Service Manual

Tektronix

WFM700HD, WFM700A, & WFM700M Waveform Monitors

071-0915-00

This document applies to firmware version 1.30 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.

www.tektronix.com

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WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of three (3) months from the date of shipment. If any such product proves defective during the three-month period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the respective warranty period and make suitable arrangements for the performance of service. Tektronix will provide such service at Customer's site without charge during the warranty period, if the service is performed within the normal on-site service area. Tektronix will provide on-site service outside the normal on-site service area only upon prior agreement and subject to payment of all travel expenses by Customer. When or where on-site service is not available, Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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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 Structure

This manual is divided into chapters, which are made up of related subordinate topics. These topics can be cross referenced as sections.

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 Mechanical Parts* in Chapter 10.

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 Documents

The following related user documents are available:

- *WFM700 User Manual*. This document provides detailed operating information.
- *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. This document is provided as a standard accessory when you order a new instrument. If you upgrade your instrument firmware from the Tektronix, Inc. website, an updated version of this document is provided.

Related Reference Documents

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

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

Contacting Tektronix

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* **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.

Specifications

Specifications

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

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

Electrical Specifications

Table 1-1: Waveform vertical deflection

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

Table 1-1: Waveform vertical deflection (cont.)

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

Table 1-1: Waveform vertical deflection (cont.)

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

Table 1-2: Serial digital video interface

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

Table 1-3: Switched serial video output (serial out)

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

Table 1-4: Eye pattern display

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

Table 1-4: Eye pattern display (cont.)

Characteristic	Performance requirement	Reference information
Deflection Factor		
Vertical	800 mV ±5% with an 800 mVp-p input signal	
Horizontal		±1%, fully digital system

Table 1-5: Jitter display

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

Table 1-5: Jitter display (cont.)

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

Table 1-6: Data error detection (EDH / Status)

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

Table 1-7: Data display mode

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

Table 1-8: External reference

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

Table 1-9: Waveform horizontal deflection

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

Table 1-10: Component vector mode

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

Table 1-11: Save and display waveform - overlay

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

Table 1-12: Lightning and diamond modes

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

Table 1-13: RGB GAMUT error detection

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

Table 1-14: Arrowhead mode (NTSC/PAL composite limit display)

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

Table 1-15: Audio mode

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

Table 1-16: Picture mode

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

Table 1-17: Serial SD only monitor outputs (SD PIX MON)

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

Table 1-18: Picture monitor outputs

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

Table 1-19: Power source

Characteristic	Performance requirement	Reference information
Electrical Rating	100 - 240 VAC, 50/60 Hz, 175 Watts max. (100 - 240 VAC, 50/60 Hz, 150 Watts max. for serial numbers B010999 and below)	Tested to 90 - 264 VAC, 50/60 Hz. 2.6 A max.
Supply Connection		Detachable cord set
Power Consumption, Typical		< 150 VA (100 Watts) with 1 video input card and 125 Watts with 2 video input cards
Standby Power Consumption, Typical		1 Watt at 110 or 240 VAC
Surge, Typical		5 amps at 90 V 2.5 amps at 240 V
Fuse Rating	T3.5, 250 V	Not operator replaceable. Refer servicing to qualified service personnel.

Table 1-20: LCD display

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

Table 1-21: External VGA output (EXT VGA)

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

Physical Specifications

Table 1-22: Physical characteristics

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

Table 1-23: Environmental performance

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

Table 1-24: Certifications and compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:	
	EN 55103	Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use.[1]
	Environment	E2 - commercial and light industrial
	Part 1 Emission	
	EN 55022	Class B radiated and conducted emissions
	EN 55103-1, Annex A	Radiated magnetic field emissions
	EN 55103-1, Annex B	Inrush current; I peak = 2.19 amps
	EN-55103-1, Annex E	Conducted emissions, signal/control ports
	Part 2 Immunity	
	IEC 61000-4-2	Electrostatic discharge immunity
	IEC 61000-4-3	RF electromagnetic field immunity
	IEC 61000-4-4	Electrical fast transient / burst immunity
	IEC 61000-4-5	Power line surge immunity
	IEC 61000-4-6	Conducted RF Immunity
	IEC 61000-4-11	Voltage dips and interruptions immunity
	EN 55103-2, Annex A	Radiated magnetic field immunity
	EN 55103-2, Annex B	Balanced ports common mode immunity
	EN 61000-3-2	AC power line harmonic emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s):	
	AS/NZS 2064.1/2	Industrial, Scientific, and Medical Equipment: 1992
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.	
EC Declaration of Conformity - Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:	
	Low Voltage Directive 73/23/EEC, amended by 93/68/EEC	
	EN 61010-1:1993/A2:1995	Safety requirements for electrical equipment for measurement control and laboratory use.
U.S. Nationally Recognized Testing Laboratory Listing	UL3111-1	Standard for electrical measuring and test equipment.
Canadian Certification	CAN/CSA C22.2 No. 1010.1	Safety requirements for electrical equipment for measurement, control, and laboratory use.

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

Table 1-24: Certifications and compliances (cont.)

Category	Standards or description	
Additional Compliance	IEC61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use.
	ISA S82.02.01:1999	Safety standard for electrical and electronic test, measuring, controlling, and related equipment.
Installation (Overvoltage) Category Descriptions	Terminals on this product may have different installation (overvoltage) category designations. The installation categories are:	
	CAT III	Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location.
	CAT II	Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected.
	CAT I	Secondary (signal level) or battery operated circuits of electronic equipment.
Pollution Degree Descriptions	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.	
	Pollution Degree 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.
Equipment type	Test and Measurement	
Safety Class	Class I	
Overvoltage Category	CAT II	
Pollution Degree	Pollution Degree 2	

Factory Default Settings

To restore all instrument settings to the factory presets, touch the Restore Factory soft key on page 2 of the Preset menu. Table 1–25 lists the factory default instrument settings restored by this soft key.

Table 1-25: Factory default instrument settings

Parameter	Setting	Comments
Display mode	Waveform	
Waveform Parade/Overlay mode	Parade	
Waveform Color Space	YPbPr	
Waveform Filter	Flat	
Gain	1x, Variable OFF	All display modes
Sweep	1H, Mag OFF	
Display V & H Position	No offset	All display modes
Line Select	Off (current line = 1)	
Sample Select	Off (current sample = 0)	
Cursors	Off	
Input	Slot 1, Input A	
Alarm Configuration		Beep is OFF for all alarms
RGB Gamut	On-screen: On	
Composite Gamut	On-screen: On	
Input Signal Missing	On-screen: On	
Input Format Change	On-screen: On	
Input-Ref Fmt Mismatch	On-screen: On	
Ext Ref Signal Missing	On-screen: Off	
Ext Ref Format Mismatch	On-screen: On	
RP165 EDH Status (SD-only)	On-screen: On	
Embedded CRC (HD-only)	On-screen: On	
Alarms Enable/Disable	Enabled	
Reference Signal	Internal	Changed text from Self
Thumbnail Display	Enabled	
Display Intensity (Waveform)	0	
Trace Color	White	
Graticule Intensity	50%	
Graticule Color	Gold	

Table 1-25: Factory default instrument settings (cont.)

Parameter	Setting	Comments
Graticule Rendition	Additive	
Vec I/Q Axis Graticule (Component)	On	Both HD and SD
Compass Rose Graticule (Component)	Off	
Readouts	Enabled	
Readout Intensity	50%	
Backlight Intensity	100%	
Button Illumination (10% constant intensity)	Disabled	
Strip EAV/SAV	Strip	
Ext Ref Format	Auto Select	
Output Brightup Line/Sample	On	
Output Brightup RGB Gamut	Off	Setting affects Int, Ext, and Thumbnail
Output Brightup Composite Gamut	Off	Setting affects Int, Ext, and Thumbnail
Output Colorimetry (HD)	Auto	
Output Active for HD	YPbPr	
Output Active for SD	YPbPr	
Audio Presence Readout	Off	
Vector/Lightning Color Bar Targets	75%	
Vector Graticule	Component	
Vector Composite Graticule Format	Auto	
Composite Setup	7.5% (IRE)	All modes
Gamut Display	Diamond	

Table 1-25: Factory default instrument settings (cont.)

Parameter	Setting	Comments
Gamut Thresholds:		
• SD Diamond: High	721 mV (3%)	
• SD Diamond: Low	-21 mV	
SD:Diamond: Area	Horizontal only; 0%	
• HD Diamond: High	721 mV (3%)	
• HD Diamond: Low	-21 mV	
• HD Diamond: Area	Horizontal only; 0%	
• SD Arrowhead: PAL	930 mV	PAL and NTSC
• SD Arrowhead: NTSC	120 IRE (840 mV)	Limits are not stored separately. Factory default will use 840 mV (NTSC) value.
• SD Arrowhead: Area	Horizontal only; 0%	
• HD Arrowhead: PAL	930 mV	
• HD Arrowhead: NTSC	120 IRE (840 mV)	
• HD Arrowhead: Area	Horizontal-only; 0%	
Arrowhead Limit Format	Auto	
Data Display	Video	
Data Display Readout Format	Hexadecimal	
Eye Display	Eye	
Eye Pattern Mode	3 Eye	
Eye Clock Bandwidth	10 Hz	
Jitter High-Pass Filter	10 Hz	

Operating Information

Functional Overview

This chapter provides a brief description of the WFM700 Waveform Monitor controls and connectors. Refer to the User manual for detailed operating insctructions.

The instrument is controlled through a combination of front-panel controls (buttons and knobs) and touch-screen controls (soft keys).

Front Panel Knobs and Indicators

The waveform monitor front panel is shown in Figure 2–1. This section describes the funtions of each knob and indicators.

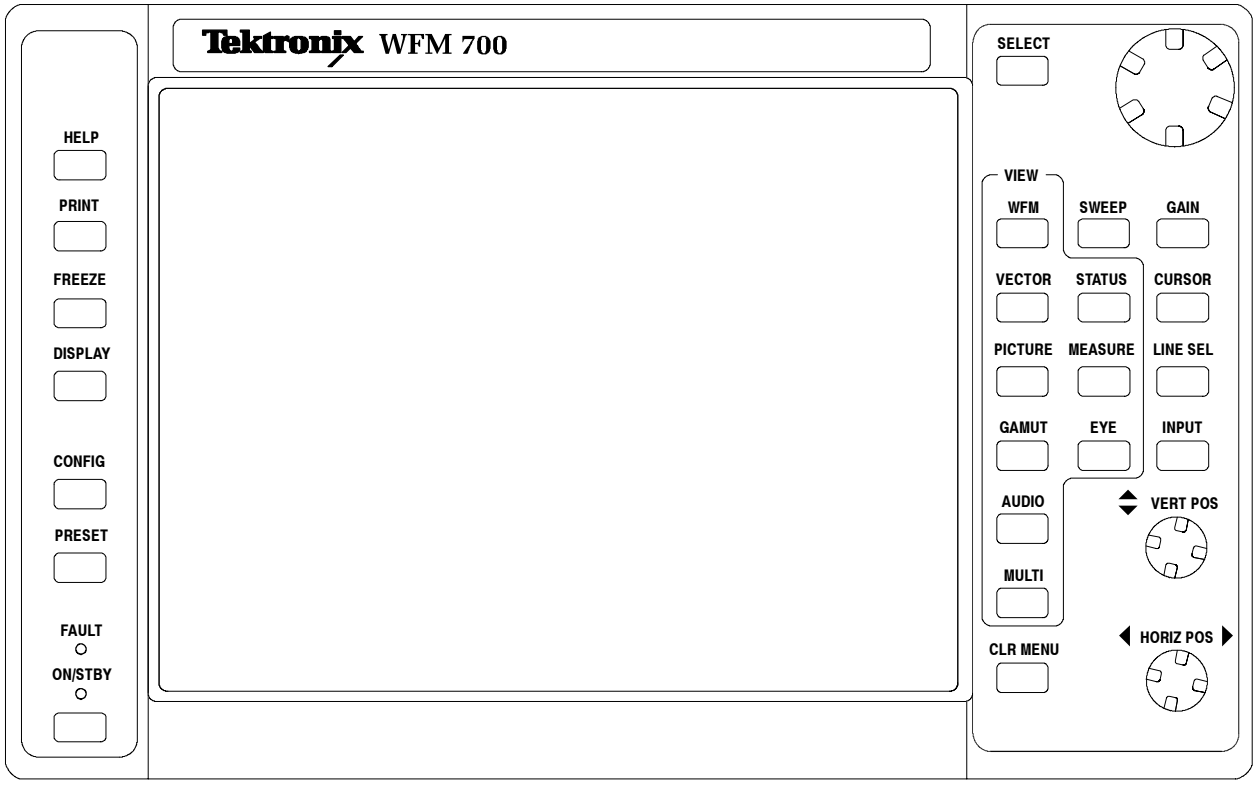


Figure 2- 1: Waveform monitor front panel

General Purpose Knob

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

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

You can use this knob with the following functions:

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

  During some modes of operation the Select button LED will stay illuminated. This is an indicator that you can press the Select button to toggle the general purpose knob between controlling two items.

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

Vertical Position Knob

Moves the waveform vertically on the screen.

Horizontal Position Knob

Moves the waveform horizontally on the screen.

ON / STBY LED

This green LED is illuminated whenever the instrument is powered on.

FAULT LED

This red LED is illuminated when a hardware fault is detected within the instrument, such as under/over voltage of a power supply. The fault conditions are discussed in the *Maintenance* chapter on page 6–31.

Front-Panel Buttons

This section describes the funtions of each front-panel button. The buttons are divided into groups depending on their actions.

Major Mode Buttons

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

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

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

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

Minor Mode Buttons

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

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

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

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

Additional buttons

Additional buttons are:

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

Touch Screen (Soft Keys)

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

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

Readouts

Various on-screen readouts and icons inform you of instrument settings and conditions.

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

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

1. Current reference (Ref). (Location = Lower left) Text indicates the current source of the video reference. May include INT(active input signal) or EXT (signal applied on the external reference connector). Also displays the type and status of the reference.
2. Vector graticule type (Bars:). (Location = Lower Left) Text indicates the current setting of the Vector Graticule, 75% or 100%.
3. Horizontal Gain (HGain). (Location = Lower Left) Text displays the variable horizontal gain value in yellow to indicate that it is not standard.
4. Vertical Gain (VGain). (Location = Lower left) Text displays which calibrated vertical gain you have selected, such as X1 or X5. If you select variable gain, the readout displays the gain value in yellow to indicate that it is not standard.
5. Selected input / input format. (Location = Lower left) Text indicates the currently selected input (1A, 1B, 2A, or 2B), followed by the input format. For example, 2A: 1.4835 Gb/s 1080sf:29.97 would indicate that the A input of the module in slot 2 is selected, it is receiving an HD signal, and that the format of the signal is 1080sf at a frame rate of 29.97 Hz.
6. Color standard. (Location = Lower Center) Text indicates the current colorimetry standard. Not present in all modes.

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

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

9. Magnification (Mag). (Location = Lower center) Text indicates the mag setting. If mag is on, the text appears in yellow to indicate that the signal is not being displayed in the normal time scale.

10. Sweep rate. (Location = Lower center) A readout indicates the selected sweep rate.

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

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

13. Cursor. (Location = Upper right) When cursors are active, the text displays the time or voltage (depending upon mode) at their location and the difference in time or voltage between them (delta).

14. Gamut error. (Location = Middle right) When gamut errors occur, the readout (if enabled) will display either “RGB Err” or “Cmpst Err” for RGB and composite gamut errors, respectively.

Icons

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

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

Context-Sensitive Help

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

Rear Panel Connectors

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

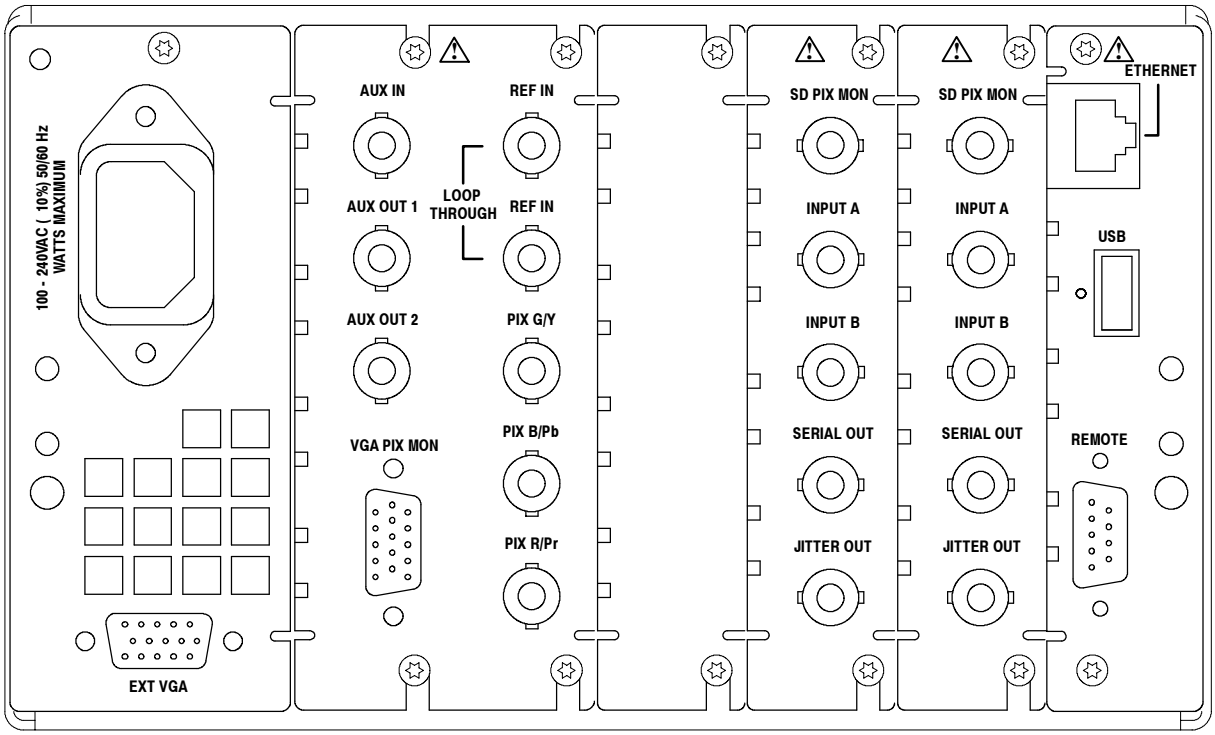


Figure 2-2: Waveform monitor rear panel with two WFM7M input modules installed

Power Connector

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

Inputs

The waveform monitor provides the following inputs:

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

Multi-Pin Connectors

The waveform monitor provides the following multi-pin connectors:

- VGA PIX MON. A copy of the PIX G/Y, B/Pb, R/Pr pix mon outputs. This allows using an inexpensive VGA monitor for non-critical HD applications. Most computer monitors will not lock to 50 Hz vertical rates or to Standard Definition line rates, so this may not work in all applications.
- EXT VGA. Provides an exact copy of the LCD screen to drive an external monitor.
- REMOTE. 9 pin subminiature D-type connector. Future capability.
- USB. Intended for interfacing with USB printers. Future capability.
- ETHERNET. (10/100 Base T). 10/100 Mbit/sec Ethernet interface. Used for downloading firmware upgrades. The firmware upgrade procedure is located in the *Maintenance* chapter on page 6–41.

Coaxial Outputs

The waveform monitor provides the following coaxial outputs:

- PIX G/Y, B/Pb, R/Pr. Provides three 75 Ω component signal outputs to drive a component picture monitor. You can set the output format to YPbPr or RGB.
- SD PIX MON. This output is a copy of the PIX G/Y, B/Pb, R/Pr pix mon output, but in SD serial digital format. It is operational only for SD input formats.
- SERIAL OUT. Provides 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.
- AUX OUT 1 / AUX OUT 2. Future capability.

Menus

This section contains a diagram for each instrument menu, starting with the major instrument modes. Refer to Table 2–1 for diagram page numbers.

Table 2-1: Menu diagram and reference information locator

Button name	Menu	Diagram / info.
AUDIO	Audio menu	page 2-14
CLR MENU	- - - - - -	page 2-14
CONFIG	Configuration menu	page 2-15
CURSOR	Cursor menu	page 2-16
DISPLAY	Display menu	page 2-17
EYE	Eye menu	page 2-18
FREEZE	Freeze menu	page 2-19
GAIN	Gain menu	page 2-20
GAMUT	Gamut menu	page 2-21
HELP	Help menu	page 2-22
INPUT	Input menu	page 2-23
LINE SEL	Line Select menu	page 2-24
MEASURE	Measure menu	page 2-25
MULTI	future capability	- - - - - -
PICTURE	- - - - - -	page 2-25
PRESET	Preset menu	page 2-26
PRINT	future capability	- - - - - -
STATUS	EDH Status menu	page 2-27
SWEEP	Sweep menu	page 2-28
VECTOR	Vector menu	page 2-29
WFM	Waveform menu	page 2-30

Using the Menu Diagrams

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

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

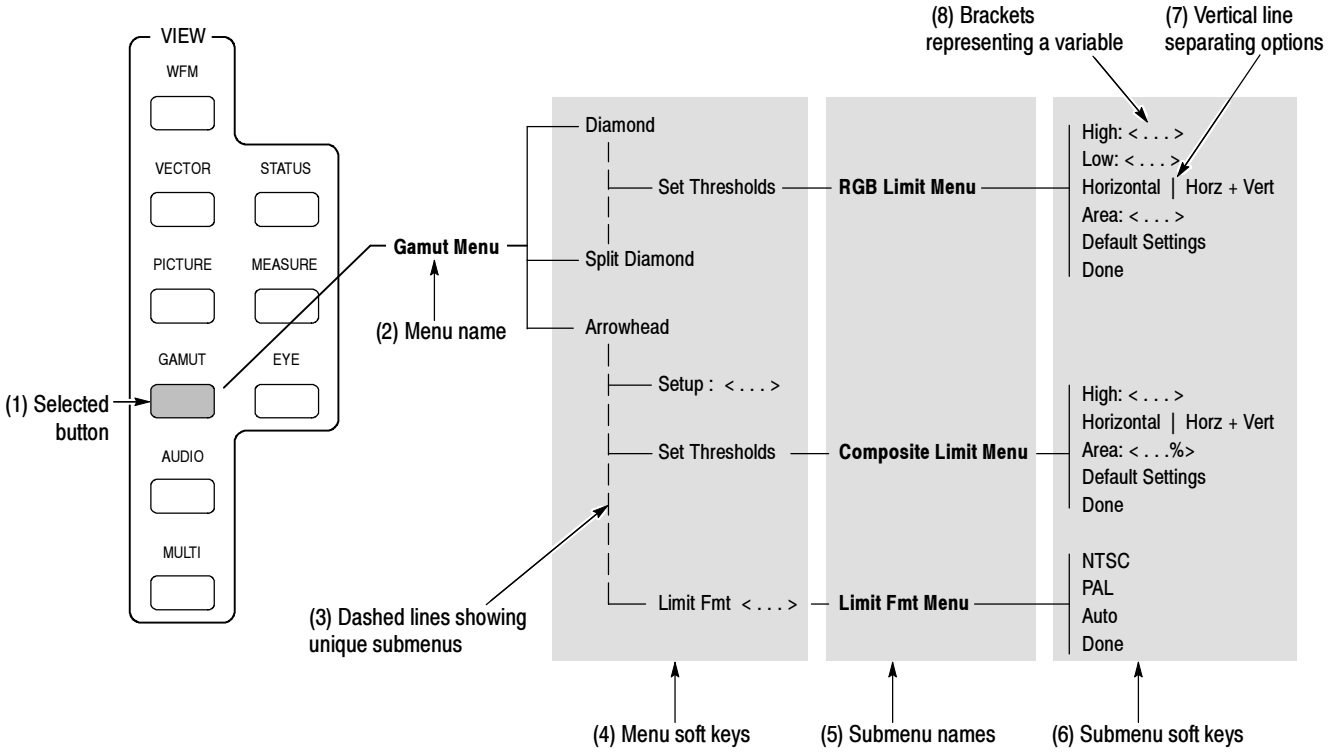


Figure 2- 3: Example menu diagram showing components of the diagram

Audio Mode

Pressing the AUDIO button displays the Audio Status screen. Audio mode has no menu; to enable the Audio Presence readout, use the Configuration menu (refer to page 2–15).

Clear Menu

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

Configuration Menu

Pressing the CONFIG button opens the Configuration menu. In this menu, you can adjust most instrument parameters.

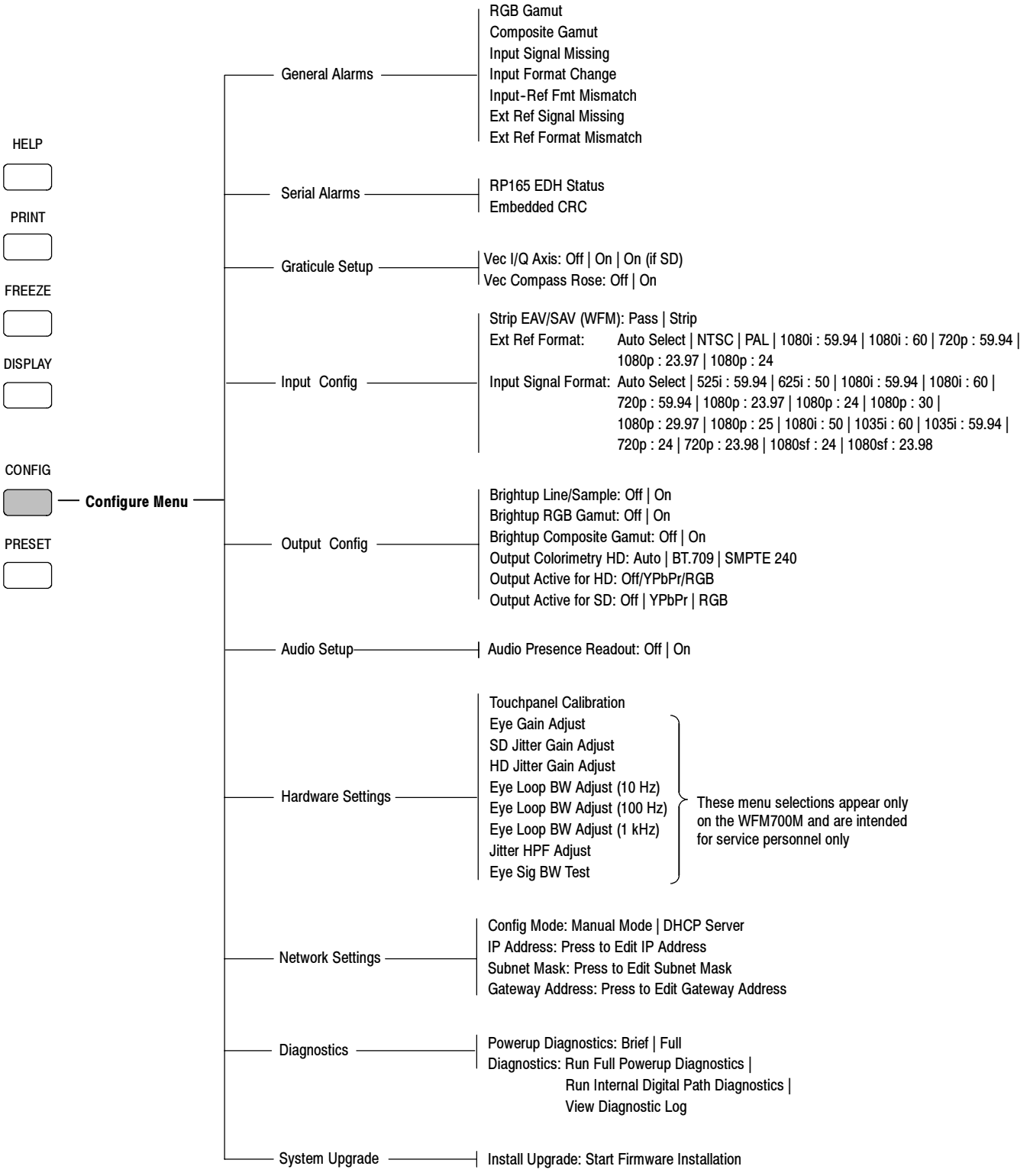


Figure 2-4: Configuration menu diagram

Cursor Menu

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

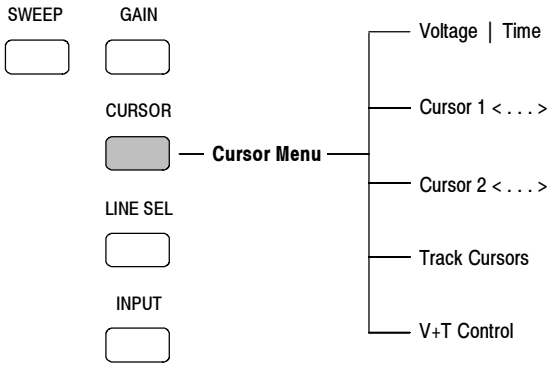


Figure 2- 5: Cursor menu diagram

Display Menu

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

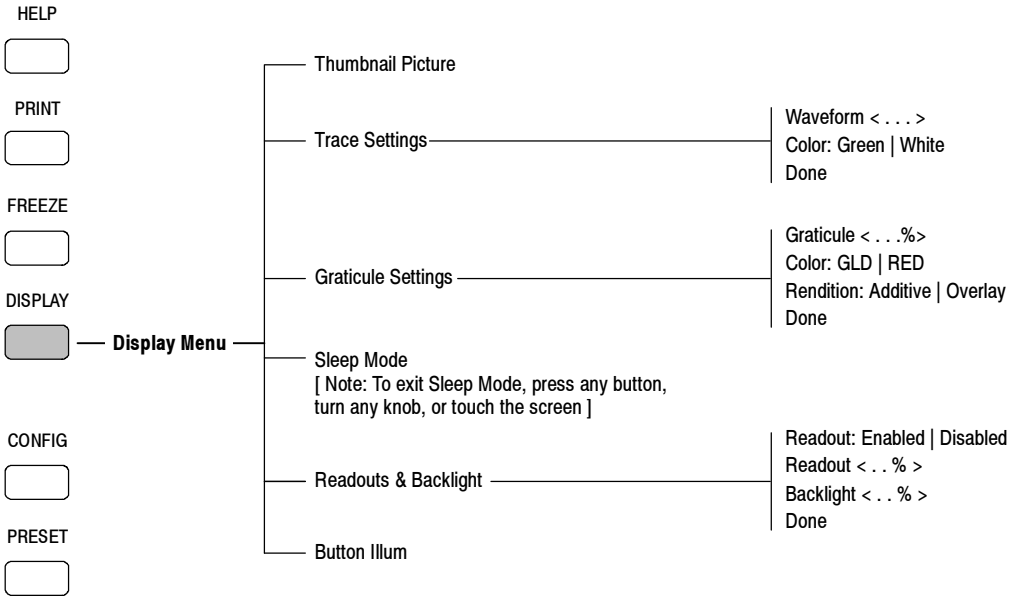


Figure 2-6: Display menu diagram

Eye Menu

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

Pressing the EYE button enters the Eye mode and displays the Eye menu as shown in Figure 2–7. You can select Eye or Jitter display. When returning to Eye mode, the last selected display (Eye or Jitter) is active.

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

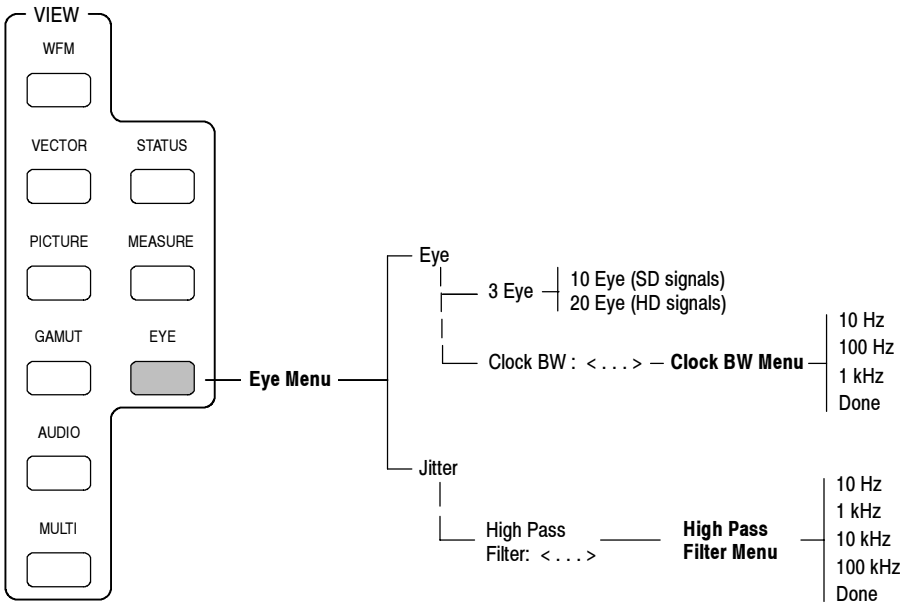


Figure 2- 7: Eye menu diagram

Freeze Menu

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

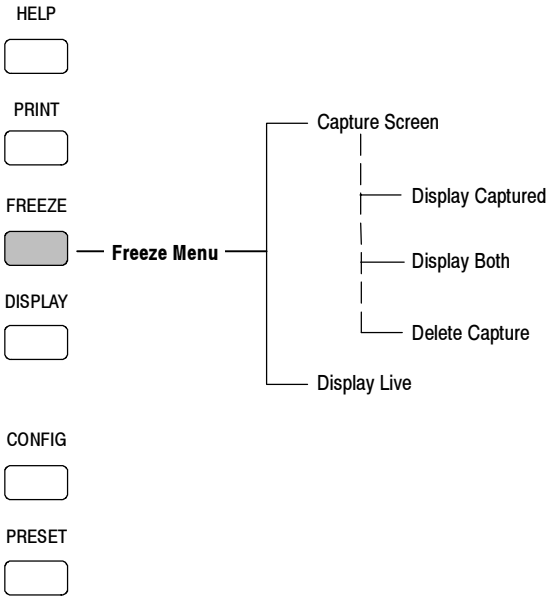


Figure 2- 8: Freeze menu diagram

Gain Menu

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

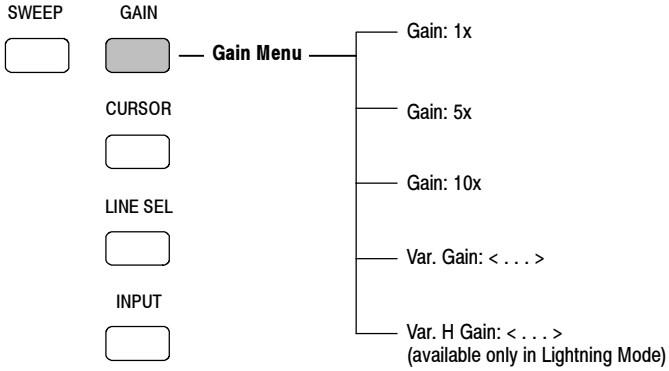


Figure 2- 9: Gain menu diagram

To change the vertical gain, touch one of the soft keys (1x, 5x, or 10x). You can also select Variable Gain or Variable Horizontal Gain (in Lightning mode only).

Gamut Menu

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

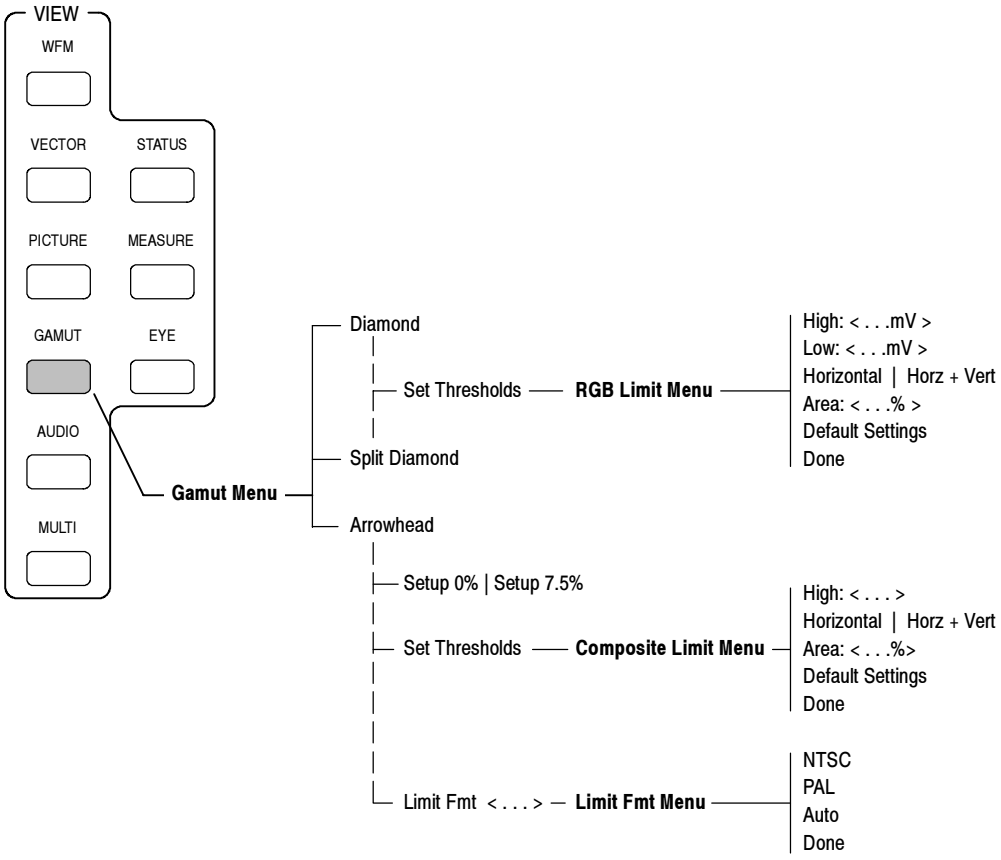


Figure 2- 10: Gamut menu diagram

Help Menu

Press the HELP button to display the Help menu shown in Figure 2-11.

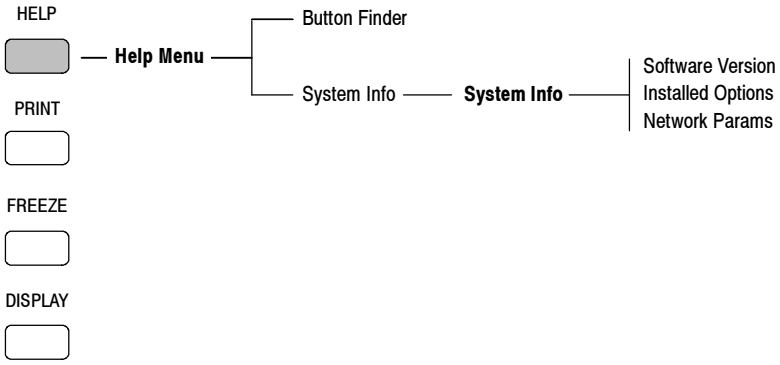


Figure 2-11: Help menu diagram

Input Menu

Press the INPUT button to enter the Input mode and display the Input menu shown in Figure 2–12.

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

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

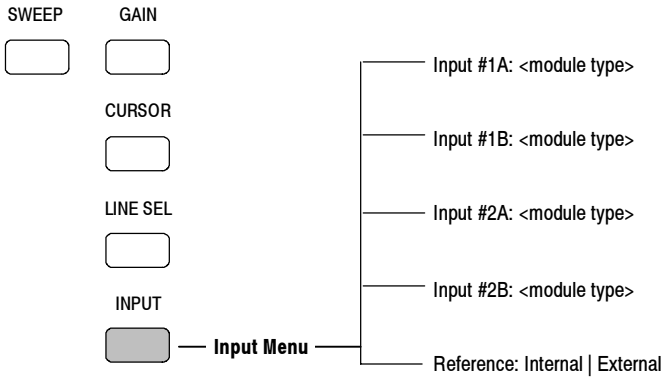


Figure 2- 12: Input menu diagram

Line Select Menu

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

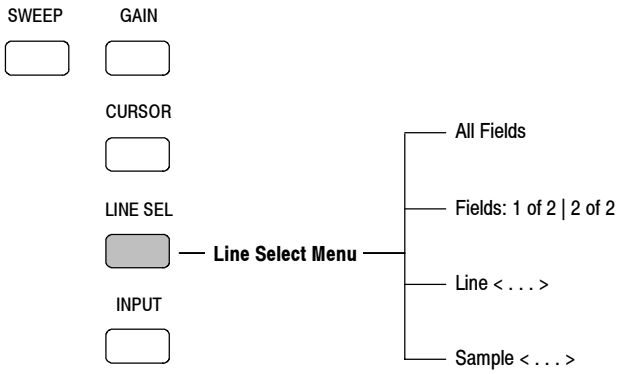


Figure 2- 13: Line Select menu diagram

Measure Menu

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

Pressing the MEASURE button enters the Measure mode and displays the Measure menu, shown in Figure 2–14.

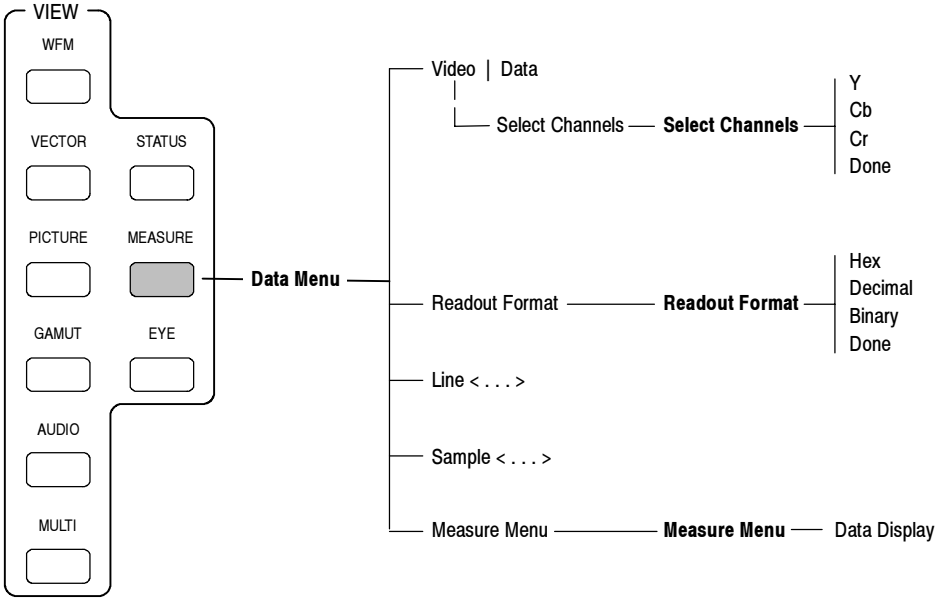


Figure 2-14: Measure menu diagram

Picture Mode

Pressing the PICTURE button displays a full screen representation of the video present at the selected input. The Picture mode has no menu. To enable a thumbnail picture that appears in other modes, go to the Display menu (see page 2–17).

Preset Menu

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

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

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

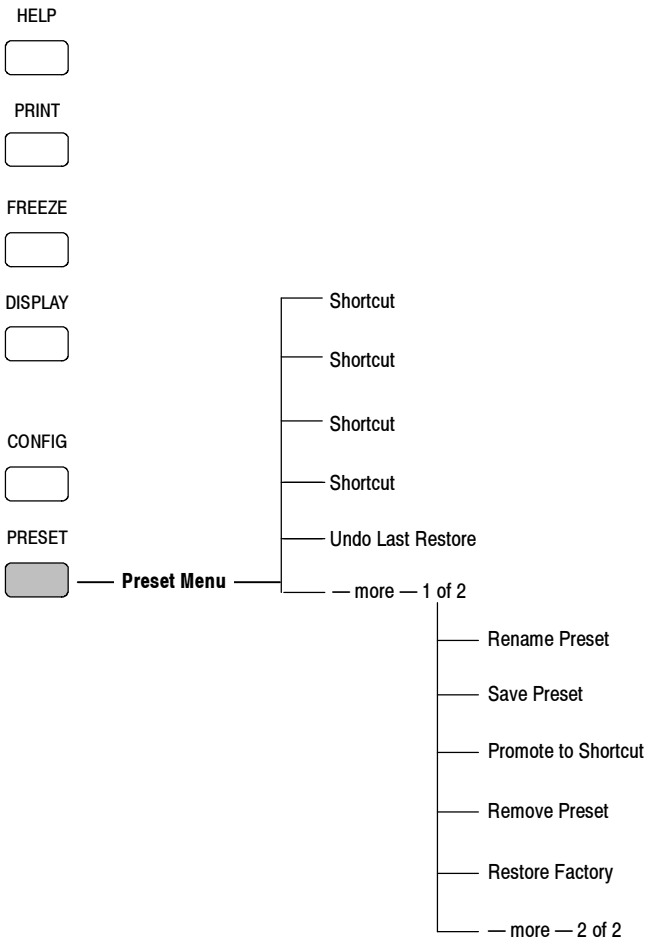


Figure 2- 15: Preset menu diagram

Status Menu

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

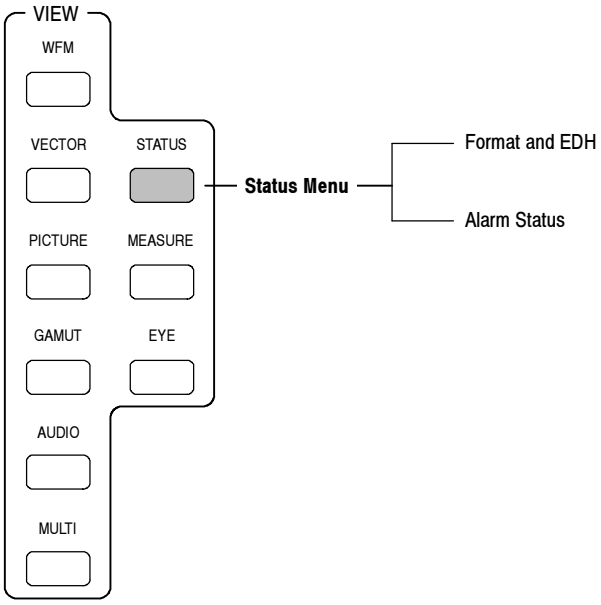


Figure 2- 16: Status menu diagram

Sweep Menu

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

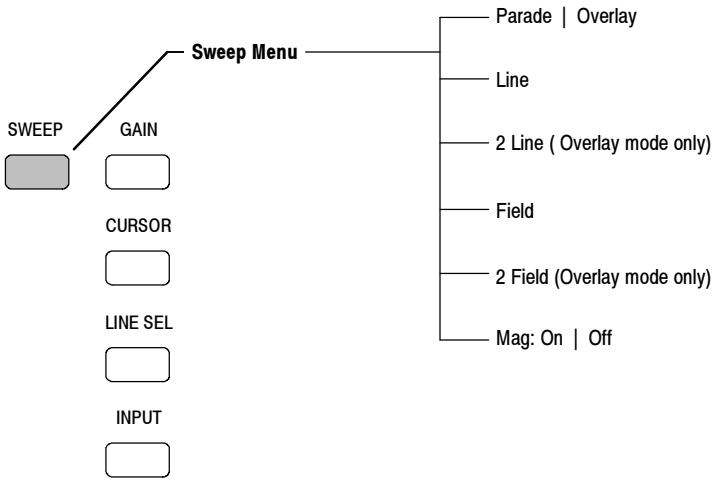


Figure 2- 17: Sweep menu diagram

Vector Menu

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

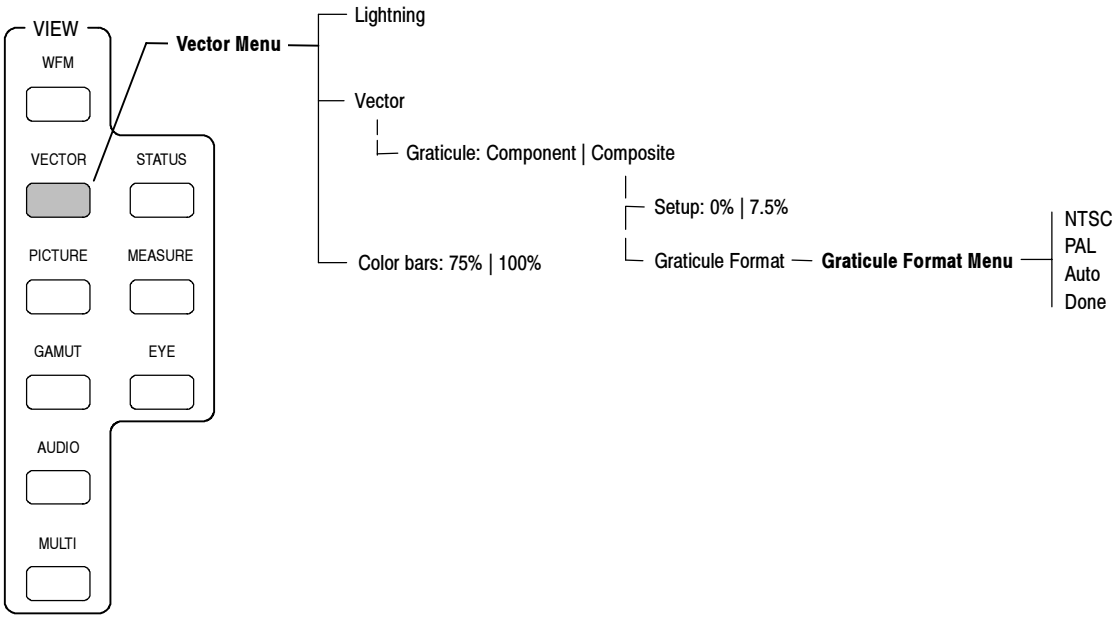


Figure 2- 18: Vector menu diagram

Waveform Menu

Pressing the WAVEFORM button brings up a waveform display of the selected signal input and displays the Waveform menu shown in Figure 2–19.

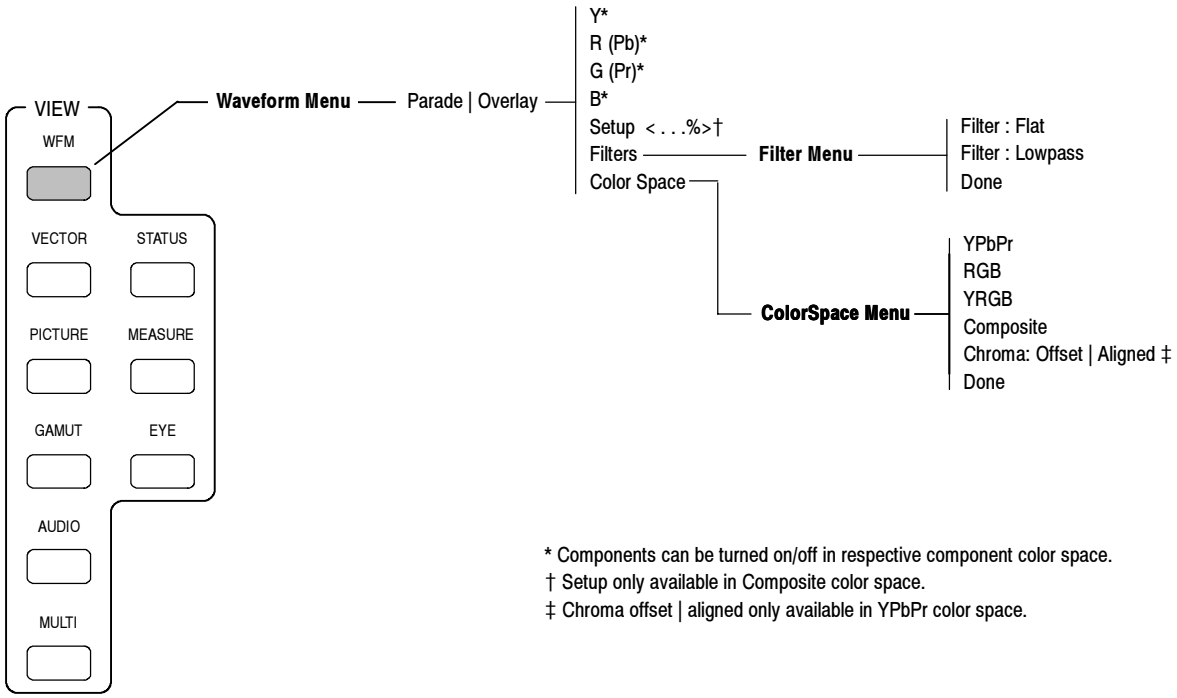


Figure 2- 19: Waveform menu diagram

Theory of Operation

Theory of Operation

This chapter contains a module-level description of the WFM700. Block diagrams located in the *Diagrams* chapter aid in the descriptions. Figure 9–1 on page 9–2 is a block diagram of the signal flow of the instrument. Figure 9–2 on page 9–3 is a block diagram of the control flow.

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 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 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 90 VAC to

250 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. Future capability.
- USB. Intended for interfacing with USB printers. Future capability.
- ETHERNET. (10/100 Base T). 10/100 Mbit/sec Ethernet interface. Used for downloading firmware upgrades.

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.

Power Supply Module

The power supply module accepts line input voltages within the range of 90 VAC to 250 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.

Performance Verification

Performance Verification

This chapter contains three performance verification procedures to verify instrument operation:

These procedures test all models of the WFM700. This includes the various Input Module types (WFM7HD, WFM7A, and WFM7M). Please disregard checks that do not apply to the Input 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* chapter. 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.

Before Performing Performance Verification Procedures

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 Input Modules** — The adjustment procedures must be performed on both input modules if two are installed in the WFM700. Complete the entire performance procedures on one input module at a time.
- **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** — Table 4–1 lists all test equipment required to perform all performance verification procedures. Some equipment may not be necessary for your waveform monitor. The 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.

Test Equipment Required

Table 4–1 lists the equipment required to verify the operation of the WFM700 Waveform Monitor.

Table 4-1: Test equipment for performance verification

Test equipment	Requirements	Example [1]	WFM700		
			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	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	TG2000 with DVG1 module	●		●
Analog video test signal generator	PAL black 1080i 50 black 1080i 60 black 720p 59.94 black	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	●	●	●
Test oscilloscope	2 GHz vertical bandwidth	TDS794	●	●	●
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	●	●	●

Table 4-1: Test equipment for performance verification (cont.)

Test equipment	Requirements	Example [1]	WFM700		
			A	HD	M
50 Ω coaxial cables (2 required)	Male-to-male BNC connectors 36 inches long		●	●	●
Precision 75 Ω-to-50 Ω adapter (for test oscilloscope input)	1.5% impedance and attenuation accuracy	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	WideBand 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

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 **Diagnostics** and then **Next Menu**.
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 the **Back Menu**.
10. Touch **View Diagnostics Log**.
11. *CHECK* the diagnostics log pages to verify that there are no red FAIL messages.
12. Touch **Diagnostics**, then **View Diagnostic Log**.
13. Touch ****Erase** NVRAM Log** to clear the log file.
14. Touch **Back to Diags Menu**.
15. Touch **Run Internal Digital Path Diagnostics**.
16. Read the screen text, and then touch **Continue** to acknowledge that a reboot will be required. The diagnostic test will run.
17. *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.

18. Press the flashing **SELECT** button to return to the diagnostics menu.
19. Touch **View Diagnostics Log**.
20. *CHECK* the diagnostics log pages to verify that there are no red FAIL messages.
21. Cycle the power to reboot the WFM700.

Functional Tests

These functional tests provide tests to check basic functionality of the inputs and general operation. A more exhaustive check of all functions and buttons is provided in the User manual.

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 **Format and EDH** soft key.
10. *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 **Format and EDH** soft key.
10. *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 **Output Config** 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* chapter. 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. Refer to the* Firmware Upgrade *section beginning on page 6–41.*

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 4–4 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 4–1.

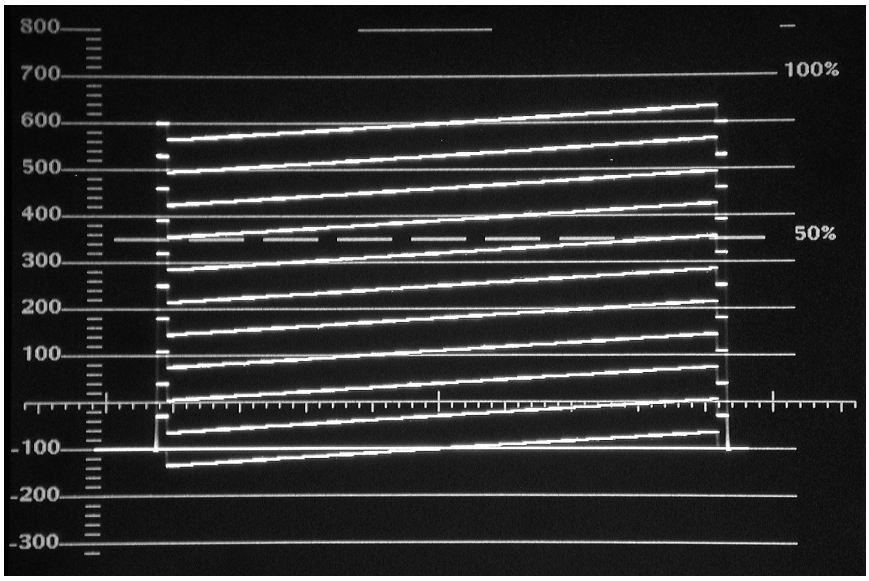


Figure 4- 1: Signal data paths performance verification screen one

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 4–2.

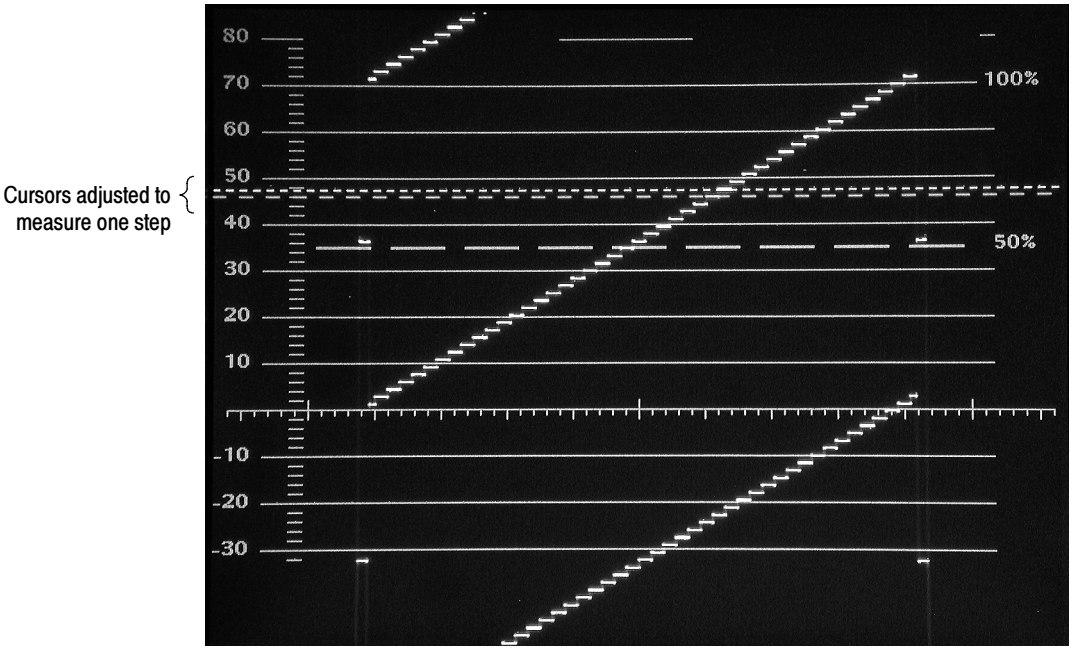


Figure 4- 2: Signal data paths performance verification screen two

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).

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 4–1.

***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 the for defective display pixels with a High Definition 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* that 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 Standard Definition 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* that 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 **Format and EDH** soft key.
6. *CHECK* that the Embedded CRC status reads:

```
Embedded CRC:   SMPTE 292   Y:OK   C:OK
```

7. Touch the **Alarm Status** soft key.
8. *CHECK* that gamut errors read as follows:

```
RGB Gamut Error          X  OK
Composite Gamut Error    X  OK
```

9. Set the HD video generator for a 1080i 59.94 SMPTE color bars signal.
10. *CHECK* that gamut errors read as follows:

```
RGB Gamut Error          X  Alarm
Composite Gamut Error    X  OK
```

11. Set the HD video generator for a 1080i 59.94 100% color bars signal.
12. *CHECK* that gamut errors read as follows:

```
RGB Gamut Error          X  OK
Composite Gamut Error    X  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 4–3.
   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

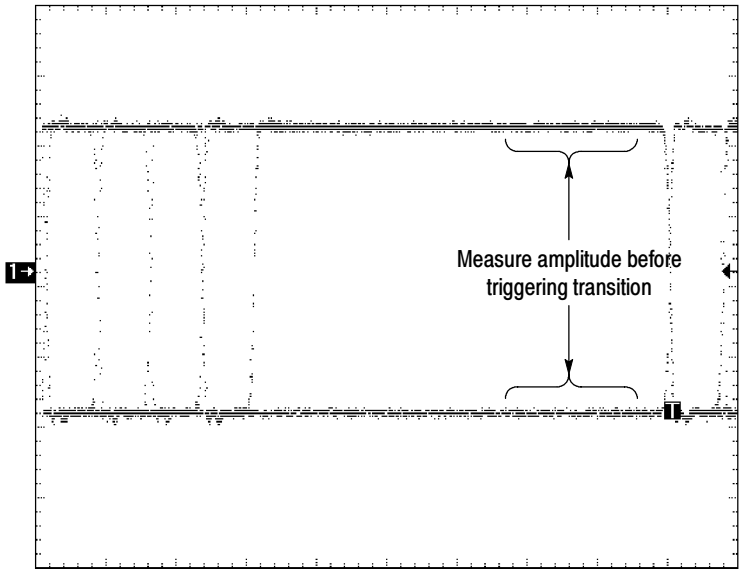


Figure 4- 3: Serial video output level performance verification screen

6. Calculate the percent amplitude error with the formula below using the measured value from step 5.

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

7. *CHECK* that the calculated error is between ± 5%.

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 4–4.

   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.

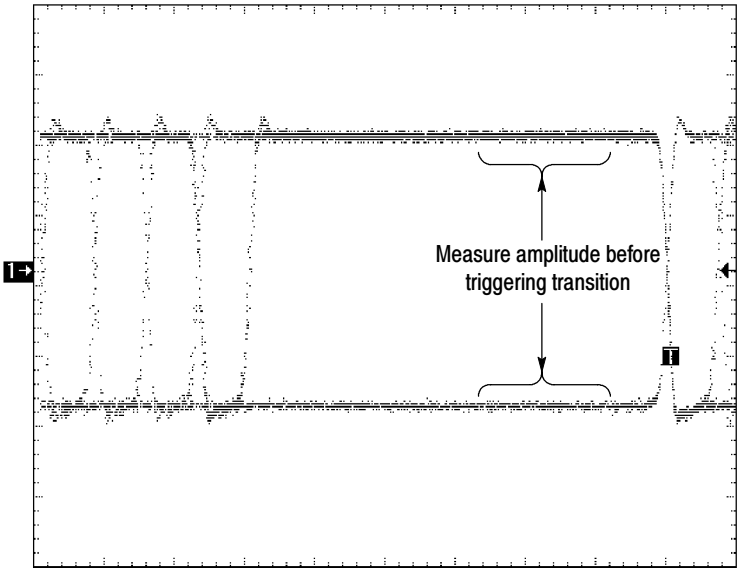


Figure 4- 4: SD PIX MON output level performance screen

6. Calculate the percent amplitude error using the formula:

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

7. *CHECK* that the calculated error is within ± 5%.

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 **Output Config** 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 4–5.

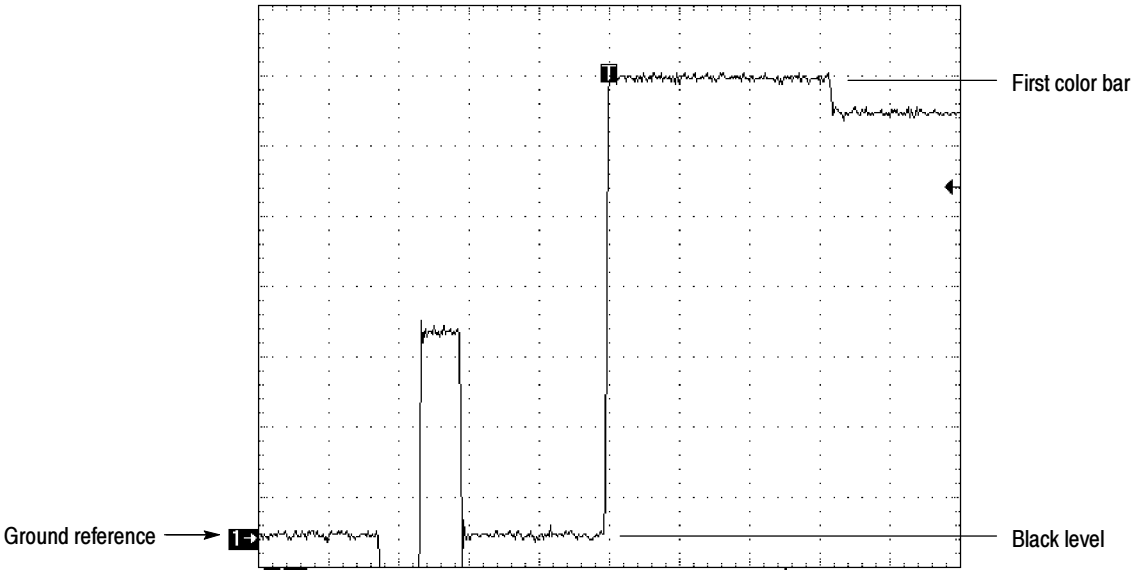


Figure 4- 5: HD pix G/Y video output level performance screen

11. Calculate the percent amplitude error using the formula:

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

12. *CHECK* that the calculated error is between ± 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 4–5.

14. *CHECK* that the black level is between ± 25 mV.

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 4–6.

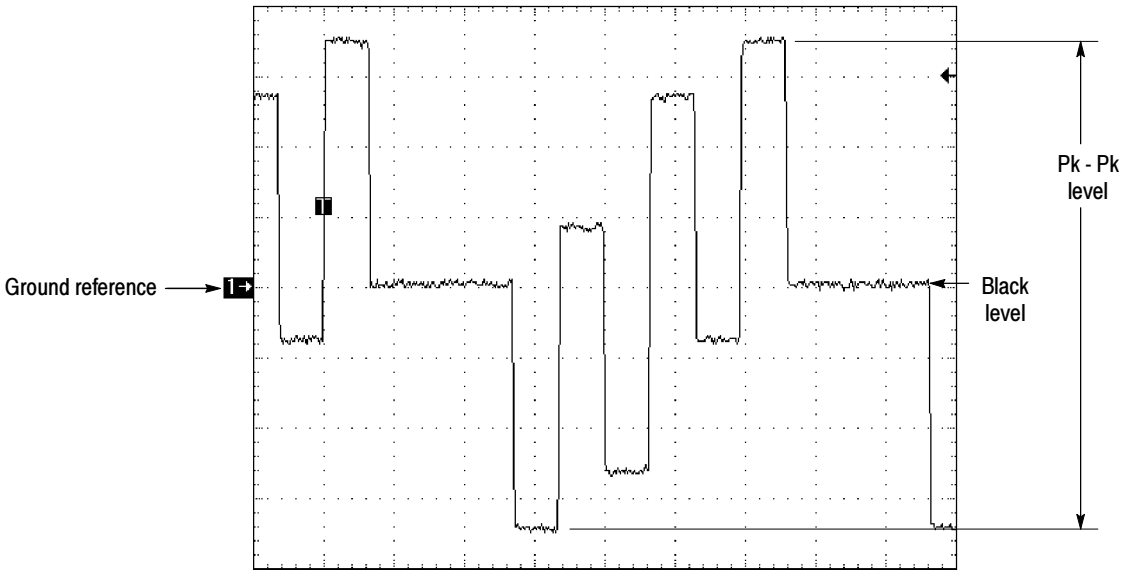


Figure 4- 6: HD pix B/Pb and R/Pr video output level performance screen

18. Calculate the percent amplitude error using the formula:

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

19. *CHECK* that the calculated error is between ± 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 4–6.

21. *CHECK* that the black level is between ± 25 mV.

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

23. Repeat steps 17 through 21.

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 **Output Config** 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 4–7.

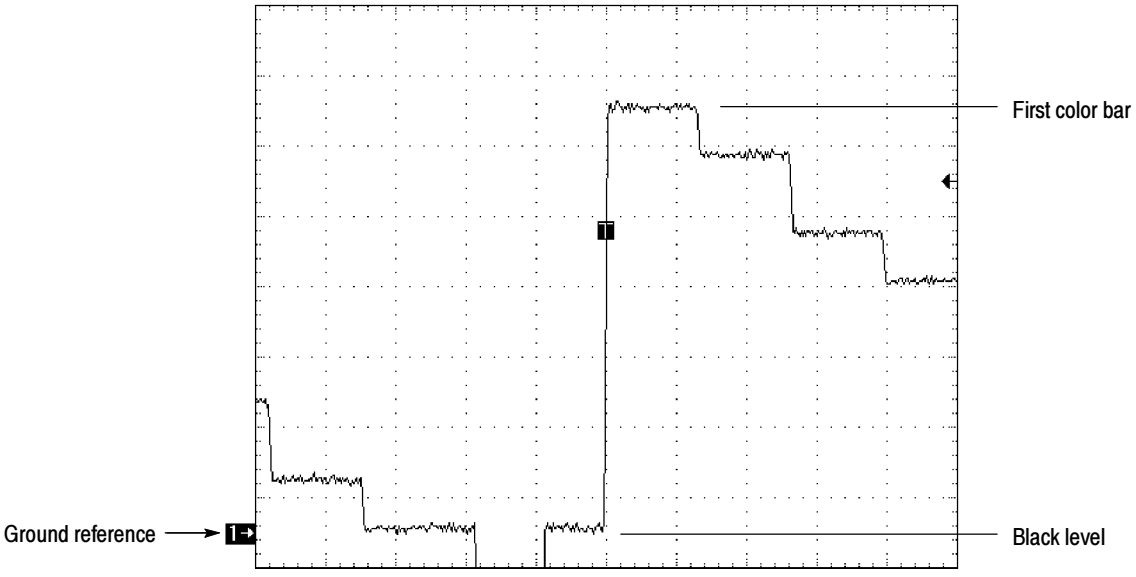


Figure 4-7: SD pix video output level performance screen

34. Calculate the percent amplitude error using the formula:

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

35. *CHECK* that the calculated error is between ± 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 4–7.

37. *CHECK* that the black level is between ± 25 mV.

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 4–6.

41. Calculate the percent amplitude error using the formula:

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

42. *CHECK* that the calculated error is between ± 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 4–6.

44. *CHECK* that the black level is between ± 25 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 75 Ω cable.
2. Connect a 75 Ω terminator 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 75 Ω 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 **Output Config** 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 4–8.

13. Measure the amplitude of the smallest packet. Note the Smallest Packet measurement. See Figure 4–8.

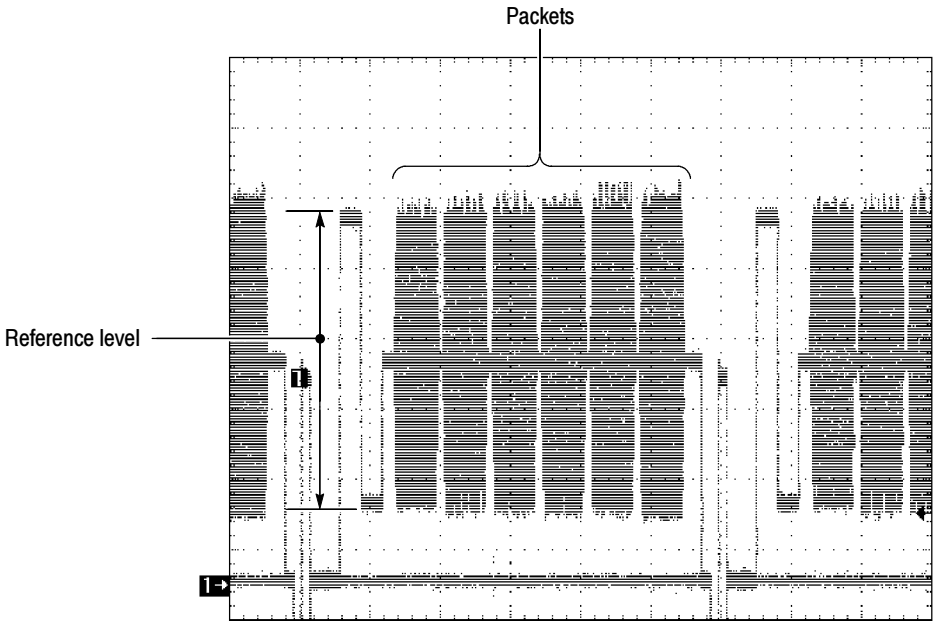


Figure 4- 8: HD GBR frequency response performance screen

14. Calculate the percent amplitude variation using the formula:

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

15. *CHECK* that the calculated measurement is between ±10% (typical).

16. Measure the amplitude of the largest packet. Note the Largest Packet measurement. See Figure 4–8.

17. Calculate the percent amplitude variation using the formula:

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

18. *CHECK* that the calculated measurement is between ±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 **Output Config** 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 4–9.

35. Measure the amplitude of the smallest packet. Note the Smallest Packet measurement. See Figure 4–9.

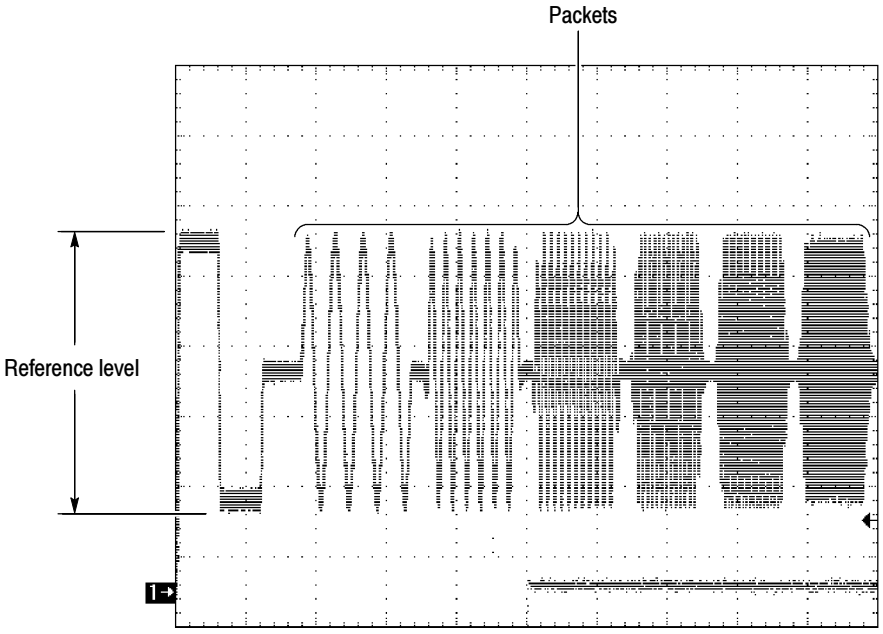


Figure 4- 9: SD GBR frequency response performance screen

36. Calculate the percent amplitude variation using the formula:

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

37. *CHECK* that the calculated measurement is between ±10% (typical)

38. Measure the amplitude of the largest packet. Note the Largest Packet measurement. See Figure 4–9.

39. Calculate the percent amplitude variation using the formula:

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

40. *CHECK* that the calculated measurement is between ±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 **Format and EDH** soft key.
6. *CHECK* that no embedded CRC Y or C errors messages occur in an interval of 10 seconds.
7. 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.

8. Set the SD video generator for a 525-format 75% color bars signal.
9. 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.*

10. Press the **INPUT** button and select **Input B**.
11. Press the **STATUS** button.
12. Touch the **Format and EDH** soft key.
13. *CHECK* that no embedded CRC Y or C errors messages occur in an interval of 10 seconds.
14. 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 4–10 for measurement points.

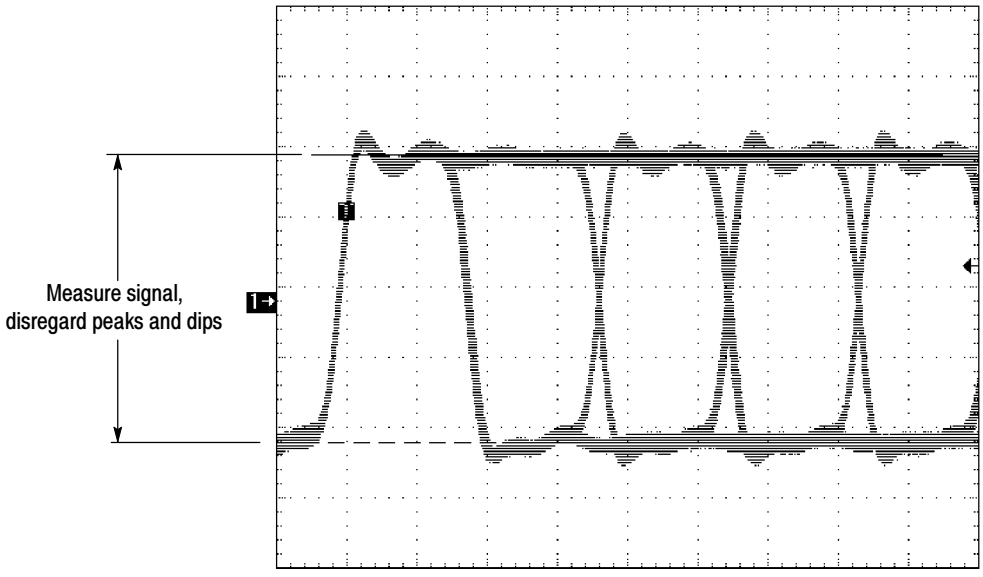


Figure 4- 10: Eye vertical scale reference level screen

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.
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 4–11.

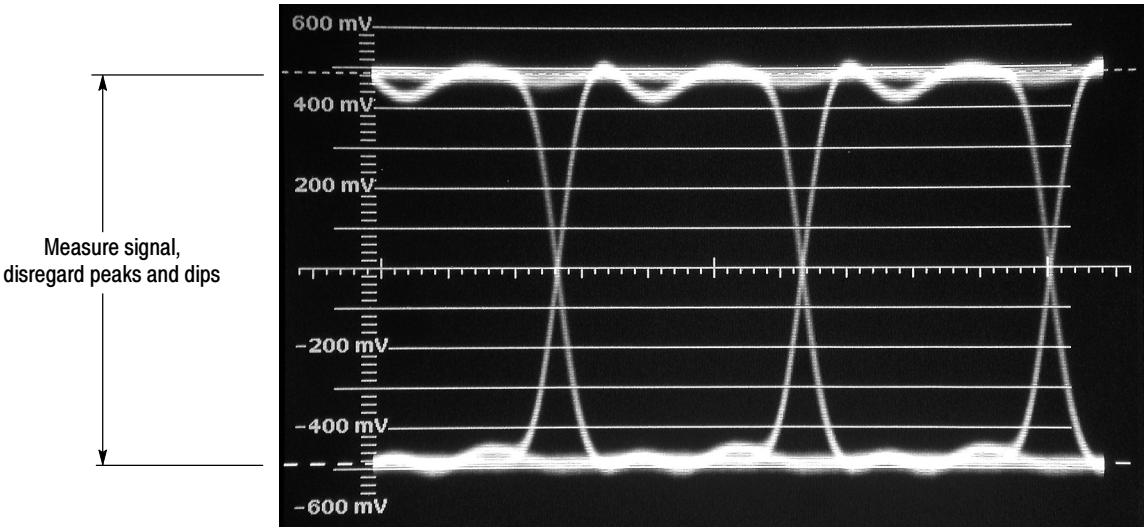


Figure 4- 11: Eye vertical scale performance screen

10. Calculate scale error using the formula:

$$Scale\ Error = 100 \times \left(\frac{Displayed\ Amplitude - Reference\ Amplitude}{Reference\ Amplitude} \right)$$

11. *CHECK* that the calculated scale error is between $\pm 5\%$.
12. Disconnect the test setup.

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.

$$Input\ A\ Return\ Loss\ =\ 20\ \times\ log10\left(\frac{Reference}{A\ Reflection}\right)$$

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.

$$Input\ B\ Return\ Loss\ =\ 20\ \times\ log10\left(\frac{Reference}{B\ Reflection}\right)$$

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 touch the **Jitter** soft key.
6. Touch the **Hi Pass Filter:** soft key and set to **100 kHz**.
7. *CHECK* that the Measured Jitter is approximately 30 ps (typical).
8. Touch the **Hi Pass Filter:** soft key and set to **10 kHz**.

9. *CHECK* that the Measured Jitter is approximately 60 ps (typical).
10. Change the RF generator settings as follows:

Frequency	135.0 MHz

11. Touch the **Hi Pass Filter:** soft key and set to **10 Hz**.
12. *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 4–12.

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 4–12.

13. *CHECK* that the measured value is approximately 0.15 ns (typical).

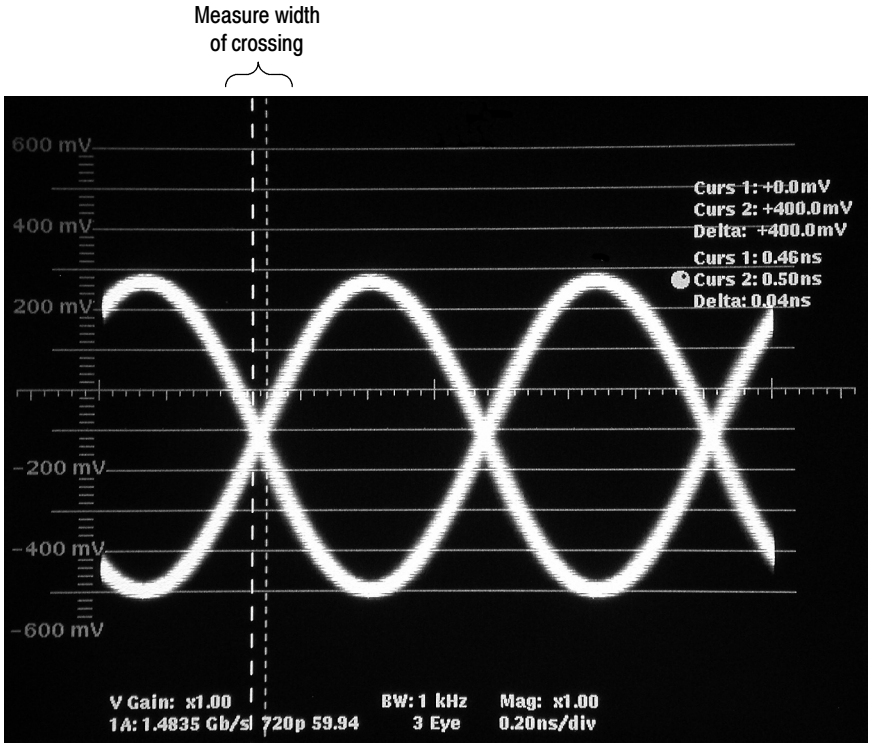


Figure 4- 12: Eye time base jitter performance screen

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 4–13.

***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.*

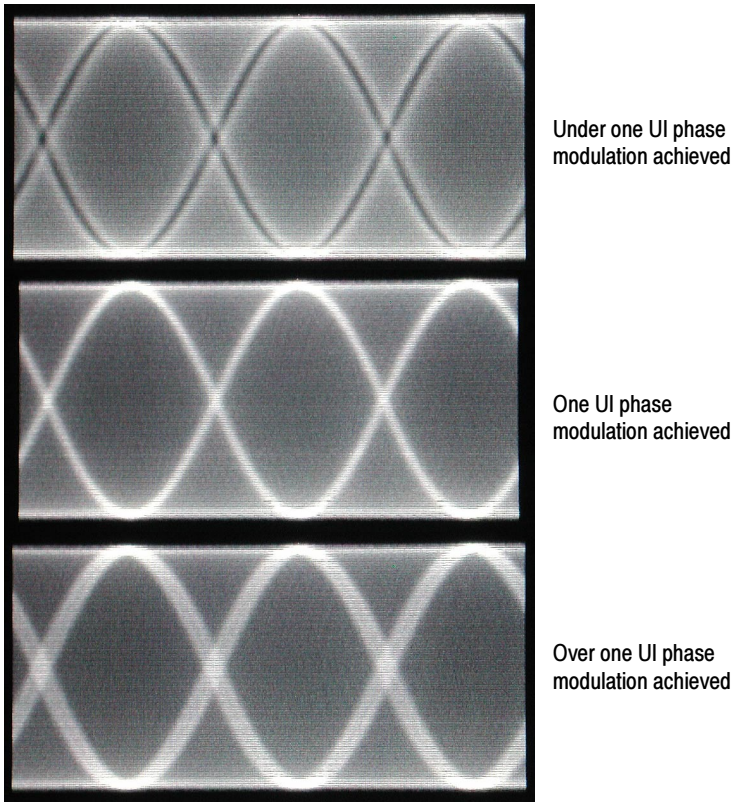


Figure 4- 13: Eye clock recovery bandwidth performance screen

8. Calculate percent amplitude error using the formula:

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

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 4–13.

13. Calculate percent amplitude error using the formula:

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

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 4–13.

18. Calculate percent amplitude error using the formula:

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

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 **Jitter** soft key.
5. Touch the **Hi Pass Filter:** soft key and set to **10 Hz**.
6. Read the Measured Jitter amplitude (in UI) displayed on screen.
7. Calculate the jitter response in db using the formula:

$$Jitter\ Response\ =\ 20\ \times\ log10\left(\frac{Measured\ Jitter}{4\ UI}\right)$$

8. *CHECK* that the calculated response is between –2 dB and –4 dB.
9. Set **Hi Pass Filter** to **1 kHz**.

10. Change RF generator settings as follows:

    LFGEN2 Frequency 1 kHz

11. Repeat steps 6 through 8.

12. Set **Hi Pass Filter** to **10 kHz**.

13. Change RF generator settings as follows:

    LFGEN2 Frequency 10 kHz

14. Repeat steps 6 through 8.

15. Change RF generator settings as follows:

    LFGEN2 Frequency 100 kHz

16. Set **Hi Pass Filter** to **1 kHz**.

17. Adjust the RF generator deviation for a Jitter reading of 4.0 UI

18. Set **Hi Pass Filter** to **100 kHz**.

19. Repeat steps 6 through 8.

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 to enter Clock BW mode.

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

4. Set the RF generator as follows:

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

5. Touch the **Clock BW:** soft key. On the resulting screen, touch the **100 Hz** soft key and then the **Done** soft key.

6. Touch the **3 Eye** soft key (**3 Eye** selected).

7. The displayed waveform should be two overlapping sine waves 180 degrees out of phase. See Figure 4–14.

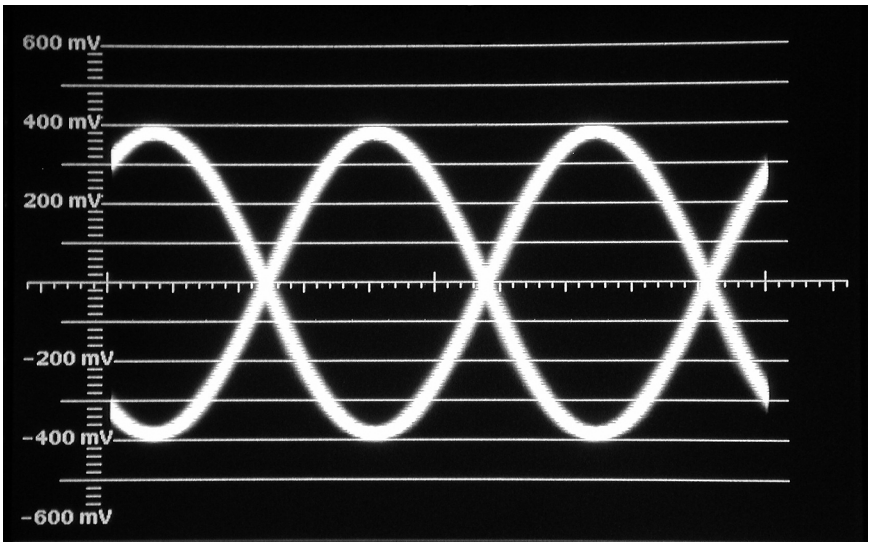


Figure 4-14: Eye clock recovery bandwidth performance screen

8. 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

9. The displayed waveform should fill in with 1 unit interval (UI) of phase modulation. See Figure 4–13.

***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.*

10. Adjust the RF generator settings as follows:

LFGEN2 Frequency	100 Hz
Phase Deviation	2.22 RADIANS

11. 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 4–13.

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

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

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

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

15. Adjust RF generator settings as follows:

LFGEN2 Frequency	10 Hz

16. Adjust the RF generator LF2 frequency in 0.1 Hz steps until the displayed waveform shows exactly 1 UI phase modulation. See Figure 4–13. Note the LFGEN2 frequency setting.

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

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

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

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

20. Adjust the RF generator settings as follows:

LFGEN2 Frequency	1 kHz

21. Adjust the RF generator LF2 frequency in 10 Hz steps until the displayed waveform shows exactly 1 UI phase modulation. See Figure 4–13. Note the LFGEN2 frequency setting.

22. Calculate percent frequency error using the formula:

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

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

24. 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 touch the **Jitter** soft key.
7. Touch the **Hi Pass Filter:** soft key and set to **10 Hz**.
8. Set the oscilloscope controls to produce a stable display. Limit the bandwidth setting to reduce displayed noise for better results. See Figure 4–15.
9. Measure the amplitude of the 10 kHz square wave on the test oscilloscope. Note the measurement.
10. Calculate the JITTER OUT scale factor error percentage using the formula:

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

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

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

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

Figure 4-15: Jitter gain check performance screen

15. Change RF generator settings as follows:

    Frequency 135.0 MHz

16. Allow the display to settle for several seconds.

17. Read the Measured Jitter amplitude in UI on the WFM700 display.

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

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

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

20. 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 **Hardware Settings** 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 terminators 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.

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 4–16.

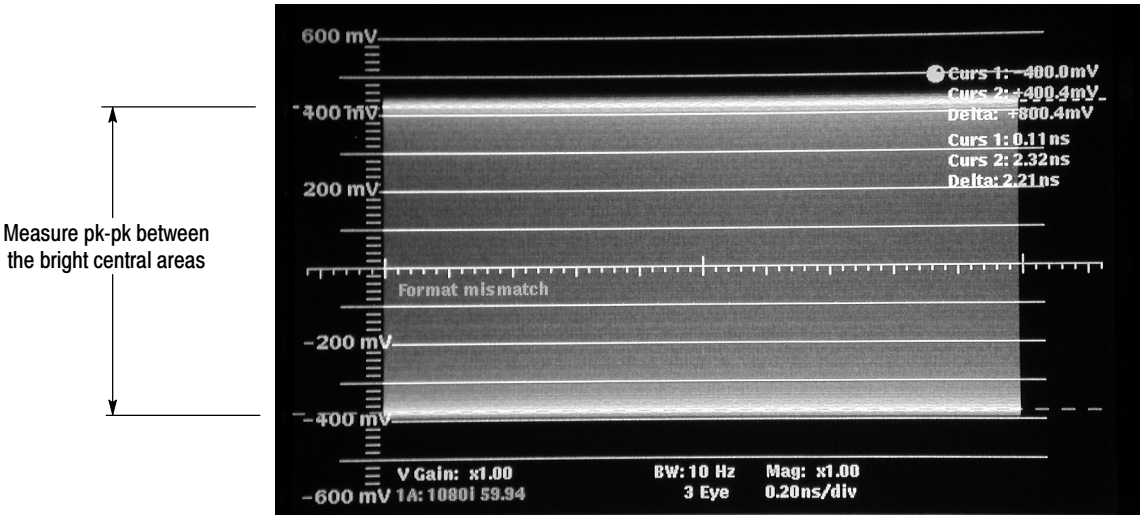


Figure 4-16: Eye pattern display signal bandwidth performance screen

***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.

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:

$$High\ Frequency\ Response\ =\ 20\ \times\ log10\left(\frac{Measured\ Minimum}{800\ mV}\right)$$

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:

$$Low\ Frequency\ Response\ =\ 20\ \times\ log10\left(\frac{Measured\ Minimum}{800\ mV}\right)$$

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.

WFM700/WFM7M Input Module Test Record

Photocopy this form and use it to record the performance test results.

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

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
Eye Vertical Scale				
Calculated scale error	-5%			+5%
Input Return Loss				
Input A				
Calculated return loss	>25 dB			N/A
Input B				
Calculated return loss	>25 dB			N/A
Eye Pattern Display Jitter Attenuation Error				
Calculated amplitude error				
10 Hz Clock BW	-10%			+10%
100 Hz Clock BW	-10%			+10%
1 kHz Clock BW	-10%			+20%
Jitter Display High Pass Filter				
Calculated jitter response				
Generator at 6.28 RADIANS Phase Deviation				
10 Hz Hi Pass Filter	–2 dB			–4 dB
1 kHz Hi Pass Filter	–2 dB			–4 dB
100 kHz Hi Pass Filter	–2 dB			–4 dB
Generator set to produce 4 UI jitter with Hi Pass Filter at 1 kHz				
100 kHz Hi Pass Filter	–2 dB			–4 dB
Eye Clock Recovery Bandwidth				
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
Eye Pattern Display Signal Bandwidth				
Calculated frequency response				
Input A				
2.5 GHz to 500 MHz	0			-3 dB
50 kHz	0			-3 dB
Input A				
2.5 GHz to 500 MHz	0			-3 dB
50 kHz	0			-3 dB

WFM700/WFM7A Input Module Test Record

Photocopy this form and use it to record the performance test results.

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

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
Input Return Loss				
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.

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
HD LCD Pixel Defects				
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

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 Chapter 1, *Specifications*. These procedures are not required to verify performance. For performance verification, see chapter 4, *Performance Verification*.

***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. Refer to the* Firmware Upgrade *section beginning on page 6–41.*

Adjustment Interval. Generally, these adjustments should be done every 2,000 hours of operation or 12 months, whichever comes first.

Adjustment After Repair. After the replacement of a WFM7M input module, perform the adjustment procedures in this chapter.

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 Input Modules** — The adjustment procedures must be performed on both input modules if two are installed the WFM700. Complete the entire adjustment procedure on one input module at a time.
- **Access to Adjustments** — The cabinet and cover must be removed to make the manual adjustments in this procedure.
- **Test Equipment** — Table 5–1 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 5–1 lists the equipment required to adjust the waveform monitor.

Table 5-1: 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	TG2000 with HDVG1 module	●	●	●
SD serial digital video test signal generator	525-format 100% color bar	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	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 5–1.

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 5–7 on page 5–11.

Serial Out Amplitude Adjustment

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

WFM700 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 Input 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 slot (2 or 3) 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 5–1.

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.

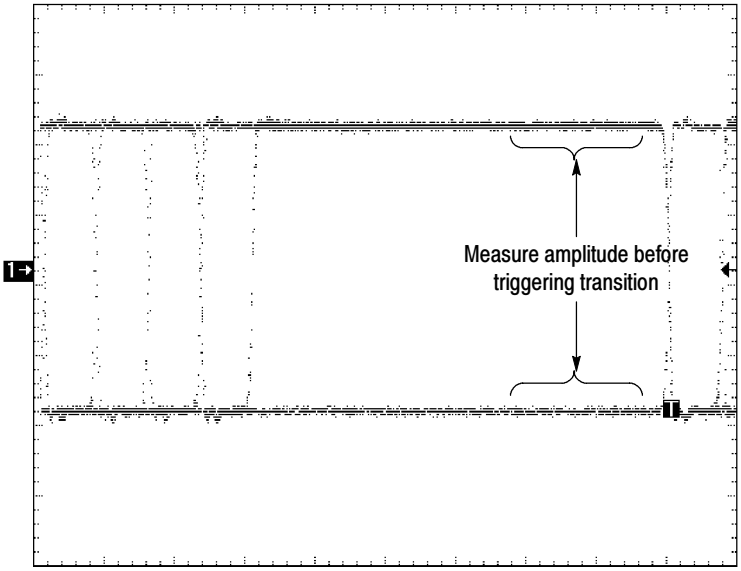


Figure 5- 1: Serial out amplitude adjustment screen

SD PIX Monitor Adjustment

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

WFM700 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 Input 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 slot (2 or 3) 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 5–2.

   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.

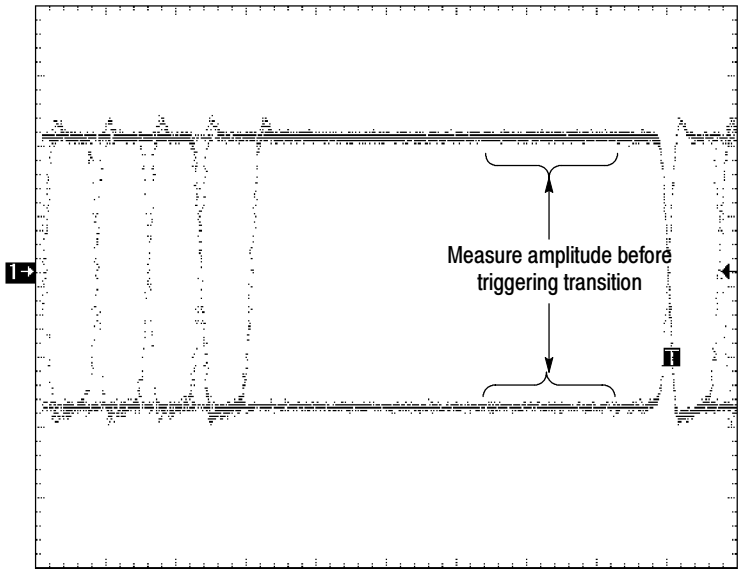


Figure 5-2: SD PIX monitor adjustment screen

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 Input 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 slot (2 or 3) and input (A or B).
5. Press the **CONFIG** button.
6. Touch the **Output Config** 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 5–3.

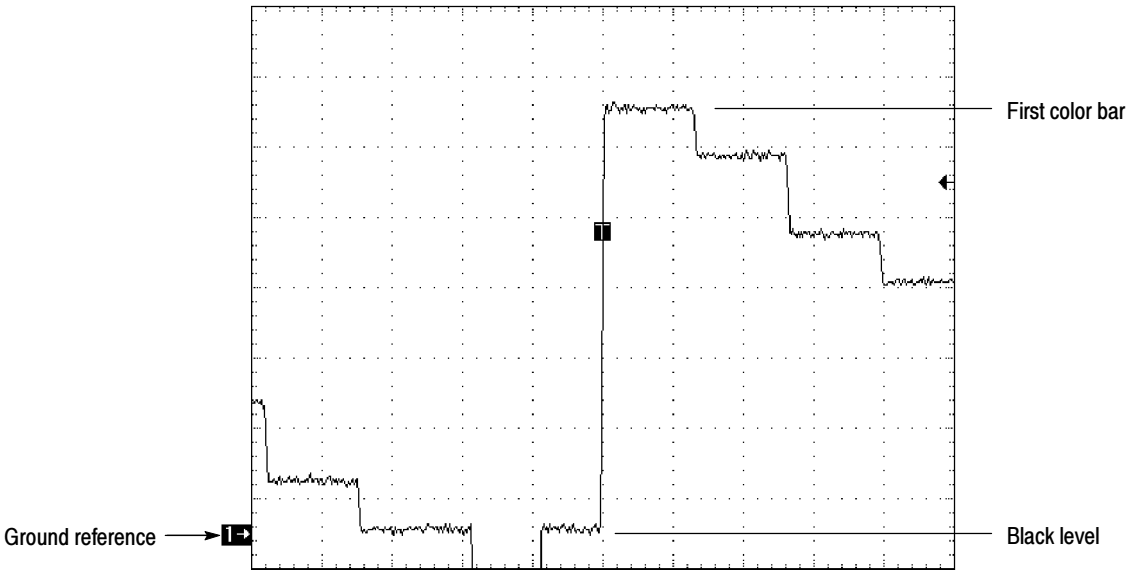


Figure 5- 3: SD PIX G/Y output adjustment screen

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 5–4.

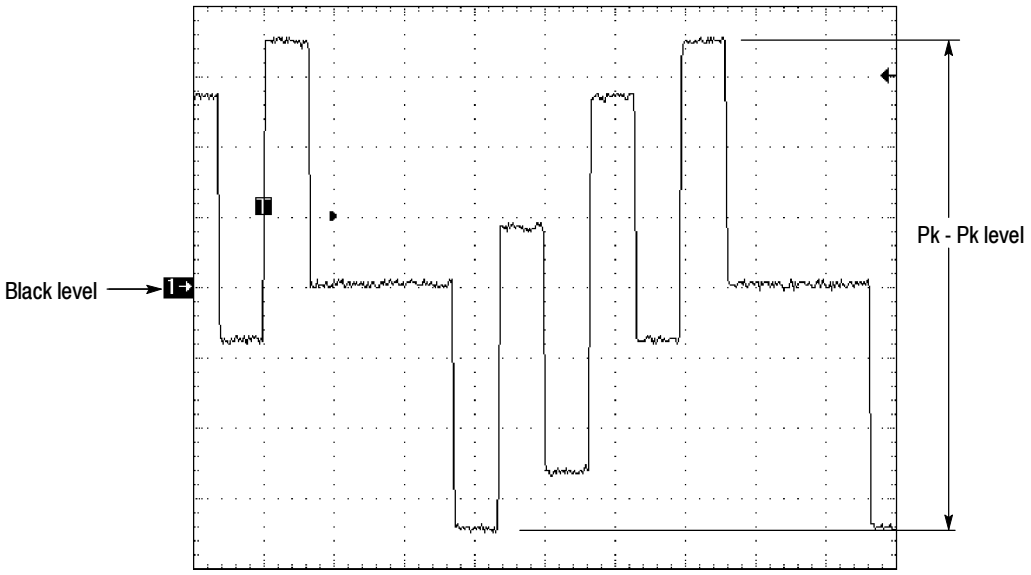


Figure 5-4: SD PIX B/Pb and R/Pr output adjustment screen

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 5–4.

HD RGB Output Adjustment

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

WFM700 Types. WFM700A, WFM700M, and WFM700HD

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

1. Connect the HD video generator to the Input Module under test using a 75 Ω cable.
2. Select the appropriate WFM700 slot (2 or 3) 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 **Output Config** 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 5-5.

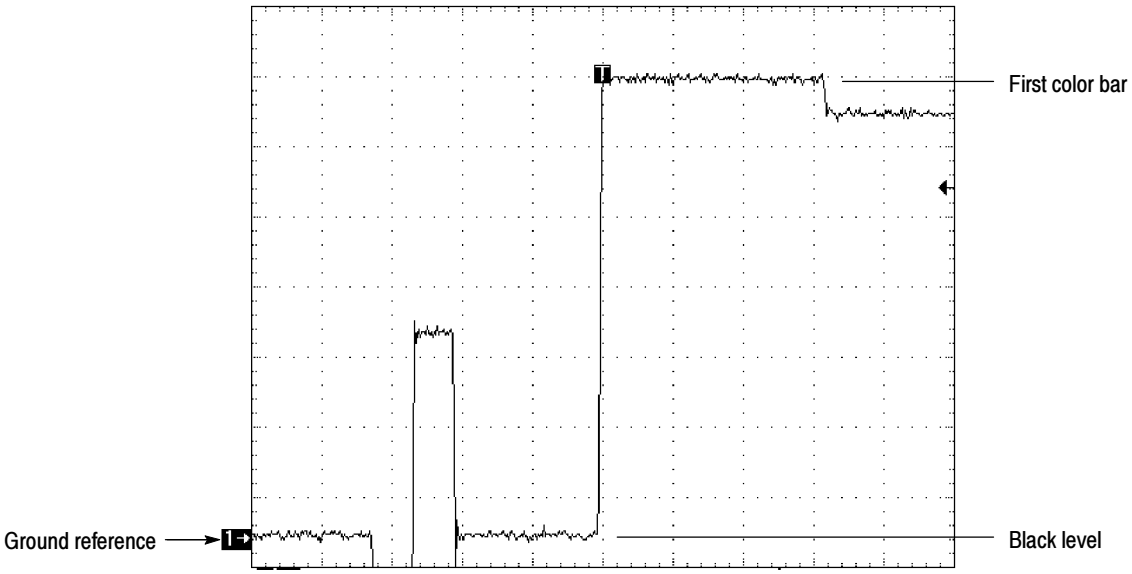


Figure 5-5: HD PIX G/Y output adjustment screen

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 5-6.

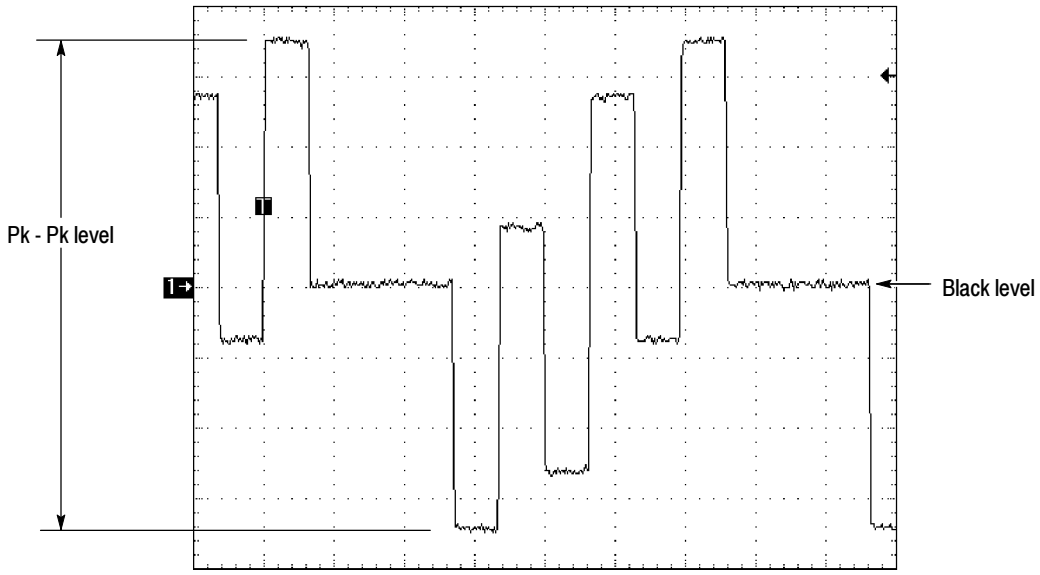


Figure 5- 6: HD PIX B/Pb and PIX R/Pr output adjustment screen

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 5–6.

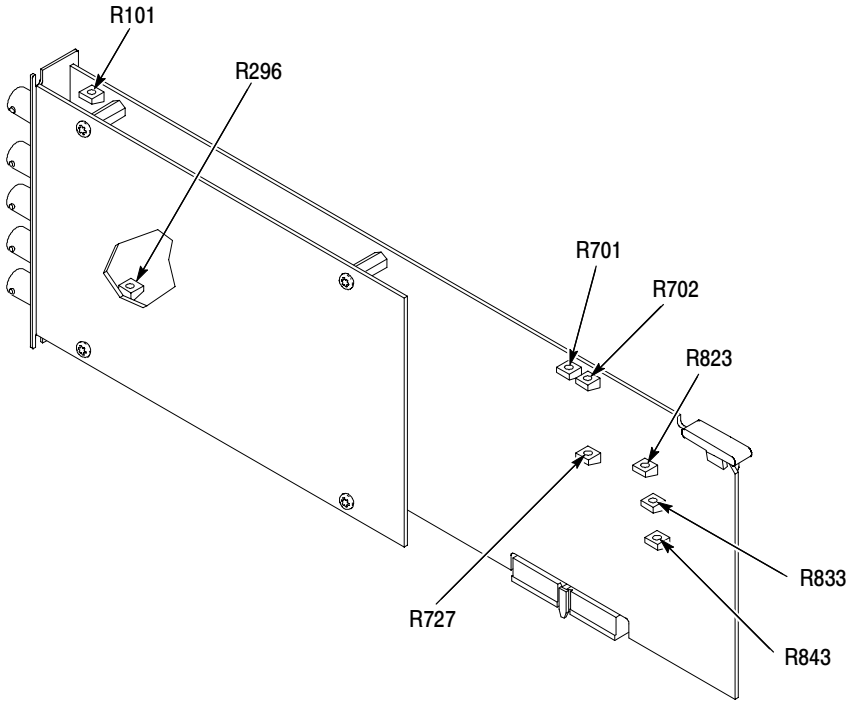


Figure 5- 7: Adjustment locations on input module

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 5–8 for the menu structure of the calibration routines.

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

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 **Hardware Settings** 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.

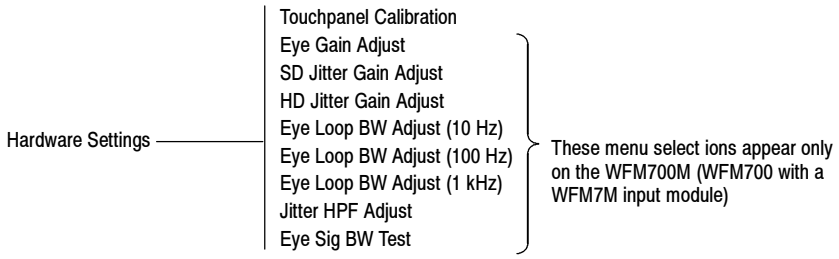


Figure 5- 8: Calibration routines menu

Touchpanel Cal

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

1. Press the **CONFIG** button, then touch the **Hardware Settings** soft key and then the **Next Menu** soft key.
2. Start the adjustment procedure by touching the **Touchpanel Cal** soft key.
3. Follow the on-screen instructions.
4. Touch the **Save and Exit** soft key at the bottom of the screen.
5. 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 5–9 for measurement points.

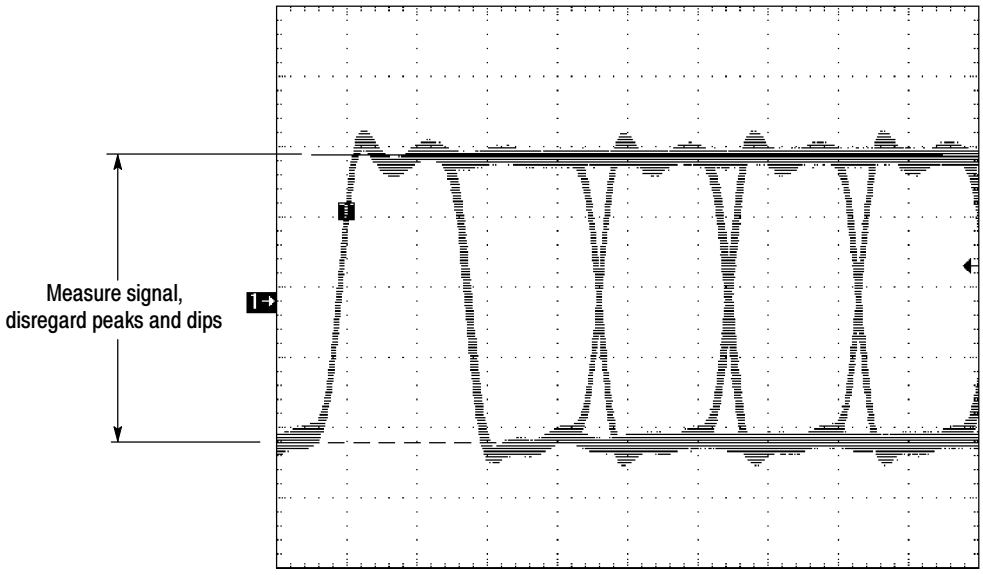


Figure 5-9: Eye vertical scale reference amplitude screen

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 touch the **3 Eye** soft key (**3 Eye** selected).
8. Press the **CURSOR** button and touch the **Voltage** soft key.
9. 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.)
10. Press the **CONFIG** button, then touch the **Hardware Settings** soft key and then the **Next Menu** soft key.
11. Touch the **Eye Gain Adjust** soft key and then the **Start Eye Gain Adjustment** soft key.
12. Press the **CURSOR** button to turn the cursors back on.
13. Use the General Purpose Knob to adjust the eye diagram amplitude to the cursors. See Figure 5-10.

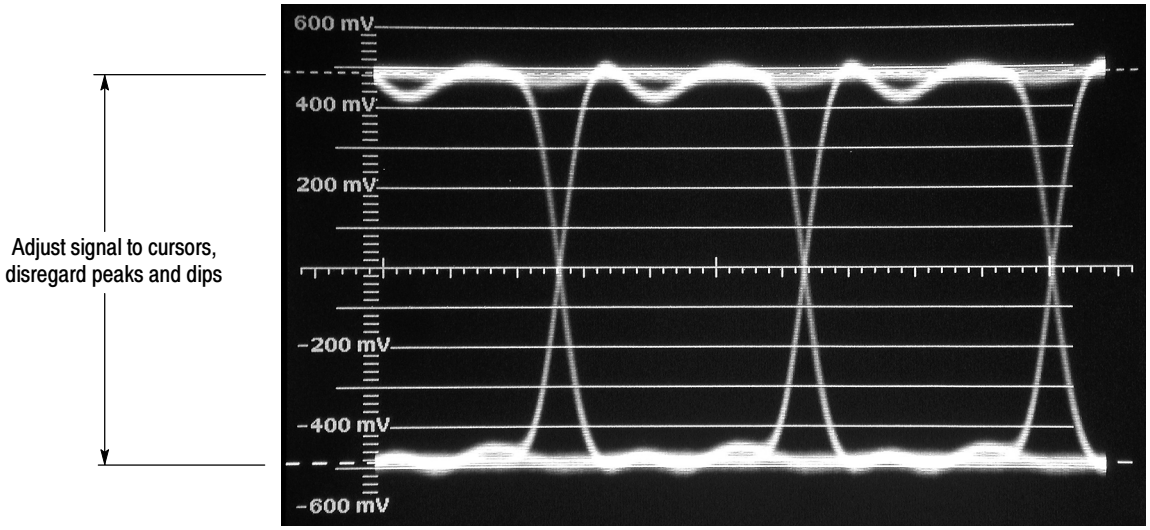


Figure 5- 10: Eye vertical scale adjustment screen

14. Touch the **Save and Exit** soft key to save the new calibration constant.

15. 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 input 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	RF generator adjusted to 800 mV output into 75 Ω at the requested frequency. You can adjust the output amplitude of the RF generator by measuring the output level with the test oscilloscope terminated into 75 Ω. With the recommended RF generator, you can modulate the signal with the following settings to obtain 2 UI of jitter. 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 **Hardware Settings** 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 5–11.

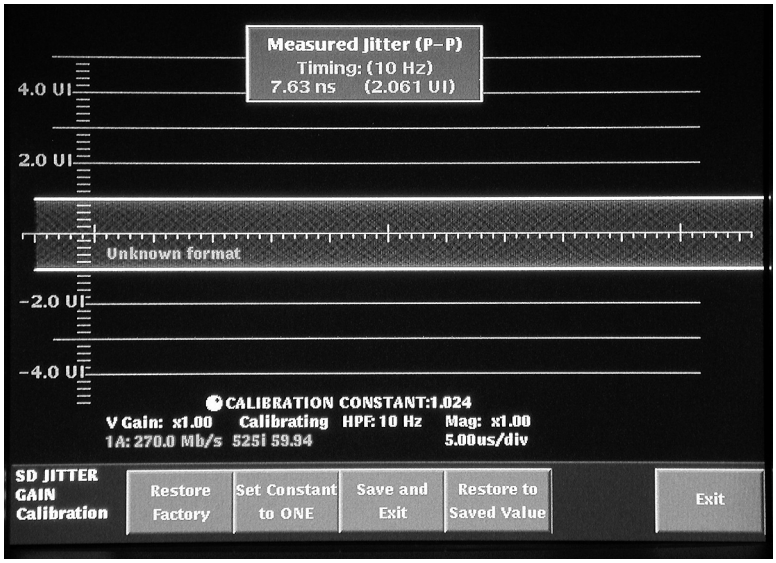


Figure 5- 11: SD Jitter gain adjustment screen

7. Touch the **Save and Exit** soft key to save the new calibration constant.

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 input 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	With the recommended RF generator, you can modulate the signal with the following settings to obtain 2 UI of jitter. 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.*

- ***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 **HD Jitter Gain Adjust** soft key and then the **Start HD Jitter Gain Adjust** soft key.
4. Adjust the signal amplitude using the General Purpose Knob to 2 UI as measured on the display. See Figure 5–12.

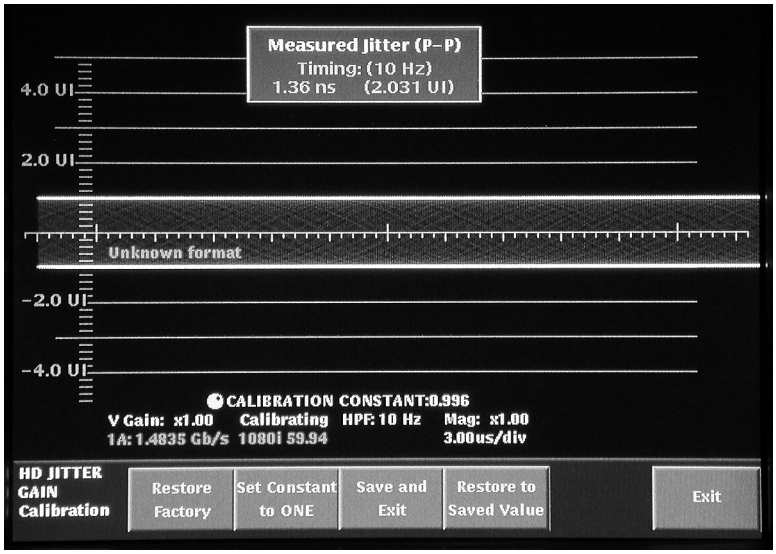


Figure 5- 12: HD Jitter gain adjustment screen

5. Touch the **Save and Exit** soft key to save the new calibration constant.

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	With the recommended RF generator, you can generate the required signal with the following settings to obtain 10 Hz jitter modulation. 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.*

- ***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 (10 Hz)** soft key and then the **Start Eye Loop BW Adjustment (10 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 5–13.

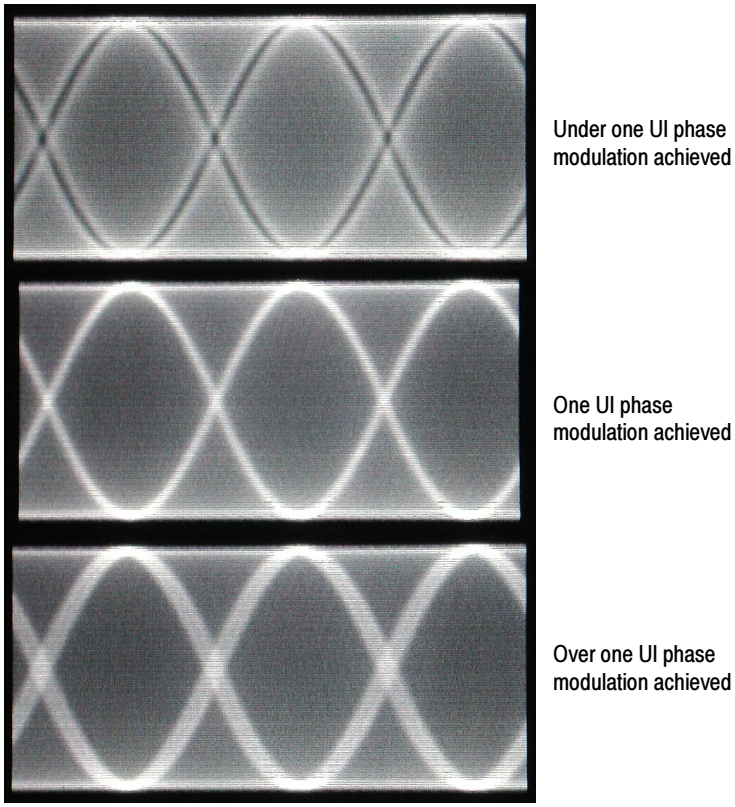


Figure 5- 13: Eye loop BW one UI adjustment screen

6. 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 5–13.
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	With the recommended RF generator, you can generate the required signal with the following settings to obtain 1 kHz jitter modulation. 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.*

- ***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 (1 kHz)** soft key and then the **Start Eye Loop BW Adjustment (1 kHz)** 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 5–13.
6. 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	RF generator adjusted to 800 mV output into 75 Ω at the requested frequency. With the recommended RF generator, you can modulate the signal with the following settings to obtain 2 UI of jitter. 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 5–14.
5. Touch the **Save and Exit** soft key to save the new calibration constant.

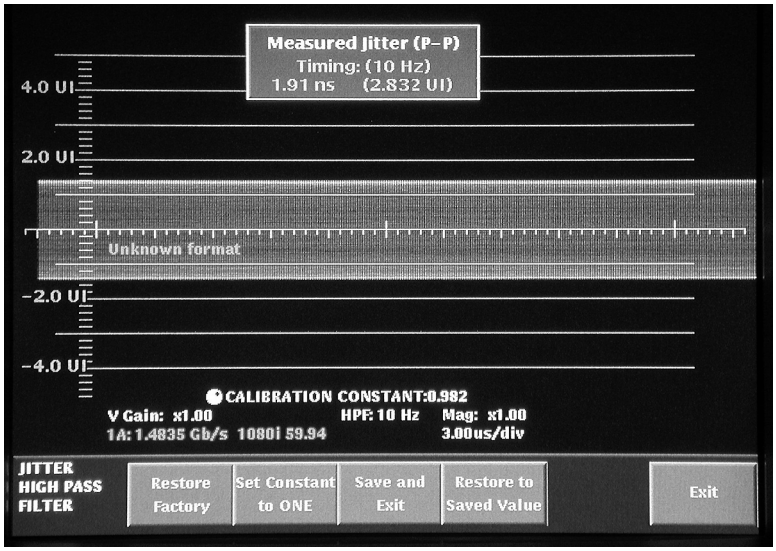


Figure 5- 14: Jitter HPF adjustment screen

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 Upgrade* — Information to obtain and install updated firmware.

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 and rinse with deionized water.

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 6–1 as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

Table 6-1: 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 6–2 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 6-2: 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.

Table 6-2: Internal inspection check list (cont.)

Item	Inspect for	Repair action
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) and rinse with warm deionized water. (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.

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 6-1*.

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 6-3: 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 6–1.

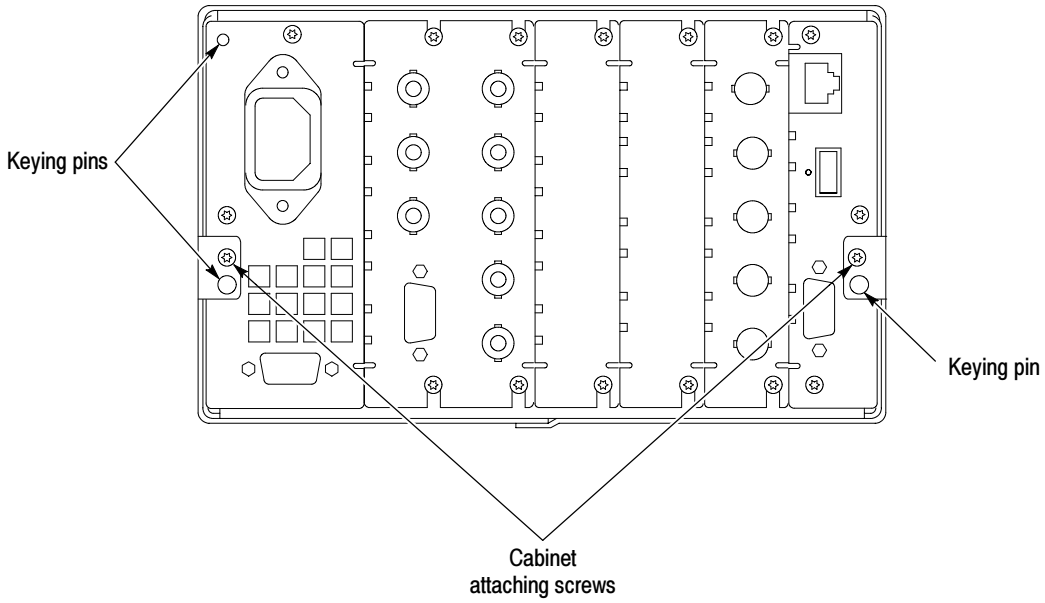


Figure 6–1: Cabinet attaching screws

3. Slide the cabinet up and off the instrument chassis.

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 6–1).
2. Loosen three attaching screws (T-10) along the left side and three screws along the right side of the chassis cover (see Figure 6–2). 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 6–2). 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 6–2 for screw locations and Figure 6–6 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.

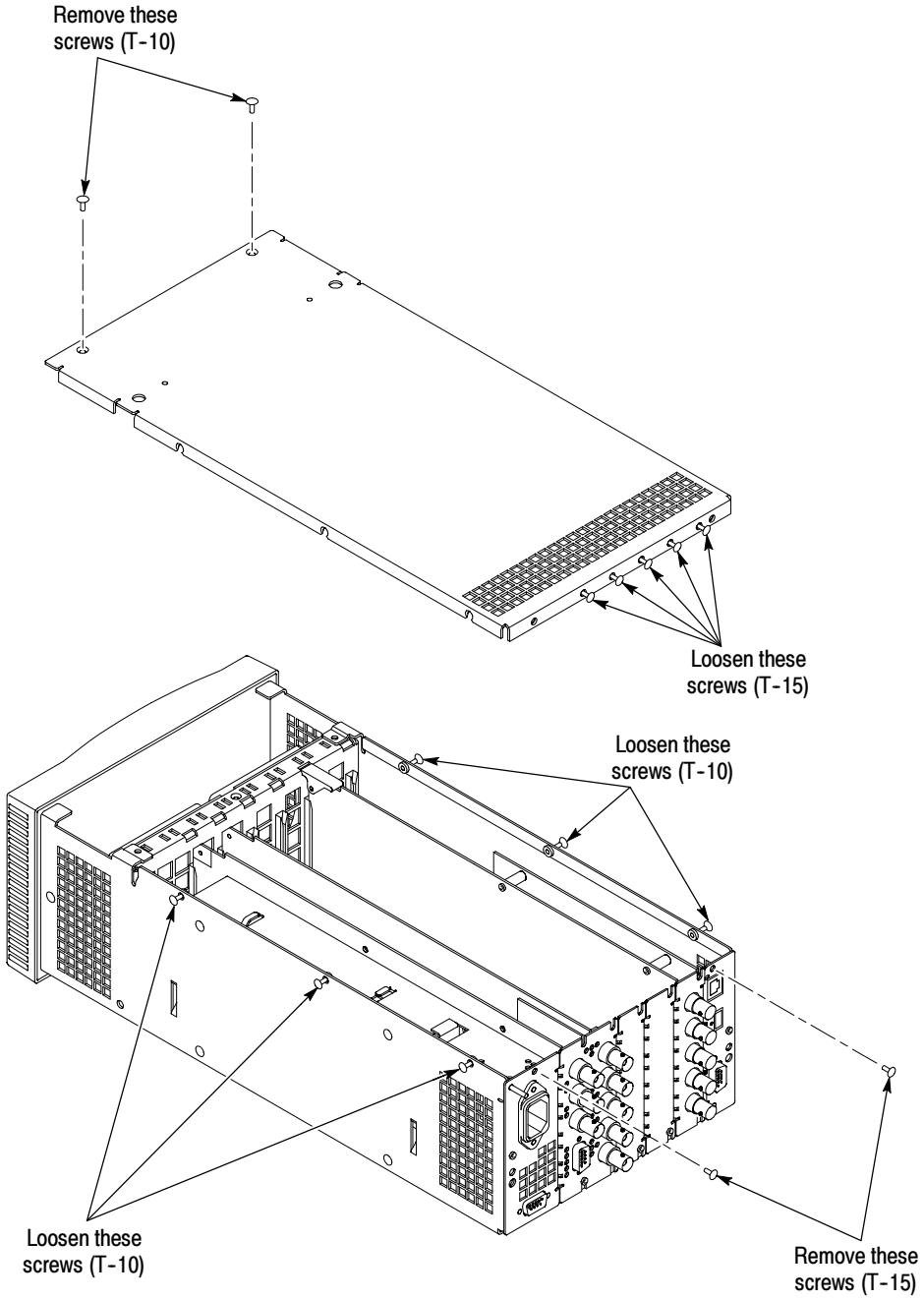


Figure 6-2: WFM700 chassis cover, showing screws to loosen and remove

5. Remove a screw (T-15) from slot 1 and from the power supply (see Figure 6–2 for screw locations and Figure 6–6 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.)

Plug-In Modules

Use the following 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 6–3.

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

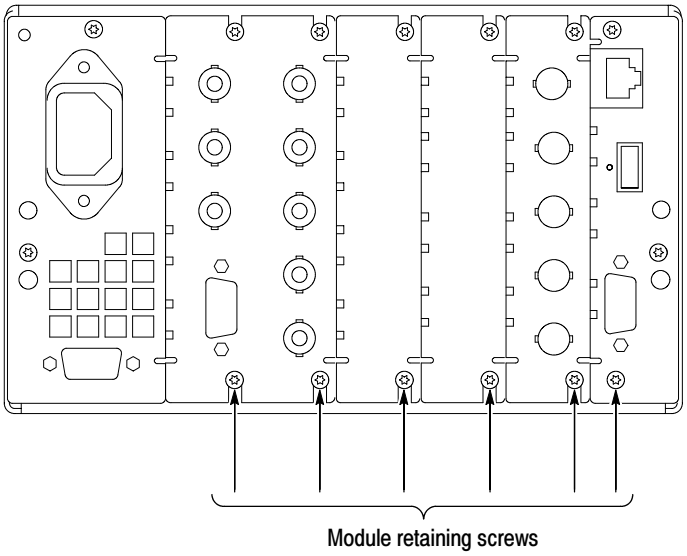


Figure 6–3: Plug-in module retaining screws

2. If you have two input modules with a grounding clip installed, remove the grounding clip (see Figure 6–4).

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

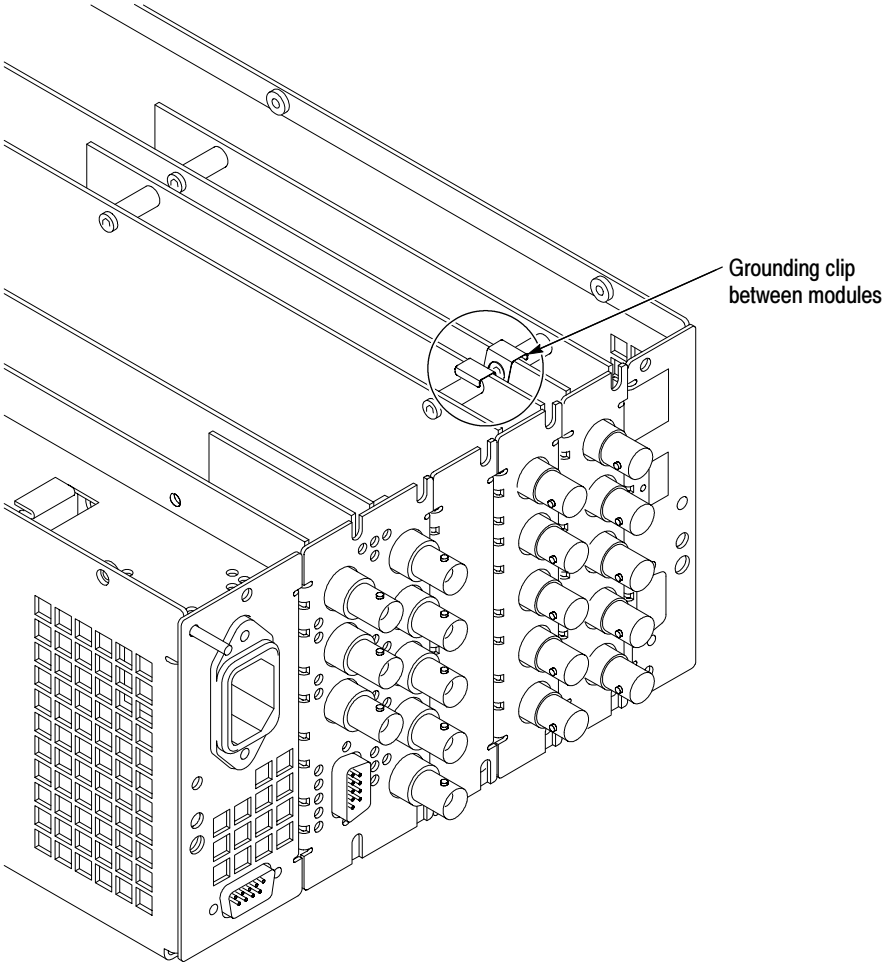


Figure 6–4: Grounding clip between two input modules

3. Lift the white ejector lever located near the front of the module.

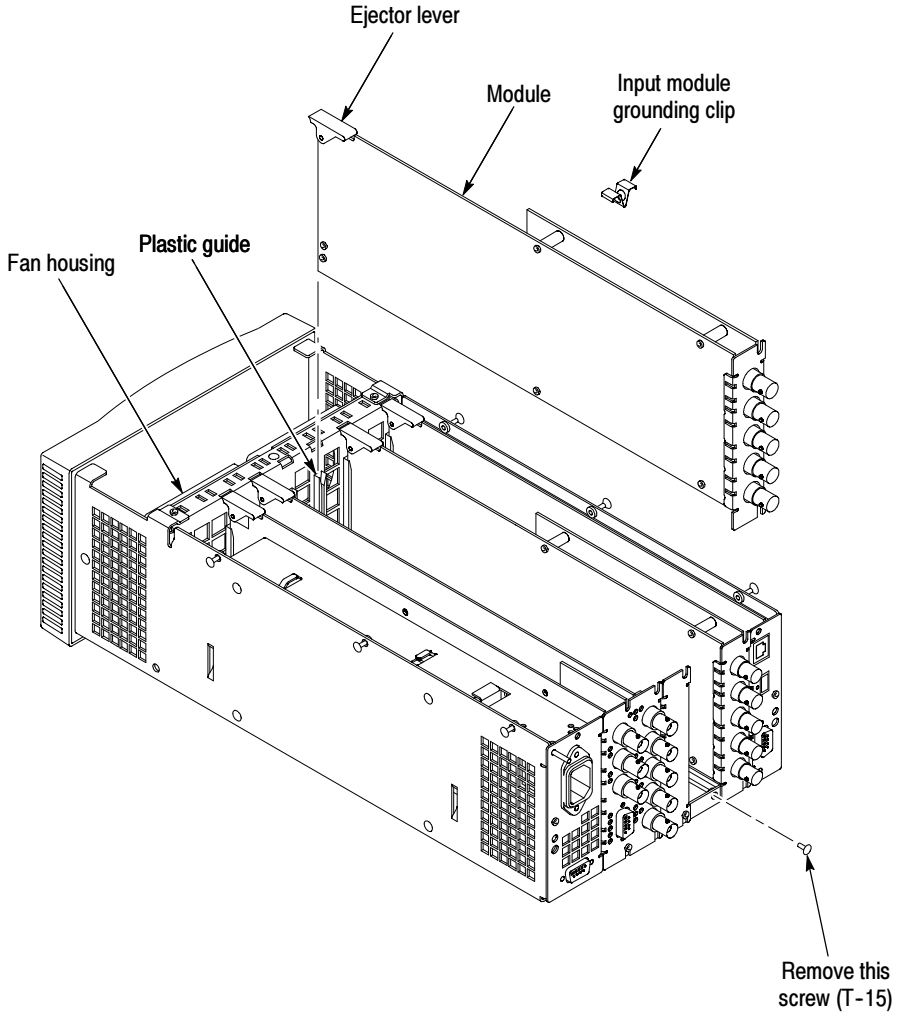


Figure 6-5: Removing a plug-in module

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.

Installation

Read the entire installation steps before proceeding.

1. Identify the slot in which you will install the plug-in module.

   - Slot 1 CPU
   - Slot 2 1st Input Module (WFM7HD, WFM7A, or WFM7M)
   - Slot 3 2nd Input Module (WFM7HD, WFM7A, or WFM7M)
   - Slot 4 Reserved
   - Slot 5 Reference Module
   - Slot 6 Real Time Display Module

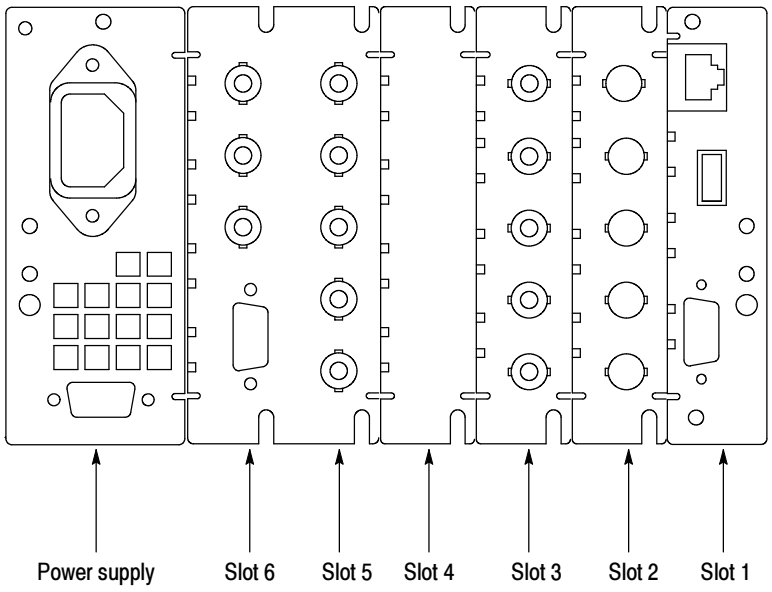


Figure 6–6: WFM700 rear panel with two input modules installed, showing slot numbers

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

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

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.

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 6–7.

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.

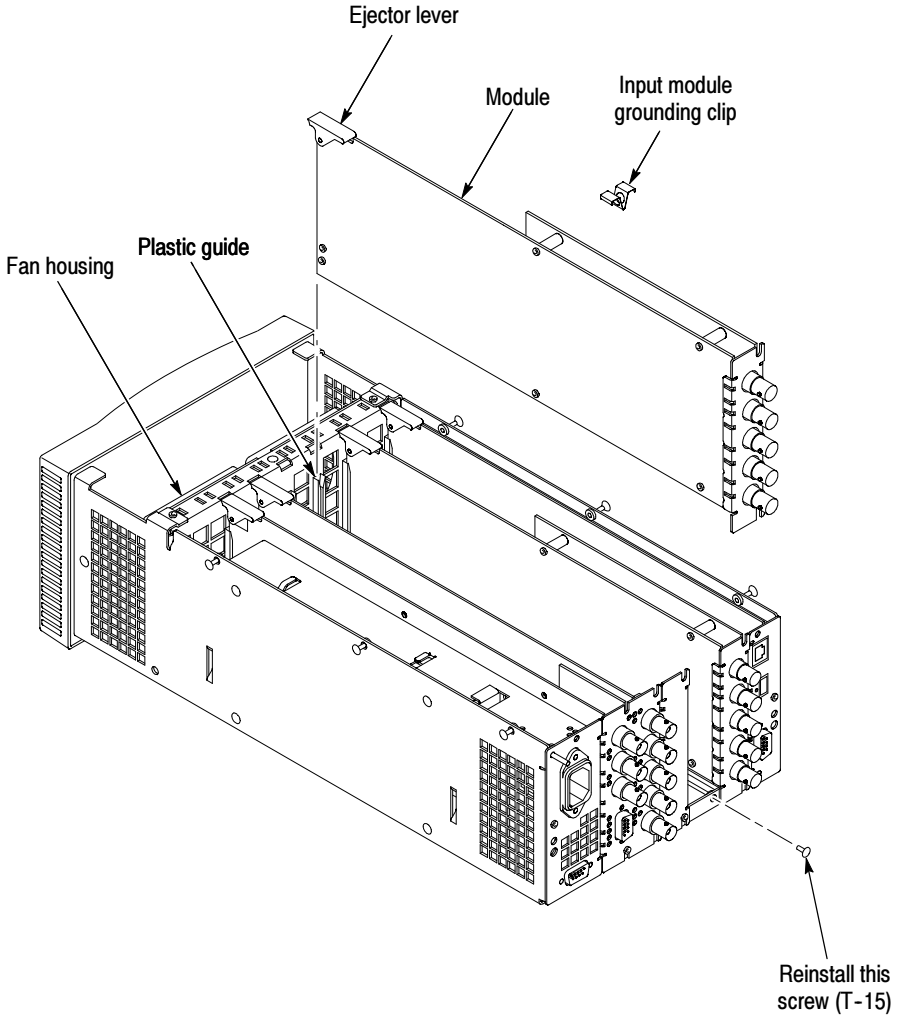


Figure 6-7: Inserting the module into the chassis

7. A grounding clip is required when two input modules are installed. See Figure 6–8 for the correct installation of the grounding clip.

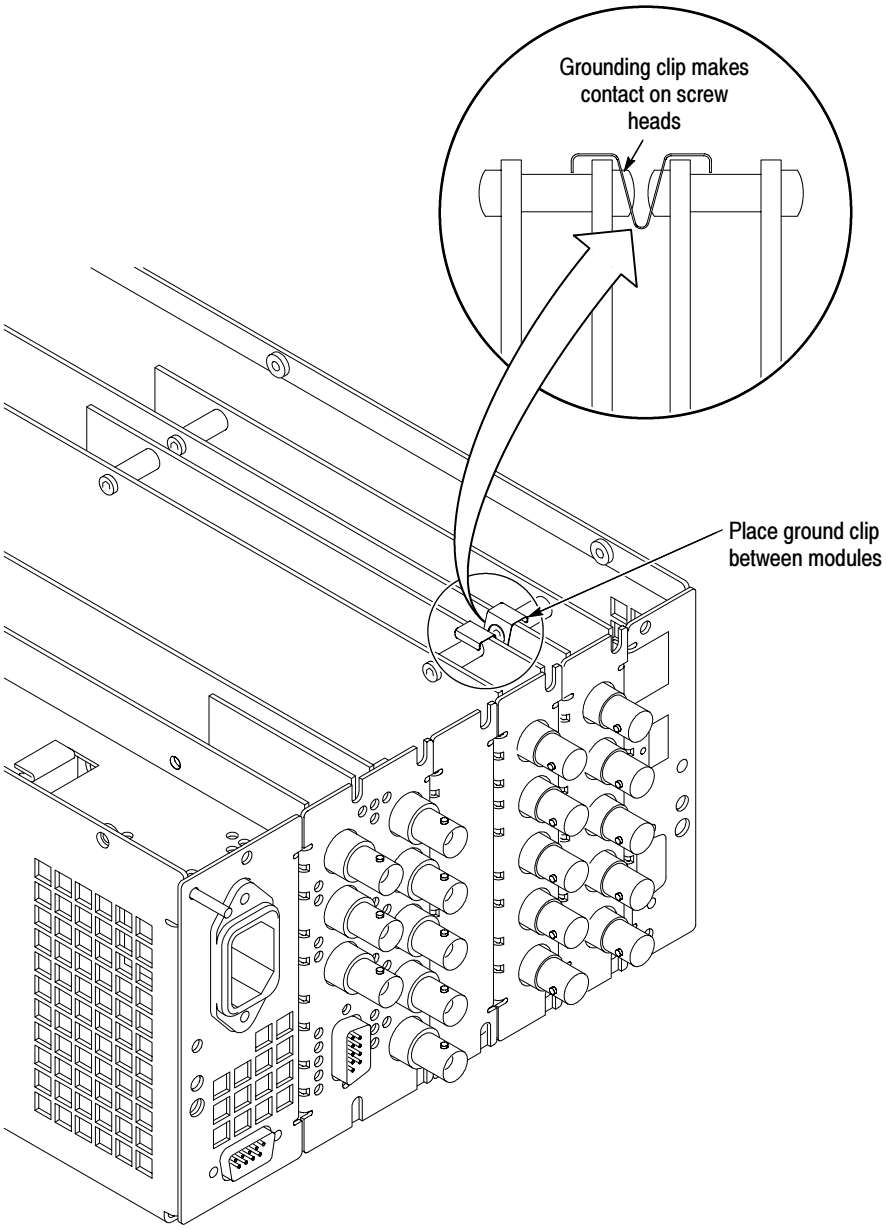


Figure 6-8: Installing the grounding clip between two input modules

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 6–9.

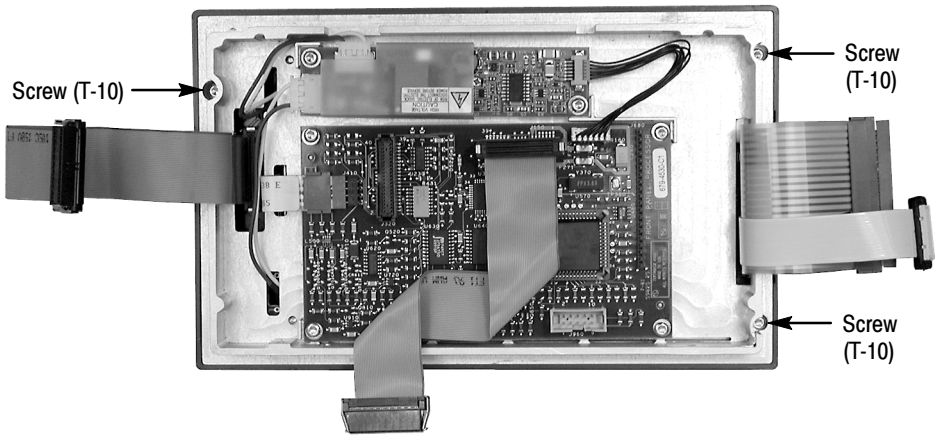


Figure 6–9: Front panel assembly

***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 6–10 on page 6–21 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 6–10.

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 6–10.

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

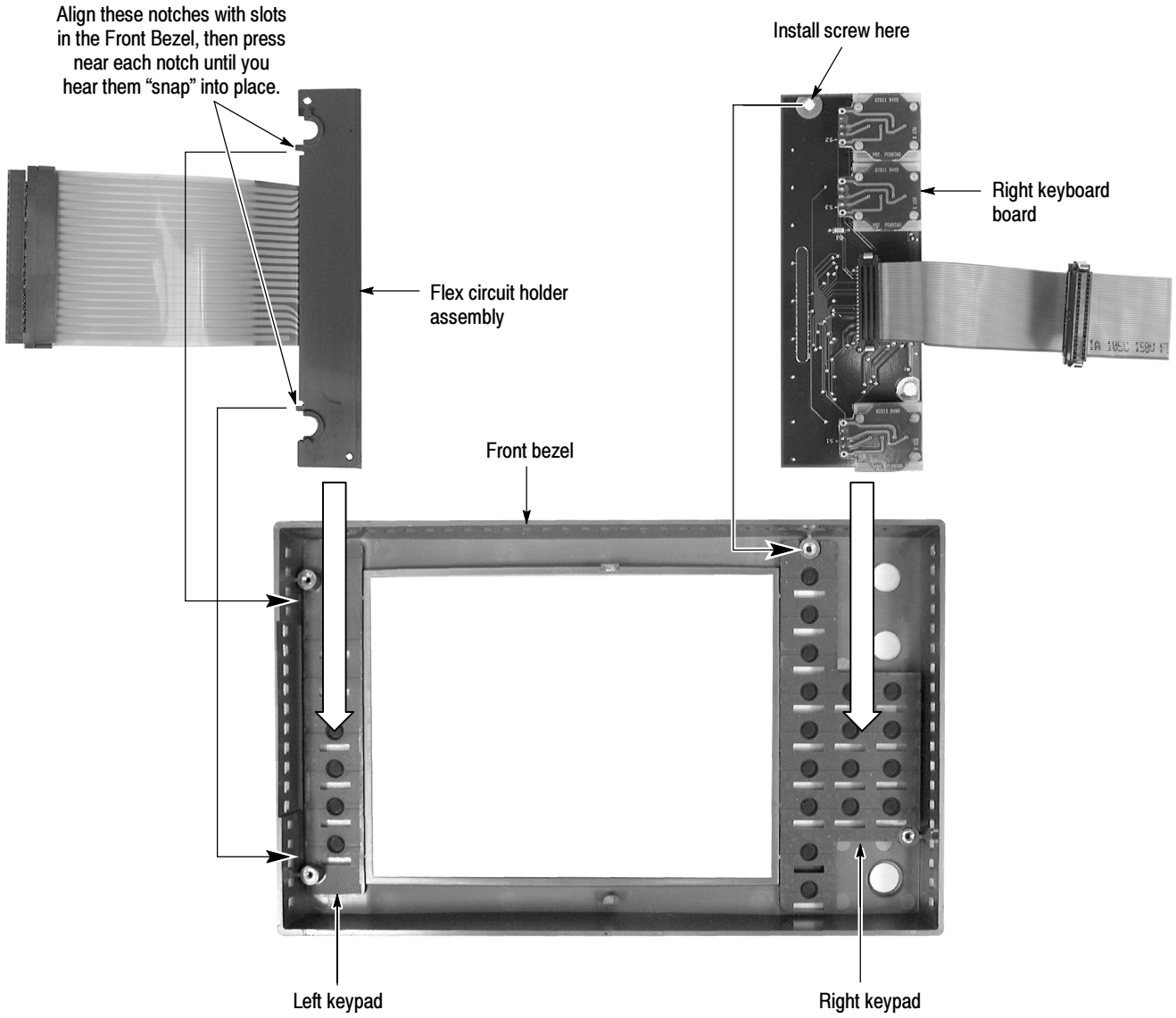


Figure 6-10: Keyboard access

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 6–11.
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.

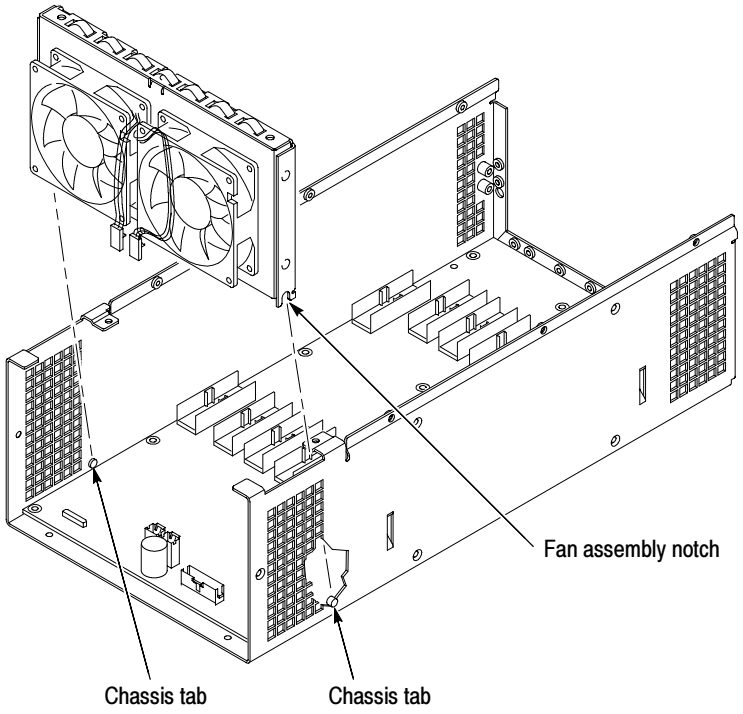


Figure 6–11: Fan assembly mounting

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 circuit board.

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

Removal

Read the entire removal procedure before proceeding.

1. Locate and remove 11 screws (T-15) attaching the Main circuit board to the chassis. See Figure 6–12.

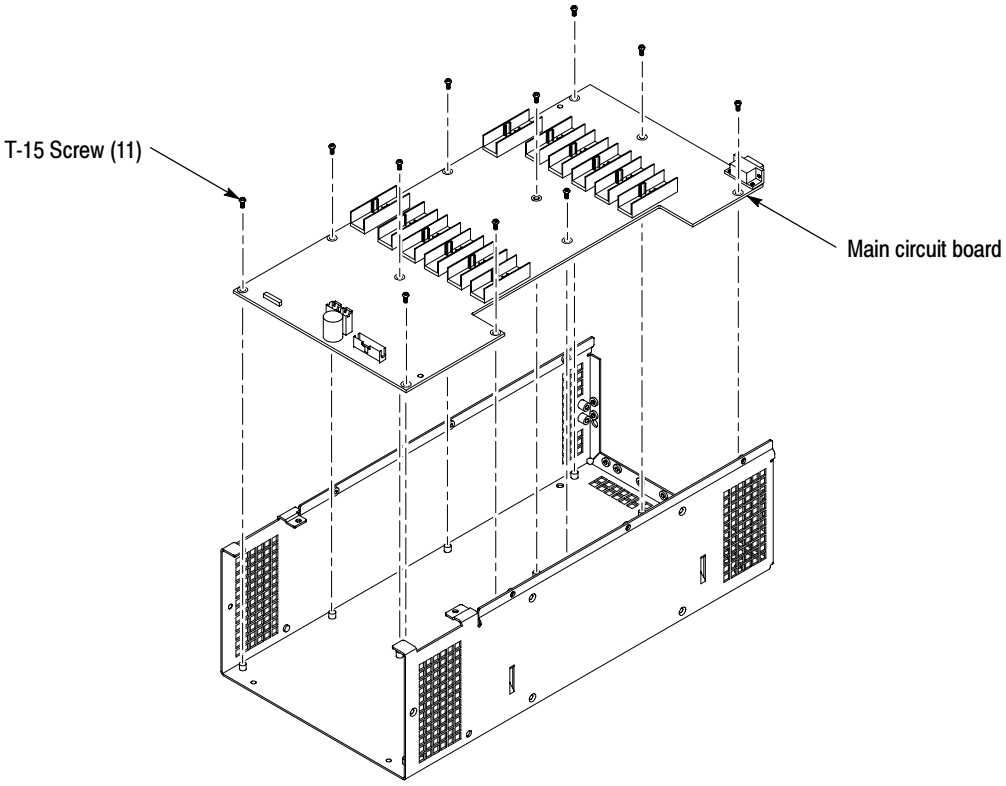


Figure 6–12: Main circuit board securing screws

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

Troubleshooting

Service Level

This 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.

Check for Problems

Use Table 6–4 to quickly isolate possible failures and how to proceed for further troubleshooting.

Table 6-4: Failure symptoms and possible causes

Symptom	Possible cause(s)
Mainframe will not power on	■ Power cord not plugged in. ■ Faulty power supply. ■ Faulty modules. ■ Front panel power switch not on. Use the Power Troubleshooting Tree on page 6-33.
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 6-5 on page 6-31.
Mainframe powers on but no signal displayed	■ Wrong slot selected, wrong input selected. ■ Module not fully installed into the slot.
LCD panel display blank	Use the Blank Screen Troubleshooting Tree on page 6-36.
Power Up Diagnostic errors Internal Digital Path Diagnostic errors	Use the Diagnostics Error Troubleshooting Tree on page 6-38.
Modules not recognized	■ Module firmware incompatible with mainframe software version. ■ Module not fully installed into the slot. ■ Faulty module.
Instrument locks up	■ Power down the instrument, then restart. ■ Replace the CPU circuit board.
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 6-37.

Table 6-4: Failure symptoms and possible causes (cont.)

Symptom	Possible cause(s)
Performance requirement not met as tested with the Performance Verification procedures.	Perform the procedures located in the *Adjustments* 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	■ Poor quality input signal. ■ Perform the Digital Signal Path Diagnostics.
Failure to lock to external reference signal	■ 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.
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	■ Verify the input signal is a known good signal. ■ Verify the proper Input and slot are selected. ■ Faulty Input Module.

Table 6-4: Failure symptoms and possible causes (cont.)

Symptom	Possible cause(s)
The following video STATUS items are indicated incorrectly: Signal Format Embedded Audio Embedded CRC	■ Faulty Input Module.
With two input modules installed, only one works	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. A second input module installed in slot 3 can only be used if a functioning input module is in slot 2. Slot 2 must always contain an input module.

Diagnostics

The WFM700 waveform monitors have built in diagnostics capabilities to very instrument operation. These are accessed through the Configuration / Diagnostics menu.

Two menu choices are presented:

- **Powerup Diagnostics**. This sets the level of diagnostics to run each time the instrument is powered on (either full or brief)
- **Diagnostics:**. This provides three selections. Selecting any of these immediately starts the routine.

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

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

LED Fault Codes

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

Table 6–5 shows the LED conditions and what they indicate.

Table 6-5: LED fault codes

ON/STBY LED	Fault LED	Additional problem description	Suggested action
Off	Off		This is normal when the instrument is in standby mode; Press the ON/STBY front panel button. Check line input to power supply. Go to the Power Troubleshooting Tree on page 6-33.
On	Off	No display.	Go to the Blank Screen Troubleshooting Tree on page 6-36.
Flashing	Off		This indicates the instrument is under temperature. The LCD may be damaged if operated at low temperatures. 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.
On	On		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. This state can occur due to an intermittent problem that requires service or from a drop-out on the AC line. If the fault persists for more than one second, then the instrument will go to the Power Fault state. It is normal for the momentary fault state to be asserted when the AC line is removed while the instrument is running.
Off	Flashing		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. Verify that the ambient temperature meets specifications. Let the instrument cool down and press the ON/STBY switch to resume normal operation.
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		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. Press the ON/STBY switch to reset the instrument. If the fault code reoccurs, go the LED Fault Troubleshooting Tree (1 and 2) on pages 6-34 and 6-35 or the Power Troubleshooting Tree on page 6-33.

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

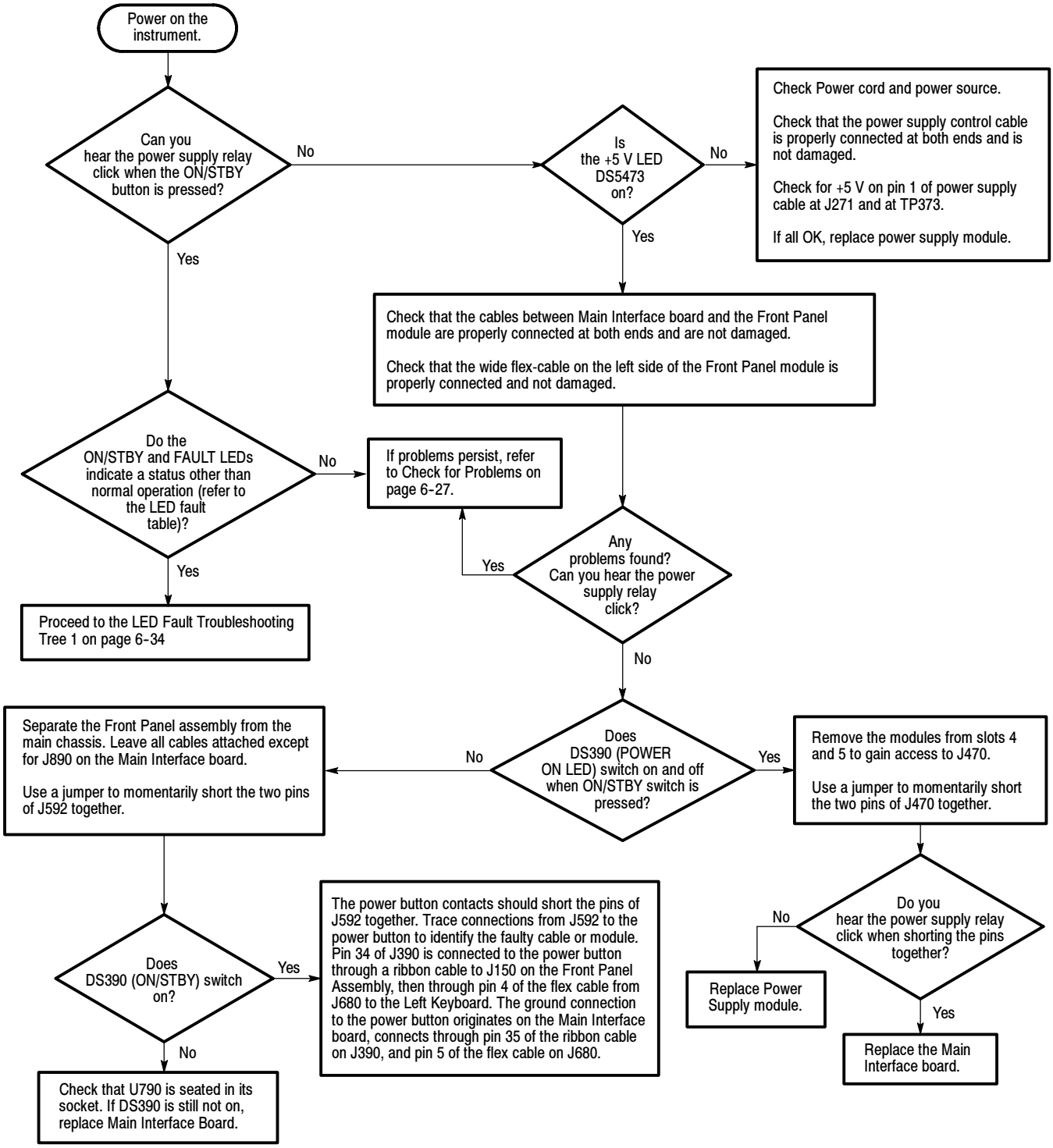


Figure 6-13: Primary troubleshooting procedure

LED Fault Troubleshooting Tree 1

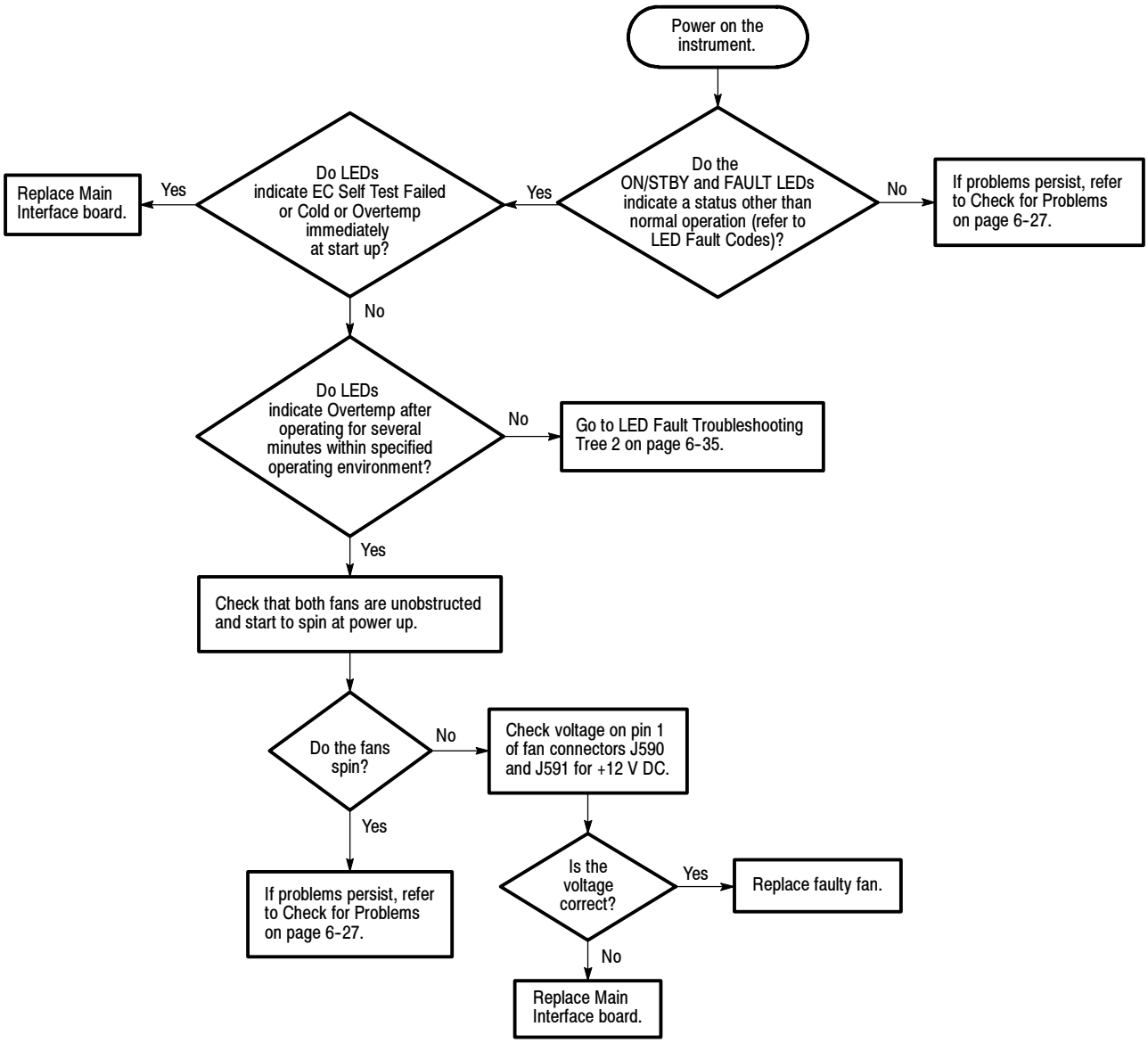


Figure 6-14: LED fault troubleshooting tree 1

LED Fault Troubleshooting Tree 2

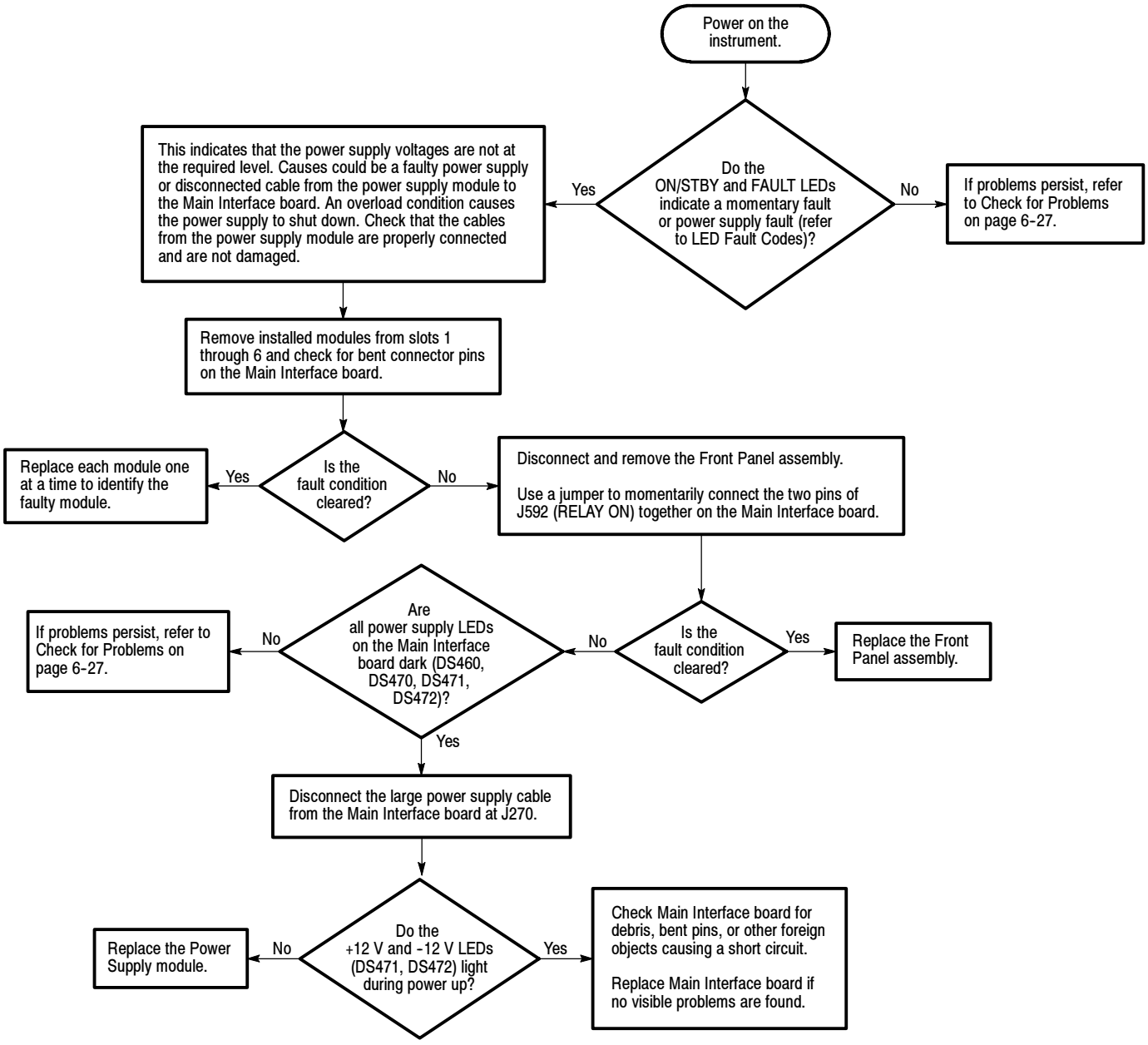


Figure 6-15: LED fault troubleshooting tree 2

Blank Screen Troubleshooting Tree

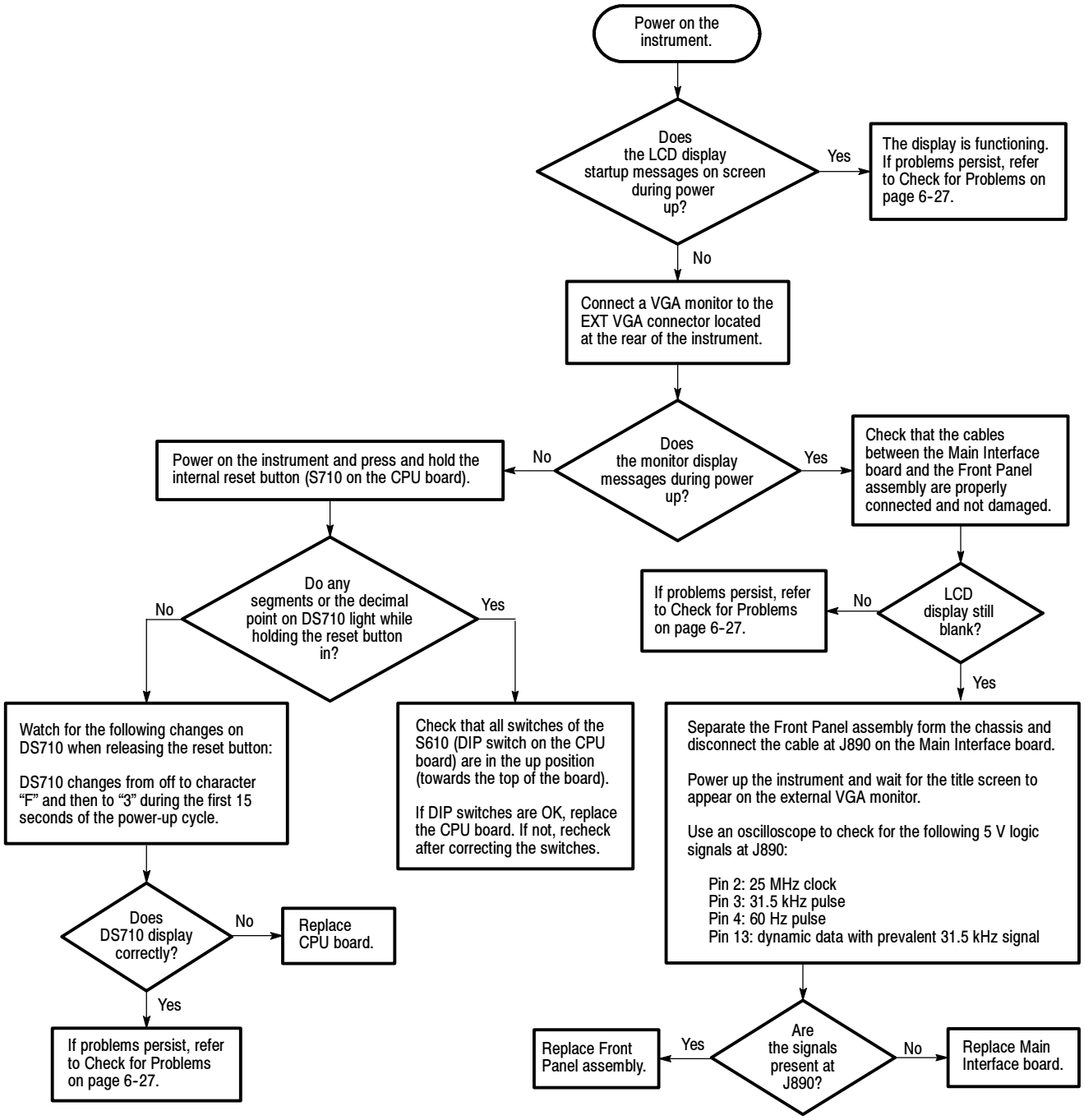


Figure 6-16: Blank screen troubleshooting tree

Front Panel Buttons and Touch Panel Troubleshooting Tree

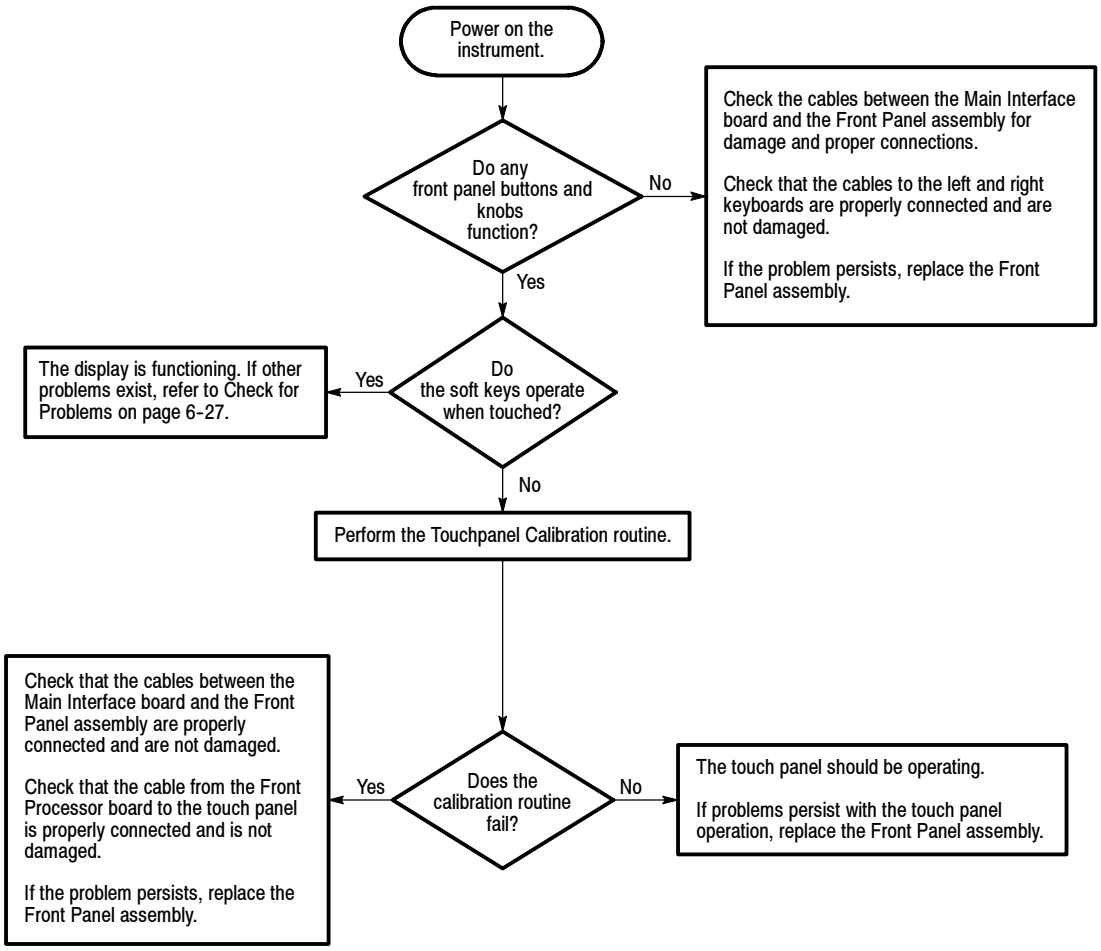


Figure 6-17: Front panel buttons and touch panel troubleshooting tree

Diagnostics Errors Troubleshooting Tree

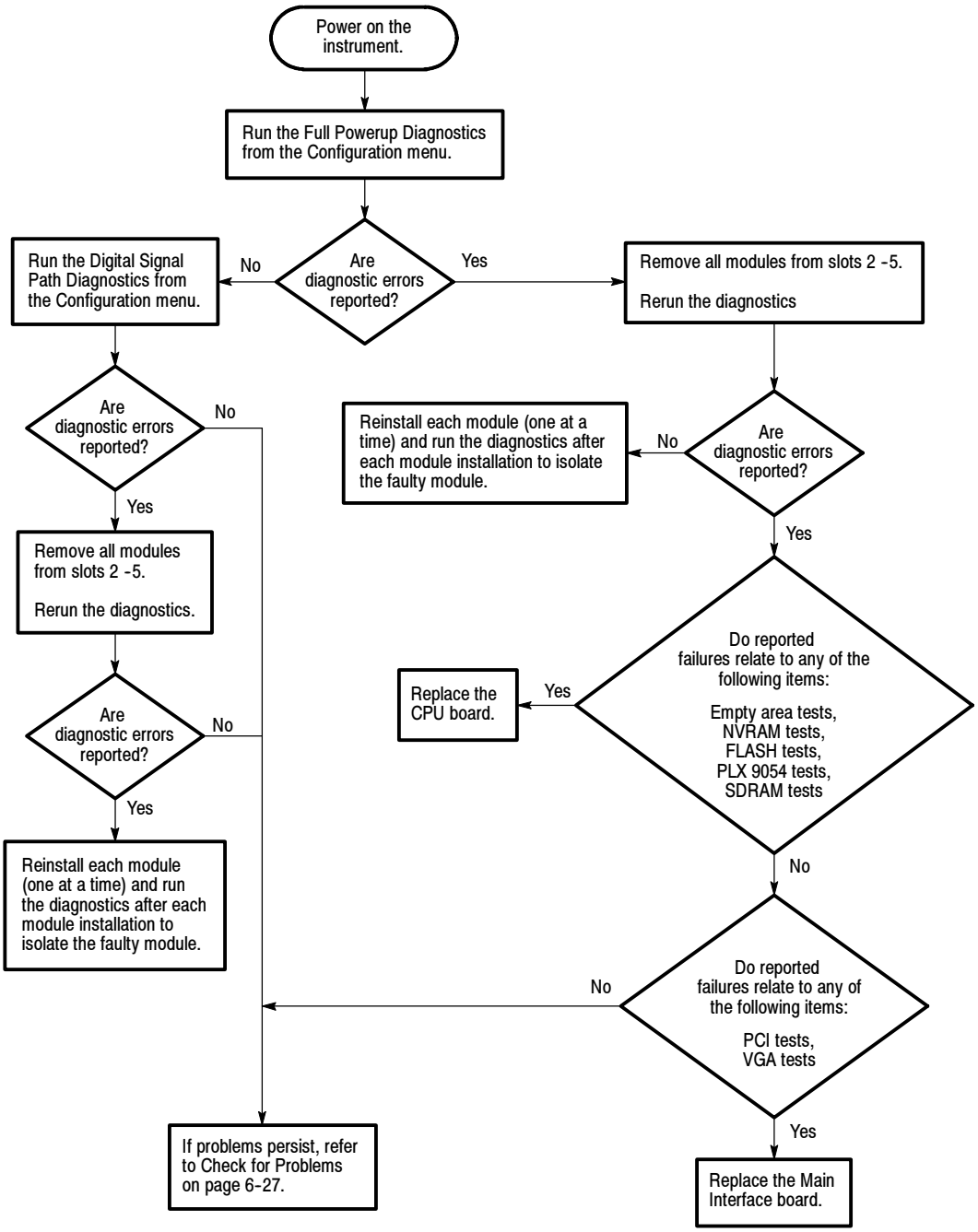


Figure 6-18: Diagnostics errors troubleshooting tree

Repackaging Instructions

This section contains the information needed to repackage the portable mainframe 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 NO TAG 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.

Firmware Upgrade

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

Required Equipment

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

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

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

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

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

Instrument Setup

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

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

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

2. Turn on the waveform monitor.
3. Assign the waveform monitor an IP address using one of the two following methods:
   - Perform the procedure *Manually Assigning an IP Address* on page 6–43 if your local network requires fixed IP addresses or if you are connecting the waveform monitor directly to the Ethernet card on the PC.
   - Perform the procedure *Using DHCP Service to Assign an Ethernet Address* on page 6–45 if your local network supports DHCP service, which dynamically assigns an IP address to connected equipment.

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

Manually Assigning an IP Address

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

***NOTE**. If the waveform monitor is already connected and operating on your local network, you will not need to reassign the instrument a new IP address. In this case, proceed to* Firmware Upgrade Procedure *on page 6–46.*

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

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

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

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

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

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

7. If you connected the waveform monitor to your local network, proceed to *Firmware Upgrade Procedure* on page 6–46.

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

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

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

---

   a. Open the Control Panel on your PC.

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

   c. Right-click the Local Area Connection icon.

   d. Click Properties.

   e. Highlight Internet Protocol (TCP/IP).

   f. Click Properties.

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

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

---

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

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

      192.168.1.1

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

   j. Close or minimize the Control Panel.

   k. Proceed to *Firmware Upgrade Procedure* on page 6–46.

Using DHCP Service to Assign an Ethernet Address

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

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

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

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

---

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

Firmware Upgrade Procedure

After you have prepared the waveform monitor for the firmware upgrade as described in *Instrument Setup* on page 6–42, perform the following procedure to upgrade the instrument firmware:

On your PC:

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

On your waveform monitor:

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

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

On your PC:

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

13. Click Upgrade in the Firmware Upgrade Utility window.

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

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

    a. Click OK on the PC.

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

    c. If you manually assigned the IP address to your waveform monitor, verify the IP address you used with your local network administrator, and then repeat the procedure in *Manually Assigning an IP Address* on page 6–43.

    d. Exit the Upgrade Utility on your PC, and then restart this procedure from step 1 on page 6–46.

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

On your waveform monitor:

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

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

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

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

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

19. Verify the instrument firmware version as follows:

a. Press the HELP button.

b. Touch the System Info soft key.

c. Make sure the new firmware version number appears correctly.

d. Exit the Help Menu.

On your PC:

20. Click Exit on the firmware upgrade screen.

21. Click Yes.

CAUTION. *If you changed the valid fixed IP address of your PC when you performed the Manually Assigning an IP Address starting on page 6–43, be sure to reset the PC's IP address back to the proper address before you reconnect the PC to your network. If you misplaced your previous valid IP address, contact you local network administrator for assistance.*

This completes the upgrade procedure. If you want to verify proper instrument operation, perform the procedures located in the *Performance Verification* chapter.

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

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

Options

Options and Accessories

This chapter lists available input modules, standard and optional accessories available for the WFM700 Waveform Monitor, as well as the product options.

The availability of options is subject to change without notice.

Options

You can order any of the following instrument options with your waveform monitor. Some of these instrument options are also available separately as optional accessories (refer to *Optional Accessories* on page 7–3).

Cabinets

Two cabinet options are available:

- Option 01. Adds the WFM7F02 Portable Cabinet, described on page 7–3.
- Option 02. Adds the WFM7F05 Rack Adapter, described on page 7–3.

Input Modules

Three video input modules are available:

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

A maximum of two video input modules are allowed. Any mix of the available input modules are allowed.

Services

You can order the following services:

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

Power Cord Options

Table 7–1 on page 7–2 lists the available power cords.

Standard Accessories

The following accessories are shipped with each waveform monitor:

Documents

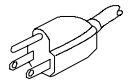
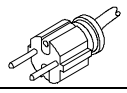
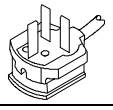
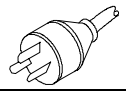
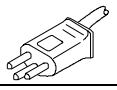
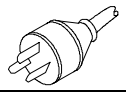
The following documents are standard accessories:

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

Power Cords

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

Table 7-1: Power cord options

Plug configuration	Normal usage	Option number
	North America 120 V	Standard
	Universal Euro	A1
	United Kingdom	A2
	Australia	A3
	Switzerland	A5
	China	AC
	No power cord supplied.	A99

Optional Accessories

You can order any of the following optional accessories to use with your waveform monitor. These can also be ordered as instrument options when you order a waveform monitor (refer to *Options* on page 7–1).

Input Modules

Additional input modules can be installed to increase the number of inputs to four. A maximum of two video input modules are allowed. Any mix of the available input modules are allowed.

You can add any of the following video input modules:

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

Cabinets

You can order one of these cabinets:

- WFM7F02 Portable Cabinet. Portable carrying case with handle and feet. The front feet flip down to form a stand. This cabinet includes a protective cover for the front of the instrument. Ordering the WFM700 Waveform Monitor with Option 01 includes the WFM7F02 portable cabinet.
- WFM7F03 Plain Cabinet. Plain cabinet without any feet or carrying handle.
- WFM7F05 Rack Adapter. Dual side-by-side adapter for installing your half-rack monitors in a rack. This adapter uses two types of sleeves, one for the waveform monitor and one for other half-rack instruments. You can configure the adapter with any combination of two half-rack-width monitors. Ordering the WFM700 Waveform Monitor with Option 02 includes the WFM7F05 rack adapter.

The type of sleeves included with the WFM7F05 rack adapter kit is configured by the option ordered. The available options are:

- Option NN: Includes two WFM7F00 sleeves to rackmount two WFM700 instruments.
- Option NO: Includes one WFM7F00 sleeve and one 1700F00A sleeve to rackmount the following:
  - One WFM700 instrument
  - One of the following instrument types: 1700 Series instruments, WFM601 Series instruments, 760A, 764, Older half rack instruments
- Option OO: Includes two 1700F00A sleeves to rackmount two of the following instrument types: 1700 Series instruments, WFM601 Series instruments, 760A, 764, Older half rack instruments

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

Replaceable Electrical Parts

Replaceable Electrical Parts

Refer to the *Replaceable Mechanical Parts* chapter for a list of all replaceable parts of the WFM700 Waveform Monitor.

Diagrams

Diagrams

This chapter contains block diagrams of the WFM700 Waveform Monitor. These diagrams support instrument descriptions located in the *Theory of Operation* chapter. Figure 9–1 on page 9–2 is a block diagram of the signal flow of the instrument. Figure 9–2 on page 9–3 is a block diagram of the control flow.

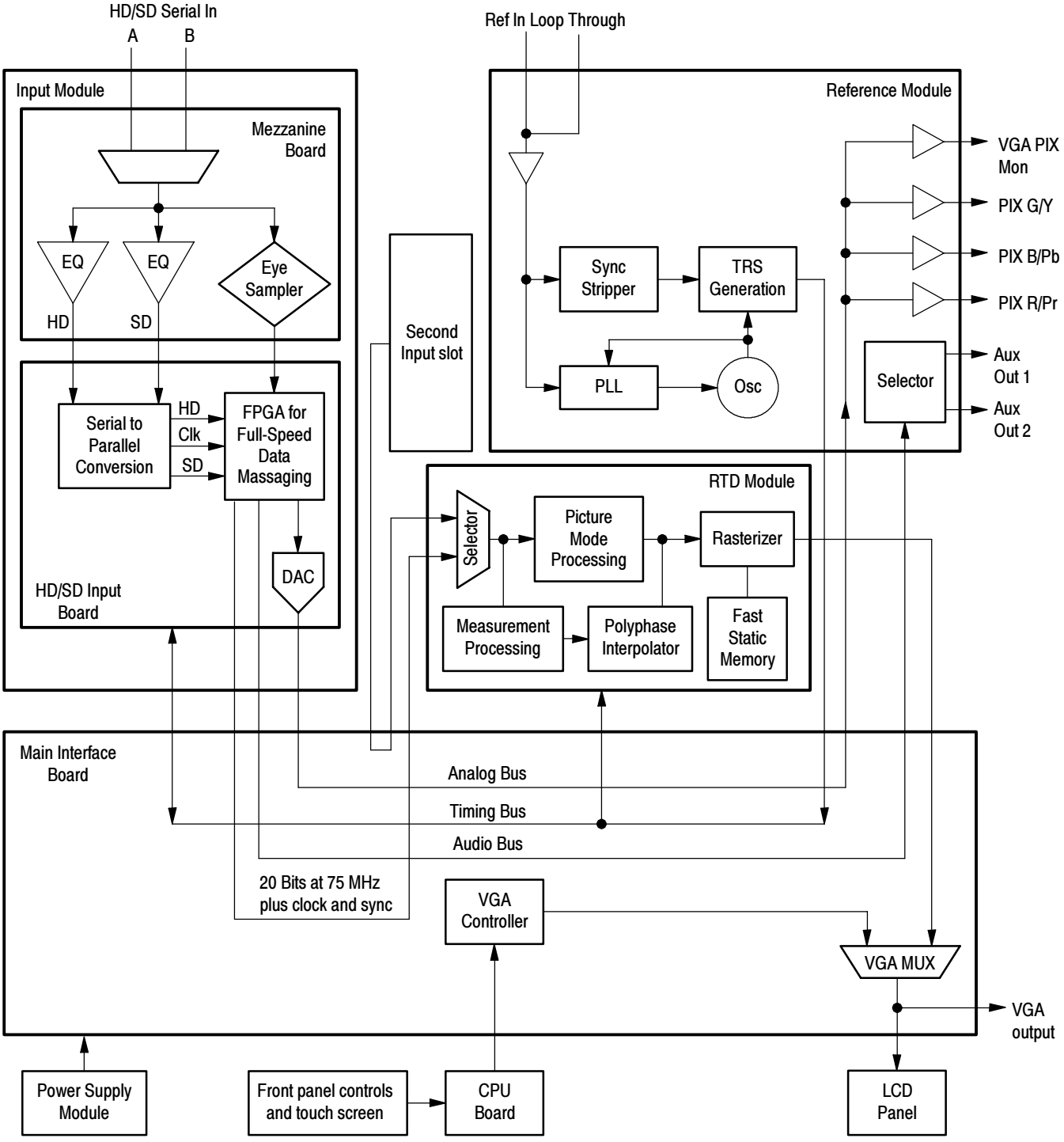


Figure 9- 1: WFM700 signal flow block diagram

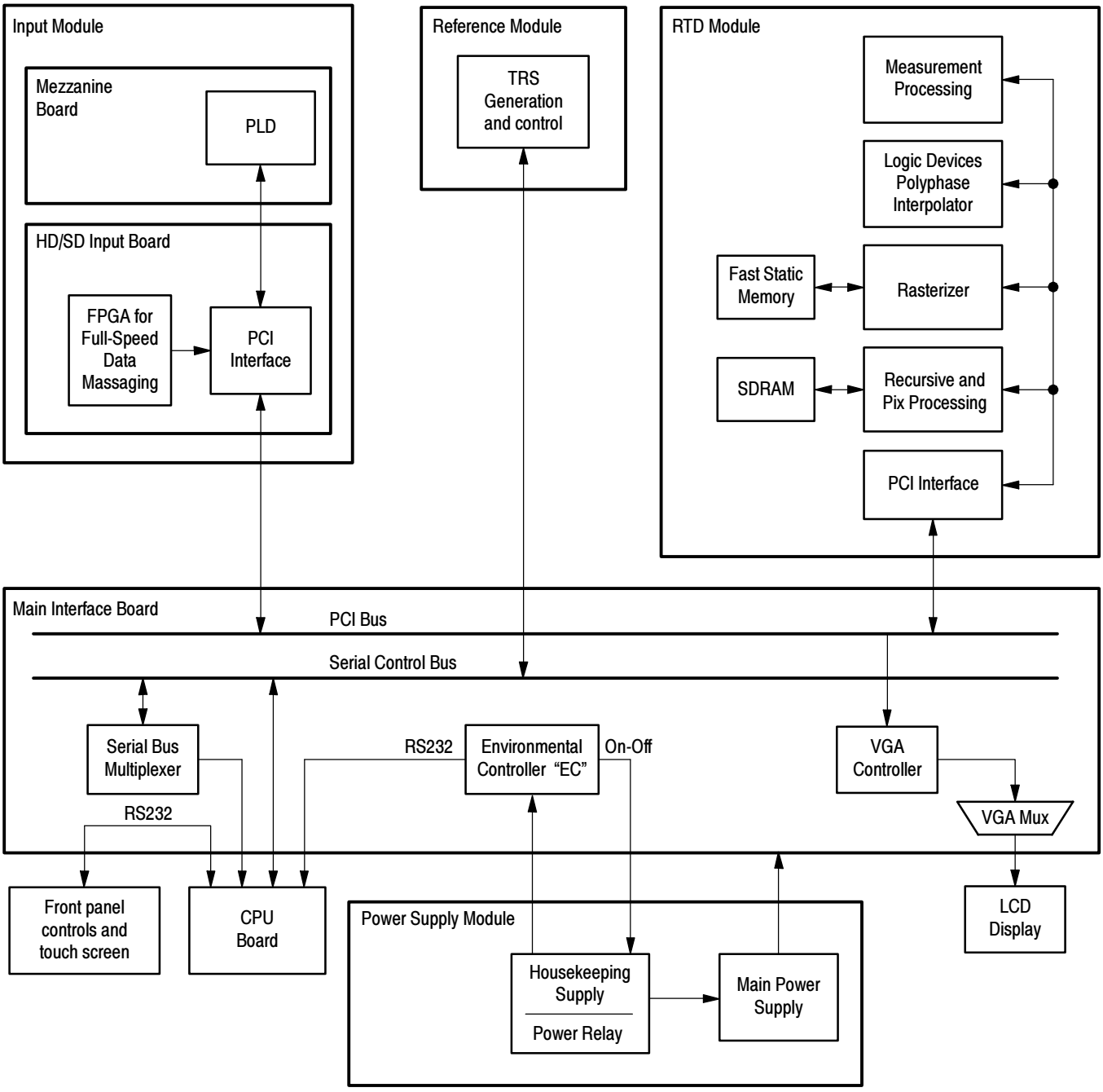


Figure 9-2: Control flow block diagram

Replaceable Mechanical Parts

Replaceable Mechanical 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	MODO INC.	1400 NW COMPTON DR	BEAVERTON, OR 97006-1992
TK2548	XEROX CORPORATION	14181 SW MILLIKAN WAY	BEAVERTON, OR 97005
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
10-1							
-1	671-4528-00			1	CIRCUIT BD ASSY: CPU, 679-4528-XX TESTED, 389-2673-XX WIRED	80009	671-4528-00
-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			1	PANEL, REAR: CPU	TK2359	333-4337-00
-5	211-0125-00			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
-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		1	CIRCUIT BD ASSY: REAL-TIME DISPLAY, 679-4529-XX TESTED, 389-2674-XX WIRED	80009	671-4529-01
-19	333-4338-01	650-4315-01		1	PANEL, REAR: POWER SUPPLY, 0.062 AL	TK2359	333-4338-01
-20	211-0725-00			2	SCREW	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
-21	650-4315-50	B011000	B010999	1	PWR SUPPLY ASSY, EOS: SEE FIGURE 10-2	80009	650-4315-50
	650-4315-51	B011000		1	PWR SUPPLY ASSY, ARTESYN: INCLUDES 174-4780-XX, 174-4467-XX, 174-4779-XX, and 174-4781-XX	80009	650-4315-51
					ATTACHING PARTS		
-22	174-4780-00	650-4315-01		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	650-4315-00		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	650-4315-01		1	CA ASSY; 3 COND,CRIMP HOUSING TO CRIMP HOUSING INCLUDED IN THE 650-4315-51	96027	174-4779-00
-25	174-4781-00	650-4315-01		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 0.25O, 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		04/08/2002	1	CIRCUIT BD ASSY: MAIN INTERFACE, TESTED, 389-2705-XX WIRED	80009	671-4597-00
	671-4597-01	04/09/2002		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			1	CKT BD ASSY: EXTERNAL REFERENCE, TESTED, 389-3205-XX WIRED	80009	671-5336-00
-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

Replaceable parts list (cont.)

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
-33	672-1682-50	B010100	05/05/02	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-50
	672-1682-51	05/06/2002	B010316	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-51
	672-1682-52	B010317		1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, HD SW ONLY (WFM700HD)	80009	672-1682-52
	672-1680-50	B010100	05/05/02	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-50
	672-1680-51	05/06/02	B010409	1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-51
	672-1680-52	B010410		1	CKT BD ASSY: 292 W/EQUALIZER MEZZANINE, SD & HD SW (WFM700A)	80009	672-1680-52
	672-1677-50	B010100	05/05/02	1	CKT BD ASSY: 292 W/RF EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-50
	672-1677-51	05/06/02	B011046	1	CKT BD ASSY: 292 W/RF EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-51
	672-1677-52	B011047		1	CKT BD ASSY: 292 W/EYE MEZZANINE, SD & HD SW (WFM700M)	80009	672-1677-52

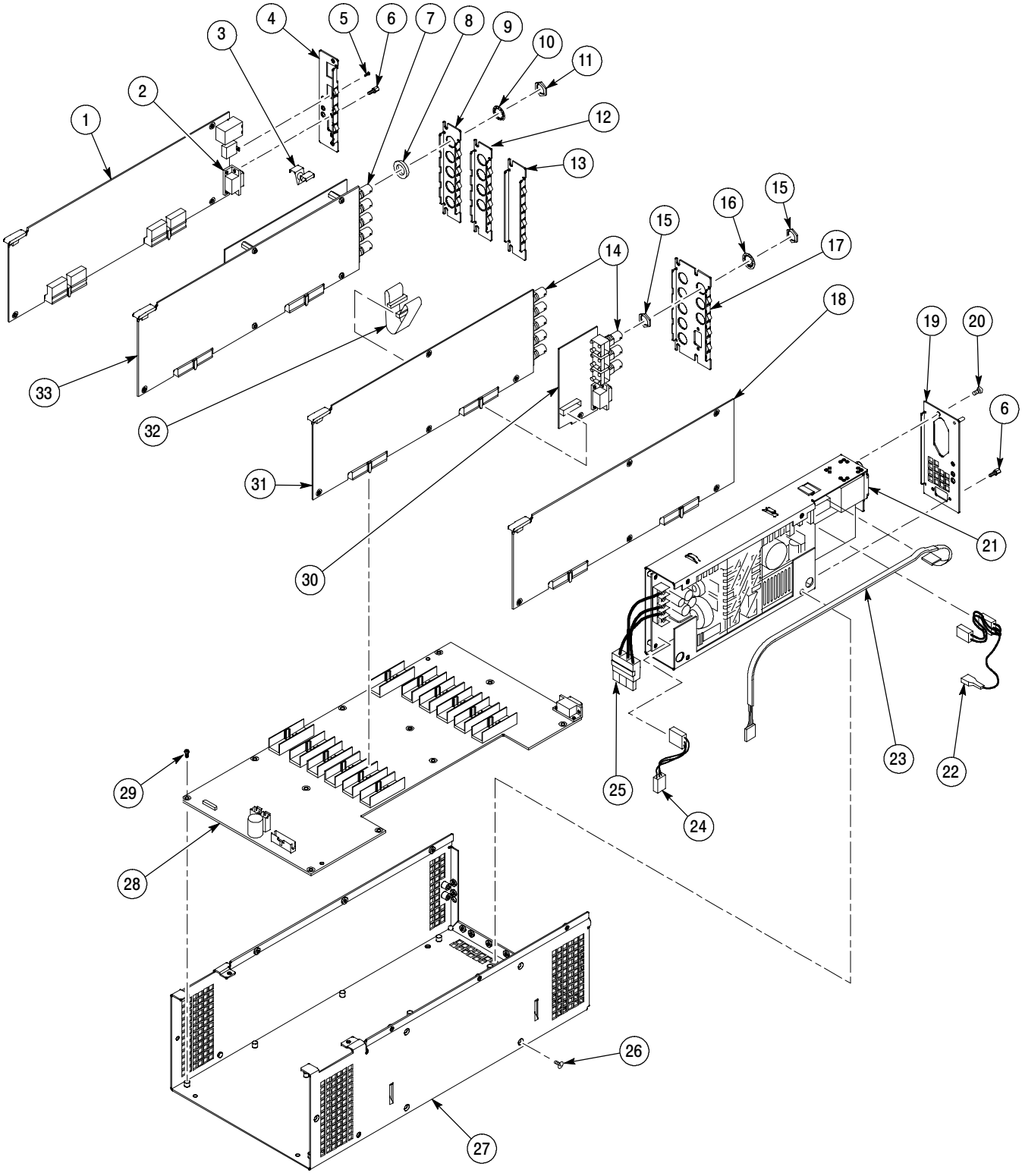


Figure 10-1: WFM700 replaceable circuit boards and cables

Replaceable parts list

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-2							
-1	650-4315-50	B010100	B011000	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	650-4315-50		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	650-4315-50	650-4315-51	1	PANEL, REAR: POWER SUPPLY, 0.062 AL NOT INCLUDED IN THE 650-4315-50	TK2359	333-4338-00
-4	174-4625-00	650-4315-50	650-4315-51	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
-5	174-4626-00	650-4315-50	650-4315-51	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

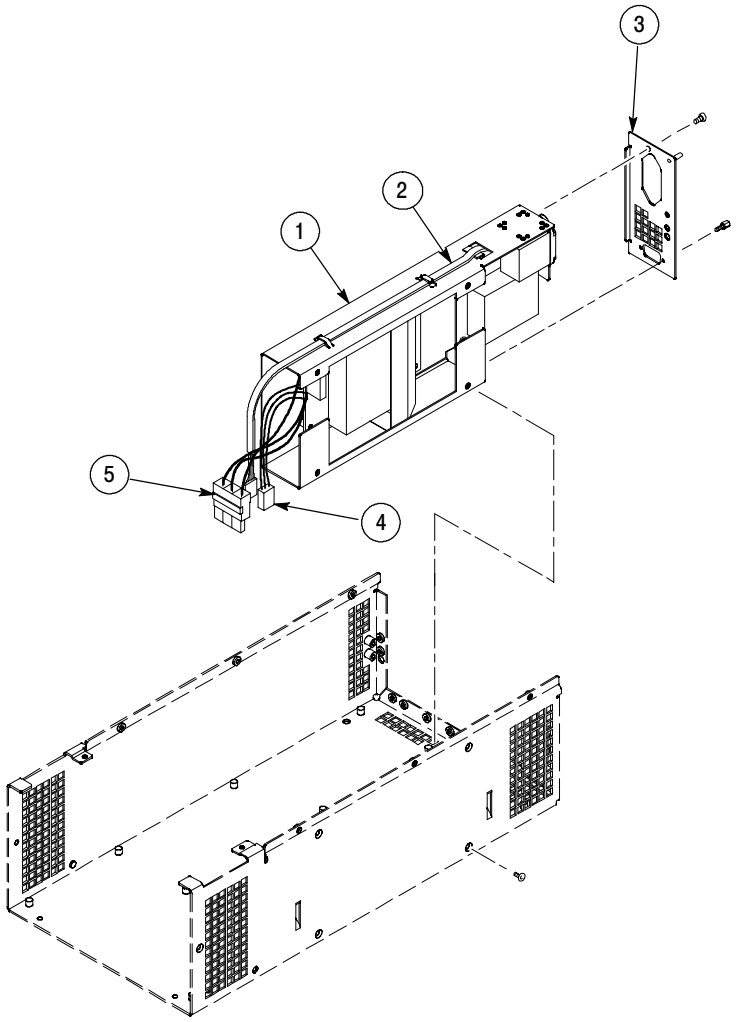


Figure 10-2: WFM700 power supply assembly and rear panel (B010999 and below)

Replaceable parts list

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-3							
-1	614-0992-50			1	PANEL ASSEMBLY: FRONT	80009	614-0992-50
					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 0.25O, 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 0.25O, FLH100, STL, CDPL, T-10 TORX DR	0KB01	211-0734-00
-22	386-7154-00			1	FAN, PLENUM: 0.062 AL	TK2359	386-7154-00

Replaceable parts list (cont.)

Fig. & index number	Tektronix part number	Effective	Discont'd	Qty	Name & description	Mfr. code	Mfr. part number
-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

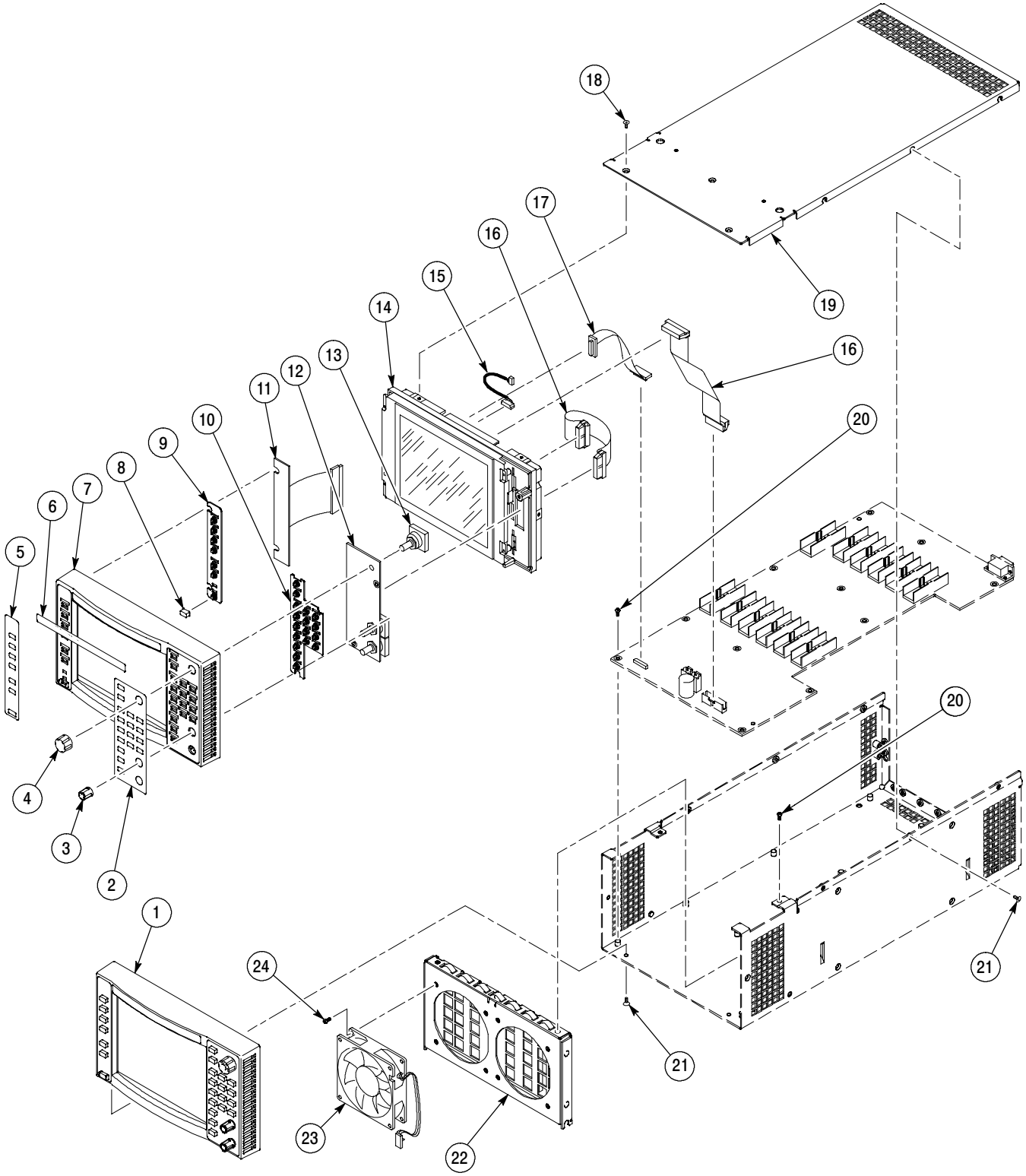


Figure 10-3: WFM700 replaceable chassis parts