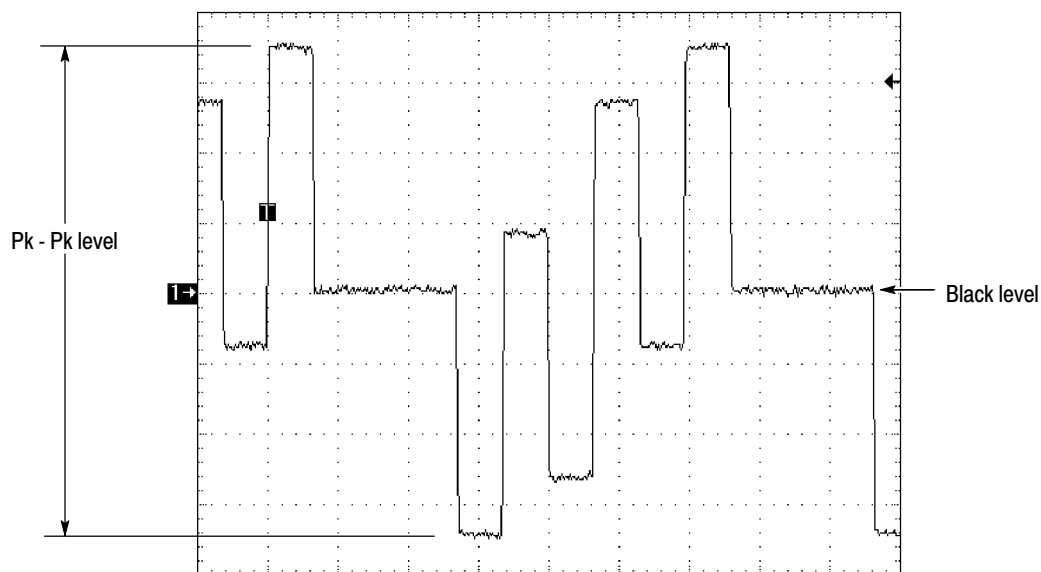


Figure 3-7: HD PIX B/Pb and PIX R/Pr output adjustment screen

Instrument Driven Procedures

The following procedures use the WFM700 internal calibration routines to load calibration constants into non-volatile memory. The routines automatically make the necessary instrument settings. The user must step through the procedure and provide the signal sources to complete the routine. See Figure 3-8 for the menu structure of the calibration routines.

Internal access to the instrument is not required for these procedures.

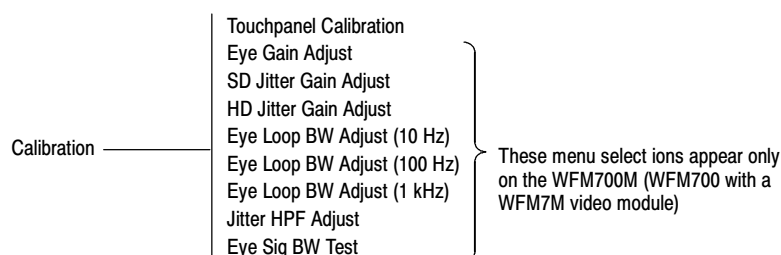


Figure 3-8: Calibration routines menu

General Instructions

The calibration routines are found in the configuration menus. Read these general instructions to familiarize yourself with the location of the menus and how to start and complete each routine.

- a. Perform the procedures in the order presented.
- b. Navigate to the calibration routines by pressing the **CONFIG** button and then the **Calibration** soft key.
- c. The on-screen provide brief instructions for signal requirements and setup. Refer to the procedural steps in this section for a description of the test, signal requirements, and operational hints for using the recommended test equipment.
- d. Each routine requires that you either save your new calibration constants, revert to the previously saved value, or set to default values.

Touchpanel Cal

This procedure adjusts the touch panel to match the screen display. This procedure is valid for all WFM700 models (all video module types).

1. Press the **CONFIG** button, then touch the **Calibration** soft key and then the **Next Menu** soft key.
2. Start the adjustment procedure by touching the **Touchpanel Calibration** soft key.
3. Follow the on-screen instructions.
4. Press the **CONFIG** button twice to exit the configuration menu.

Eye Gain Adjustment

This procedure adjusts the eye display vertical gain. This adjustment is only available for the WFM700M (WFM700 with a WFM7M module).

Following is a list of the signal requirements to perform the adjustment. Adjacent to the requirement is the recommended equipment and test signals.

Adjustment requirements	Recommended test equipment and test signal
REC601 800 mV test signal	SD video generator set to 525-format 100% color bar The amplitude of the signal is typical. Use the adjustment procedure to obtain the actual generator output level.
75 Ω coaxial cable	One meter long

1. Connect the SD video generator to the 75 Ω input of the test oscilloscope using a 75 Ω cable. Use a 75 Ω -to-50 Ω adapter on the input of the test oscilloscope if necessary.
2. Set the SD video generator for a 525-format 100% color bar signal.
3. Set the test oscilloscope to view the signal. The following oscilloscope settings normally provide a usable display.

Vertical Scale	200 mV
Horizontal Scale	2 ns/div
Horizontal Trigger Position	10%
Trigger Level	100 mV

4. Measure the amplitude of the signal on the test oscilloscope. Note this measurement as the Reference Amplitude. See Figure 3-9 for measurement points.

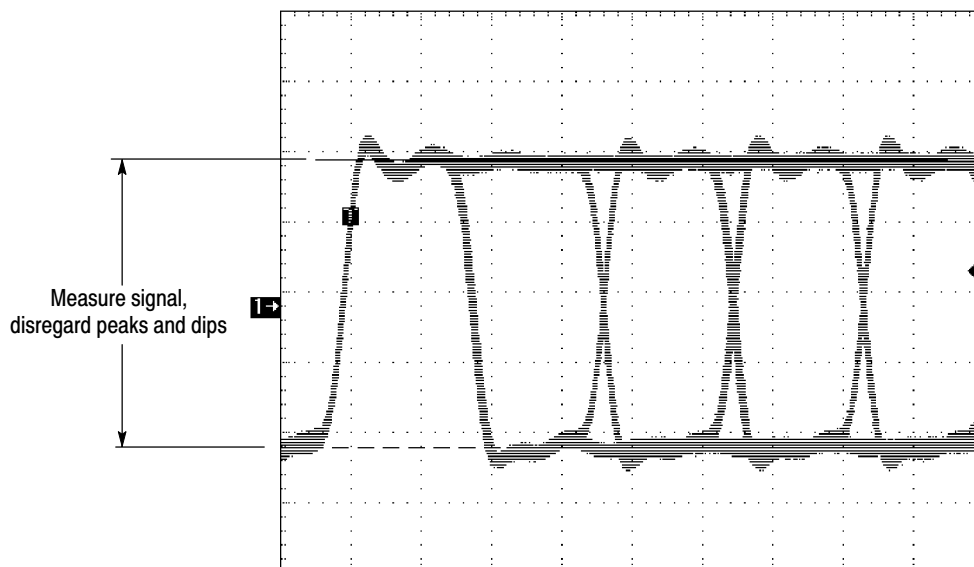


Figure 3-9: Eye vertical scale reference amplitude screen

5. Move the signal from the test oscilloscope to **INPUT B**.
6. Press the **INPUT** button and select **Input B**.
7. Press the **EYE** button and then touch the **Display** soft key.
8. Touch the **Eye** soft key and then touch the **Done** soft key.
9. Touch the **3 Eye** soft key (**3 Eye** selected).
10. Press the **CURSOR** button and touch the **Voltage** soft key (**Voltage** selected).
11. Position the cursors so that the delta value matches the measured amplitude of the test signal in step 4. (Adjust the + and - cursor values to approximately the same value to vertically center the cursors on screen.)
12. Press the **CONFIG** button, then touch the **Calibration** soft key and then the **Next Menu** soft key.
13. Touch the **Eye Gain Adjust** soft key and then the **Start Eye Gain Adjustment** soft key.
14. Press the **CURSOR** button to turn the cursors back on.
15. Use the General Purpose Knob to adjust the eye diagram amplitude to the cursors. See Figure 3-10.

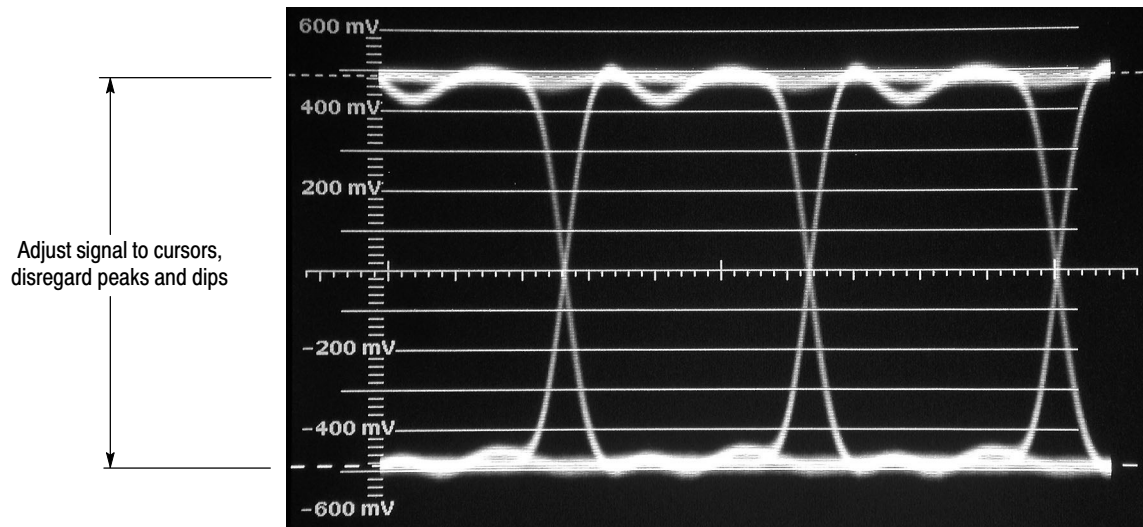


Figure 3-10: Eye vertical scale adjustment screen

- 16.** Touch the **Save and Exit** soft key to save the new calibration constant.
- 17.** Touch the **CONFIG** button twice to exit the configuration menu.

SD Jitter Gain Adjust

This procedure adjusts the scale factor for the SD jitter display and the measured jitter readout. This adjustment is only available for the WFM700M (WFM700 with a WFM7M video module).

Following is a list of the signal requirements to perform the adjustment. Adjacent to the requirement is the recommended equipment and test signals.

Adjustment requirements	Recommended test equipment and test signal																
Calibrated sine wave generator, 135 MHz, 800 mV into 75 Ω , FM modulated to generate 2 UI jitter amplitude	<p>RF generator adjusted to 800 mV output into 75 Ω at the requested frequency.</p> <p>You can adjust the output amplitude of the RF generator by measuring the output level with the test oscilloscope terminated into 75 Ω.</p> <p>With the recommended RF generator, you can modulate the signal with the following settings to obtain 2 UI of jitter.</p> <table> <tr> <td>Frequency</td><td>135 MHz</td></tr> <tr> <td>Frequency Modulation</td><td>OFF</td></tr> <tr> <td>LFGEN2 Frequency</td><td>10 kHz</td></tr> <tr> <td>LFGEN2 Waveshape</td><td>SQUARE</td></tr> <tr> <td>Phase Modulation Source</td><td>LFGEN2</td></tr> <tr> <td>Phase Deviation</td><td>3.14 RADIANS</td></tr> <tr> <td>RF Output</td><td>ON</td></tr> <tr> <td>Phase Modulation</td><td>ON</td></tr> </table>	Frequency	135 MHz	Frequency Modulation	OFF	LFGEN2 Frequency	10 kHz	LFGEN2 Waveshape	SQUARE	Phase Modulation Source	LFGEN2	Phase Deviation	3.14 RADIANS	RF Output	ON	Phase Modulation	ON
Frequency	135 MHz																
Frequency Modulation	OFF																
LFGEN2 Frequency	10 kHz																
LFGEN2 Waveshape	SQUARE																
Phase Modulation Source	LFGEN2																
Phase Deviation	3.14 RADIANS																
RF Output	ON																
Phase Modulation	ON																
75 Ω coaxial cable	36 inches long																

NOTE. If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.

- a. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
- b. Set the SD video generator for a 525-format 100% color bar signal.
- c. Press the **INPUT** button and select **Input B**.
- d. Press the **EYE** button.

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this connection.
3. Press the **INPUT** button and select **Input A**.

4. Press the **CONFIG** button, then touch the **Calibration** soft key and then the **Next Menu** soft key.
5. Touch the **SD Jitter Gain Adjust** soft key and then the **Start SD Jitter Gain Adjust** soft key.
6. Adjust the signal amplitude using the General Purpose Knob to 2 UI as measured on the display. See Figure 3-11.
7. Touch the **Save and Exit** soft key to save the new calibration constant.

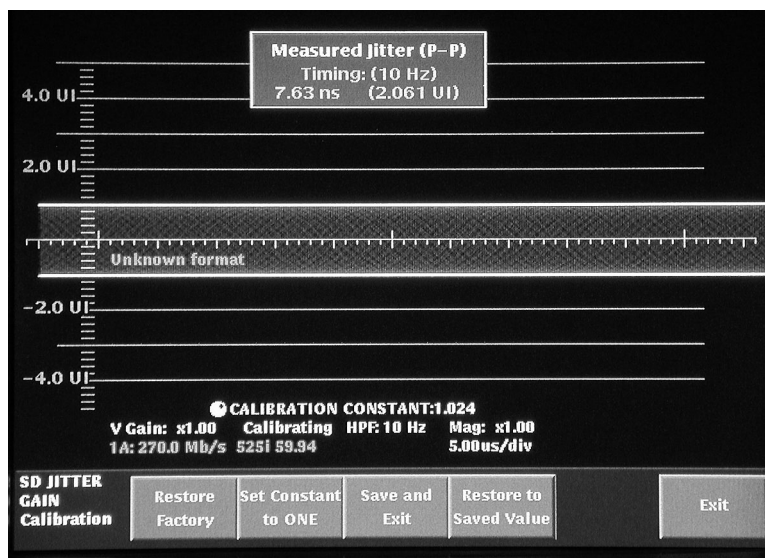


Figure 3- 11: SD Jitter gain adjustment screen

HD Jitter Gain Adjust

This procedure adjusts the scale factor for the HD jitter display and the measured jitter readout. This adjustment is only available for the WFM700M (WFM700 with a WFM7M video module).

Following is a list of the signal requirements to perform the adjustment. Adjacent to the requirement is the recommended equipment and test signals.

Adjustment requirements	Recommended test equipment and test signal																		
Calibrated sine wave generator, 741.7582 MHz, 800 mV into 75 Ω , FM modulated to generate 2 UI jitter amplitude	<p>With the recommended RF generator, you can modulate the signal with the following settings to obtain 2 UI of jitter.</p> <table> <tr> <td>Frequency</td><td>741.7582 MHz</td></tr> <tr> <td>Output Level</td><td>0 dB</td></tr> <tr> <td>Frequency Modulation</td><td>OFF</td></tr> <tr> <td>LFGEN2 Frequency</td><td>10 kHz</td></tr> <tr> <td>LFGEN2 Waveshape</td><td>SQUARE</td></tr> <tr> <td>Phase Modulation Source</td><td>LFGEN2</td></tr> <tr> <td>Phase Deviation</td><td>3.14 RADIANS</td></tr> <tr> <td>RF Output</td><td>ON</td></tr> <tr> <td>Phase Modulation</td><td>ON</td></tr> </table>	Frequency	741.7582 MHz	Output Level	0 dB	Frequency Modulation	OFF	LFGEN2 Frequency	10 kHz	LFGEN2 Waveshape	SQUARE	Phase Modulation Source	LFGEN2	Phase Deviation	3.14 RADIANS	RF Output	ON	Phase Modulation	ON
Frequency	741.7582 MHz																		
Output Level	0 dB																		
Frequency Modulation	OFF																		
LFGEN2 Frequency	10 kHz																		
LFGEN2 Waveshape	SQUARE																		
Phase Modulation Source	LFGEN2																		
Phase Deviation	3.14 RADIANS																		
RF Output	ON																		
Phase Modulation	ON																		
75 Ω coaxial cable	36 inches long																		

NOTE. If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.

- Connect the SD video generator to **INPUT B** using a 75 Ω cable.
- Set the SD video generator for a 525-format 100% color bar signal.
- Press the **INPUT** button and select **Input B**.
- Press the **EYE** button.
- Press the **INPUT** button and select **Input A**.

- Install the 50 Ω N-to-BNC adapter on the RF generator output.
- Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this connection.
- Touch the **HD Jitter Gain Adjust** soft key and then the **Start HD Jitter Gain Adjust** soft key.
- Adjust the signal amplitude using the General Purpose Knob to 2 UI as measured on the display. See Figure 3-12.
- Touch the **Save and Exit** soft key to save the new calibration constant.

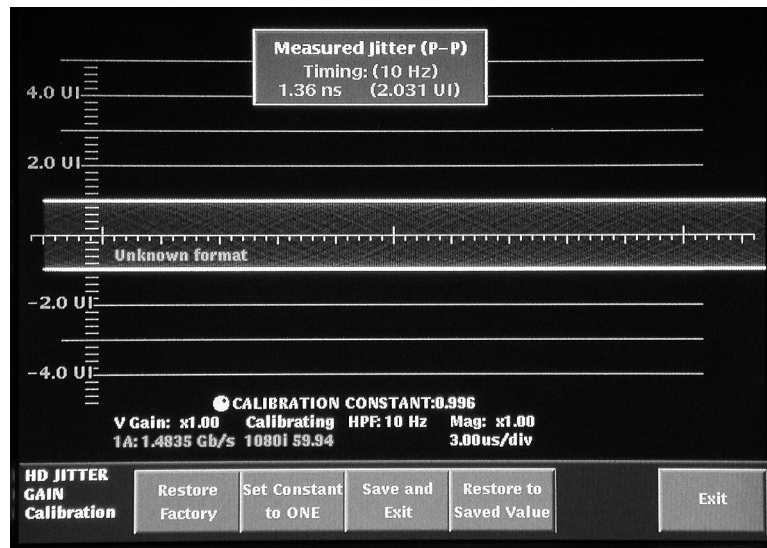


Figure 3- 12: HD Jitter gain adjustment screen

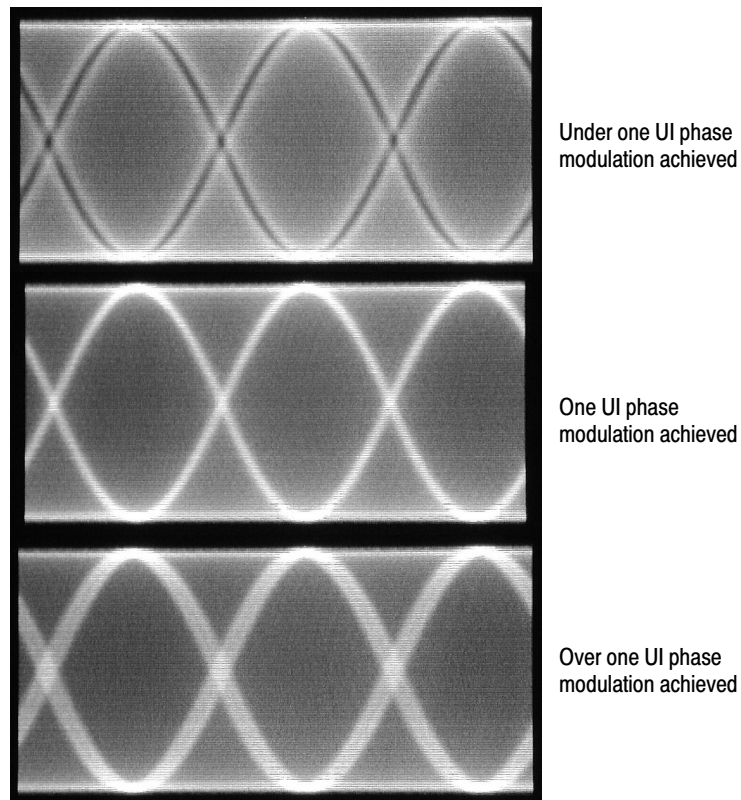


Figure 3- 13: Eye loop BW one UI adjustment screen

Eye Loop BW Adjust (10 Hz)

This procedure sets the calibration constant for the eye diagram clock recovery bandwidth. This calibration routine is only available for the WFM700M (WFM700 with a WFM7M module).

Following is a list of the signal requirements to perform the adjustment. Adjacent to the requirement is the recommended equipment and test signals.

Adjustment requirements	Recommended test equipment and test signal																
Calibrated sine wave generator, 741.7582 MHz, 800 mV into 75 Ω , with 10 Hz jitter modulation	<p>With the recommended RF generator, you can generate the required signal with the following settings to obtain 10 Hz jitter modulation.</p> <table> <tr> <td>Frequency</td><td>741.7582 MHz</td></tr> <tr> <td>Output Level</td><td>0 dB</td></tr> <tr> <td>LFGEN2 Frequency</td><td>10 Hz</td></tr> <tr> <td>LFGEN2 Waveshape</td><td>SINE</td></tr> <tr> <td>Phase Modulation Source</td><td>LFGEN2</td></tr> <tr> <td>Phase Deviation</td><td>2.22 RADIANS</td></tr> <tr> <td>RF Output</td><td>ON</td></tr> <tr> <td>Phase Modulation</td><td>ON</td></tr> </table>	Frequency	741.7582 MHz	Output Level	0 dB	LFGEN2 Frequency	10 Hz	LFGEN2 Waveshape	SINE	Phase Modulation Source	LFGEN2	Phase Deviation	2.22 RADIANS	RF Output	ON	Phase Modulation	ON
Frequency	741.7582 MHz																
Output Level	0 dB																
LFGEN2 Frequency	10 Hz																
LFGEN2 Waveshape	SINE																
Phase Modulation Source	LFGEN2																
Phase Deviation	2.22 RADIANS																
RF Output	ON																
Phase Modulation	ON																
75 Ω coaxial cable	36 inches long																

NOTE. If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.

- Connect the SD video generator to **INPUT B** using a 75 Ω cable.
- Set the SD video generator for a 525-format 100% color bar signal.
- Press the **INPUT** button and select **Input B**.
- Press the **EYE** button.
- Press the **INPUT** button and select **Input A**.

- Install the 50 Ω N-to-BNC adapter on the RF generator output.
- Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this connection.
- Touch the **Eye Loop BW Adjust (10 Hz)** soft key and then the **Start Eye Loop BW Adjustment (10 Hz)** soft key.
- Adjust the RF generator output level for a displayed waveform amplitude of approximately 800 mV.
- Adjust the displayed modulation using the General Purpose Knob for exactly 1 UI as measured on the display. See Figure 3-13.
- Touch the **Save and Exit** soft key to save the new calibration constant.

**Eye Loop BW Adjust
(100 Hz)**

This procedure sets the calibration constant for the eye diagram clock recovery bandwidth. This calibration routine is only available for the WFM700M (WFM700 with a WFM7M module).

Following is a list of the signal requirements to perform the adjustment. Adjacent to the requirement is the recommended equipment and test signals.

Adjustment requirements	Recommended test equipment and test signal
Calibrated sine wave generator, 741.7582 MHz, 800 mV into 75 Ω , with 100 Hz jitter modulation	With the recommended RF generator, you can generate the required signal with the following settings to obtain 100 Hz jitter modulation. Frequency 741.7582 MHz Output Level 0 dB LFGEN2 Frequency 100 Hz LFGEN2 Waveshape SINE Phase Modulation Source LFGEN2 Phase Deviation 2.22 RADIANS RF Output ON Phase Modulation ON
75 Ω coaxial cable	36 inches long

NOTE. If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.

- a. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
- b. Set the SD video generator for a 525-format 100% color bar signal.
- c. Press the **INPUT** button and select **Input B**.
- d. Press the **EYE** button.
- e. Press the **INPUT** button and select **Input A**.

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this connection.
3. Touch the **Eye Loop BW Adjust (100 Hz)** soft key and then the **Start Eye Loop BW Adjustment (100 Hz)** soft key.
4. Adjust the RF generator output level for a displayed waveform amplitude of approximately 800 mV.
5. Adjust the displayed modulation using the General Purpose Knob for exactly 1 UI as measured on the display. See Figure 3-13 on page 3-18.
6. Touch the **Save and Exit** soft key to save the new calibration constant.

Eye Loop BW Adjust (1 kHz)

This procedure sets the calibration constant for the eye diagram clock recovery bandwidth. This calibration routine is only available for the WFM700M (WFM700 with a WFM7M module).

Following is a list of the signal requirements to perform the adjustment. Adjacent to the requirement is the recommended equipment and test signals.

Adjustment requirements	Recommended test equipment and test signal																
Calibrated sine wave generator, 741.7582 MHz, 800 mV into 75 Ω , with 1 kHz jitter modulation	<p>With the recommended RF generator, you can generate the required signal with the following settings to obtain 1 kHz jitter modulation.</p> <table> <tr> <td>Frequency</td><td>741.7582 MHz</td></tr> <tr> <td>Output Level</td><td>0 dB</td></tr> <tr> <td>LFGEN2 Frequency</td><td>1 kHz</td></tr> <tr> <td>LFGEN2 Waveshape</td><td>SINE</td></tr> <tr> <td>Phase Modulation Source</td><td>LFGEN2</td></tr> <tr> <td>Phase Deviation</td><td>2.22 RADIANS</td></tr> <tr> <td>RF Output</td><td>ON</td></tr> <tr> <td>Phase Modulation</td><td>ON</td></tr> </table>	Frequency	741.7582 MHz	Output Level	0 dB	LFGEN2 Frequency	1 kHz	LFGEN2 Waveshape	SINE	Phase Modulation Source	LFGEN2	Phase Deviation	2.22 RADIANS	RF Output	ON	Phase Modulation	ON
Frequency	741.7582 MHz																
Output Level	0 dB																
LFGEN2 Frequency	1 kHz																
LFGEN2 Waveshape	SINE																
Phase Modulation Source	LFGEN2																
Phase Deviation	2.22 RADIANS																
RF Output	ON																
Phase Modulation	ON																
75 Ω coaxial cable	36 inches long																

NOTE. If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.

- Connect the SD video generator to **INPUT B** using a 75 Ω cable.
- Set the SD video generator for a 525-format 100% color bar signal.
- Press the **INPUT** button and select **Input B**.
- Press the **EYE** button.
- Press the **INPUT** button and select **Input A**.

- Install the 50 Ω N-to-BNC adapter on the RF generator output.
- Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this connection.
- Touch the **Eye Loop BW Adjust (1 kHz)** soft key and then the **Start Eye Loop BW Adjustment (1 kHz)** soft key.
- Adjust the RF generator output level for a displayed waveform amplitude of approximately 800 mV.
- Adjust the displayed modulation using the General Purpose Knob for exactly 1 UI as measured on the display. See Figure 3-13 on page 3-18.
- Touch the **Save and Exit** soft key to save the new calibration constant.

Jitter HPF Adjust

Performing this procedure loads new calibration constants into the instrument. This calibration routine is only available for the WFM700M (WFM700 with a WFM7M module).

The following test items are required to perform the entire adjustment.

Adjustment requirements	Recommended test equipment and test signal																		
Calibrated sine wave generator, 741.7582 MHz, 800 mV into 75 Ω , FM modulated to generate 2 UI jitter amplitude	<p>RF generator adjusted to 800 mV output into 75 Ω at the requested frequency.</p> <p>With the recommended RF generator, you can modulate the signal with the following settings to obtain 2 UI of jitter.</p> <table> <tr> <td>Frequency</td><td>741.7582 MHz</td></tr> <tr> <td>Output Level</td><td>0 dB</td></tr> <tr> <td>Frequency Modulation</td><td>OFF</td></tr> <tr> <td>LFGEN2 Frequency</td><td>10 Hz</td></tr> <tr> <td>LFGEN2 Waveshape</td><td>SINE</td></tr> <tr> <td>Phase Modulation Source</td><td>LF2</td></tr> <tr> <td>Phase Deviation</td><td>6.28 RADIANS</td></tr> <tr> <td>RF Output</td><td>ON</td></tr> <tr> <td>Phase Modulation</td><td>ON</td></tr> </table>	Frequency	741.7582 MHz	Output Level	0 dB	Frequency Modulation	OFF	LFGEN2 Frequency	10 Hz	LFGEN2 Waveshape	SINE	Phase Modulation Source	LF2	Phase Deviation	6.28 RADIANS	RF Output	ON	Phase Modulation	ON
Frequency	741.7582 MHz																		
Output Level	0 dB																		
Frequency Modulation	OFF																		
LFGEN2 Frequency	10 Hz																		
LFGEN2 Waveshape	SINE																		
Phase Modulation Source	LF2																		
Phase Deviation	6.28 RADIANS																		
RF Output	ON																		
Phase Modulation	ON																		
75 Ω coaxial cable	36 inches long																		

NOTE. If this test is performed out of sequence or the sequence of tests has been interrupted (such as power off or input from another module was selected), perform the steps in this note to prepare the instrument to continue testing.

- a. Connect the SD video generator to **INPUT B** using a 75 Ω cable.
- b. Set the SD video generator for a 525-format 100% color bar signal.
- c. Press the **INPUT** button and select **Input B**.
- d. Press the **EYE** button.
- e. Press the **INPUT** button and select **Input A**.

1. Install the 50 Ω N-to-BNC adapter on the RF generator output.
2. Connect the RF generator output to **INPUT A** using a 75 Ω cable. Impedance matching is not important for this connection.
3. Touch the **Jitter HPF Adjust** soft key and then the **Start Jitter HPF Adjustment** soft key.
4. Adjust the displayed Measured Jitter amplitude using the General Purpose Knob for a reading of 2.83 UI. See Figure 3-14.
5. Touch the **Save and Exit** soft key to save the new calibration constant.

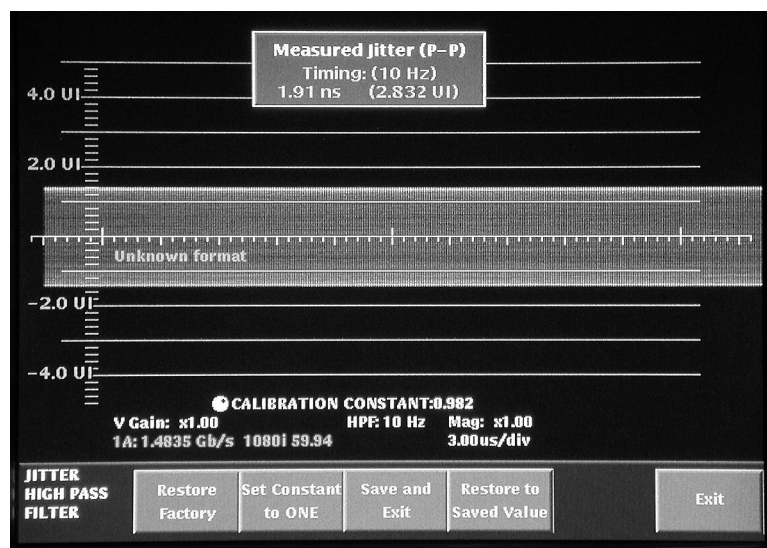


Figure 3-14: Jitter HPF adjustment screen



Maintenance

General Maintenance

This chapter contains the information needed to do periodic and corrective maintenance on the instrument. The chapter is divided into four main sections.

- *General Maintenance (this section)* — Introduction plus general information on preventing damage to internal modules and cleaning instructions.
- *Removal and Installation Procedures* — Procedures for the removal of defective modules and replacement of new or repaired modules. Also included is a procedure for disassembly of the instrument for cleaning.
- *Troubleshooting* — Information for isolating and troubleshooting failed modules. Included are instructions for operating the instrument's internal diagnostic routines and troubleshooting trees. Most of the trees make use of these internal diagnostic routines to speed fault isolation to a module.
- *Repackaging Instructions* - Information to safely package the instrument for shipment.

Firmware Upgrades

Firmware upgrades for the waveform monitor become available periodically and can be downloaded from the Tektronix, Inc. Web site (www.tektronix.com).

Instructions for obtaining and installing updated firmware is located in the *WFM700 Series Technical Reference* document.

Preventing ESD

Before servicing this product, read the *Safety Summary* and *Introduction* at the front of the manual and the ESD information below.



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

When performing any service which requires internal access to the instrument, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive circuit boards and components.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive boards.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.
6. Do not slide the circuit boards over any surface.
7. Avoid handling circuit boards in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the instrument. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent instrument malfunction and enhance its reliability.

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

How often to do maintenance depends on the severity of the environment in which the instrument is used. A proper time to perform preventive maintenance is just before instrument adjustment.

General Care

The cabinet helps keep dust out of the instrument and should normally be in place when operating the instrument.



WARNING. Before performing any procedure that follows, power down the instrument and disconnect it from line voltage.

Interior Cleaning

Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle, non-static-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution with a cotton cloth or swab for hard to reach areas. Use only enough solution to dampen the cloth or swab.

Exterior Cleaning

Clean the exterior surfaces of the chassis with a dry lint-free cloth or a soft-bristle brush. If any dirt remains, use a cloth or swab dipped in a 75% isopropyl alcohol solution. Use a swab to clean narrow spaces around controls and connectors. Do not use abrasive compounds on any part of the chassis.



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

Inspection — Exterior. Inspect the outside of the instrument for damage, wear, and missing parts, using Table 4-1 as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

Table 4- 1: External inspection check list

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

Flat Panel Display Cleaning



The flat panel display must be treated with care during cleaning.

CAUTION. *Improper cleaning agents or methods can damage the flat panel display.*

Avoid using abrasive cleaners or commercial glass cleaners to clean the display surface.

Avoid spraying liquids directly on the display surface.

Avoid scrubbing the display with excessive force.

Clean the flat panel display surface by gently rubbing the display with a clean-room wipe (such as Wypall Medium Duty Wipes, #05701, available from Kimberly-Clark Corporation).

If the display is very dirty, moisten the wipe with distilled water or a 75% isopropyl alcohol solution and gently rub the display surface. Avoid using excess force or you may damage the plastic display surface.



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

Inspection — Interior. To access the inside of the instrument for inspection and cleaning, refer to the *Removal and Installation Procedures* in this section.

Inspect the internal portions of the instrument for damage and wear, using Table 4-2 as a guide. Defects found should be repaired immediately.



CAUTION. To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the instrument.

Table 4-2: Internal inspection check list

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove and replace damaged circuit board.
Resistors	Burned, cracked, broken, blistered condition.	Remove and replace damaged circuit board.
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove and replace damaged circuit board.
Semiconductors	Loosely inserted in sockets. Distorted pins.	Firmly seat loose semiconductors. Remove devices that have distorted pins. Carefully straighten pins (as required to fit the socket), using long-nose pliers, and reinsert firmly. Ensure that straightening action does not crack pins, causing them to break off.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Cleaning Procedure — Interior. To clean the instrument interior, do the following steps:

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in isopropyl alcohol (75% solution). (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

STOP. *If, after doing steps 1 and 2, a module is clean upon inspection, skip the remaining steps.*

3. If steps 1 and 2 do not remove all the dust or dirt, the instrument may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see *Removal and Installation Procedures*).
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (120 °F to 140 °F) deionized water to thoroughly rinse them.
7. Dry all parts with low-pressure, deionized air.
8. Dry all components and assemblies in an oven or drying compartment using low-temperature (125 °F to 150 °F) circulating air.

This section contains the information needed to repack the portable main-frame for shipment or storage.

Removal and Installation Procedures

This section contains procedures for removal and installation of all replaceable mechanical and electrical modules.

Cleaning instructions are found under *Inspection and Cleaning* at the beginning of this chapter.

Preparation

Before using any of these procedures:

- Read the warning statements.
- Review the list of tools required for the disassembly procedure.
- Become familiar with the instrument and its assemblies by reviewing the exploded views in the *Replaceable Mechanical Parts* chapter.



WARNING. Before doing this or any other procedure in this manual, read the Safety Summary found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to this instrument's components, read Preventing ESD on page 4-2.



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.

Equipment Required. Most modules in this instrument can be removed with a screwdriver handle mounted with a size T-15, Torx® screwdriver tip. Use this tool whenever a procedure step instructs you to remove or install a screw unless a different size screwdriver is specified in that step.

Table 4-3: Tools required for module removal

Item No.	Name	Description	Part number
1	Screwdriver handle	Accepts Torx®-driver bits	General Tool: 620-440
2	T-10 Torx tip	Torx®-driver bit for T-10 size screw heads.	General Tool: 640-235
3	T-15 Torx tip	Torx®-driver bit for T-15 size screw heads.	General Tool: 640-247
4	#0 Phillips screwdriver	Screwdriver for removing small Phillips screws.	Standard tool

Cabinet

The WFM700 series uses various cabinets (sleeves) that slide over the WFM700 chassis for portable and rackmount applications. Each type of cabinet is removed and installed in the same manner.

Removal Read the entire removal procedure before proceeding.

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. At the rear of the cabinet, remove the two attaching screws through the left and right tabs and into the instrument chassis. See Figure 4-1.
3. Slide the cabinet up and off the instrument chassis.

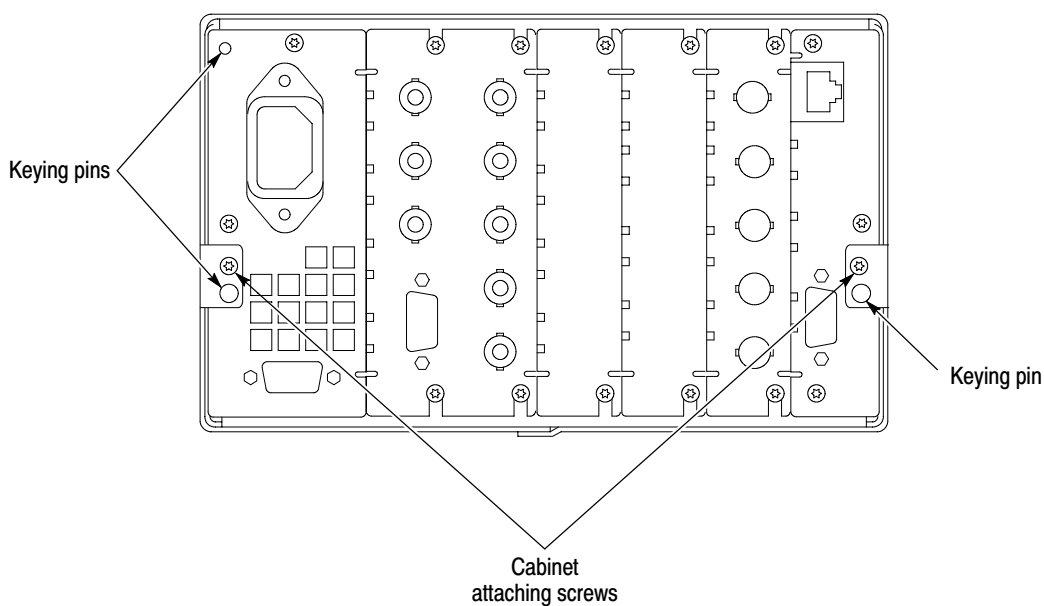


Figure 4-1: Cabinet attaching screws

Reinstallation Reinstall the cabinet in the reverse order of the removal procedure, being careful not to pinch any cables between the chassis and cabinet.

Chassis Cover

Use this procedure to open the chassis, allowing access to internal modules and components. Removal procedures required before starting:

- Cabinet Removal

Removal

Read the entire removal procedure before proceeding.

1. 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 ESD* on page 4-2).
2. Loosen three attaching screws (T-10) along the left side and three screws along the right side of the chassis cover (see Figure 4-2). Loosen the screws sufficiently to free the cutouts in the cover (about 3 turns); you do not need to remove the screws from the side of the chassis.
3. Remove two screws (T-10) from the front of the chassis cover (see Figure 4-2). Save the screws for reinstallation.
4. Loosen the attaching rear-panel screws (T-15) at the top of the module rear panels in slots 2 through 6 (see Figure 4-2 for screw locations and Figure 4-6 for slot numbering). Loosen the screws sufficiently to free the cutouts in the cover (about 3 turns). It is okay to remove the screws, but be sure to save them for reassembly.
5. Remove a screw (T-15) from slot 1 and from the power supply (see Figure 4-2 for screw locations and Figure 4-6 for slot numbers).
6. Lift the cover off the instrument. The rear-panel screws that you loosened will remain in the cover.

Reinstallation

Replace the chassis cover as follows:

1. 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.
2. Line up the screws along the left and right sides of the cover with the cutouts on the sides of the chassis.
3. 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.
4. 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.)

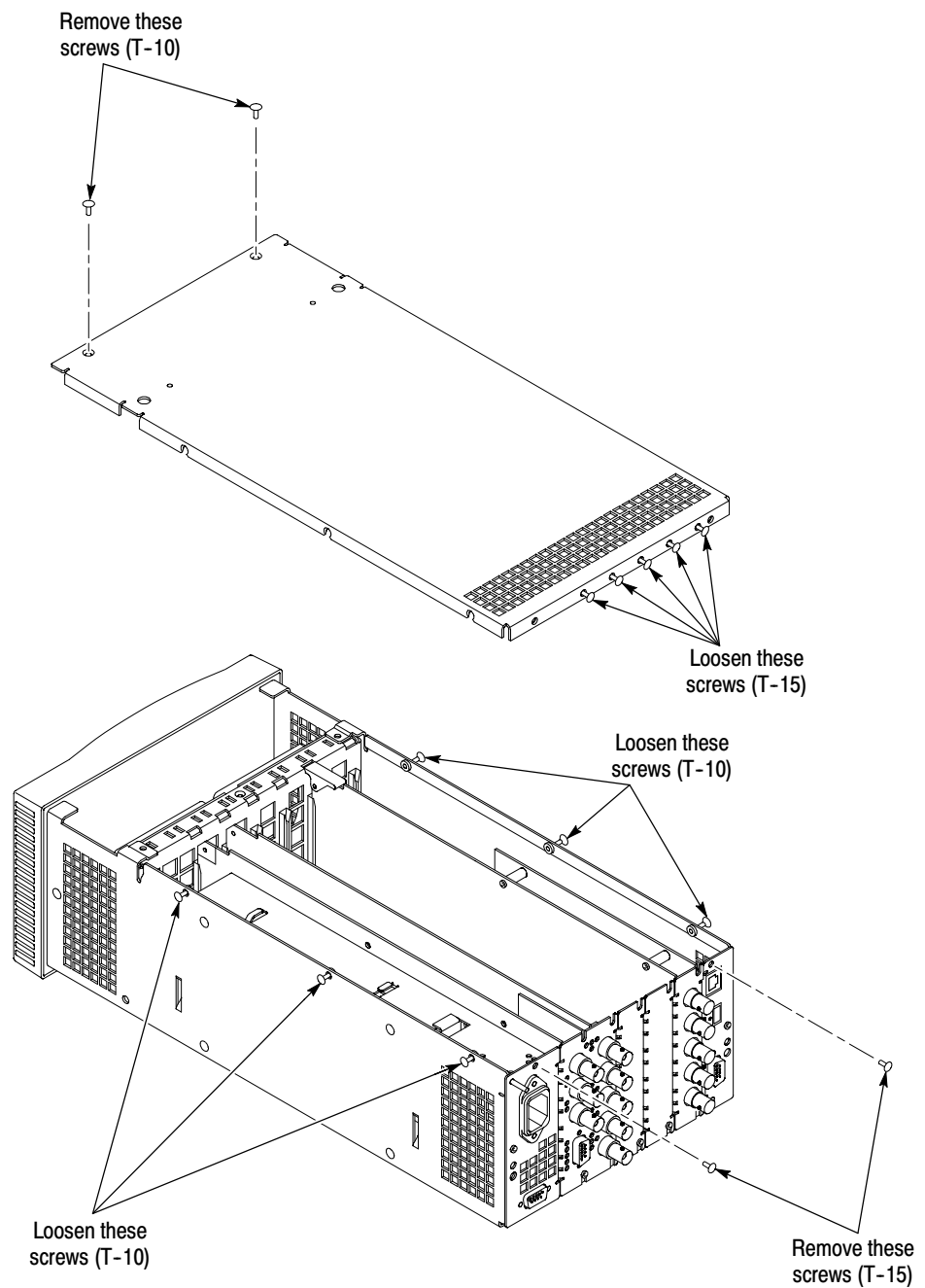


Figure 4-2: WFM700 chassis cover, showing screws to loosen and remove

Plug-In Modules

Use this procedure to remove one or all plug-in modules in the instrument.

The following removal procedures must be performed before starting:

- Cabinet Removal
- Chassis Cover Removal

Removal

Read the entire removal procedure before proceeding.

1. Loosen the bottom screw on the rear panel of each plug-in module you are going to remove. See Figure 4-3.

NOTE. If removing the CPU plug-in module, the bottom screw needs to be removed instead of just loosened.

CPU and Real Time Display Modules: With the introduction of the “B” version of the Real Time Display module, you must replace the CPU or Real Time Display modules with the same version, “A” or “B,” that was installed in the instrument, or else you must replace both modules. Only the following combinations of CPU and Real Time Display boards will function in the instrument:

Version A: CPU 671-4528-xx & Real Time Display 671-4529-xx

Version B: CPU 671-5751-xx & Real Time Display 671-5661-xx

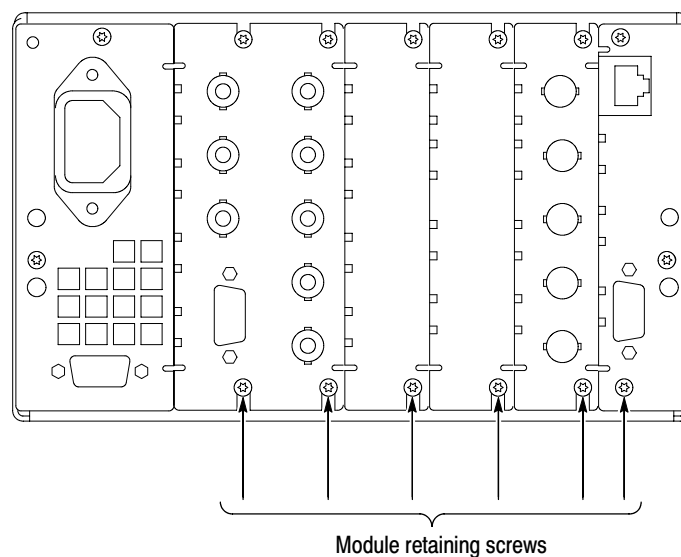


Figure 4-3: Plug-in module retaining screws

2. If you have two video modules with a grounding clip installed, remove the grounding clip (see Figure 4-4).



CAUTION. When removing a module, be careful to avoid damaging the EMI flaps on the rear panels.

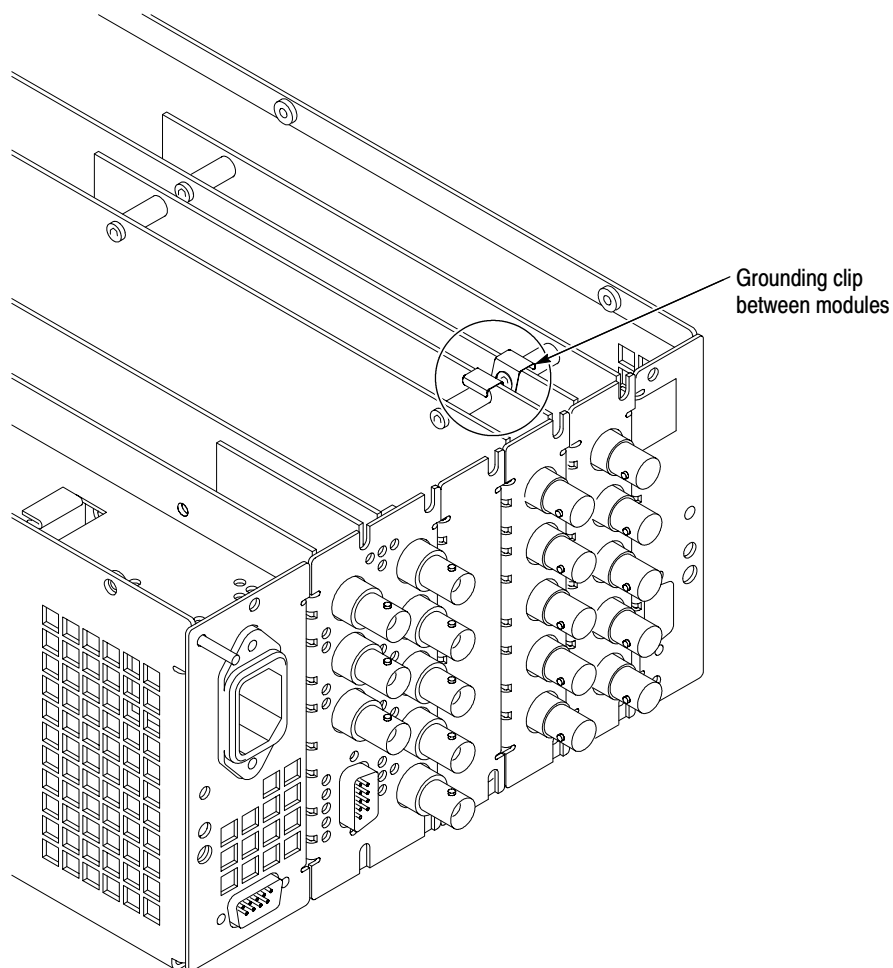


Figure 4-4: Grounding clip between two video modules

3. Lift the white ejector lever located near the front of the module.
4. Holding onto the lever and the rear panel BNC, carefully pull the plug-in module up and out of the instrument. Be careful not to damage the EMI flaps on the rear of the modules.

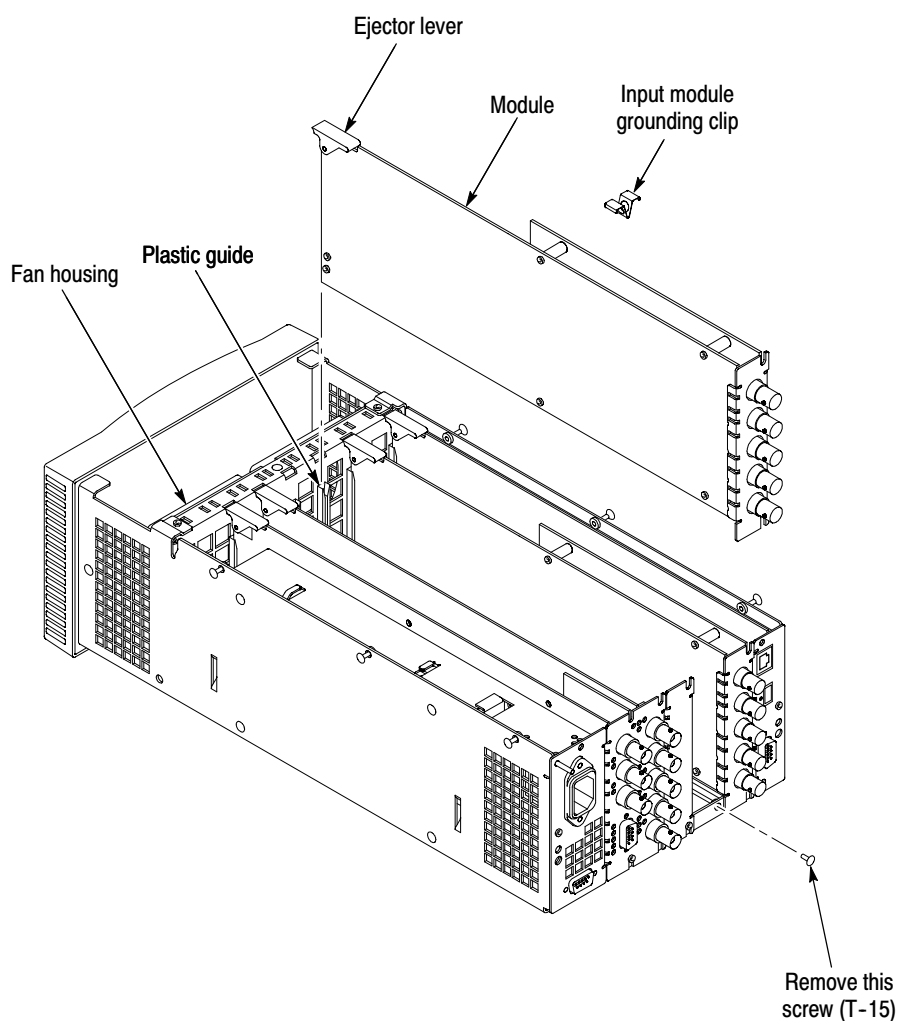


Figure 4-5: Removing a plug-in module

Installation

Read the entire plug-in module installation steps before proceeding.

1. Identify the instrument slot in which you will install the plug-in module (see Figure 4-6).

- | | |
|----------|--|
| ■ Slot 1 | CPU Module (see <i>Note</i> below) |
| ■ Slot 2 | 1st Video Module (WFM7HD, WFM7A, or WFM7M) |
| ■ Slot 3 | 2nd Video Module (WFM7HD, WFM7A, or WFM7M) |
| ■ Slot 4 | Option DG Audio Module (WFM7DG) |
| ■ Slot 5 | Reference Module |
| ■ Slot 6 | Real Time Display Module (see <i>Note</i> below) |

NOTE. *Plug-in modules will not operate if they are not installed in the proper slots and will cause a failure in the power up diagnostics.*

Video Modules: Before you can install a WFM7HD, WFM7A, or WFM7M video module in slot 3, you must have one of these modules installed in slot 2.

CPU and Real Time Display Modules: With the introduction of the “B” version of the Real Time Display module, you must replace the CPU or Real Time Display modules with the same version, “A” or “B,” that was installed in the instrument, or else you must replace both modules. Only the following combinations of CPU and Real Time Display boards will function in the instrument:

Version A: CPU 671-4528-xx & Real Time Display 671-4529-xx

Version B: CPU 671-5751-xx & Real Time Display 671-5661-xx

2. 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 plug-in 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 won't get jammed in the fan housing as you install the module.

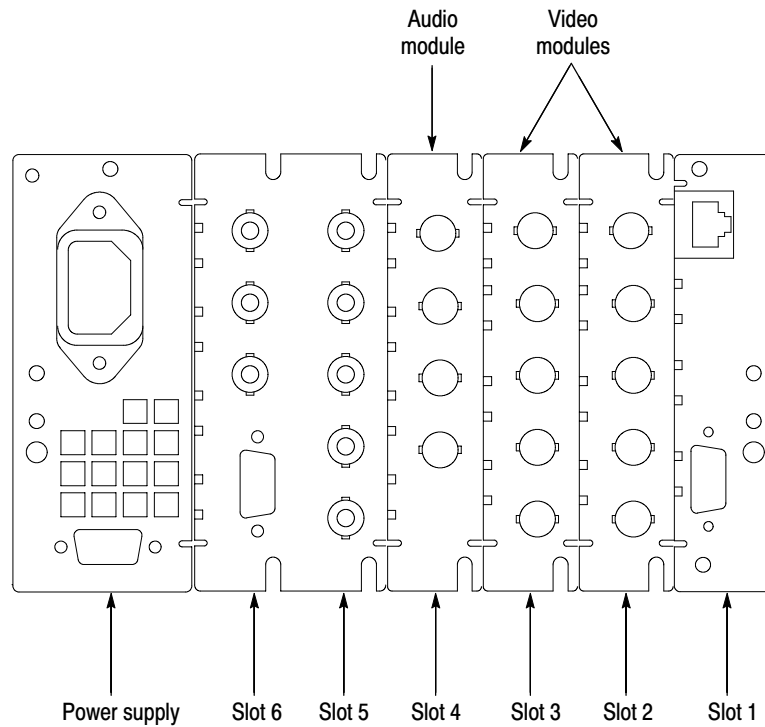


Figure 4-6: WFM700 rear panel showing slot numbers

3. Prepare to insert the plug-in 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 4-7.
4. 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.
5. Applying firm pressure to both ends of the module, press it all the way down and into place.
6. Install and tighten the screw (T-15) that attaches the bottom of the module rear panel to the instrument chassis.
7. A grounding clip is required when two video modules are installed. See Figure 4-8 for the correct installation of the grounding clip.

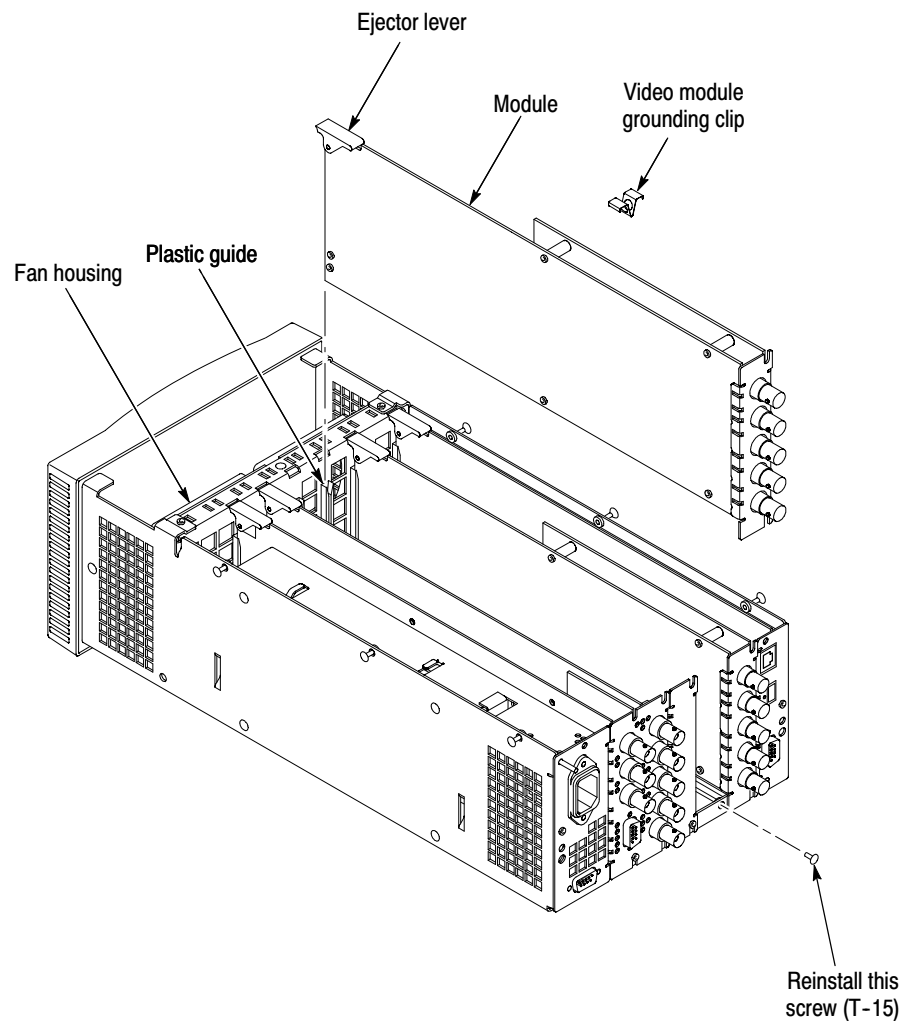


Figure 4-7: Inserting a module into the chassis

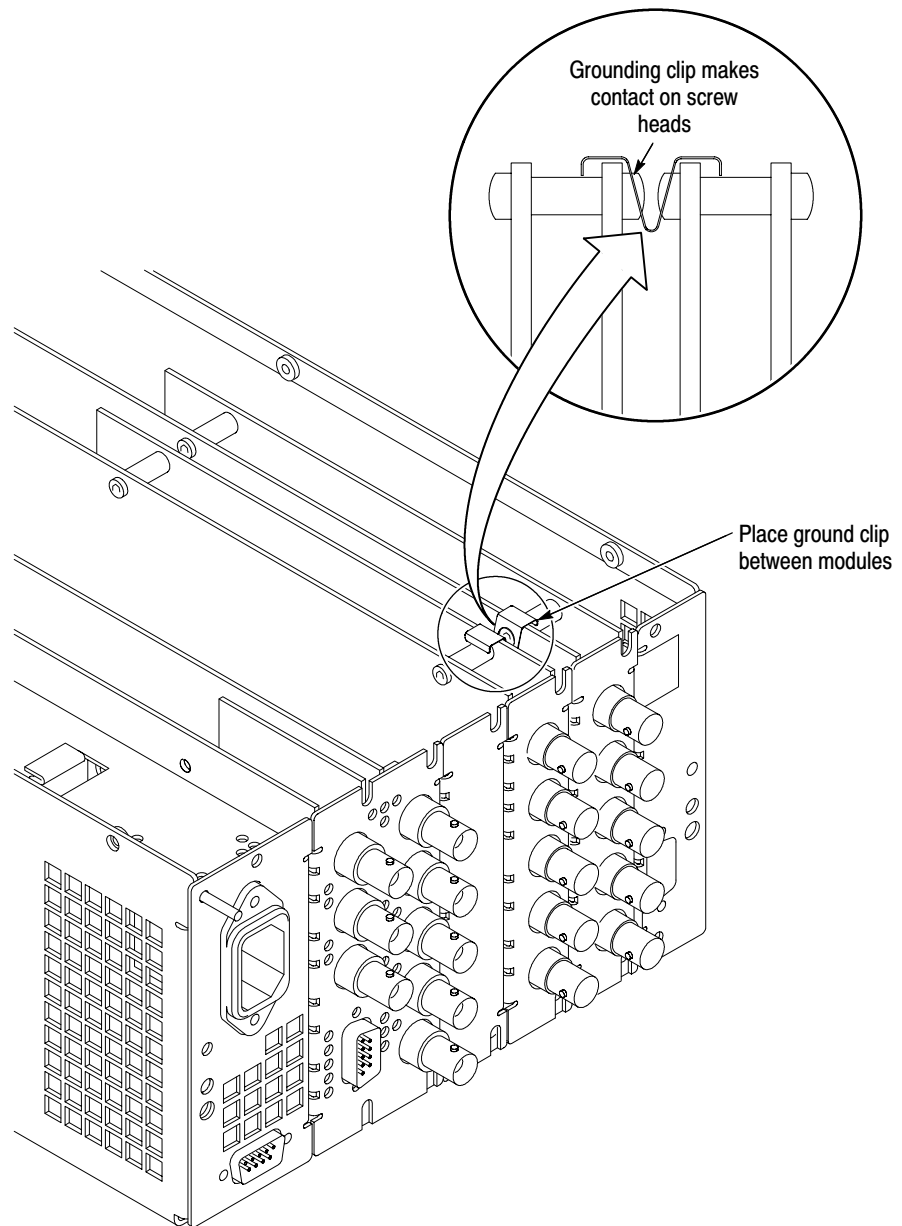


Figure 4-8: Installing the grounding clip between two video modules

Power Supply

The following removal procedures must be performed before removing the power supply module:

- Cabinet
- Chassis Cover
- Plug-in Modules (slots 5 and 6)



CAUTION. To prevent damage to the instrument, do not exchange cables between the two versions of the power supply module: Artesyn and EOS. The Artesyn power supply module has fuses in one of the cables and the other cables are a different length than those in the EOS power supply module. The cable fuses are required in the Artesyn power supply module to ensure safe operation of the instrument.

Although the two versions of the power supply module are directly interchangeable at the module level (which includes the cables), the boards, chassis, and other components are not interchangeable.

Removal

Read the entire removal procedure before proceeding.

1. Remove the plug-in modules located in slots 5 and 6. This allows easier access to the power supply cables.
2. Disconnect the three power supply cables attached to the main circuit board at the following locations:
 - J170
 - J270
 - J271
3. Remove the four screws (T-10) from the side of the chassis.

Reinstallation

Reinstall the power supply module in the reverse order of the removal procedure.

Front End Assembly

The Front End assembly contains several replaceable subparts. The Front End assembly must be removed from the instrument to gain access to these subparts. The Front End Assembly contains the following replaceable subparts:

- LCD assembly (containing LCD, subchassis, Front Panel Processor circuit board, Backlight circuit board, and touch panel)
- Keyboards (two)
- Touch pads (two)
- Front Bezel

The following removal procedures must be performed before removing the front panel assembly.

- Cabinet
- Chassis Cover

Removal

Read the entire removal procedure before proceeding.

1. Remove the four screws (T-10) securing the front panel assembly to the chassis, two on the bottom and one on each side.
2. Slide the assembly away from the chassis to gain access to the cables connecting the main circuit board.
3. Disconnect the two cables attached to the main circuit board at the following locations:
 - J890
 - J390

NOTE. *Stop here unless you need to continue disassembling the Front Panel Assembly.*

4. To further disassemble the Front End Assembly into its replaceable pieces, use the following substeps.
 - a. Remove the three control knobs from the front panel. This is easier accomplished by sliding a non-metallic spudger (or other non-metallic flat-bladed tool) under the knob and prying it off its shaft.
 - b. Lay the Front End Assembly face down on a flat surface.

- c. Disconnect the two keyboard ribbon cables from the Front Panel Processor board.
 - J680
 - J320
- d. Remove the three screws (T-10) that secure the metal chassis to the front panel bezel. See Figure 4-9.

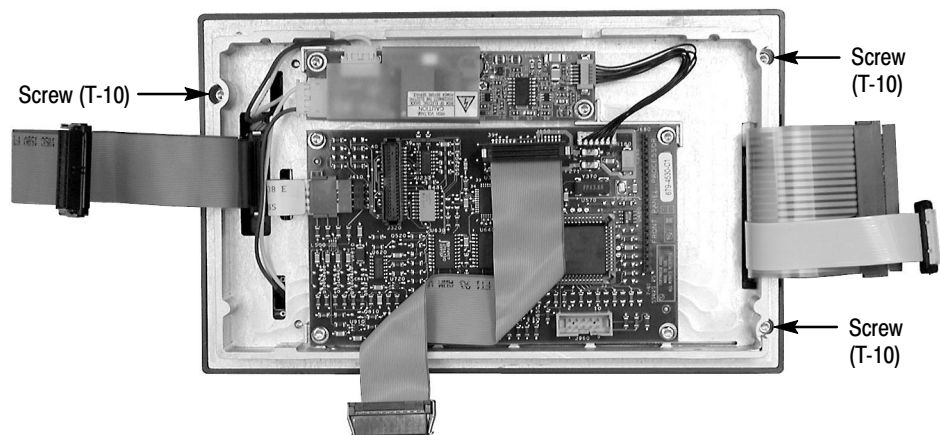


Figure 4-9: Front panel assembly

NOTE. Continue with the following steps to remove the circuit boards for the front panel controls and gain access to the push buttons and button elastomers. See Figure 4-10 on page 4-21 while removing and reinstalling these parts.

- e. Lift the metal chassis (with circuit boards and LCD) out of the front panel bezel. This assembly is a replaceable unit. No further disassembly of this unit is recommended.
- f. To remove the circuit board and keypad for the right-hand side controls (SELECT button side), remove the one screw securing the circuit board and lift the board out. See Figure 4-10.
- g. To remove the circuit board and keypad for the left-hand side controls (ON/STBY button side), first lift the edge near the LCD opening up and then remove the circuit board. See Figure 4-10.

Reinstallation Reinstall the front end assembly in the reverse order of the removal procedure.

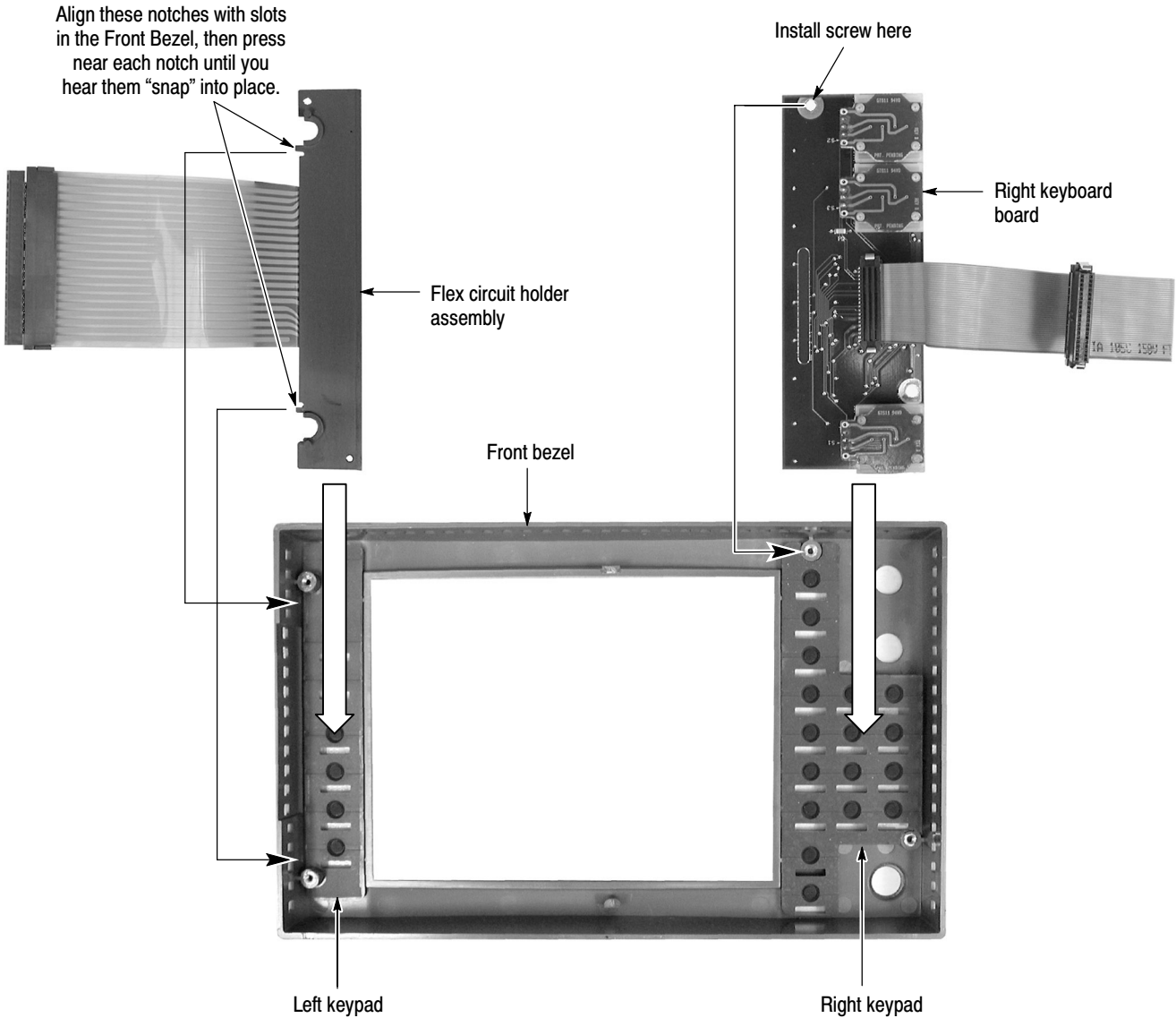


Figure 4-10: Keyboard access

Fans

The fans are mounted to a subchassis of the instrument. You do not need to remove the fans to remove fan chassis. If you need to remove the fans, perform this procedure. If you need to remove the fan assembly (to gain access to the Main board), go the Fan Assembly procedure.

The following removal procedures must be performed before removing either of the fans:

- Cabinet
- Chassis Cover
- Front Panel Assembly

Removal

Read the entire removal procedure before proceeding.

1. Remove the four screws (T-15) securing each fan to the fan chassis.
2. Unplug the fan connector/s from the Main board and lift the fan out.
 - J580
 - J590

Reinstallation

To reinstall the fans, read this entire reinstallation steps before proceeding.



CAUTION. *The fans must be mounted to the chassis such that the airflow is toward the rear of the instrument.*

1. Install the four screws (T-15) securing the fan to the fan chassis. The airflow arrow must point toward the rear of the instrument.
2. Plug the keyed fan connector/s to the Main board.

Fan Assembly

The following removal procedures must be performed prior to removing the fan assembly.

- Cabinet
- Chassis Cover
- Power Supply
- All installed modules
- Front Panel Assembly

Removal

Read the entire removal procedure before proceeding. You do not need to remove the fans to remove the fan assembly.

1. Remove the two T-15 screws securing the fan chassis to the rest of the instrument chassis.
2. Unplug the two fan connectors from the Main board.
 - J580
 - J590
3. Tilt the fan assembly out from under the chassis tabs and lift the assembly out.

Reinstallation

To reinstall the fan assembly, read the entire reinstallation steps before proceeding.

NOTE. *Ensure that all EMI strips are in place and undamaged before installing the fan assembly.*

1. Before installing the assembly, note the notches located on the bottom of the assembly at each end. Then note the two matching tabs located in the instrument chassis. See Figure 4-11.
2. Tilt and lower the fan assembly into the instrument chassis, lining up the notches in the fan assembly to the tabs in the chassis.

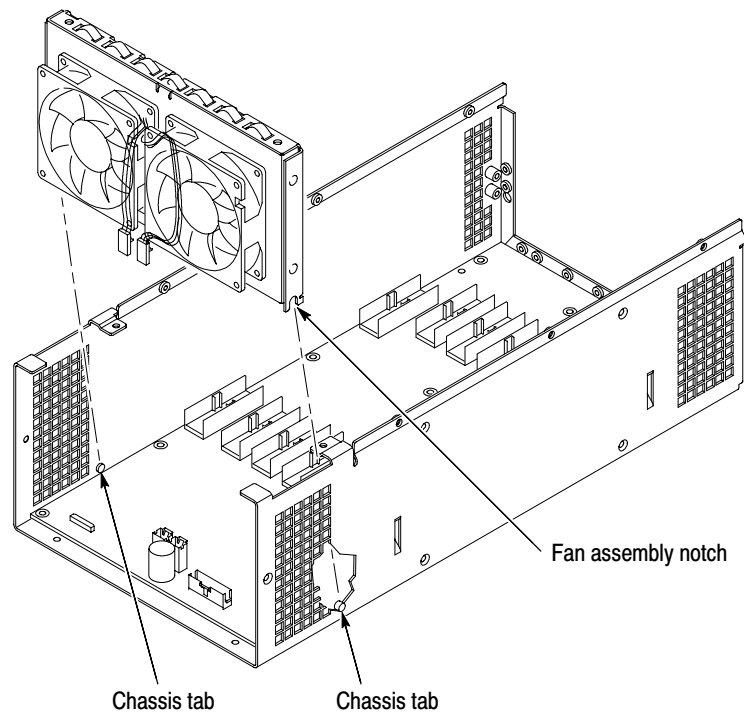


Figure 4-11: Fan assembly mounting

3. After the bottom of the fan assembly is properly inserted, tilt the assembly to the vertical position, lining up the holes in both chassis for the screws.
4. Install the two screws (T-15) on the top to secure the fan assembly to the chassis.
5. Plug the keyed fan connector/s into the Main circuit board.
 - J580
 - J590

Main Circuit Board

The following removal procedures must be performed prior to removing the Main board.

- Cabinet
- Chassis Cover
- Power Supply
- All installed modules
- Front Panel Assembly
- Fan Assembly

Removal Locate and remove 11 screws (T-15) attaching the Main circuit board to the chassis. See Figure 4-12.

Reinstallation Reinstall the Main circuit board in the reverse order of the removal procedure.

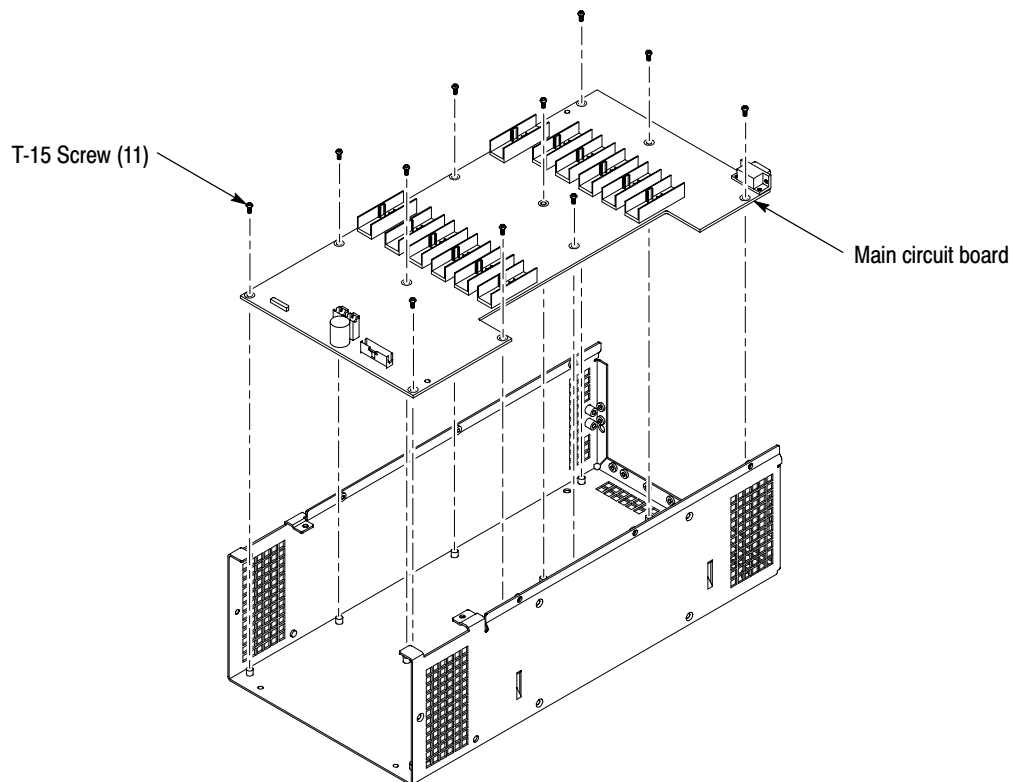


Figure 4-12: Main circuit board securing screws

Troubleshooting

This troubleshooting section contains information and procedures designed to help you isolate faulty modules in the instrument. If a module needs to be replaced, follow the *Removal and Installation Procedures* located in this chapter.

This troubleshooting section is divided into four subsections. The order in which they are presented is generally a good practice to follow.

1. **Check for Problems.** This is usually the best place to start when trying to diagnose any type of failure. The information may solve the problem or point you to other subsections.
2. **Diagnostics.** Describes where to find the built-in diagnostic tools and how to use them.
3. **LED Fault Codes.** Describes the fault indicated by the status of the front-panel LEDs.
4. **Troubleshooting Trees.** The troubleshooting trees help diagnose problems that need to be looked at in more detail. These trees are usually referred to by the previous troubleshooting sections.

Check for Problems

Use Table 4-4 to quickly isolate possible failures and how to proceed for further troubleshooting.

Table 4-4: Failure symptoms and possible causes

Symptom	Possible cause(s)
Mainframe will not power on	<ul style="list-style-type: none">■ Power cord not plugged in.■ Faulty power supply.■ Faulty modules.■ Front panel power switch not on. Use the Power Troubleshooting Tree on page 4-34.
If any of these conditions exist: FAULT LED glows FAULT LED flashes ON/STBY LED flashes Front panel LEDs do not light	Refer to the LED fault codes in Table 4-5 on page 4-32.
LCD panel display blank	Use the Blank Screen Troubleshooting Tree on page 4-37.

Table 4-4: Failure symptoms and possible causes (cont.)

Symptom	Possible cause(s)
Instrument locks up	<ul style="list-style-type: none"> ■ Power down the instrument, then restart. ■ Replace the CPU circuit board.
Power Up Diagnostic errors Internal Digital Path Diagnostic errors Audio Path Diagnostics	Use the Diagnostics Error Troubleshooting Tree on page 4-39.
Modules not recognized	<ul style="list-style-type: none"> ■ Module firmware incompatible with mainframe software version. ■ Module not fully installed into the slot. ■ Faulty module.
Mainframe powers on but no signal displayed	<ul style="list-style-type: none"> ■ Wrong slot selected, wrong input selected. ■ Module not fully installed into the slot.
Front panel buttons don't operate correctly. Touch panel doesn't operate correctly.	Use the Front Panel Buttons and Touch Panel Troubleshooting Tree on page 4-38.
Performance requirement not met as tested with the Performance Verification procedures.	Perform the procedures located in the <i>Adjustments</i> chapter.
One (or any combination) of the following functions fail to perform: WFM VECTOR PICTURE GAMUT MEASURE	Real Time Display module faulty.
Spurious gamut errors	<ul style="list-style-type: none"> ■ Poor quality input signal. ■ Perform the Digital Signal Path Diagnostics.
Failure to lock to external reference signal	<ul style="list-style-type: none"> ■ Verify the reference input signal is of the proper type as listed in the User manual. ■ External Reference module faulty.
G/Y, B/Pb, R/Pr output signals correct but not at the VGA PIX MON connector	Check the ribbon cable connections on the External Reference module between the two circuit boards at J1 and J270.
INPUT A or INPUT B work but not both	Faulty Input Module.
HD or SD waveform work but not both	Faulty Input Module.

Table 4-4: Failure symptoms and possible causes (cont.)

Symptom	Possible cause(s)
Out of specification or malfunction of the following: SD PIX MON SERIAL OUT JITTER OUT Eye, Jitter	Faulty Input Module.
One of the following error messages are displayed: INPUT UNLOCKED #A: UNKNOWN #B: UNKNOWN	<ul style="list-style-type: none"> ■ Verify the input signal is a known good signal. ■ Verify the proper Input and slot are selected. ■ Faulty Input Module.
The following video STATUS items are indicated incorrectly: Signal Format Embedded Audio Embedded CRC	<ul style="list-style-type: none"> ■ Faulty Input Module.
With two video modules installed, only one works	<p>Swap the modules and recheck. If the fault follows the suspected input module, the module is faulty. If the fault remains in place (same slot), check the main board for bent pins or the main board is faulty.</p> <p>A second video module installed in slot 3 can only be used if a functioning video module is in slot 2. Slot 2 must always contain a video module.</p>
Audio performance verification indicates the following failures: Ext AES input AES output amplitude, rise/fall time, return loss	If the Performance Verification procedure for the Audio option indicates a malfunction or is out of the specification range, replace the Audio Module.
Audio performance verification indicates the following failures: AES output bit errors, excessive jitter Embedded source selection Embedded audio presence readout	If the Performance Verification procedure for the Audio option indicates a malfunction or is out of the specification range, replace the faulty Video module.

Diagnostics

The waveform monitor provides diagnostics capabilities, which are accessed through the System submenu of the Configure menu. You can view or print the Diagnostics Log, which contains the results of the last diagnostic test that the instrument performed.

Powerup Diagnostics Setting

The instrument runs either full or brief diagnostics at power up, depending on the Powerup Diagnostics setting in the System submenu of the Configure menu.

Running Diagnostics

You should run diagnostics after installing a new module, software upgrade or firmware upgrade, or when troubleshooting suspected instrument problems. You have the following diagnostic 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.

NOTE. *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.*

Run Audio Path Diagnostics (WFM7DG Only). The instrument checks the audio paths within the instrument from the optional WFM7DG audio module and displays the results of the various tests.

NOTE. *Running the Audio 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.*

Viewing and Printing the Diagnostic Log

From the System submenu of the Configure menu, you can view or print the Diagnostic Log, which contains the results of the last diagnostic test that the instrument performed.

When you are viewing the log, 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.

To print the Diagnostic Log, you must have first configured the printing function for the instrument. Refer to the User manual for information about configuring the instrument for printing.

You can also download the Diagnostic Log using the Remote Web Interface. Refer to the User manual for more information.

LED Fault Codes

The ON/STBY LED (green) and the FAULT LED (red) indicate instrument status. The ON/STBY LED is illuminated whenever the instrument is on. The FAULT LED is illuminated when the environment controller detects a fault within the instrument. The LEDs do not report input signal problems.

Table 4-5 shows the LED conditions and what they indicate.

Table 4-5: LED fault codes

ON/STBY LED	Fault LED	Additional problem description	Suggested action
Off	Off		<p>This is normal when the instrument is in standby mode; Press the ON/STBY front panel button.</p> <p>Check line input to power supply.</p> <p>Go to the Power Troubleshooting Tree on page 4-34.</p>
On	Off	No display.	Go to the Blank Screen Troubleshooting Tree on page 4-37.
Flashing	Off		<p>This indicates the instrument is under temperature. The LCD may be damaged if operated at low temperatures.</p> <p>Verify that the ambient temperature meets specifications. Let the unit warm up and cycle the power or press the ON/STBY switch for normal operation to occur.</p>
On	On		<p>This is a transient (momentary) 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.</p> <p>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.</p> <p>It is normal for the momentary fault state to be asserted when the AC line is removed while the instrument is running.</p>
Off	Flashing		<p>This indicates the instrument is over temperature. 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.</p> <p>Verify that the ambient temperature meets specifications. Let the instrument cool down and press the ON/STBY switch to resume normal operation.</p>
Flashing	Flashing		The Environmental Controller is not able to test the temperature sensors and fan circuits. If this occurs, replace the Main Interface board.
Off	On		<p>If the internal monitors detect that an internal power supply 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.</p> <p>Press the ON/STBY switch to reset the instrument. If the fault code reoccurs, go to the LED Fault Troubleshooting Tree (1 and 2) on pages 4-35 and 4-36 or the Power Troubleshooting Tree on page 4-34.</p>

Troubleshooting Trees

Equipment Required for Troubleshooting Trees

The troubleshooting trees may require some test equipment, depending on the instrument fault. You will need an oscilloscope to check waveforms for video display problems. A digital voltmeter is needed to check voltages and continuity between cables.

Power Troubleshooting Tree

Use this troubleshooting tree to help diagnose instrument power-up problems or failures. You can also start with this tree if unsure of the nature of the problem.

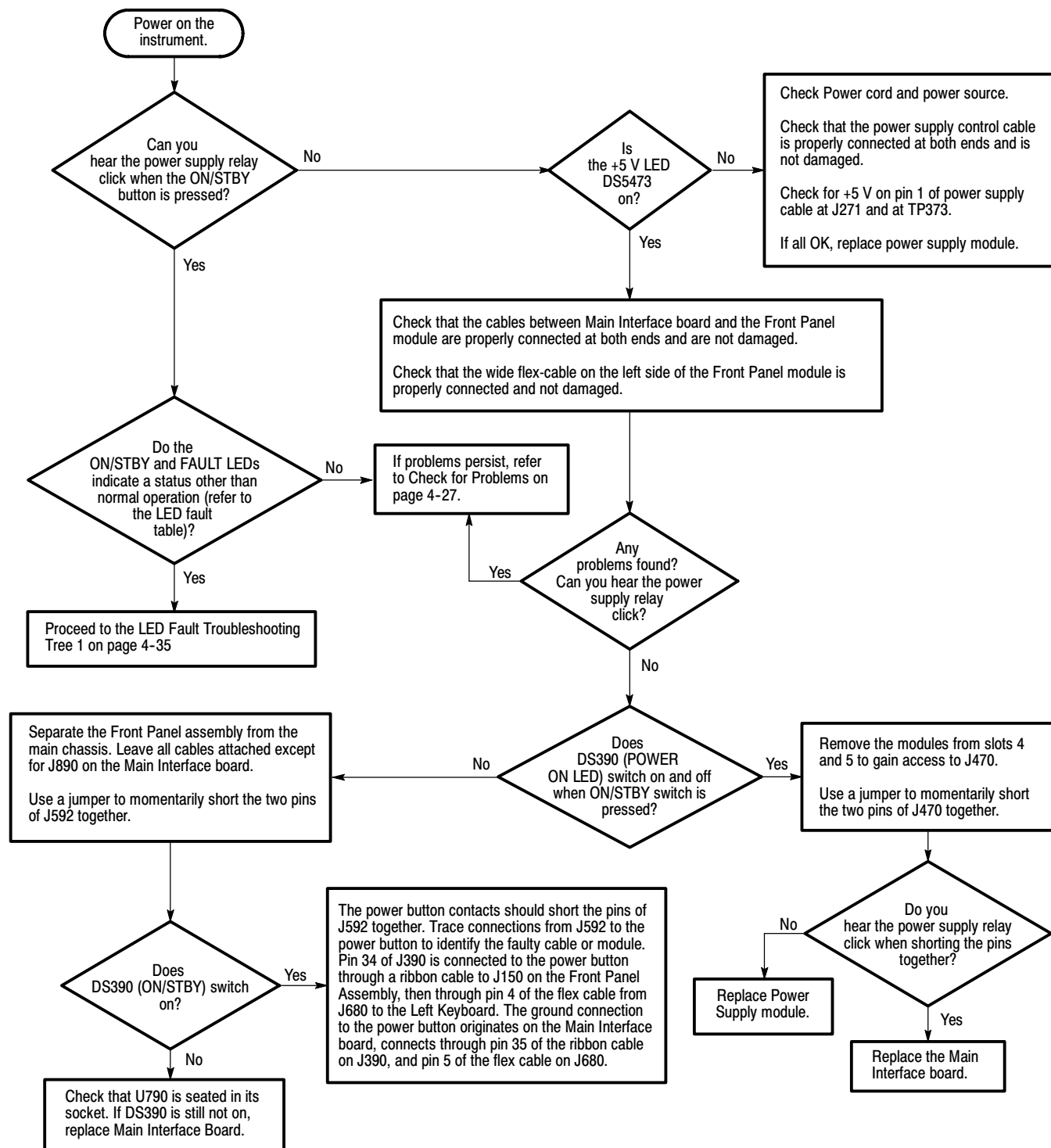


Figure 4- 13: Primary troubleshooting procedure

LED Fault Troubleshooting Tree 1

Use this troubleshooting tree as the starting point when the front panel LEDs indicate an error.

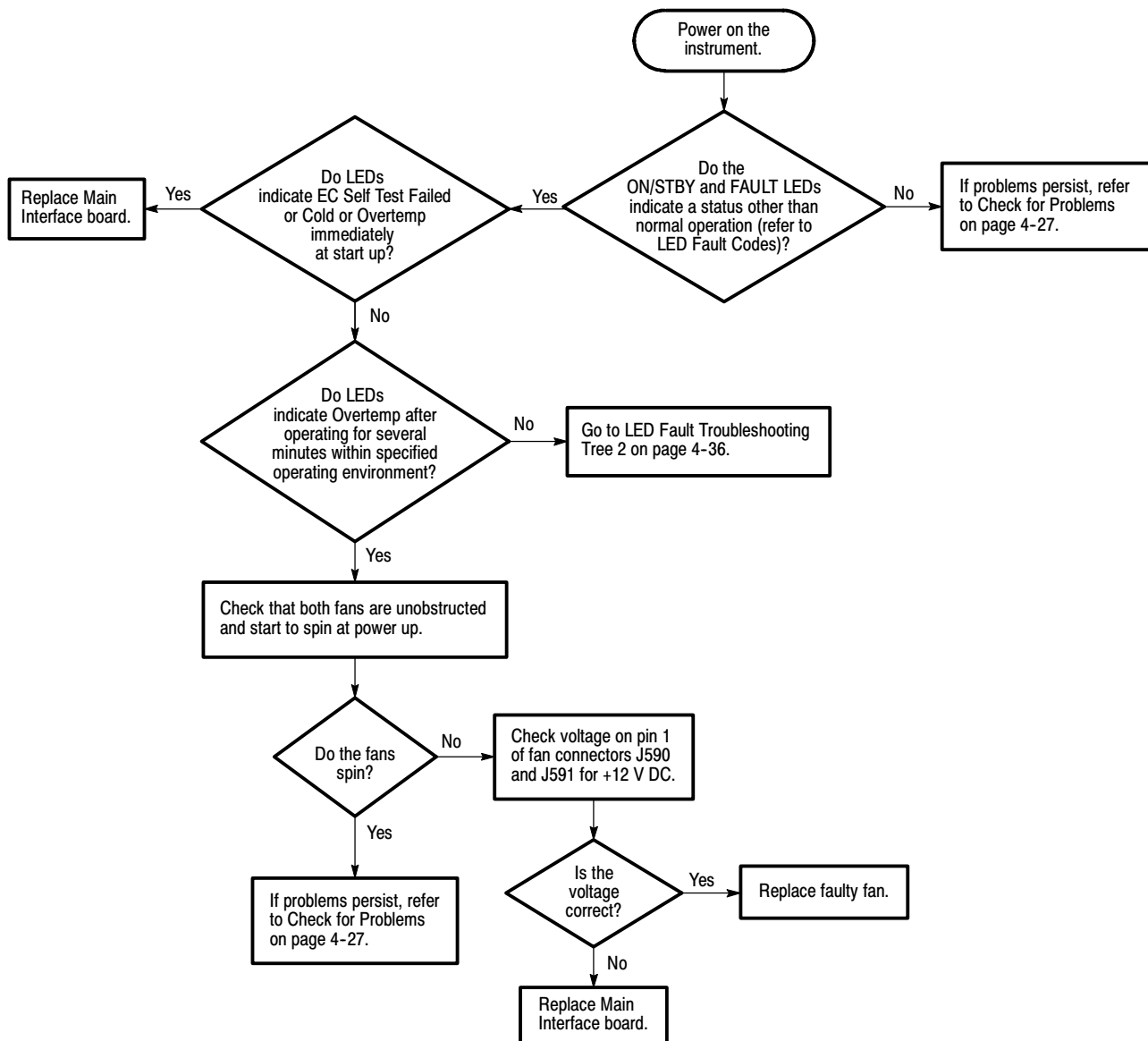


Figure 4- 14: LED fault troubleshooting tree 1

LED Fault Troubleshooting Tree 2

This troubleshooting tree is the second LED fault troubleshooting tree. Typically perform the LED Fault Troubleshooting Tree 1 prior to this tree unless directed here by other procedures.

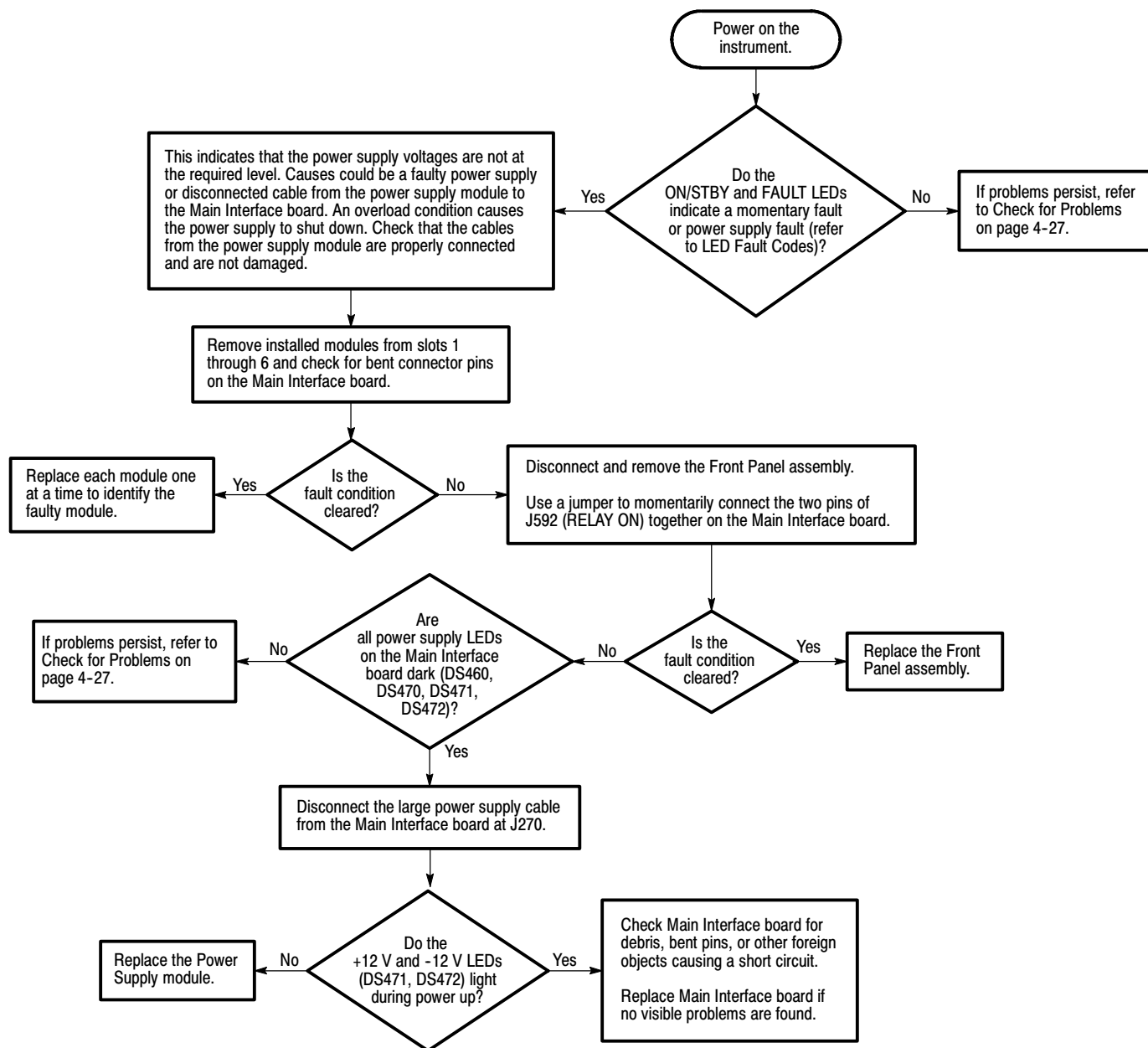


Figure 4- 15: LED fault troubleshooting tree 2

Blank Screen Troubleshooting Tree

Use this troubleshooting tree to help diagnose a blank screen.

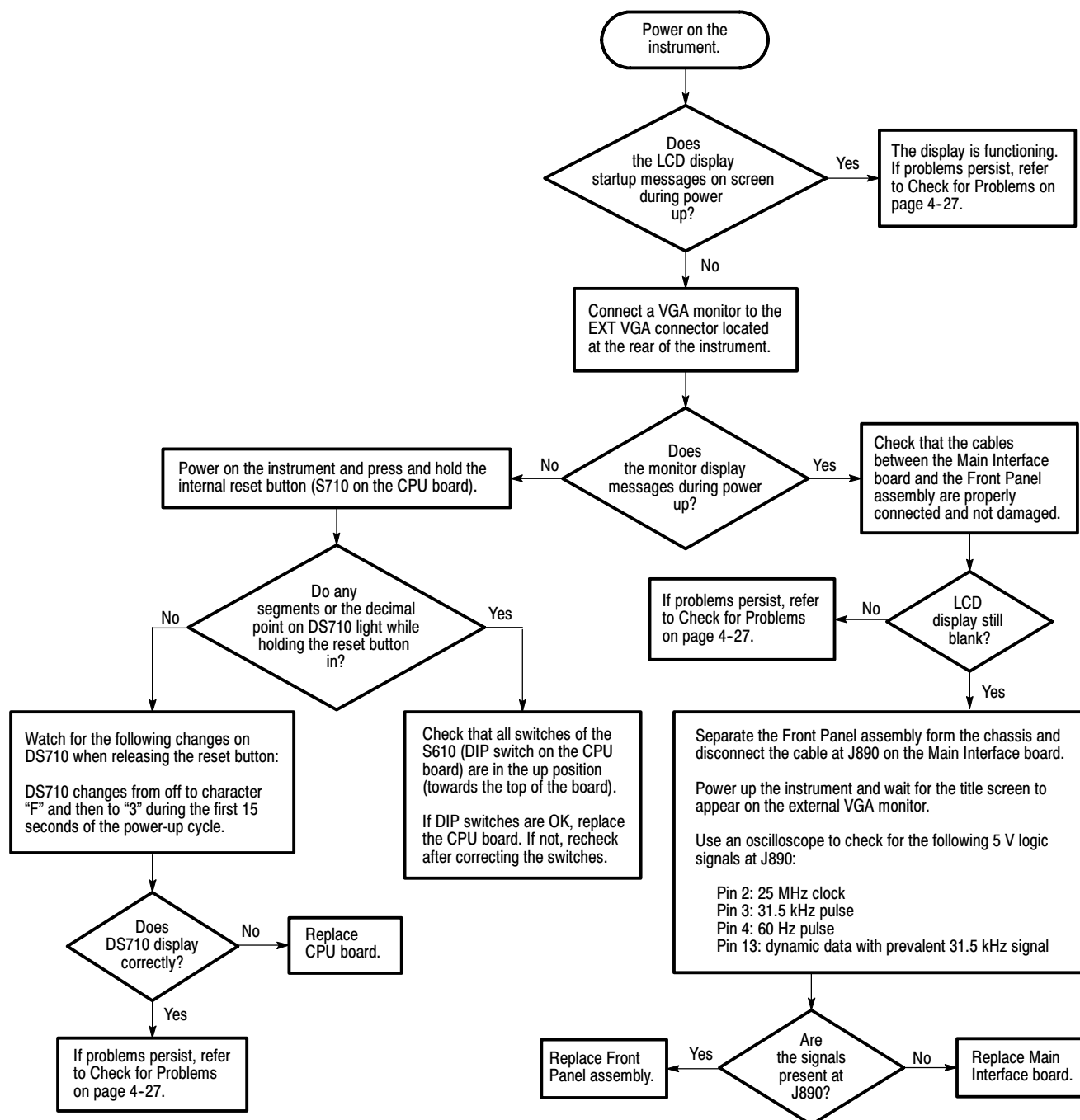


Figure 4- 16: Blank screen troubleshooting tree

Front Panel Buttons and Touch Panel Troubleshooting Tree

Use this troubleshooting tree to help diagnose problems with the front panel buttons or the touch panel.

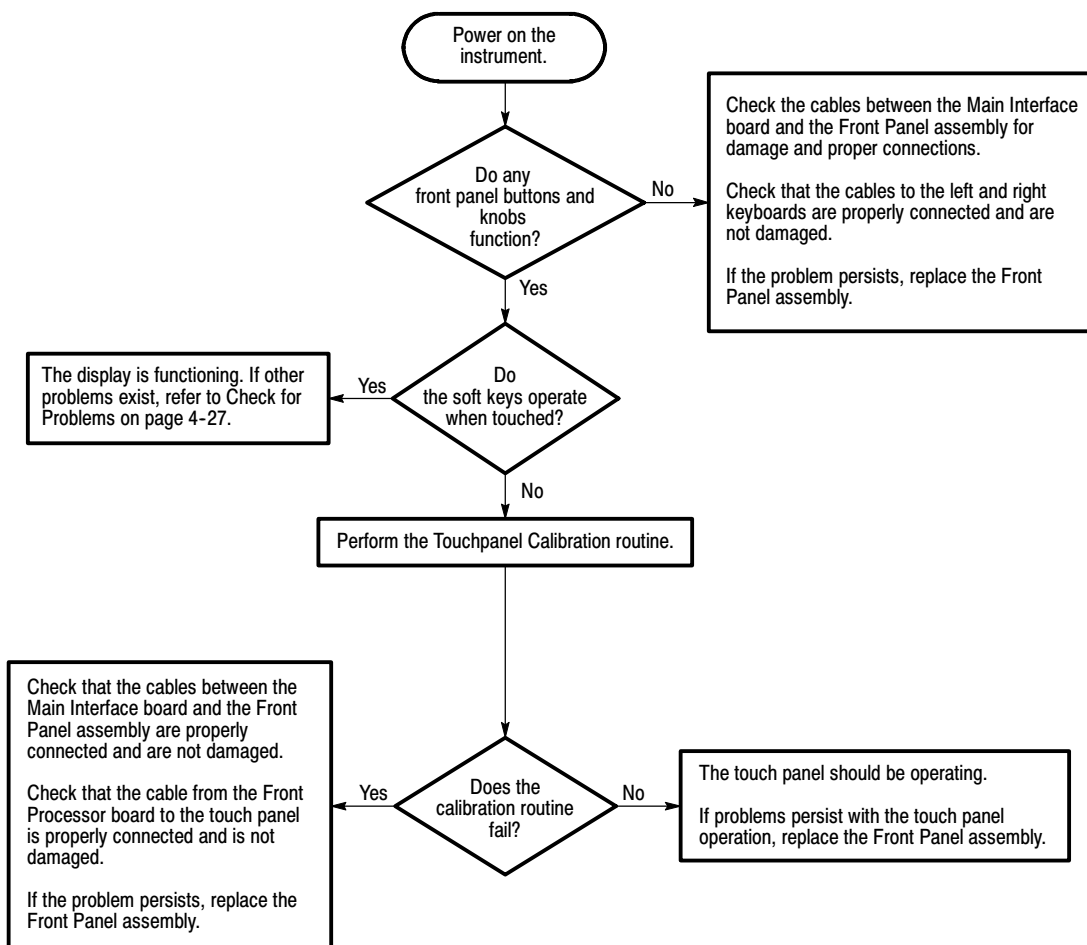


Figure 4- 17: Front panel buttons and touch panel troubleshooting tree

Diagnostics Errors Troubleshooting Tree

Use this troubleshooting tree to help diagnose problems when errors are reported by the waveform monitor's diagnostics.

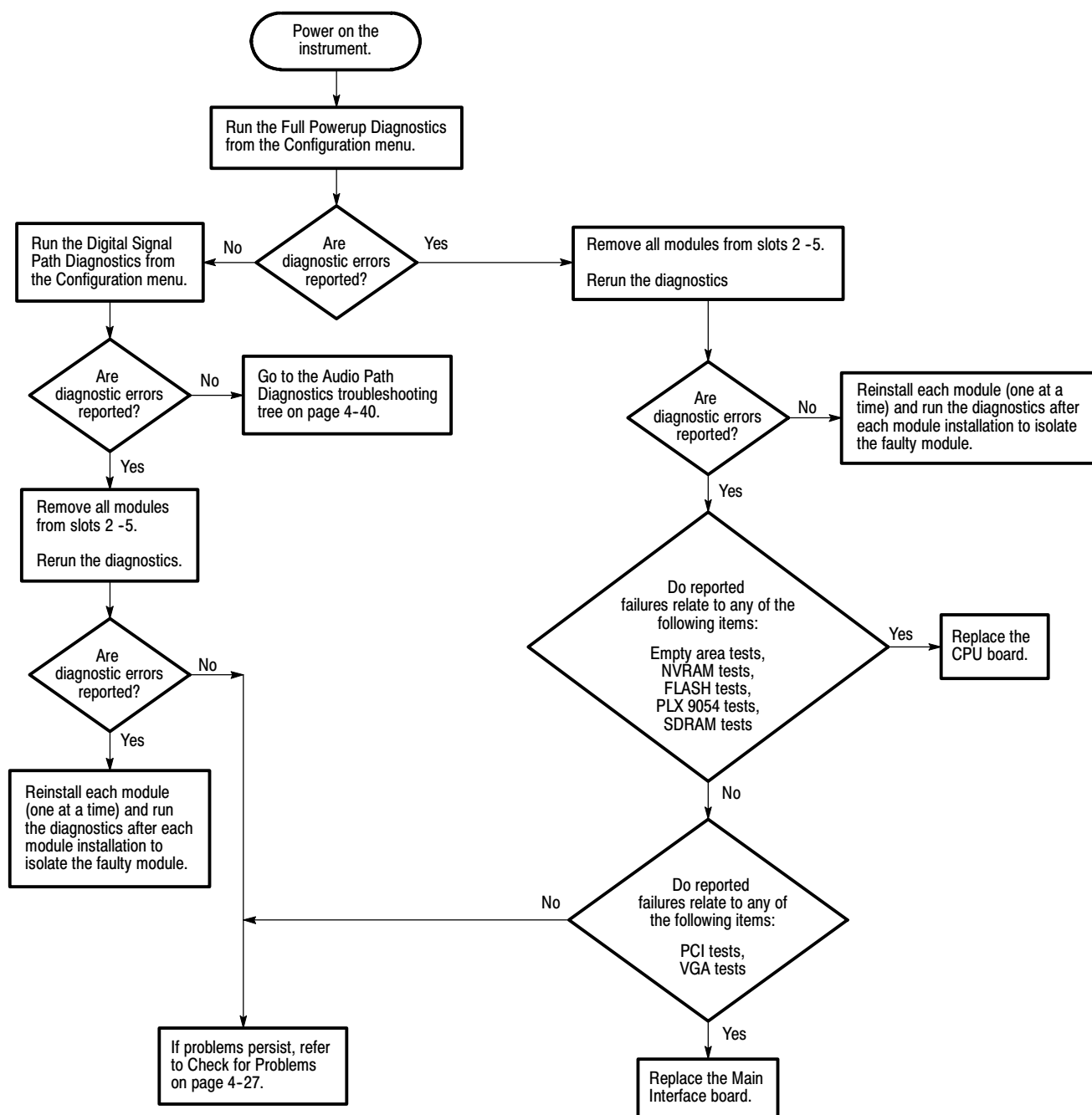


Figure 4- 18: Diagnostics errors troubleshooting tree

Audio (Option DG) Diagnostics Errors Troubleshooting Tree

Use this troubleshooting tree to help diagnose problems when errors are reported by the waveform monitor's audio path diagnostics.

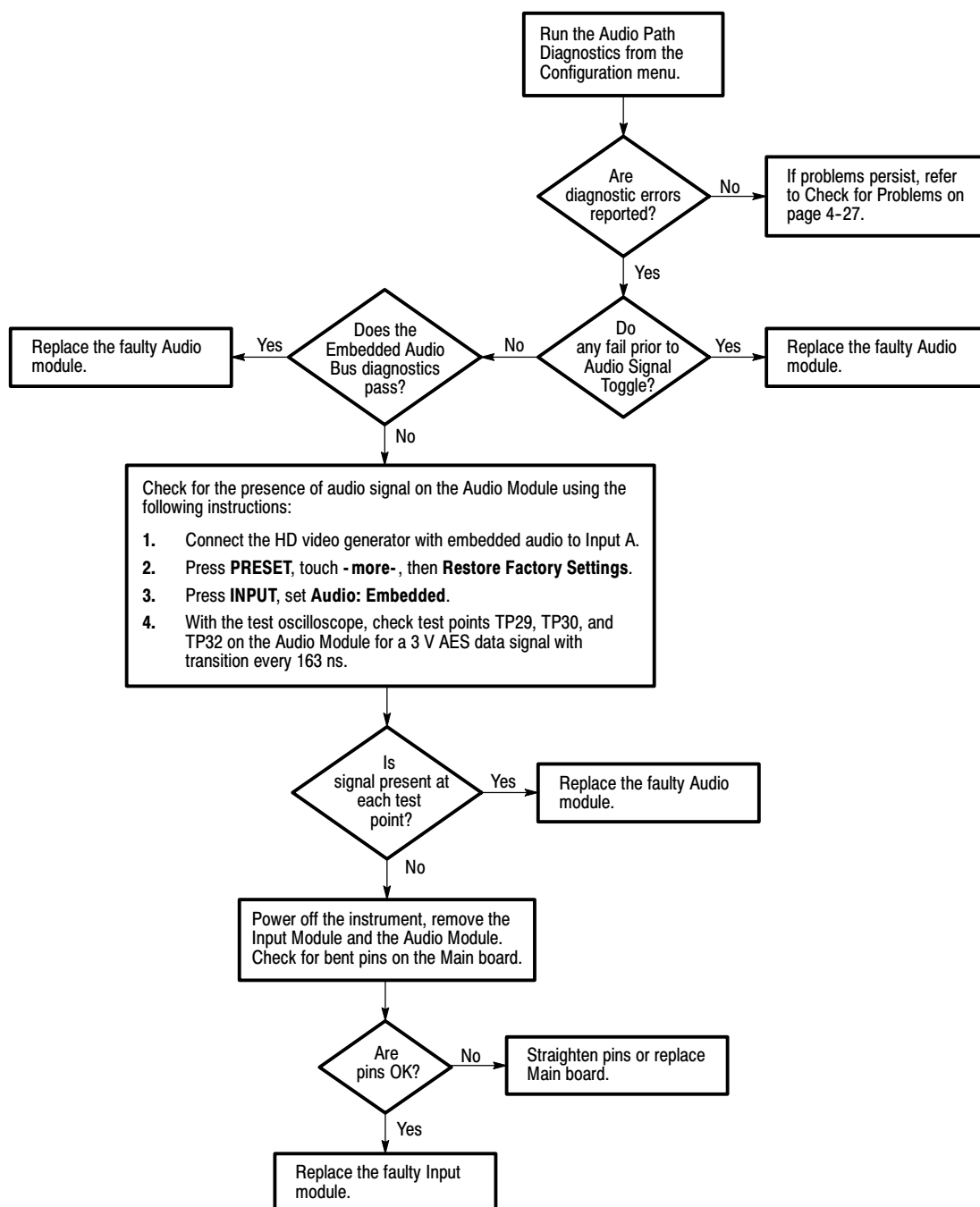


Figure 4- 19: Audio (Option DG) diagnostics errors troubleshooting tree

Repackaging Instructions

This section contains the information needed to repack the portable main-frame for shipment or storage.

Packaging

When repacking the instrument for shipment, use the original packaging. If the packaging is unavailable or unfit for use, contact your local Tektronix representative to obtain new packaging. Refer to *Contacting Tektronix* on page xiv for the address, the email address, and phone number.

Seal the shipping carton with an industrial stapler or strapping tape.

Shipping to the Service Center

Contact the Service Center to get an RMA (return material authorization) number, and any return or shipping information you may need.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information:

- The RMA number.
- The owner's address.
- Name and phone number of a contact person.
- Type and serial number of the instrument.
- Reason for returning.
- A complete description of the service required.

Mark the address of the Tektronix Service Center and the return address on the shipping carton in two prominent locations.



Replaceable Parts

Replaceable Parts

This section contains a list of the replaceable electrical modules and mechanical parts for the WFM700 Waveform Monitor. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Module Servicing

Modules can be serviced through one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange

In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-833-9200 and press 2 for Factory Service.

Module Repair and Return

You may ship your module to us for repair, after which we will return it to you.

New Modules

You may purchase replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

This section contains a list of the mechanical and/or electrical components that are replaceable for this product. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Parts List Column Descriptions

Column	Column name	Description
1	Figure & Index Number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that follow.
2	Tektronix Part Number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial Number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entries indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & Description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
7	Mfr. Code	This indicates the code of the actual manufacturer of the part.
8	Mfr. Part Number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations

Abbreviations conform to American National Standard ANSI Y1.1-1972.

Mfr. Code to Manufacturer Cross Index

The table titled Manufacturers Cross Index shows codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
00779	TYCO ELECTRONICS CORPORATION	CUSTOMER SERVICE DEPT PO BOX 3608	HARRISBURG, PA 17105-3608
02660	AMPHENOL CORP	720 SHERMAN AVE	HAMDEN, CT 06514-6514
060D9	TENSOLITE COMPANY	PRECISION HARNESS AND ASSEMBLY 3000 COLUMBIA HOUSE BLVD #120	VANCOUVER, WA 98661
07416	NELSON NAME PLATE COMPANY	2800 CASITAS AVENUE	LOS ANGELES, CA 90039-2942
0KB01	STAUFFER SUPPLY CO	810 SE SHERMAN	PORTLAND, OR 97214-4657
0KB05	NORTH STAR NAMEPLATE INC.	LABEL PRODUCTS 5750 NE MOORE COURT	HILLSBORO, OR 97124-6474
0L0L7	RADISYS CORPORATION	5445 NE DAWSON CREEK DRIVE	HILLSBORO, OR 97124
1DM20	PARLEX CORP	7 INDUSTRIAL WAY	SALEM, NH 03079
22670	GM NAMEPLATE INCORPORATED	2040 15TH AVE WEST	SEATTLE, WA 98119-2783
4Y264	CANARE CABLE INC.	531 5TH STREET, UNIT A	SAN FERNANDO, CA 91340
55322	SAMTEC INC.	810 PROGRESS BLVD PO BOX 1147	NEW ALBANY, IN 47150-1147
55566	RAF ELECTRONIC HARDWARE INC.	95 SILVERMINE ROAD	SEYMOUR, CT 06483
57924	BOURNS INC	INTEGRATED TECHNOLOGY DIV. 1400 NORTH 1000 WEST	LOGAN, UT 84321
78189	SHAKEPROOF	DIVISION OF ILLINOIS TOOL WORK ST. CHARLES ROAD	ELGIN, IL 60120
7X318	KASO PLASTICS INC.	5720-C NE 121ST AVE, STE 110	VANCOUVER, WA 98682
80009	TEKTRONIX INC.	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077-0001
92607	TENSOLITE COMPANY	PERFORMANCE CABLE 100 TENSOLITE DRIVE	SAINT AUGUSTINE, FL 32092
93907	CAMCAR DIV OF TEXTRON INC.	ATTN: ALICIA SANFORD 516 18TH AVE	ROCKFORD, IL 61104-5181
TK0JL	CHROMA ATE INC.	43 WU-CHUAN ROAD WU-KU INDUSTRIAL PARK	WU-KU, TAIPEI HSIEN, TAIWAN CN
TK0JO	POWER CHOICE SDN BHD	19,21, LORONG USAHAJAYA 4 KAW, PERIND, USAHAJAYA, MUKIM 14	PENANG, MY 11900
TK1943	NEILSEN MANUFACTURING INC.	3501 PORTLAND RD NE	SALEM, OR 97303
TK2359	STROM MANUFACTURING	5289 NE ELAM YOUNG PKWY E-300	HILLSBORO, OR 97124
TK2476	MOD0 INC.	1400 NW COMPTON DR	BEAVERTON, OR 97006-1992
TK2565	VISION PLASTICS INC.	26000 SW PARKWAY CENTER DRIVE	WILSONVILLE, OR 97070
TK6085	OXFORD WIRE & CABLE SERVICE INC.	10 INDUSTRIAL DR	OXFORD, MS 38655

Replaceable parts list

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-1							
-1	671-4528-00	B010100	B011114	1	CIRCUIT BD ASSY: CPU, 679-4528-00 TESTED, 389-2673-00 WIRED	80009	671-4528-00
	671-4528-01	B011115		1	CIRCUIT BD ASSY: CPU, 679-4528-01 TESTED, 389-2673-00 WIRED	80009	671-4528-01
	671-4528-02			1	CIRCUIT BD ASSY: CPU, 679-4528-02 TESTED, 389-2673-01 WIRED	80009	671-4528-02
	671-4528-03			1	CIRCUIT BD ASSY: CPU, 679-4528-02 TESTED, 389-2673-01 WIRED	80009	671-4528-03
	671-4528-04		B019999	1	CIRCUIT BD ASSY: CPU, 679-4528-03 TESTED, 389-2673-01 WIRED	80009	671-4528-04
	671-5751-00	B020000		1	CIRCUIT BD ASSY: CPU, 679-4528-01 TESTED, 389-2673-00 WIRED	80009	671-5751-00
	671-5751-01	B020000	B023741	1	CIRCUIT BD ASSY: CPU, 679-4528-02 TESTED, 389-2673-01 WIRED	80009	671-5751-01
	671-5751-02	B023742	B024088	1	CIRCUIT BD ASSY: CPU, 679-4528-02 TESTED, 389-2673-01 WIRED	80009	671-5751-02
	671-5751-03	B024089		1	CIRCUIT BD ASSY: CPU, 679-4528-03 TESTED, 389-2673-01 WIRED	80009	671-5751-03
<p><i>NOTE: You must replace the CPU board with the same part number (671-4528-XX or 671-5751-XX) that is installed in the instrument, or else you must also replace the Real Time Display board. Only the following combinations of CPU and Real Time Display boards will function in the instrument:</i></p> <p>1. CPU 671-4528-xx & Real Time Display 671-4529-xx 2. CPU 671-5751-xx & Real Time Display 671-5661-xx</p>							
-2	131-3925-00			1	CONN, DSUB; PCB, FEMALE, RTANG, 9 POS, 0.112 CTR, 0.318 MLG X 0.125 TAIL	02660	617C009SAJ120
-3	344-0598-00			1	CLIP, GROUND: 0.008 SST	TK1943	344-0598-00
-4	333-4337-00	B010100	B024088	1	PANEL, REAR: CPU	TK2359	333-4337-00
	333-4337-01	B024089		1	PANEL, REAR: CPU	TK2359	333-4337-01
-5	211-0125-00	B010100	B024088	1	SCREW, MACHINE: 1-72 X 0.25, PNH, STL BK OXD, POZ	93907	ORDER BY DESCR
-6	214-3903-00			6	SCREW, JACK: 4-40 X 0.312 LONG, 0.188 H HEX HEAD STAND OFF, 4-40 INT THD, X 0.312 THD EXT 4-40	05791	LT4276
-7	131-6684-00			4	CONN, RF JACK; BNC, 75 OHM, FEMALE, RTANG: USED ON 292 ASSEMBLY (WFM700A, WFM700HD)	4Y264	BCJ-FPLV01
	131-6684-00			5	CONN, RF JACK; BNC, 75 OHM, FEMALE, RTANG: USED ON 292 ASSEMBLY (WFM700M)	4Y264	BCJ-FPLV01

Replaceable parts list (cont.)

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-1							
-8	210-0388-00			4	SPACER, BNC: USE WITH 131-6684-XX BNC (WFM700A, WFM700HD)	4Y264	BN6003
	210-0388-00			5	SPACER, BNC: USE WITH 131-6684-XX BNC (WFM700M)	4Y264	BN6003
-9	333-4413-00			2	PANEL, REAR: 292 (WFM700A, WFM700HD)	TK1943	333-4413-00
-10	210-0199-00			13	WASHER, LOCK: NICKEL PLATED	4Y264	B91008
-11	220-0256-00			13	NUT: NICKEL PLATED	4Y264	B90010
-12	333-4427-00			1	PANEL, REAR: 292 (WFM700M)	TK1943	333-4427-00
-13	333-4416-00			2	PANEL, REAR: BLANK	TK1943	333-4416-00
-14	131-3378-00			8	CONN, RF JACK; BNC, 50 OHM, FEMALE, RTANG, USED ON EXT REF & EXT REF BASEMENT BOARD ASSEMBLIES	00779	227677-1
-15	220-0497-00			8	NUT, PLAIN, HEX: 0.5-28 X 0.562 HEX, BRS CD PL	73743	ORDER BY DESCR
-16	210-1039-00			5	WASHER, LOCK: 0.521 ID, INT, 0.025 THK, SST	0KB01	1224-02-00-0541C
-17	333-4414-00			1	PANEL, REAR: R-TD, 0.062 AL, 4.563 X 2.000	TK1943	333-4414-00
-18	671-4529-00	B010100	B010468	1	CIRCUIT BD ASSY: REAL-TIME DISPLAY, 679-4529-XX TESTED, 389-2674-XX WIRED	80009	671-4529-00
	671-4529-01	B010469	B019999	1	CIRCUIT BD ASSY: REAL-TIME DISPLAY, 679-4529-XX TESTED, 389-2674-XX WIRED	80009	671-4529-01
	671-5661-00	B020000		1	CIRCUIT BD ASSY: REAL-TIME DISPLAY, 679-5661-00 TESTED, 389-2674-01 WIRED	80009	671-5661-00
<p><i>NOTE: You must replace the Real Time Display board with the same part number (671-4529-XX or 671-5661-XX) that is installed in the instrument, or else you must also replace the CPU board. Only the following combinations of CPU and Real Time Display boards will function in the instrument:</i></p> <p><i>1. CPU 671-4528-xx & Real Time Display 671-4529-xx</i> <i>2. CPU 671-5751-xx & Real Time Display 671-5661-xx</i></p>							
-19	333-4338-01	B011000		1	PANEL, REAR: POWER SUPPLY, 0.062 AL	TK2359	333-4338-01
-20	211-0725-00			2	SCREW, MACHINE: 6-32 X 0.375, FLH TORX	0KB01	211-0725-00

Replaceable parts list (cont.)

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-1							
-21	650-4315-50	B010100	B010999	1	PWR SUPPLY ASSY, EOS: SEE FIGURE 5-2	80009	650-4315-50
	650-4315-51	B011000	B021958	1	PWR SUPPLY ASSY, ARTESYN: INCLUDES 174-4780-XX, 174-4467-XX, 174-4779-XX, and 174-4781-XX	80009	650-4315-51
	650-4315-52	B021959	B022217	1	PWR SUPPLY ASSY, ARTESYN: INCLUDES 174-4780-XX, 174-4467-XX, 174-4779-XX, and 174-4781-XX	80009	650-4315-52
	650-4315-53	B022218	B023637	1	PWR SUPPLY ASSY, ARTESYN: INCLUDES 174-4780-XX, 174-4467-XX, 174-4779-XX, and 174-4781-XX	80009	650-4315-53
	650-4315-54	B023638		1	PWR SUPPLY ASSY, ARTESYN: INCLUDES 174-4780-XX, 174-4467-XX, 174-4779-XX, and 174-4781-XX	80009	650-4315-54
					ATTACHING PARTS		
-22	174-4780-00	B011000		1	CA ASSY; 3 COND,5 POS HOUSING TO 3 POS HOUSING AND AMP ULTRA FAST,POWER SUPPLY TO SWITCH ECB INCLUDED IN THE 650-4315-51	92607	174-4780-00
-23	174-4467-00	B011000		1	CABLE ASSY,SP; RIBBON,IDC,5,22-26 AWG,15.00L,1 X 5 CONN BOTH ENDS;12 INCHES HEAT SHRINK IN THE CENTER INCLUDED IN THE 650-4315-51	060D9	174-4467-00
-24	174-4779-00	B011000		1	CA ASSY; 3 COND,CRIMP HOUSING TO CRIMP HOUSING INCLUDED IN THE 650-4315-51	96027	174-4779-00
-25	174-4781-00	B011000		1	CA ASSY; 3 COND,BLOCK SPADE TERMINAL TO TERMINAL HOUSING INCLUDED IN THE 650-4315-51	96027	174-4781-00
					END ATTACHING PARTS		
-26	211-0734-00			16	SCREW, MACHINE: 6-32 X 0.250, FLH100, STL, CDPL, T-10 TORX DR	0KB01	211-0734-00
-27	441-2192-00			1	COVER, CHASSIS	TK2359	441-2192-00
-28	671-4597-00	B010100		1	CIRCUIT BD ASSY: MAIN INTERFACE, TESTED, 389-2705-XX WIRED	80009	671-4597-00
	671-4597-01			1	CIRCUIT BD ASSY: MAIN INTERFACE, TESTED, 389-2705-XX WIRED	80009	671-4597-01
-29	211-0722-00			25	SCREW,MACHINE:6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR	OKB01	ORDER BY DESCR
-30	671-5403-00			1	CIRCUIT BD ASSY: EXTERNAL REFERENCE BASEMENT, TESTED, 389-3280-XX WIRED	80009	671-5403-00
-31	671-5336-00	B010100	B022219	1	CKT BD ASSY: EXTERNAL REFERENCE, TESTED, 389-3205-XX WIRED	80009	671-5336-00
	671-5336-01	B022220		1	CKT BD ASSY: EXTERNAL REFERENCE, TESTED, 389-3205-XX WIRED	80009	671-5336-01

Replaceable parts list (cont.)

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-1							
-32	174-4616-00			1	CA ASSY: RIBBON, 5.0 L, DOUBLE ENDED, IDC, FEMALE, 2 X 10, 0.0.079 CTR (2MM), PLZ	55322	TCSD-10-D-05.00-01-N
-33	672-1682-50	B010100		1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-50
	672-1682-51		B010316	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-51
	672-1682-52	B010317	B022186	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-52
	672-1682-53	B022187	B022406	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-53
	672-1682-54	B022407	B022636	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-54
	672-1682-55	B022637		1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-55
	672-1680-50	B010100		1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-50
	672-1680-51		B010409	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-51
	672-1680-52	B010410	B022189	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-52
	672-1680-53	B022190	B022394	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-53
	672-1680-54	B022395	B022604	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-54
	672-1680-55	B022605		1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-54
	672-1677-50	B010100		1	CKT BD ASSY: 292 W/RF EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-50
	672-1677-51		B011046	1	CKT BD ASSY: 292 W/RF EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-51
	672-1677-52	B011047	B011122	1	CKT BD ASSY: 292 W/EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-52
	672-1677-53	B011123	B022195	1	CKT BD ASSY: 292 W/EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-53
	672-1677-54	B022196	B022479	1	CKT BD ASSY: 292 W/EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-54
	672-1677-55	B022480	B022603	1	CKT BD ASSY: 292 W/EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-55
	672-1677-56	B022604		1	CKT BD ASSY: 292 W/EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-56

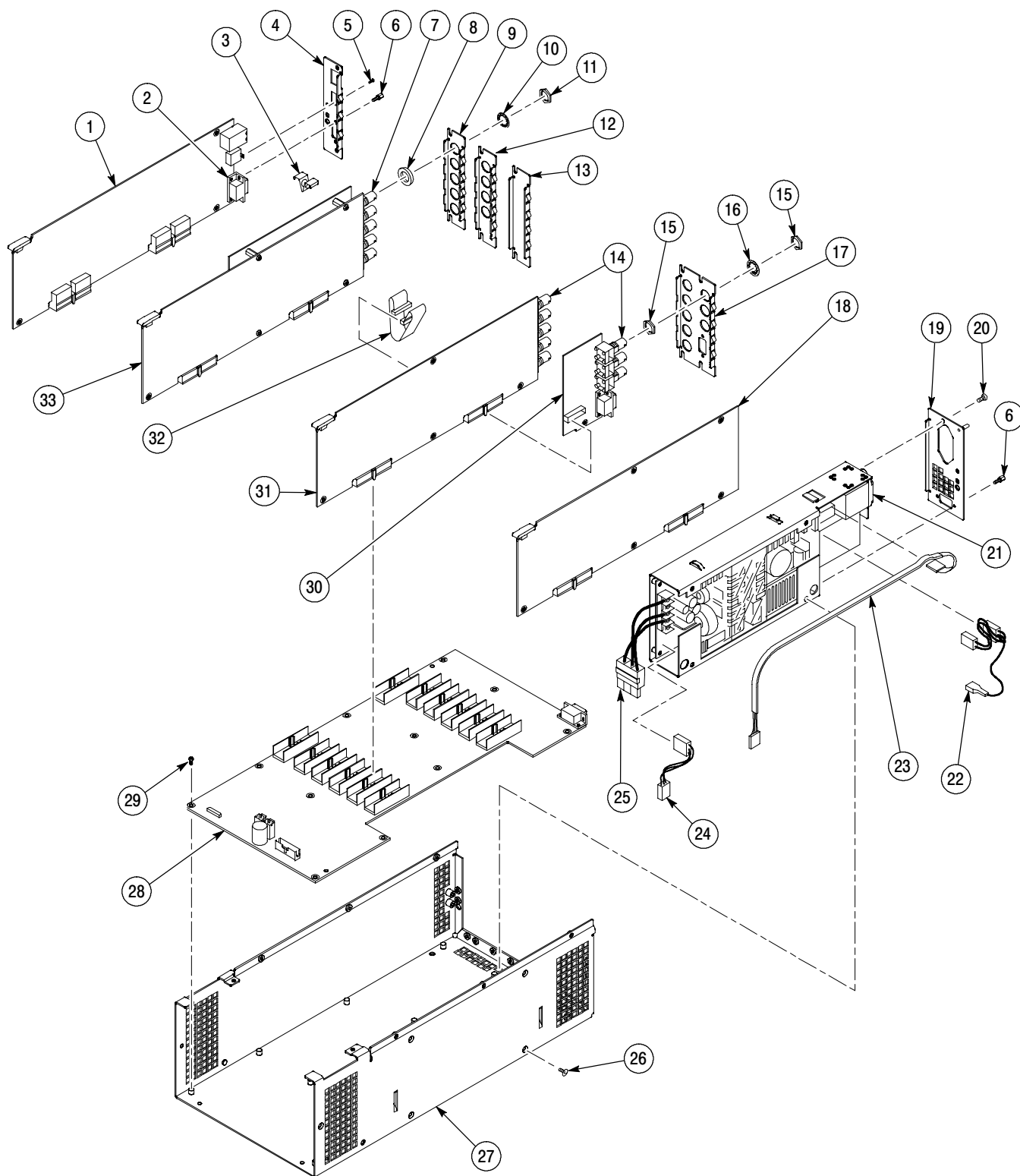


Figure 5- 1: WFM700 replaceable circuit boards and cables

Replaceable parts list

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-2							
-1	650-4315-50	B010100	B010999	1	PWR SUPPLY ASSY, EOS: INCLUDES 174-4624-00, 174-4467-00, 174-4625-00, & 174-4626-00	80009	650-4315-50
-2	174-4467-00	B010100	B010999	1	CABLE ASSY,SP; RIBBON,IDC,5,22-26 AWG,15.00L,1 X 5 CONN BOTH ENDS;12 INCHES HEAT SHRINK IN THE CENTER INCLUDED IN THE 650-4315-50	060D9	174-4467-00
-3	333-4338-00	B010100	B010999	1	PANEL, REAR: POWER SUPPLY, 0.062 AL NOT INCLUDED IN THE 650-4315-50	TK2359	333-4338-00
-4	174-4624-00	B010100	B010999	1	CABLE ASSY,SP; DISCRETE,CPM,3,18 AWG,5.0 L,FEMALE,STR,1X5,0.156 CTR(POS 1,3&5 ONLY) X FEMALE,STR,1X3,0.156 CTR(POS 1&3 ONLY) X 1 POS,FEMALE,STR,SAFETY CONTROLLED INCLUDED IN THE 650-4315-50	060D9	174-4624-00
-5	174-4625-00	B010100	B010999	1	CABLE ASSY,SP; DISCRETE,CPM,3,18 AWG,4.0 L, FEMALE,STR,1X3,0.156 CTR X STRIPPED ENDS,0.200 INCLUDED IN THE 650-4315-50	060D9	174-4625-00
-6	174-4626-00	B010100	B010999	1	CABLE ASSY,SP; DISCRETE,CPM,3,14 AWG,5.0 L, FEMALE,STR,1X3,0.156 CTR X STRIPPED ENDS,0.200,HIGH VOLTAGE INCLUDED IN THE 650-4315-50	060D9	174-4626-00

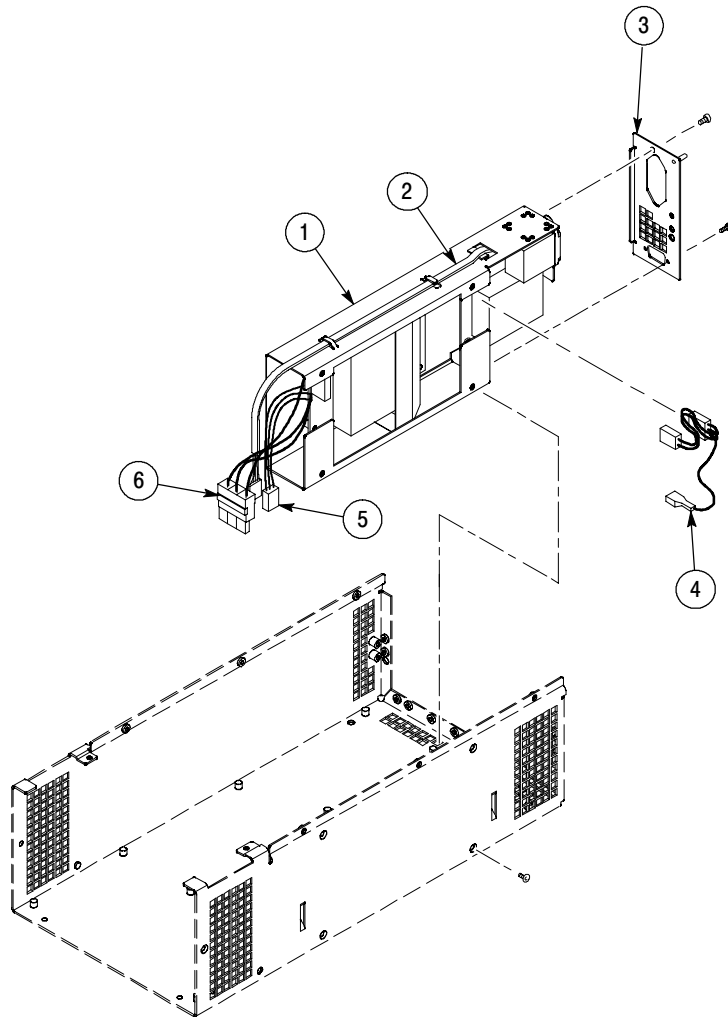


Figure 5-2: WFM700 power supply assembly and rear panel (B010999 and below)

Replaceable parts list

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-3							
-1	614-0992-50	B010100		1	PANEL ASSEMBLY: FRONT	80009	614-0992-50
	614-0992-51		B022249	1	PANEL ASSEMBLY: FRONT	80009	614-0992-51
	614-0992-52	B022250		1	PANEL ASSEMBLY: FRONT	80009	614-0992-52
					ATTACHING PARTS		
-2	335-0013-00			1	MARKER, IDENT: RIGHT FRONT, LEXAN	0KB05	335-0013-00
-3	366-0816-00			2	KNOB: SILVER GRAY, 0.420 OD, 0.520 H, PC/ABS BAYBLEND FR110, FRONT PANEL	TK1163	366-0816-00
-4	366-0817-00			1	KNOB: SILVER GRAY, 0.650 OD, 0.520 H, PC/ABS BAYBLEND FR110, FRONT PANEL	TK1163	366-0817-00
-5	335-0012-00			1	MARKER, IDENT: LEFT FRONT, LEXAN	0KB05	355-0012-00
-6	335-0017-00			1	MARKER, IDENT: NOMENCLATURE, LEXAN	0KB05	335-0017-00
-7	426-2599-00			1	FRAME, FRONT: PL-ABS, MODULE BEZEL	TK2565	426-2599-00
-8	200-4538-00			23	KEYCAP: AC-ABS	7X318	200-4538-00
-9	119-6131-00			1	SWITCH, KEYPAD: ELASTOMERIC, FRONT PANEL, PUSHBUTTON, F/P LEFT ASSY	22670	119-6131-00
-10	119-6132-00			1	SWITCH, KEYPAD: ELASTOMERIC, FRONT PANEL, PUSHBUTTON, F/P RIGHT ASSY	22670	119-3162-00
-11	259-0163-00			1	FLEX CIRCUIT BD: LEFT KEYBOARD	07416	259-0163-00
-12	679-4640-00			1	CKT BD SUBASSY: RIGHT KEYBOARD SUB ASSY, 671-4640-XX TESTED, 389-2733-XX WIRED	80009	679-4640-00
-13	311-2567-00			1	ENCODER,DIGITAL; PANEL, SPD;36 CPR, INCREMENTAL, NON-DETENTED, QUADRATURE OUTPUT, METAL SHAFT AND BUSHING	57294	EJZ1D-Z27-JEO/002
-14	-----			1	ORDER THE FRONT PANEL ASSEMBLY (614-0992-XX)		
-15	174-3767-01			1	CABLE ASSY,SP; DISCRETE,BACKLIGHT,IDC,26 AWG,5.0 L,PCB,1 X 6,0.079 CTR (2MM),SHRINK WRAPPED	TK6085	174-3767-01
-16	174-4281-00			2	CA ASSY. SP: FLAT RIBBON, IDC, 30 AWG, 6.100L, 40 POS	060D9	174-4281-00
-17	174-4340-00			1	CABLE ASSEMBLY: SP, FLAT FLEX, 31 POSITION BOTH ENDS, 4.5 IN L	1DM20	174-4340-00
					END ATTACHING PARTS		
-18	211-0734-00			9	SCREW, MACHINE: 6-32 X 0.250, FLH100, STL, CDPL, T-10 TORX DR	0KB01	211-0734-00
-19	386-7155-00			1	COVER, CHASSIS: 0.062 AL	TK2359	386-7155-00
-20	211-0722-00			25	SCREW, MACHINE: 6-32 X 0.250, PNH, STL, CDPL, T-15 TORX DR	0KB01	ORDER BY DESCR
-21	211-0734-00			16	SCREW, MACHINE: 6-32 X 0.250, FLH100, STL, CDPL, T-10 TORX DR	0KB01	211-0734-00

Replaceable parts list (cont.)

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
-22	386-7154-00			1	FAN, PLENUM: 0.062 AL	TK2359	386-7154-00
-23	119-6554-00			2	FAN ASSEMBLY: 12 V, 0.11A, 1.3W, 28CFM, 2450RPM, 27DBA, 80MM SQ X 20MM), 6 IN, 3 LEAD WITH CONN, UL, CS	TK0JL	DC 3108NL-04W-B29 -P00 W/CONTS &HO
-24	211-1050-00			8	SCREW, MACHINE: 6-32 X 0.312 L, PNH, STL CAD PLT, T15	0KB01	ORDER BY DESCR

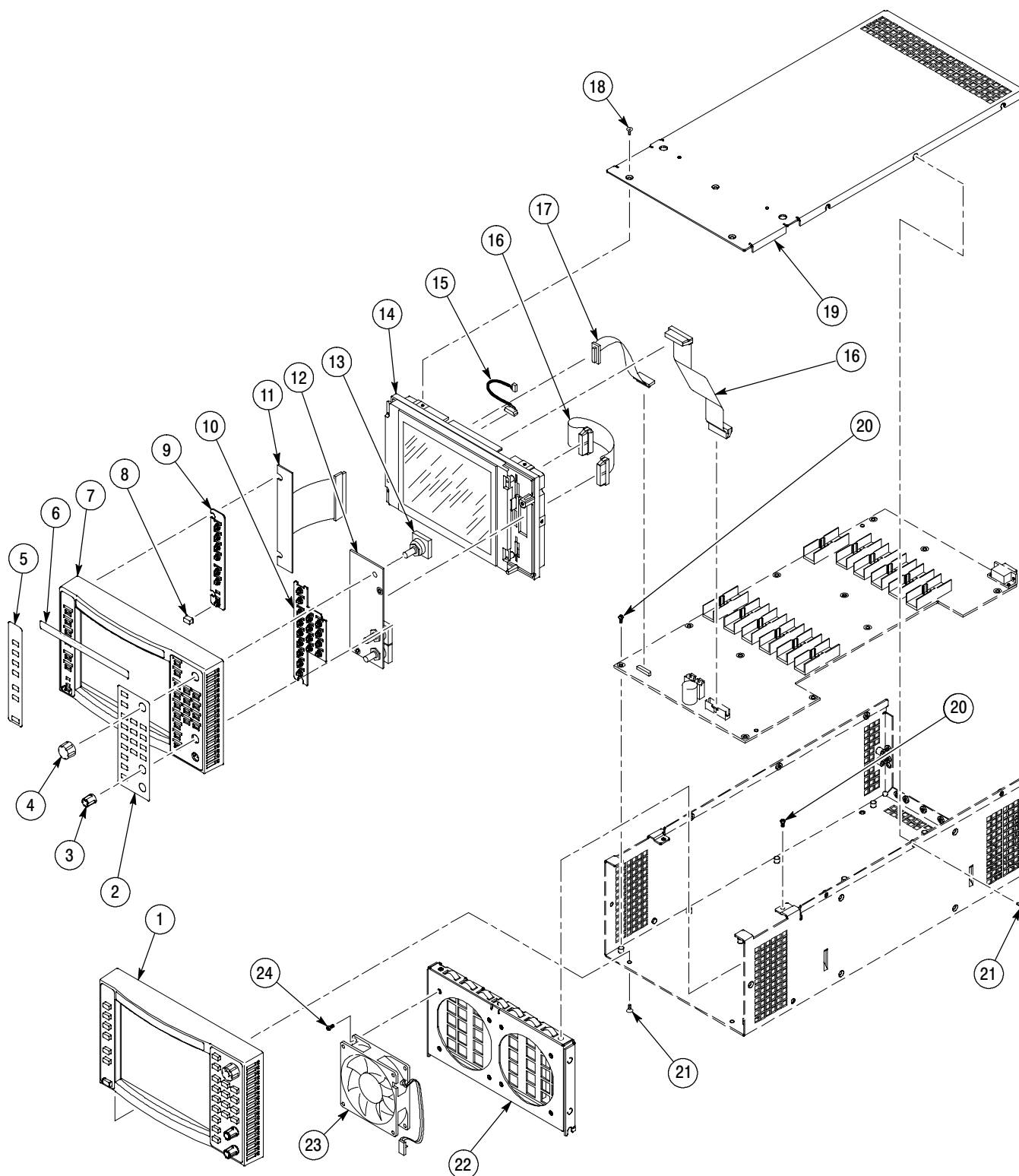


Figure 5-3: WFM700 replaceable chassis parts

Replaceable parts list

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-4							
-1	672-1720-50			1	CIRCUIT BD ASSY; AUDIO,TESTED,389-3388-00 WIRED	80009	672-1720-50
-2	131-3378-00			4	CONN,RF JACK; BNC,;50 OHM,FE- MALE,RTANG,PCB/REAR PNL,0.5-28 THD,0.625 H X 0.187 TAIL,W/O MTG FLANGE,W/MTG POSTS,MET- AL BODY;	00779	227677-1
-3	333-4447-00			1	PANEL,REAR; AUDIO,0.050 AL,4.562 L X 0.980 W,SAFETY CONTROLLED	TK2359	333-4447-00
-4	210-1039-00			4	WASHER,LOCK; 0.521 ID,INT,0.025 THK,SST	78189	1224-02
-5	220-0497-00			4	NUT,PLAIN,HEX; 0.5-28 X 0.562 HEX,BRS CD PL	0KB01	220-0497-00

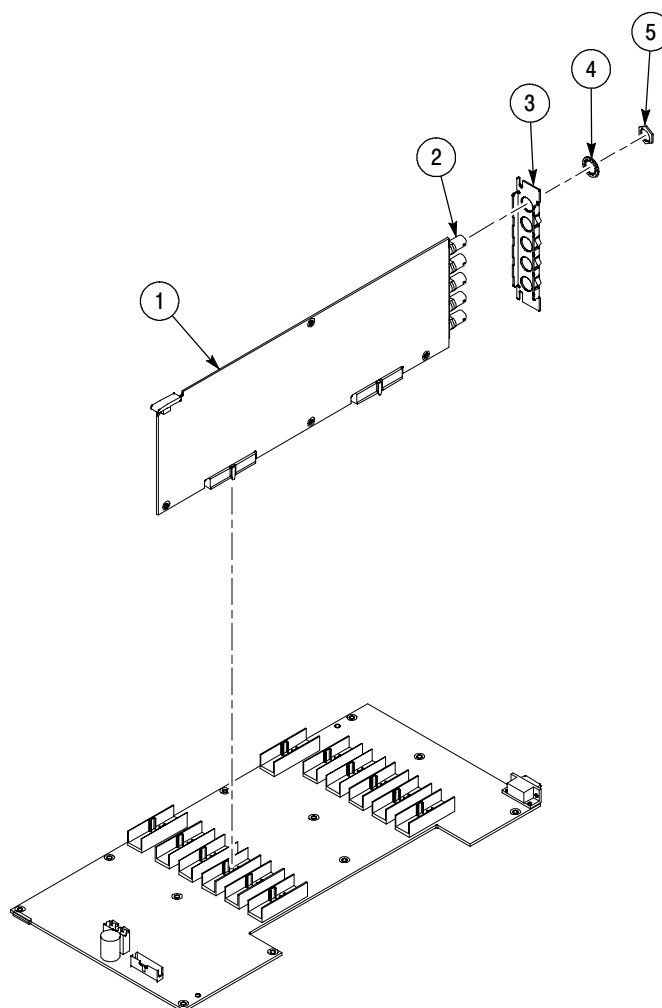


Figure 5-4: WFM700 Audio board option DG

